

CHAPTER 4.

CUMULATIVE IMPACTS

After release of the Draft EIS, changes were made to this chapter to address comments that were received from members of the public and government agencies. These changes include: 1) the Council on Environmental Quality (CEQ) cumulative impact guidance used in the Draft EIS has been supplemented with methodology contained in *Defining Cumulative Impact, Approach and Guidance* (California Department of Transportation, EPA, and FHWA 2005), as recommended by the EPA; 2) the cumulative project list was updated based on information provided in comments and additional information received following publication of the Draft EIS; 3) there is additional text describing the cumulative impact assessment findings, by resource, in this chapter; and 4) global warming and climate change analyses were expanded and consolidated in this chapter.

Many of the public comments on the Draft EIS that referred to “cumulative impacts” were actually comments regarding the summary of impacts for all of the proposed actions. The concern was that the impacts described in Volumes 2 through 6 did not address the impacts of the proposed action in its entirety. That summary analysis for the preferred alternatives continues to be in Volume 7, Chapter 3, *Preferred Alternatives: Summary of Impacts* and has been updated accordingly. Revisions to that chapter resulting from public and agency comments have been further considered and integrated into the cumulative impacts analysis contained in this chapter in accordance with the guidance and methodology described below.

Because climate change is a global problem, the climate change impacts resulting from the preferred alternatives, along with the projected impacts of climate change on Guam and Tinian, are assessed in Section 4.4., Climate Change and Global Warming.

4.1 CONSISTENCY WITH CUMULATIVE IMPACTS ANALYSIS GUIDANCE

Defining Cumulative Impact, Approach and Guidance (California Department of Transportation, EPA, and FHWA 2005) identifies eight steps for a cumulative impact analysis. This EIS is consistent with the guidance; some of the steps were completed in greater detail in earlier volumes and chapters of this EIS (e.g., descriptions of existing conditions). In such instances, this chapter attempts to refer the reader to earlier sections of the EIS for more detailed discussion and additional information regarding each resource area. The following is a list of the steps taken for this cumulative impacts analysis:

1. **Identify resources to consider in the cumulative impact analysis.** Volumes 1 through 6 address the proposed action’s impacts on the following resources: geological and soils, water, air quality, noise, airspace, land and submerged land use, recreation, terrestrial biological resources, marine biological resources, cultural resources, visual resources, marine transportation, utilities, off-base roadways, socioeconomic and general services, hazardous materials and wastes, public health and safety, and environmental justice and protection of children. Due to the magnitude of the proposed action, all of these environmental resources addressed earlier in this EIS are considered in this cumulative impact analysis.
2. **Define the study area for each resource.** In Volume 7, the study area is island-wide (Guam and Tinian) for each resource. The cumulative impacts study area extends 164 ft (50 m) from the coastline of each island into marine waters. Guam and Tinian are sufficiently distant from one another that additive impacts between the islands are not anticipated. Cumulative impacts

- to Guam are addressed in Section 4.3.5.1 and cumulative impacts to Tinian are addressed in Section 4.3.5.2.
3. **Describe the current health and historical context for each resource.** Volume 7 begins with an overview of key events in the history of Guam and Tinian that have influenced the islands' environmental resources. The trends in, and factors affecting, resource health island-wide (i.e., human behavior and natural events) have played a role in the existing conditions (or affected environment) of each resource described in previous EIS volumes. The trend information is summarized and augmented in Section 4.3.5 of this chapter. Additionally, the trends are assessed in conjunction with recently completed and present projects on Guam and Tinian. For the purposes of this analysis, recently completed projects are projects that have been completed in the past six years. Tables 4.3-3 and 4.3-4 in Volume 7, Section 4.3 are lists of cumulative projects considered in the cumulative impact analysis for Guam and Tinian, respectively. These tables contain recently completed, present, and reasonably foreseeable projects.
 4. **Describe direct and indirect impacts of the proposed project that might contribute to a cumulative impact.** The individual impacts of the proposed actions are described in Volumes 2 through 6. The summary of the preferred alternatives' combined impacts are described in Volume 7, Chapter 3. The results are brought forward into this chapter for the discussion of cumulative impacts.
 5. **Identify other reasonably foreseeable future actions that affect each resource.** As described under Step 3, Tables 4.3-3 and 4.3-4 in Volume 7 list cumulative projects considered in the cumulative impact analysis for Guam and Tinian, respectively. These tables include the reasonably foreseeable future projects on each island. Reasonably foreseeable projects are anticipated to be completed by 2019. Step 5 considers the potential cumulative impacts resulting from reasonably foreseeable projects.
 6. **Assess potential cumulative impacts.** The cumulative impact analysis was primarily qualitative due to the absence of detail for most of the reasonably foreseeable future projects on Guam and Tinian. The assessment discussion indicates whether the proposed actions could have an additive cumulative impact, when considered in conjunction with the listed cumulative projects, and describes the anticipated extent of the preferred alternatives' contribution to the cumulative impact expected to result from past, present, and reasonably foreseeable future actions.
 7. **Report the results.** The cumulative impact assessment results are presented for each resource in Section 4.3.5 and summarized in Tables 4.3-3 and 4.3-5. Additionally, the climate change cumulative impact assessment is reported in Section 4.4, Climate Change and Global Warming.
 8. **Assess the need for mitigation.** Navy policy is to avoid impacts when possible and reduce impacts when avoidance is not possible. Mitigation measures to avoid or reduce impacts are listed in Volume 7, Chapter 2. In addition to avoiding or reducing impacts resulting from the proposed action, these mitigation measures would avoid or reduce cumulative impacts. No additional mitigation measures for cumulative impacts are proposed.

4.2 CUMULATIVE IMPACT METHODOLOGY: STEPS 5 THROUGH 7

No universally accepted framework for cumulative effect analysis exists. The cumulative impacts methodology applied in this chapter is consistent with the objectives of the National Environmental Policy Act (NEPA) of 1969 and CEQ regulations (40 Code of Federal Regulations [CFR] §§ 1500-1508) that provide the implementing procedures for NEPA. The CEQ regulations define “cumulative effects” as:

“... the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.” (40 CFR 1508.7).

As mentioned in Section 4.1, some of the data for the cumulative impact analysis was presented in previous volumes or chapters of this EIS. The relevant information is referenced in this cumulative impact analysis chapter. The following approach was applied for implementing Steps 5 through 7:

1. Develop a list of recently completed, present, and reasonably foreseeable future actions, referred to as “cumulative projects,” within a designated timeframe (2004-2019) beginning six years before implementation of the proposed action and ending five years after the completion of construction (see Tables 4.3-1 and 4.3-2).
2. Screen the projects to develop a list of cumulative projects to be used in the assessment of cumulative impacts (see Tables 4.3-3 and 4.3-5). Projects were eliminated from the analysis if:
 - a. They are located outside the geographic boundary of Guam and Tinian (e.g., undersea cables and the Marianas Trench Monument designation).
 - b. They are proposed beyond the cumulative project timeline (2019).
 - c. There is insufficient, readily available data on project magnitude, location, or description such that potential impacts from the project cannot be ascertained.
 - d. The project was categorically excluded (CATEX) under NEPA. 40 CFR 1508.4 defines categorical exclusion as “...a category of actions which do not individually or cumulatively have a significant effect on the human environment, and which have been found to have no such effect in procedures adopted by a federal agency in implementation of these regulations (Sec. 1507.3) and for which, therefore, neither an environmental assessment nor an environmental impact statement is required.”
 - e. The project would have *de minimus* impact on the environment (e.g., maintenance and repair of existing facilities or construction of minor or accessory structures within a built environment).
 - f. The project is a plan or policy not a physical action or development.
3. Identify the resources that may be affected by the project (Tables 4.3-3 and 4.3-5) for each of the projects on the screened cumulative project list for Guam and Tinian.
4. Evaluate the direct and indirect impacts of the preferred alternatives in combination with the impacts of other projects.

5. If a cumulative impact is identified, assess the extent to which the preferred alternatives would contribute to the cumulative impact.
6. Report the results of the cumulative impact assessment for each resource to meet the requirements of Step 7.

4.3 RECENTLY COMPLETED, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

The Recently Completed, Present, and Reasonably Foreseeable Future Actions, herein referred to as the “cumulative projects list,” were developed via Navy and Air Force planners, and the Guam Land Use Commission (GLUC) database. Tables 4.3-1 and 4.3-2 list projects that were identified on Guam and Tinian, respectively, based on readily available information. The status of these would change and proposals for new projects would continue to be developed. Both tables are divided by region and not all projects listed are discussed in detail. Project locations for the four regions on Guam are shown on Figures 4.3-1, 4.3-2, 4.3-3, and 4.3-4. Project locations on Tinian are shown on Figure 4.3-5.

The most substantial projects on Guam from the cumulative projects list include the Commercial Port Modernization Program, the Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability Project on Andersen Air Force Base (AFB), and Guam and the Mariana Islands Range Complex (MIRC) improvements. Each of these projects either had master plans or NEPA documents prepared describing the proposed actions. A brief description of these projects is provided below.

Table 4.3-1. Recently Completed, Present and Reasonably Foreseeable Projects on Guam

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
GUAM									
Guam – General Actions (not mapped)									
1	Core Tech	Ironwood Estates	Residential construction, Machanao (private)	Guam	2007-2008	Construction complete	Ironwood Estates, 108-lot subdivision, low income rentals.	RC	Retain
2	Commander Navy Region Marianas (CNM)	Navy	Joint Basing	Guam	2009	In progress	Consolidation of support services at the Navy and Air Force base under the Dept of the Navy effective Oct 1, 2009.	P	No cumulative impacts are anticipated
3	Secretary of Commerce, Secretary of Interior, National Oceanic and Atmospheric Administration	Unknown	Marianas Trench National Marine Monument	Guam, CNMI	2009	Established	Establishment of the Marianas Trench Marine National Monument by proclamation of the President of the United States on January 6, 2009. 95,222 square miles (mi ²) for both Guam and the CNMI.	P	Outside the geographical region of influence. Policy, not development
4	Commander Navy Region (COMNAV) Pacific	Nora Macariola-See Naval Facilities Engineering Command (NAVFAC) Pacific	MIRC EIS/OEIS	Guam, CNMI	2011	FEIS May 2010	Covers proposed action and alternatives for continued use of the Mariana Islands Range Complex.	RF	Retain
5	Department of Public Works (DPW)	GovGuam	2030 Guam Transportation Plan projects	Guam	To Be Determined (TBD)	The plan guides federally-funded transportation projects from 2010 - 2030.	The plan involves significant repairs and upgrades of Guam's transportation network. The project would be funded through grants from the U.S. Department of Transportation, Federal Highway Administration and other funding sources.	RF	Plan or policy, not development
6	DPW	GovGuam	Territorial Transportation Improvement Plan (TTIP)	Guam	2008-2011	Constructed	Adjunct to the 2030 Guam Transportation Plan. Short-term federally-funded transportation projects (65). Projects are largely safety projects and capacity improvements to address immediate short-term needs.	P	Categorical Exclusion
7	Guam Department of Corrections	Guam Department of Corrections	Territorial Prison	Guam	TBD	Organizing funding	New Territorial prison to house 1,000 inmates. Site to be determined.	RF	Retain
8	Unknown	Unknown	CAME Alternative Energy	Guam	TBD	Unknown	To develop an energy supply for the CAME that is renewable, sustainable, environmental-friendly and economical. To evaluate the potential for development of a geothermal power system within the CAME based on the scientific findings of exploitable geothermal formations and the economics of distributing the energy generating. - Comprehensive Economic Development Study (January 2009)	Unknown	Too speculative
9*	CNM	Navy	Marianas Communications Backbone, Guam/CNMI various locations	Guam, CNMI	TBD	Unknown	Data backbone (microwave and data link backbone, electronic warfare (portable) staging site.	Unknown	CATEX anticipated with no significant impacts.
10	U.S. Fish and Wildlife Service (USFWS)	USFWS	Five year review of species under the federal Endangered Species Act	Guam, CNMI	TBD	Public Comment ended June 30, 2008	The Pacific Region of the USFWS is initiating 5-year reviews of 70 species protected under the federal Endangered Species Act. One of the species under review is the Micronesian Megapode (<i>Megapodius laperouse</i>) which is endangered with a current range of the Mariana Islands.	Unknown	Plan or policy, not development
11	U.S. Army	U.S. Army	Theater Internment Facility	Guam	TBD	Unknown	Construct a Theater Internment Facility (TIF)	Unknown	Insufficient project information

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
12	Guam Power Authority	Guam Power Authority	60 MW Power Plant	Guam	TBD	Unknown	Establish a new 60 MW power plant on Guam.	RF	Retain
Guam - Offshore (not mapped)									
13	PIPE Networks	Bevan Slattery, CEO	"Project Runway" Australia – Guam submarine cable (private)	Guam-Offshore	2009-2010	Pending	Submarine cable link from Australia to Guam.	RC	Outside the geographical region of influence
14	USEPA	USEPA	Designation of Ocean Dredged Material Disposal Site EIS, Guam (offshore)	11-nautical miles west of Apra Harbor	2010	Notice of Availability of Draft EIS published in August 2009	USEPA designation of offshore disposal site for dredged materials.	P	Outside the geographical region of influence
Guam - North									
N-1	Guam Air National Guard	Unknown	GUANG Operations and Training Facility	Guam-North	2003	Unknown	254 th Air Base Group, Guam Air National Guard at Andersen Air Force Base. The project would involve the construction of a 10,400-ft ² Operations & Training facility and the associated 97-stall parking lot within the existing Guam Air National Guard installation.	RC	Impacts are included in EIS affected environment
N-2	Air Force	Air Force	Shopette Construction	Guam-North	2004	Unknown	The AAFES shopette is located, together with the existing gas station, a store, administrative area, an automated car wash building, additional 35 parking spaces and site access roads encompassing 79,000 ft ² of pavement surrounding the building, within an approximately 2.4 ac site.	RC	Impacts are included in EIS affected environment
N-3	Air Force	Air Force	AT/FP Perimeter Fence and Road Construction and Main Gate Relocation at Andersen AFB	Guam-North	2010-2011	Construction initiated	Construct a perimeter 8.2-ft (2.5m) tall chain-link fence in the western portion of Andersen AFB along Routes 9 and 3a. The perimeter fence was proposed in two phases, the eastern portion of which is complete. Total length is 35,440 ft (10,802 m). The project includes a gravel access road adjacent to the perimeter fence. The fence and the roadway extend from Potts Junction to the northern cliff line. The length of the roadway is 43,980 ft (13405 ac) and the width is 13ft (4m). Total area of disturbance is estimated at 16 ac (64,423 m ²). The main entrance gate to Andersen AFB would be reconfigured and expanded at the existing location with utility service improvements. The area of disturbance is estimated at 5.47 ac (22.2 m ²).	RC: Phase 1 of fencing is complete; other components are future (RF).	Retain
N-4	Unknown	Air Force	Unknown	Guam-North	2007	Unknown	Removal and Control of Vegetation at Runway, in accordance with AICUZ Program.	RC	<i>De minimus</i> impacts
N-5*	Fleet Area Control and Surveillance Facility (FACSFAC) Range Control	Navy	FACSFAC, Andersen AFB	Guam-North	2010	Unknown	Training Operations Center (FACSFAC/Range Control), CVW-5 liaison office.	RF	<i>De minimus</i> impacts
N-6	36 WG of the Pacific Air Forces (PACAF)	Air Force	Beddown of Training and Support Initiatives at NWF	Guam-North	2006 to 2011	Finding of No Significant Impact (FONSI) (signed 6-20-06)	Relocate a Rapid Engineer Deployable Heavy Operations Repair Squadron Engineer (REDHORSE) of mobile engineering forces, the PACAF Commando Warrior training program, and a Combat Communication Squadron and its training program at the same location. This includes an additional 400 personnel, utility and infrastructure improvements, and construction of field training areas, offices, classrooms, and warehouses to be based at Northwest Field, Andersen AFB.	P	Retain

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N-7	36 WG of the Pacific Air Forces (PACAF)	Air Force	ISR Strike Capability, Andersen AFB	Guam-North	2007 to 2016	ROD (signed 01-12-07)	Base four unmanned aerial reconnaissance aircraft and 12 refueling aircraft at Andersen AFB and accommodate 48 fighter and six bomber aircraft on a rotational basis. An additional 2,400 personnel would be based at Andersen AFB.	P	Retain
N-8	Base Corp.	Unknown	Paradise Estates, Yigo	Guam-North	2007-2008	Phase III Under construction	Paradise Estates residential homes, 400-lot subdivision. Villa Pacita residential homes, near AAFB back gate.	P	Retain
N-9	Air Force	Air Force	Andersen AFB water supply system construction	Guam-North	Unknown	Unknown	Construction of an on-base water supply system on the Andersen AFB.	RF	Retain
N-10	36 WG of the PACAF	Air Force/ Navy	Unknown	Guam-North	TBD	Unknown	Additional FY10-FY15 MILCON Projects: War Readiness Materials Storage Warehouse, Education/Library Complex, Permanent Party Enlisted Dorm, Consolidate Youth Programs, Postal Service Center.	RF	Retain
N-11	36 WG of the PACAF	Air Force	Unknown	Guam-North	TBD	Unknown	Repair AEF FOL South Runway (Phase 1). Additional FY12 Projects: repair AEF FOL South Runway (Phase 2).	RC	<i>De minimus</i> impacts.
N-12	Air Force/U.S. Army Corps of Engineers (USACE)	Air Force	Enhancement of Tarague and Sirena Beaches	Guam-North	TBD	Unknown	Air Force, USACE File No. POH-2007-45, to install 31 anchors for marker buoys to serve as a perimeter safe zone for swimming and reef walking activities, in accordance with Wing Command, 36 SVS; Wing Safety, enhancement of passive recreational opportunities at Tarague Beach; and installation of two navigation poles at the Tarague and Sirena Beaches, Andersen Air Force Base, Guam.	RC	<i>De minimus</i> impacts.
N-13	36 WG of the PACAF	Air Force	Munitions Storage Igloos Andersen AFB Guam	Guam-North		Two phases: Phase 1 operational since 2008 and Phase 2 NEPA EA prepared. FONSI pending.	New munitions igloos are required to enable the 36 WG's existing mission and ongoing military operations. Phase 1 to construct 12 munitions igloos is complete at Munitions Storage Area 1 (MSA 1). Phase II would construct 48 additional munitions igloos to meet the same purpose and need.	P	Retain
N-14	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Conditional Use Request	Guam-North	TBD	Conditionally Approved by the GLUC	Conditional Use Permits for a variety of commercial, retail and residential projects.	RF	Insufficient information, but retain because these projects are in the northern area of Guam, in proximity to preferred alternatives
N-15	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Subdivision Variance Request	Guam-North	TBD	Pending Approval by the GLUC	Subdivision Variance Requests for a variety of residential, commercial, and light industrial projects. Variances include deletion or reduction of easements.	RF	
N-16	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Subdivision Approval	Guam-North	TBD	Pending Approval by the GLUC	Tentative Subdivision Approvals for a combined 131 subdivision lots.	RF	
N-17	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Wetland Permit	Guam-North	TBD	Conditionally Approved by the GLUC	Permits to impact wetlands.	RF	Retain
N-18	GLUC	Terry Perez, Guam Coastal	Zone Change Request	Guam-North	TBD	Conditionally Approved or Pending Approval	A wide variety of zone change requests that are conditionally approved or pending approval by the GLUC. Proposed uses include	RF	Insufficient data

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		Management Program, Bureau of Statistics and Plans				by the GLUC	residential, commercial, recreational, and one landfill.		
N-19	Private Development	Vantage Group	Villa Pacita Estates	Guam-North	TBD	Under construction	Private housing division along Rte. 15 in Yigo on the west side of Mt. Santa Rosa.	P	Retain
N-20	Archdiocese of Guam	Unknown	Catholic High School	Guam-North	TBD	Task force assessing prospect as of Nov. 2008	New construction of private Catholic high school on the north side of Guam.	RF	Insufficient data
N-21	Younex Enterprises LLC	Guam Land Use Commission	Ukudu Workforce Village	Guam - North	2010-2011	GLUC approved permit 10/29/09	New workforce housing to support military build-up on Guam. 18,000 person capacity.	P	Retain
N-22	Air Force	US Air Force Headquarters	Create Broad Area Maritime Surveillance (BAMS) capability	Guam-North	TBD	Feasibility being assessed	The BAMS is an information hub that would operate in direct collaboration with other manned and unmanned airborne space-based platforms. BAMS operate at greater than 40,000 ft, above the weather and most air traffic, to conduct open ocean and littoral surveillance of targets as small as submarine periscopes. Information on the infrastructure required is not available.	RF	Retain
N-23	Pacific International Guam Inc.	Guam Land Use Commission	Workforce Housing	Guam - North	2010-2011	GLUC approval pending	New workforce housing to support military build-up on Guam. 1,176 person capacity.	RF	Retain
N-24	Air Force	Air Force	Milky Way Site for MUTES	Guam-North	TBD	NEPA review being initiated	Communications facility near Northwest Field under consideration.	RF	Insufficient data
N-25	Army	Army	Regional hub node	Guam-North	2010	CATEX anticipated with no significant impacts.	Upgrade to existing communications facility.	RF	CATEX anticipated with no significant impacts.
Guam - Central									
C-1	Federal Highway Administration (FHWA)	Unknown	Route 15 Construction	Guam-Central	2005	Unknown	Reconstruction/rehabilitation of the Route 15 existing two-lane roadway and construction of roadway appurtenances for a complete and useable safe facility, in the municipalities of Mangilao and Yigo.	RC	May not be required if actions proposed in this EIS are implemented.
C-2	Home Depot	Various	Home Depot and Garden Center (private), Tamuning (Airport Road)	Guam-Central	2007	Operational	New Home Depot and Garden Center on Airport Road (Tamuning).	RC	Retain
C-3	Private Development	Access Development Company	Talo Verde Estates	Guam-Central	2007-2009	Operational	Luxury housing community; Single family dwellings (62) and Townhouses (82).	RC	Retain
C-4	TBD	Unknown	Residential construction, Tamuning (private)	Guam-Central	2007-2009	Unknown	700-unit condominium (Near Nikko Hotel), units to be complete by 2010.	P	Retain
C-5	Private Development	Access Development Company	Talo Vista Tower	Guam-Central	2010-2012	Construction pending	236 unit condominium; obtained GLUC approval (Nov 2007).	P	Retain
C-6	Core Tech International	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 856 person capacity.	RF	Retain
C-7	Private Development	Access Development Company	Ypao Resort	Guam-Central	2010-2012	Pending	700 units full-service resort condominium; under GLUC review.	RF	Retain
C-8	Private Development	Younex International Corp	Emerald Ocean View Park	Guam-Central	2008-2011	Under construction	260 luxury condo unit - 20 villas, two 18-story towers and two 15-story towers.	P	Retain

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C-9	Unknown	Unknown	Veterans Clinic	Guam-Central	2009	Under construction	The Veterans Clinic would be located just outside of the Naval Hospital along Route 7.	P	Retain
C-10	CNM	Navy	Defense Access Road	Guam-Central	Unknown	U.S. Gov is committing \$1B per U.S./Japan pact signed by Secretary of State Hillary Clinton on February 17, 2009	The proposed highway would cut across largely undeveloped hills and valleys of Chalan Pago, Yona and Piti, starting from the area in Chalan Pago where Routes 10 and 4 meet.	Unknown	Project replaced by EIS proposed action roadway improvements
C-11	CNM	Navy	Joint Region Headquarters & Operations Center (P-572)	Guam-Central	2010	Contract awarded	Renovate and adapt existing Buildings 200, 202, and 205 currently used as DoDEA high schools for joint use by Navy and JGPO.	P	De minimus impacts
C-12	Private Development	Tanota Partners (Ysrael family)	Hotel Construction Bayview 5 Luxury Project, Tumon Bay	Guam-Central	2010	Under construction	Construction of 400-room, 28-story hotel in Tumon Bay.	P	Retain
C-13	BUMED	Unknown	Bureau of Medicine Naval Replacement Hospital Project	Guam-Central	2010-2012	Environmental Assessment (EA) under review	Naval Replacement Hospital at Nimitz Hill. The existing one would be demolished. The site of the new hospital is located within the Naval Hospital Complex at Agana Heights.	P	Retain.
C-14	Private Development	Access Development Company	Hemlani Apartments	Guam-Central	TBD	Planning	300 unit apartments (behind Acanta Mall, Tumon Bay).	RF	Retain
C-15	Guam International Airport Authority (GIAA)	GovGuam	Project Airport Guam	Guam-Central	2009 -2029	Construction initiated for some projects	Various upgrades to airport property, main terminal, industrial park, airfield, and south ramp.	RF	Retain
C-16	GovGuam and the U.S. Navy	GovGuam	Reforestation of Masso Reservoir	Guam-Central	TBD	Completed within 3 years (by 2012)	The reforestation plan was developed as a mitigation project for coral reef loss in Apra Harbor.	RF	Retain
C-17	Private Development	Ino Corp. Development	Ino Corp Development	Guam-Central	TBD	Pending	396 unit resort condo and commercial spaces; approved Mar 2008 by GLUC.	RF	Retain
C-18	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Conditional Use Request	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Conditional Use Permits for a variety of commercial, retail and residential projects.	RF	Retain
C-19	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	PUD - Amendment	Guam-Central	TBD	Approved by the GLUC in 2005	A PUD Amendment for a project in Agana with civic, commercial and recreational use.	RF	Retain
C-20	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Seashore Clearance Request	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Seashore Clearance Requests for a variety of commercial, residential and recreational projects.	RF	Retain
C-21	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Subdivision Variance Request	Guam-Central	TBD	Approved, Conditionally Approved or Pending Approval by the GLUC	Subdivision Variance Requests for a variety of residential, commercial, and light industrial projects. Variances include deletion or reduction of easements.	RF	Retain

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C-22	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Development Plan Application	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Tentative Development Plans for a variety of residential, commercial and recreational projects that are conditionally approved or pending approval by the GLUC. Combined totals: 43 apartments, 960 condos, and 1 single family dwelling.	RF	Retain
C-23	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Subdivision Approval	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Tentative Subdivision Approvals for a combined 417 subdivision lots.	RF	Retain
C-24	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Wetland Permit	Guam-Central	TBD	Pending Approval by the GLUC	Permits to impact wetlands.	RF	Retain
C-25	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Zone Change Request	Guam-Central	TBD	Approved, Conditionally Approved or Pending Approval by the GLUC	A wide variety of zone change requests that are conditionally approved or pending approval by the GLUC. Proposed uses include residential, commercial, recreational, and one landfill.	RF	Retain
C-26	Unknown	Unknown	Guam Greyhound Casino	Guam-Central	TBD	Unknown	Approved on the Nov. 2008 voting ballot and failed. Guam Greyhound is currently closed.	Unknown	No longer viable.
C-27	Unknown	Unknown	Unknown	Guam-Central	TBD	Unknown	Subdivision on Ypao Road, in construction.	RF	Insufficient data, but in proximity to proposed firing ranges. Retain
C-28	PACAF A7P (Air Force)	Navy	Upgrade JP-8 Receipt Pipeline	Guam-Central	2013	Planning and Programming Phase	Infrastructure improvements to fuel pumps and pipelines that extend from the Sasa Valley Fuel Farm to Andersen AFB. Project includes a new 15.7 mile pipeline that is parallel and adjacent to existing pipeline and located within an existing 10-foot wide easement.	RF	De minimus impacts.
C-29	Chugach World Services	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 696 person capacity.	RF	Retain
C-30	S.K Construction Inc.	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 350 person capacity.	RF	Retain
C-31	Black Construction Corp	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit approved 2/25/10.	New workforce housing to support military build-up on Guam. 1,200 person capacity.	RF	Retain
C-32	DDT Konstract	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 390 person capacity.	RF	Retain
C-33	Bob Salas	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 64 person capacity.	RF	Retain
C-34	Bascon Corp	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 30 person capacity.	RF	Retain
Guam - Apra Harbor									
AH-1	CNM	Navy	Kilo Wharf Improvements (P-451)	Guam-Apra Harbor	2005	Operational	Construct concrete ordnance container handling pad for handling, loading, and unloading of containerized ordnance on Orote Plateau, with an access road from Orote Point road to the container holding yard and the new facilities proposed under P-425 and P-447. Replace fenders, renovate Gate House and service buildings, upgrade fire	RC	Retain

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
							protection, lighting, and steam utilities at Kilo Wharf.		
AH-2	CNM	Navy	Alpha/Bravo Wharves Improvements (P-431)	Guam- Apra Harbor	2008	Operational	Extension of Bravo Wharf and construction dredging to meet requirements for new class of submarines. Project includes utility upgrades at Alpha and Bravo Wharves.	RC	Included in affected environment of EIS.
AH-3	CNM	Navy	Open Ammo Storage, Orote Point (P-447)	Guam- Apra Harbor	2007	Draft EA currently in progress as of May 2008	Construct eight 9,350 ft ² open ammunition storage pads for temporary storage of one million pounds net explosive weight (NEW) C/D 1.1 on Orote Plateau. Each pad can accommodate 20 standard shipping containers stacked two high. Includes paved access, earthen berms, lightning protection, security fencing, and video surveillance.	RF	Included in AH-4.
AH-4	CNM	Navy	Orote Magazines (P-425)	Guam- Apra Harbor	2012	Draft EA currently in progress as of May 2008	Construct 17 non-propagation wall magazines for storage of 2M lbs NEW C/D 1.1 on Orote Plateau. Provides sufficient capacity for one full cargo ship. Includes security fencing, utility extensions, access road, and vegetation clearing.	RF	Retain
AH-5	CNM	Navy	Electrical Distribution System Hardening, Main Base (P-494) Phase 4	Guam- Apra Harbor	2008	FONSI	Improve Navy's power infrastructure by increasing capacity of Orote Substation to increase backup generation capacity and placing two miles of overhead power lines underground.	RC	De minimus impacts
AH-6	CNM	Navy	Potable Water System Recapitalization, Phase 1 (P-532), multiple locations	Guam- Apra Harbor	2008	Under construction	Replace existing water lines with larger size lines, provide miscellaneous water mains and line connections, construction of a concrete enclosure for the Fena Lake Pump Station, and install pressure reducing valves for waterlines feeding Sasa Valley, X-Ray Wharf, and Polaris Point.	P	CATEX.
AH-7	CNM	Navy	Construct New BEQ, Main Base (P-469R/P-484)	Guam- Apra Harbor	2009-2010	EA FONSI Prepared	Construct new Bachelor Enlisted Quarters (BEQ) at Guam Naval Base for enlisted personnel; includes three and four story buildings with reinforced concrete walls, flooring and foundation, containing 376 modules.	P	Adverse impacts (explosive safety) were mitigated through design. No cumulative impacts
AH-8	Port Authority of Guam (PAG)	GovGuam	Modernization Program: Port Reconfiguration, Maintenance and Repair	Guam- Apra Harbor	2011-2013	NEPA document being prepared	Phase 1 A: productivity and efficiency improvements such as new equipment, systems, and buildings, and terminal modernization and new yard capacity. Includes demolition of buildings, new utilities, paving, lighting, cargo handling equipment, stormwater outfalls into Apra Harbor and security systems.	RF	Retain
AH-9	Port Authority of Guam (PAG)	GovGuam	Modernization Program: Port Reconfiguration, Maintenance and Repair	Guam- Apra Harbor	> 2019	Un-programmed	Phase 1B: structural refurbishment of existing docks (F4, F5, F6), modernization of terminal areas to the west and acquisition of cranes. Phase 2: Hotel Wharf Improvements (more recent version of AH-19 project)	Unknown	Beyond cumulative impact analysis time period
AH-10	CNM	Navy	Kilo Wharf Extension (P-502)	Guam- Apra Harbor	2010	Construction completion anticipated by summer of 2010.	Construct new facilities at Kilo Wharf to meet DoD technical design standards to ensure safe and efficient ordnance loading/offloading for the Auxiliary Dry Cargo/Ammunition Ship (T-AKE). Project involves extension of wharf and construction of associated facilities.	P	Retain
AH-11	CNM	Navy	X-Ray Wharf Improvements (P-518)	Guam- Apra Harbor	2013	Programmed, unfunded	Waterfront improvements to accommodate the new T-AKE supply ship and utility upgrades to meet wharf requirements. Includes construction and dredging at the southern portion of Inner Apra Harbor to -35 ft.	RF	Retain
AH-12	CNM	Navy	Consolidated Port and Harbor Security Operations Facility (P-473), Polaris Point	Guam- Apra Harbor	2010	Pending approval, EA required	A new consolidated waterfront operations complex (37,900 ft ²) at Sumay Cove, equipment storage facility at Polaris Point, and installation of two surface approach radar systems. 37,900 ft ² .	Unknown	Cancelled

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
AH-13	CNM	Navy	Harden Electrical System – Phase 2 (P-495)	Guam- Apra Harbor	2010	Un-programmed	Project would harden Navy’s electrical distribution system by replacing the existing overhead primary and secondary electrical distribution with an underground installation for increased system reliability during frequent typhoons.	RF	CATEX
AH-14	CNM	Navy	Consolidated Submarine Learning Center (SLC) and Commander Submarine Squadron (CSS) Headquarters Facility	Guam- Apra Harbor	2010	Pending site approval	Construct a new two-story consolidated SLC and CCS headquarters facility. The SLC would house valuable equipment that would allow multiple undersea warfare training scenarios. The CSS facility would include administrative spaces, conference room, emergency control center and classified material storage. Built on fill.	RF	CATEX
AH-15	CNM	Navy	Construct Torpedo Exercise Support Building (P-528)	Guam- Apra Harbor	2010	Pending site approval	Construct one-story torpedo exercise support facility (8,000 ft ²) on fill.	RF	CATEX
AH-16*	MARFORPAC	Marine Corps	Amphibious Training, Dadi Beach (Marine Corps Proj. 10)	Guam- Apra Harbor	2014+	Unknown	Amphibious Assault Vehicle (AAV) training. Beach improvements: one concrete revetment at each beach, remove non-native vegetation, no in-water improvements.	RF	Retain
AH-17*	MARFORPAC	Marine Corps	Amphibious Training, Tupalao Beach (Marine Corps Proj. 11)	Guam- Apra Harbor	2014+	Unknown	AAV training. Beach improvements: one concrete revetment at each beach, remove non-native vegetation, no in-water improvements.	RF	Retain
AH-18*	MARFORPAC	Marine Corps	Amphibious Training, Boat Ramp and Overland Route	Guam- Apra Harbor	2014+	Unknown	One concrete boat ramp in southern end of Inner Apra Harbor, for one AAV craft at a time, overland paved route to Tupalao includes steep descent to Tupalao Beach. Site improvements associated with amphibious training include a new ramp at the southernmost point of Inner Apra Harbor. Overland route would be along the wetland area between the inner harbor and Dadi Beach.	RF	Retain
AH-19	PAG	GovGuam	Master Plan for Deep Draft Wharf and Fill Improvements at Apra Harbor	Guam- Apra Harbor	Unknown	Final EIS prepared February 2009. No ROD was issued. Project is postponed.	Construct new wharf east of Hotel Wharf to accommodate deep-draft container vessels and cruise ships. Dredging and filling of GovGuam submerged lands required.	Unknown	Beyond the timeframe for the cumulative impact analysis and no longer a reasonably foreseeable project.
AH-20*	CNM	Navy	Target Support Building and TSV Wharf Upgrades, Navy Base	Guam- Apra Harbor	TBD	Unknown	Surface, sub-surface and aerial target facility, underwater tracking range (portable acoustic range), TSV.	Unknown	Cancelled
AH-21	CNM	Navy	Mitigation for Kilo Wharf Extension	Guam- Apra Harbor	TBD	Trees have been planted	Afforestation of 500 acres (202 ha) in Cetti Bay Watershed.	P	Retain
AH-22	Army	Army	Stationing and Operation of Joint High Speed Vessels (JHSV)	Guam- Apra Harbor (not mapped - wharf location unknown)	TBD	Draft Programmatic EIS anticipated in June 2010	Stationing and operation of up to 12 Army JHSVs at military port facilities in the United States and abroad. The proposed stationing of JHSVs may occur at the following military port locations: Virginia Tidewater area; San Diego, Calif. area; Seattle-Tacoma, Wash. area; Pearl Harbor, Hawaii area; and Guam.	RF	Retain

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
Guam - South									
S-1	USFWS	USFWS	Draft Safe Harbor Agreement, Cocos Island	Guam-South	2008	The draft agreement and proposed permit was published in the <i>Federal Register</i> on January 10, 2008	Cocos Island Resort and the Guam Department of Agriculture have applied for an enhancement of survival permit and a proposed Safe Harbor Agreement for the benefit of the ko'ko'. Implementation of the proposed agreement would provide for voluntary habitat restoration, maintenance, and activities to enhance the habitat and recovery of the Guam rail on 83.1 ac of Cocos Island partly owned by Cocos Island Resort, and the Guam Department of Parks and Recreation.	P	Retain
S-2	DPW	GovGuam	New Landfill, Dandan	Guam-South	TBD	Design complete	Development of a municipal solid waste landfill facility. Project involves construction and operation of integrated solid waste facility and transfer stations. It would provide for waste management through diversion, recycling, composting, and processing.	RF	Retain
S-3	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Conditional Use Request	Guam-South	TBD	Pending or Conditionally Approved by the GLUC	Conditional Use Permits for a variety of commercial, retail and residential projects.	RF	Insufficient information on location or magnitude
S-4	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Seashore Clearance Request	Guam-South	TBD	Conditionally Approved or Pending Approval by the GLUC	Seashore Clearance Requests for a variety of commercial, residential and recreational projects.	RF	Insufficient information on location or magnitude
S-5	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Seashore Permit Application	Guam-South	TBD	Application was entertained by the ARC on 2/2/2006	Seashore permit for the construction of a rock revetment.	RF	Insufficient information on location or magnitude
S-6	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Subdivision Approval	Guam-South	TBD	Conditionally Approved or Pending Approval by the GLUC	Tentative subdivision approvals for a combined 98 subdivision lots.	RF	Insufficient information on location or magnitude
S-7	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Wetland Permit	Guam-South	TBD	Conditionally Approved by the GLUC	Permits to impact wetlands.	RF	Retain
S-8	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Zone Change Request	Guam-South	TBD	Conditionally Approved or Pending Approval by the GLUC	A wide variety of zone change requests that are conditionally approved or pending approval by the GLUC. Proposed uses include residential, commercial, recreational, and one landfill.	RF	Insufficient information on location or magnitude

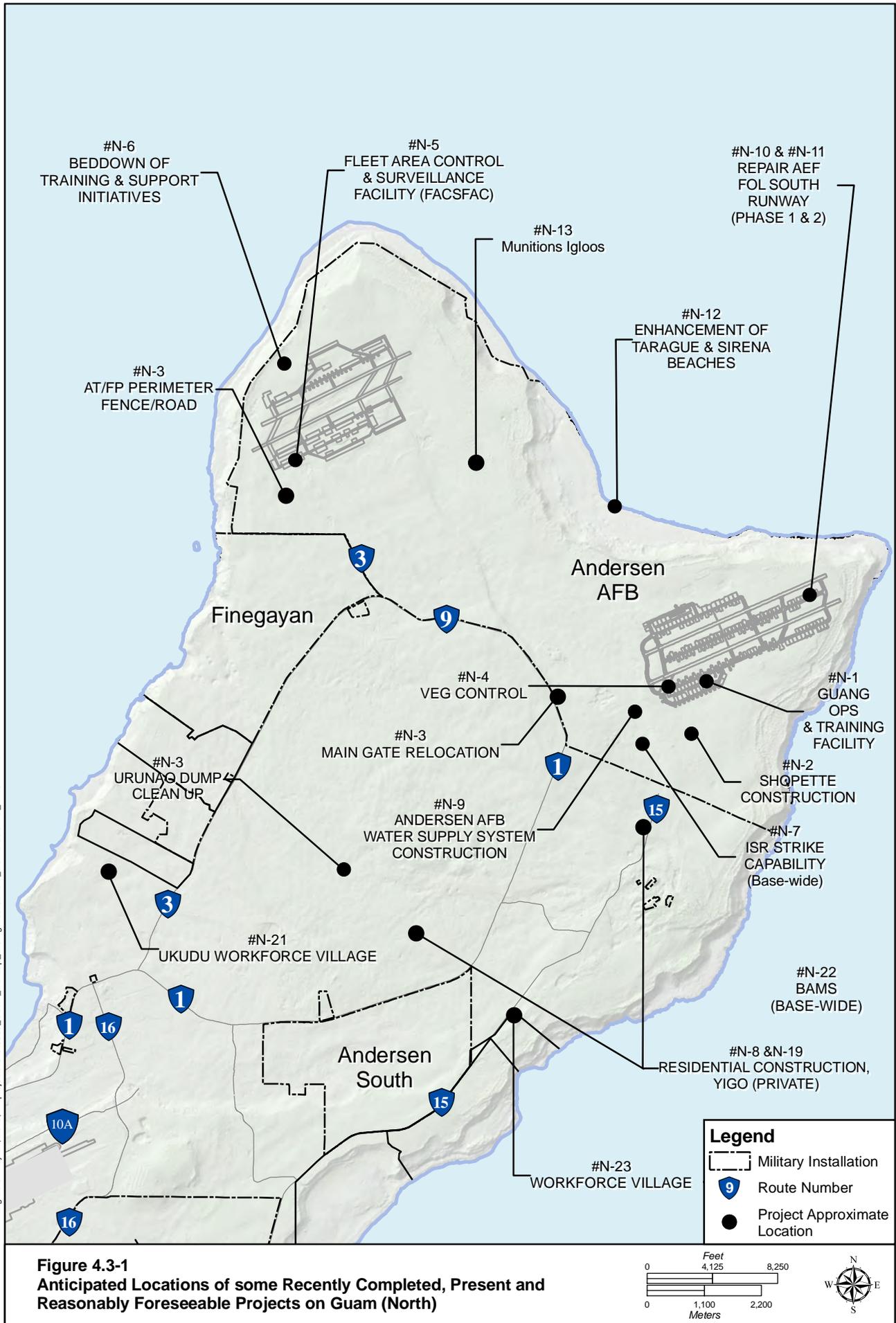
#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
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Legend: **Bold:** Projects are shown on Guam figures. RC = Recently completed, P = Present, RF = Reasonably foreseeable

Sources:

- 1) * Identified in the Training Concept Plan (Marine Forces Pacific 2009), but siting would need to be revisited after the Record of Decision (ROD) is issued for this EIS.
- 2) Projects included from the GLUC database (accessed 2/25/09) and organized by GLUC Request Type (e.g., Zone Variance, Seashore Clearance, Tentative Development Plan, etc.) provided in fourth column. They were/would be permitted between 2000 and 2019.
- 3) Navy projects last updated 9/09 by Navy
- 4) Air Force Projects updated 10/09 by Air Force
- 5) Additional projects added and project status updated based on agency review of the Draft EIS.

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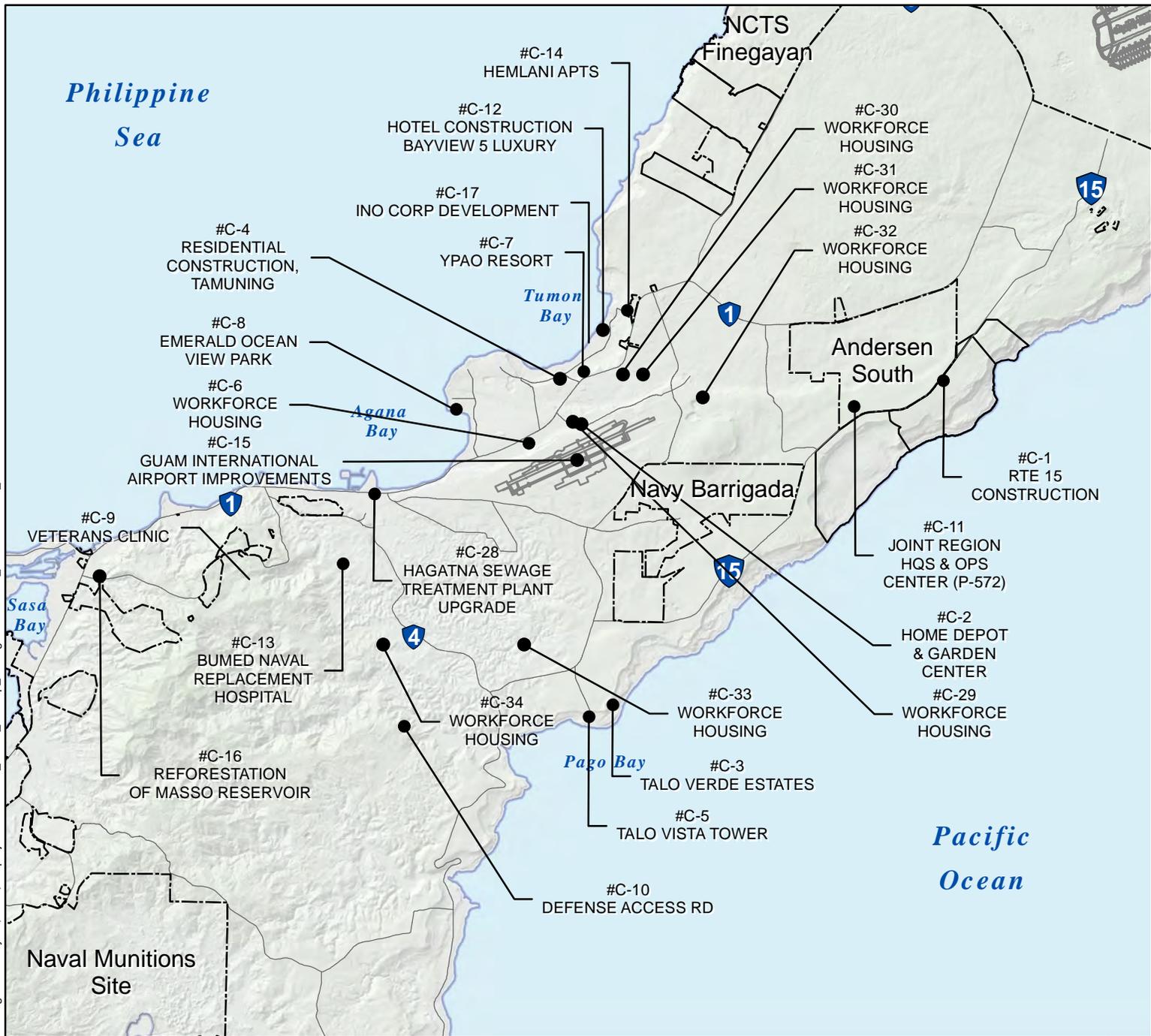
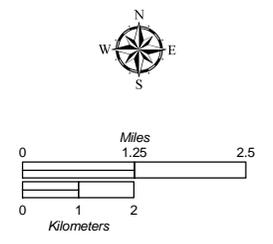


Figure 4.3-2
Anticipated Locations of some Recently Completed, Present and Reasonably Foreseeable Projects on Guam (Central)

- Legend**
-  Military Installation
 -  Route Number
 -  Project Approximate Location



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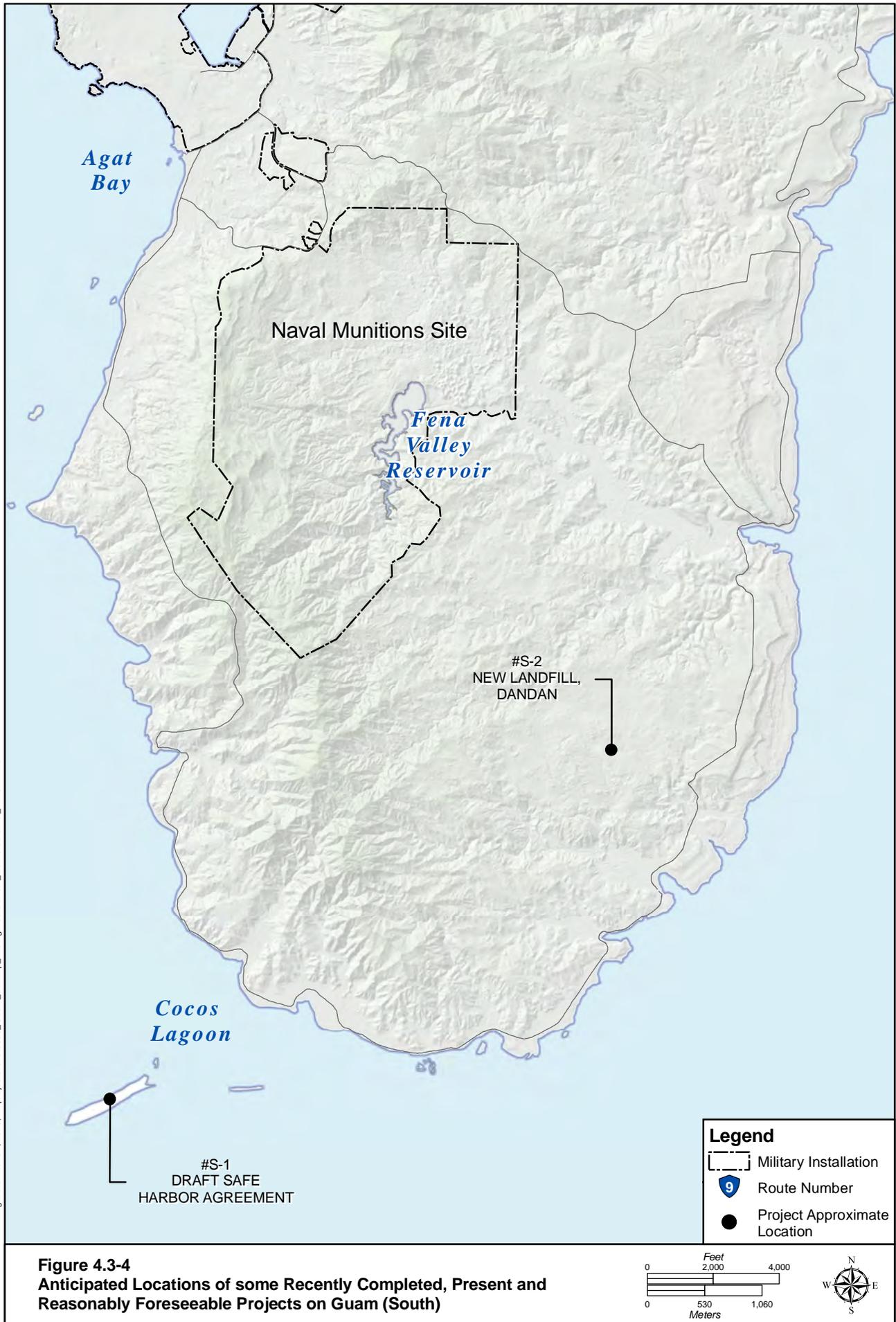


Figure 4.3-4
Anticipated Locations of some Recently Completed, Present and Reasonably Foreseeable Projects on Guam (South)

Table 4.3-2. Recently Completed, Present and Reasonably Foreseeable Projects in Tinian

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC), Present (P); Reasonably Foreseeable (RF)	Potential Impacts
CNMI-Tinian									
T-2*	Marine Corps Proj. 13B	Marine Corps	1,500/3,000 Man Base Camp, Phase 2 (Marine Corps Proj. 13B)	MLA	2014+	Unknown	Additional construction to accommodate up to 3,000 personnel.	RF	Retain
T-3*	Marine Corps Proj. 14	Marine Corps	Ammunition Storage (Marine Corps Proj. 14)	MLA	2014+	Unknown	Ammunition storage facility. Includes six igloo magazines, a segregation facility, operations building, security systems, and a road network.	RF	
T-4*	Marine Corps Proj. 15	Marine Corps	Automated Multipurpose Range (Marine Corps Proj. 15)	MLA	2014+	Unknown	Automated multipurpose range. Includes range support building, ammunitions storage, range observations tower, general instruction building, covered mess, covered bleachers, field range latrines, and 788 target emplacements.	RF	
T-5*	Marine Corps Proj. 16	Marine Corps	Combined Arms Live Fire Training Area (Marine Corps Proj. 16)	MLA	2014+	Unknown	1.5 x 3 mile area for live-fire and maneuver training, including stationary and automated targets. Supports up to .50 caliber ammunition.	RF	
T-6*	Marine Corps Proj. 17	Marine Corps	Company Level Live-Fire and Movement Range (Marine Corps Proj. 17)	MLA	2014+	Unknown	2,000 x 4,000-ft area for live-fire and movement training. Supports up to 7.62-mm infantry weapons.	RF	
T-7*	Marine Corps Proj. 18	Marine Corps	Mortar and Artillery Ranges (Marine Corps Proj. 18)	MLA	2014+	Unknown	Areas for mortar and artillery firing points.	RF	
T-8*	Marine Corps Proj. 19	Marine Corps	North Field Helicopter Operations (Marine Corps Proj. 19)	MLA	2014+	Unknown	Paved area at North Field for helicopter landings, weekly aviation training. Includes fire protection and bermed area for fuel bladder.	RF	
T-9*	Marine Corps Proj. 20	Marine Corps	Small Arms and Machine Gun Ranges (Marine Corps Proj. 20)	MLA	2014+	Unknown	6 pistol and rifle firing ranges, including stationary/automated targets, standard set of range support facilities.	RF	
T-10*	Marine Corps Proj. 21	Marine Corps	Stationary Target Range (Marine Corps Proj. 21)	MLA	2014+	Unknown	100 x 300-foot area for tank/fighting vehicle training. one firing point, central dubbed impact area.	RF	
T-11*	Marine Corps Proj. 22	Marine Corps	Waterfront Upgrades (Marine Corps Proj. 22)	MLA	2014+	Unknown	Breakwater repair, pier face structures repair, loading ramp, holding yard for customs, storage/transfer area, harbor dredging. Includes demolishing finger pier.	RF	
T-12*	Marine Corps Proj. 23	Marine Corps	Infrastructure Upgrades (Marine Corps Proj. 23)	MLA	2014+	Unknown	Roadway improvements, electrical distribution changes, fire protection facilities, and access to Unai Dankulo.	RF	
T-13*	Marine Corps Proj. 24	Marine Corps	Voice of America Relocation (Marine Corps Proj. 24)	Saipan and MLA	2014+	Unknown	Relocate Voice of America facility to northern portion of Saipan.	Unknown	
T-14	Commonwealth Ports Authority (CPA)	Unknown	Harbor Rehabilitation Project	Port	Ongoing	Ongoing	Power Builders International is presently upgrading dock surfaces, bulkheads, and bollards.	P	<i>De minimus</i> impacts

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC), Presently (P); Reasonably Foreseeable (RF)	Potential Impacts
T-15	DPW	Unknown	Marpo Valley Quarry (government)	non-MLA	2008 (FY)	CRMO application ongoing. CRM permit issued December 2008	Existing quarry operated by Power Builders International has to be relocated due to land lease to developers.	RF	Retain
T-16	Bridge Investment Group	Bridge Investment Group, Mr. Phillip Long	Tinian Oceanview Resort	non-MLA	2009 (FY)	CRM permit issued January 2008; construction has been initiated	This would be the second casino for Tinian and the first condominium project for the CNMI. It would also include 396 rooms and an 18-hole golf course. Construction to begin in 2009.	RF	Retain
T-17	Marianas Resort Development Group	MRDG, Mr. David Choi 670.235.0020	Matua Bay Resort and Golf Course	non-MLA	2009 for golf course; hotel and casino in later phase	CRM Permit issued December 2008; golf course under design	A 1,000-room hotel that would feature a golf course and a casino. The first phase of the two-phased project would involve the construction of a 500-room hotel and an 18-hole golf course at an estimated cost of U.S. \$179 million. The second phase would include the completion of the facility.	RF	Retain
T-18	DPW	Unknown	Landfill	non-MLA	TBD	NEPA document prepared	Relocation of current landfill was pending DoD approval. As of November 2008, DoD was not taking action and CNMI was researching other potential locations.	RF	Retain
T-19	CUC	Unknown	WWTP Project (government), western Tinian	non-MLA	TBD	Awaiting final NEPA	Proposed Tinian WWTP to be co-located with proposed landfill.	RF	Retain
T-20	CPA	Unknown	Tinian Airport	airport	TBD	Ongoing	Project and construction specifics TBD.	Unknown	Too speculative
T-21	CPA	Unknown	Tinian Airport Instrument Landing System	airport	TBD	unknown	ILS is necessary to attract tourists to the island and remove a level of danger for large aircraft. The bigger planes require the ILS. The funds are there. Need to expedite the process.	RF	There are no anticipated cumulative impacts
T-22	Unknown	Unknown	Reconstruction of Roads	MLA	TBD	Ongoing	Reconstruction of Broadway and 8 th Avenues along existing alignments	RC	<i>De minimus</i> impacts
T-23	Neo Goldwings Paradise	Unknown	Neo Goldwings Paradise Casino on Tinian	non-MLA	TBD	Provisional lease signed by Governor and submitted to Legislature in Dec. '08	To be located on public land at the north end of Tinian. Plans include a 1,000-room hotel, casino, observatory, sauna and fitness center, indoor ice skating rink, outdoor concert hall, amusement park, water park, 36-hole golf link, horse riding ground, yacht basin, hot air balloon area, and a Chamorro cultural village.	RF	Retain
T-24	Unknown	Unknown	Tinian and Rota Seaport Rehabilitation	non-MLA and Rota	TBD	Unknown	Critical to help improve the port. Although these projects require a plethora of planning, environmental studies and have a level of high costs, these are critical to every aspect of these islands economy. A continuing decline in their condition would cause economic damage to these islands. Tinian - \$45,000,000 Rota - \$20,000,000 Comprehensive Economic Development Study (January 2009)	Unknown	Too speculative
T-25	CNMI DPW	CNMI Government	2030 CNMI Transportation Plan	island-wide	TBD	This plan guides federally -	This plan involves repairs and upgrades of Tinian transportation network. Projects are funded by FHWA and other sources.	RF	There are no anticipated cumulative impacts related to a plan

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC), Present (P); Reasonably Foreseeable (RF)	Potential Impacts
						funded transportation projects from 2010 to 2030			
T-26	CNMI DPW	CNMI Government	Territorial Transportation Improvement Plan (TTIP)	island-wide	2008-2011	In place	Short-term federally-funded transportation projects (two projects).	P	Both projects are CATEX. There are no cumulative impacts
T-27	Resources - Management International	Unknown	Management International Quarry	non-MLA	2010	Permit application being reviewed	Quarry - approximately 5 ha.	RF	Retain
T-28	Department of Public Lands	CNMI Government	Homesteads (various proposals)	non-MLA	2010	Permitted, some lots assigned	Develop homestead villages (various projects)	RF	Retain

Legend: **Bold**: Project identified on Figure 4.3-5. RC = Recently completed, P = Present; RF = Reasonably foreseeable; MLA= Military Lease Area

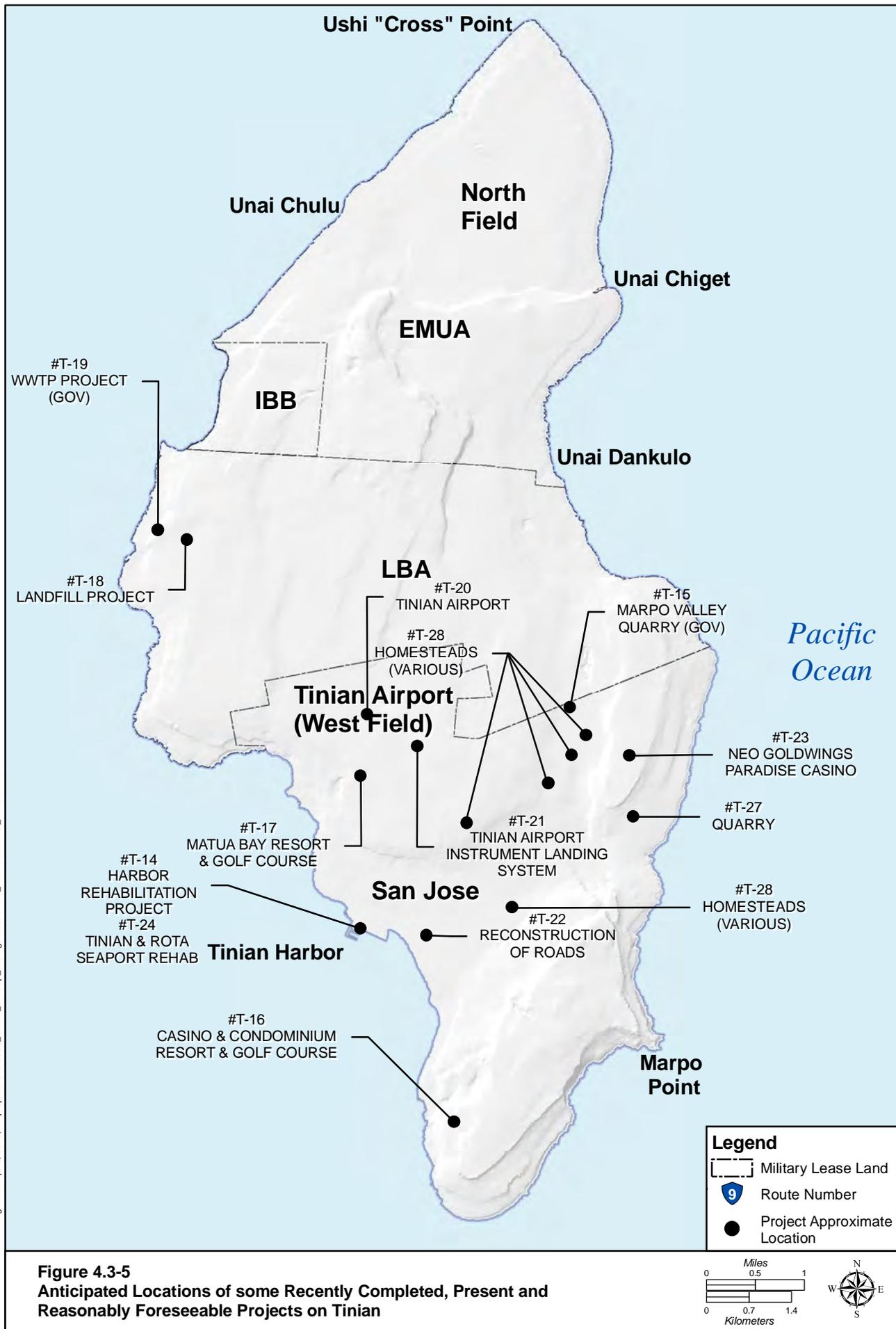
Note: T-1 eliminated for being a duplicate project to another in the list

Sources:

- 1) * Identified in the Training Concept Plan (Marine Forces Pacific 2009), but siting would need to be revisited after the Record of Decision (ROD) is issued for this EIS. The project locations are too conceptual to site on a figure, but they generally would be within the Military Lease Area.
- 2) Interviews with CNMI agencies circa February 2009.
- 3) Additional projects added and project status updated based on agency review of the Draft EIS.

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4.3.1 Commercial Port Modernization Program

The commercial port improvements were identified in Volume 6 as a non-DoD decision point action. There are three phases to the port modernization program: IA, IB, and II (Rosenthal 2010).

Phase IA: The focus is on productivity and efficiency improvements, such as new equipment, systems, and buildings, and terminal modernization and new yard capacity. Elements include demolition of buildings; installation of utilities; terminal yard paving and upgrade of pavement; installation of high mast lighting; installation of water, sewer, stormwater and fire protection systems including installation of new stormwater outfalls into Apra Harbor; installation of security systems; and new cargo handling and equipment systems. The project would significantly increase the operating efficiency and capacity of the terminal by an eastward extension of useable terminal area and through modernization of upland port facilities, equipment, utilities and systems including new gate systems with automated gate technology and modern truck scanning equipment (Rosenthal 2010). The NEPA process would be completed by the end of 2010, and full funding is anticipated in 2011. Preliminary design is projected to be complete in June 2010 and construction is to be completed in 2013 (Rosenthal 2010).

Phase IB: The focus is on structural refurbishment of existing docks (F4, F5, F6), modernization of terminal areas to the west, and acquisition of cranes. It includes dredging to increase berth depths at F4 through F6 to -42 ft (-13 m) MLLW, and security equipment and process improvements to meet International Ship and Port Facility Security Code (ISPS) requirements. Construction would last approximately two years. The preliminary design, preparation of permits and the NEPA process would start as soon as funding has been identified (Rosenthal 2010).

Phase II: The focus is on construction of a new berth (F7) and additional terminal capacity to the east to meet long-term organic growth. Creation of the new berth (F7) would require some land reclamation (i.e., placement of fill in Apra Harbor), removal of existing derelict vessels, and the addition of 900 ft (274 m) of berthing/wharf space. Dredging would also be included. Execution of this phase is likely to take 20 or more years; funding has not been identified (Rosenthal 2010).

4.3.2 Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability

The proposed action would establish an ISR/Strike operational capability in the Western Pacific, in four phases, over an approximate 16-year period beginning in fiscal year 2007. The ISR/Strike capability would consist of fighter, aerial refueling, bomber, unmanned aerial vehicle aircraft, and support personnel. The ISR/Strike EIS was finalized and a Record of Decision (ROD) was issued in January 2007 (PACAF 2007).

Andersen AFB was identified as the installation best suited to host the ISR/Strike capability. The average daily airfield operations would increase from 235 to 297 as a result of the action. The increase in aircraft events into and out of Andersen AFB requires improved range infrastructure to accommodate this increased training tempo, newer aircraft, and weapon systems commensurate with ISR/Strike force structure. There would be increased activity on all the current training areas supporting Air Force activities. Land acquisition is not proposed.

There would be construction to support approximately 3,000 additional personnel, including 190 family housing units. The Air Force would beddown and operate two squadrons and three training programs at Northwest Field, concurrent with ISR/Strike capability (addressed in a separate environmental assessment).

As part of the ISR/Strike mitigation plan, a new Habitat Management Unit of 148 ac (60 ha) would be established as a mitigation measure for impacts to biological resources. This mitigation plan would include:

- Development of an ungulate control plan.
- Ungulate exclusion fencing.
- A full-time wildlife management specialist position would be funded.
- Trees that are important to the Mariana Fruit Bat or the Marianna Crow would be planted.
- A noise study would be conducted.

At the time of the ISR/Strike EIS, there was an insufficient project description for the Guam and CNMI Military Relocation to be addressed and included in the Air Force cumulative impact project list. The Air Force was able to address the cumulative impacts of establishing an ISR/Strike Capability in their EIS (PACAF 2006) relative to a host of other cumulative projects identified.

4.3.3 Mariana Islands Range Complex (MIRC)

The Mariana Islands Range Complex (MIRC) EIS/OEIS proposes military training activities within the Mariana Islands (DoN 2010). The MIRC consists of the ranges, airspace, and ocean areas surrounding the ranges that make up the Study Area. The study area described in the MIRC EIS/OEIS does not include the sovereign territory (including waters out to 12 nautical miles [nm]) of the Federated States of Micronesia.

The proposed action would result in critical enhancements to increase training capabilities (especially in the undersea and air warfare areas) that are necessary if the military services are to maintain a state of military readiness commensurate with the national defense mission. The proposed action primarily focuses on the development and improvement of existing training capabilities in the MIRC, and would not include any military construction projects. However, the proposed action does not involve extensive changes to the MIRC facilities, activities, or training capabilities, nor does it involve an expansion of the existing MIRC property or airspace requirements. It does not involve the redeployment of Marine Corps or Air Force personnel or assets, carrier berthing capability, or deployment of strategic missile defense assets to the Marianas. Because new ranges are not being proposed, the project location is not shown in Table 4.3-1.

Governing procedures for the use of training areas, ranges, and airspace operated and controlled by the Commander U.S. Naval Forces, Marianas (such as instructions and procedures for the use of Guam, Saipan, Tinian, Rota and Farallon de Medinilla) are included in Commander Navy Region Marianas Instruction 3500.4 (Marianas Training Handbook). This guidance identifies specific land use constraints to enable protection of environmental resources during military training in the MIRC. These procedures would continue to be followed. Modification and augmentations of these procedures are being discussed among stakeholders. No new types of training would be required that would warrant new procedures in the MIRC EIS/OEIS.

4.3.4 Workforce Housing

There are nine permit applications approved, or pending approval, by the Guam Land Use Commission (GLUC) for workforce housing that would support the proposed action. The socioeconomic impacts of workforce housing are described in Volume 2, Chapter 16, as an indirect impact of the proposed action. Volume 1, Chapter 4 presents a qualitative impact assessment of workforce housing. Also, the workforce permit applications are included as cumulative projects (N-21, N-23, C-29 through C-33) as shown on

Figures 4.3-1 and 4.3-2. The cumulative impact discussion assumes that GovGuam would not permit land uses that could not be supported by Guam's infrastructure. The permits are temporary and extensions are subject to approval by the GLUC.

4.3.5 Cumulative Impact Assessment

For a proposed action of the scale addressed in this EIS, many of the project-specific impacts of the proposed action are inseparable from those of recently completed, present, and reasonably foreseeable future actions on Guam and in the CNMI. Many aspects of the proposed action are inherently interconnected with Guam's or the CNMI's systems; therefore, resulting impacts from the proposed action would be cumulative in nature. Throughout much of the analysis in this EIS, environmental conditions arising from recently completed, present, and future actions have been incorporated into the description of existing conditions and impact analysis. Therefore, most of the cumulative effects analysis contained below refers to analysis provided earlier in this EIS.

The primary purpose of this section is to identify additional impacts that could arise from the proposed action in combination with recently completed, present, and reasonably foreseeable future actions on Guam and in the CNMI. Adverse impacts would result to most resources on Guam and in the CNMI from the proposed action in combination with recently completed, present, and reasonably foreseeable future actions.

As previously stated, the Navy's position is to avoid impacts when possible, and to reduce impacts when avoidance is not possible. Mitigation measures to reduce or avoid impacts resulting from the proposed action, along with mitigation measures beyond DoD's control, are discussed in earlier analysis in Volumes 2 through 6 of this EIS and are listed in Chapter 2 of this volume. Additionally, Chapter 2 of this volume indicates that each of the mitigation measures proposed in this EIS would not only reduce or avoid project-specific impacts, they could also reduce or avoid cumulative impacts of the proposed action in combination with past, present, and reasonably foreseeable future actions on Guam and in the CNMI. The cumulative impacts identified below are considered unavoidable and could not be reasonably avoided or reduced with additional mitigation measures. Therefore, no additional measures are proposed in this section to mitigate cumulative impacts resulting from the proposed action.

The force flow reduction mitigation measure and APM of construction would reduce the peak population associated with the proposed action during construction. The APM measure necessarily includes force flow reduction because military population would not arrive until there are facilities to accommodate them. Chapter 2 of this volume discusses how these mitigation measures would reduce or avoid individual impacts resulting from the proposed action. This reduction, or avoidance, of individual impacts to resources would likewise result in a reduction or avoidance of cumulative impacts to resources, particularly during the construction phase of the proposed action.

4.3.5.1 Guam Cumulative Impacts Assessment

Table 4.3-3 shows the cumulative projects that were retained following the screening for relevance of the initial cumulative projects list (Table 4.3-1). Based on the limited information available on the cumulative projects, a qualitative assessment was made regarding the potential impacts of the cumulative projects on resources. Attempts could not be made to distinguish between less than significant and significant adverse impacts for some projects because not enough information about the projects was readily available. Beneficial impacts are indicated by "B" and adverse impacts are indicated by "X." The number of projects that potentially have an adverse impact on each resource is totaled at the bottom of the cumulative projects list. The next line identifies the impact findings from Chapter 3.

Table 4.3-3. Summary of Potential Operations Impacts to Resource Area – Guam Projects

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
Guam – General Actions																					
1	Core Tech	Ironwood Estates (affordable housing)	RC		X		X		X		X		X	X			X	B	X		B
4	Commander Navy Region (COMNAV) Pacific	MIRC EIS/OEIS (See Section 4.3.3)	P	X	X	X	X				X	X	X						X		
7	Guam Department of Corrections	Territorial Prison	RF						X		X		X	X			X	B	X		
12	GPA	60 MW Power Plant	RF			X											B				
Guam - North																					
N-3	Air Force	AT/FP Perimeter Fence and Road Construction and Main Gate Relocation at Andersen AFB	RF						X		X		X	X			B	X	X		B
N-6	36 WG of the Pacific Air Forces (PACAF)	Beddown of Training and Support Initiatives at NWF	P			X					X		X			X	X	X	X	X	X
N-7	36 WG of the Pacific Air Forces (PACAF)	ISR/Strike Capability, Andersen AFB (See Section 4.3.2)	P		X	X	X	X			X	X	X			X		X	X	X	X
N-8	Base Corp.	Paradise Estates, Yigo	P						X		X		X		X	X	X	X	X		

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
N-10	36 WG of the PACAF	Various small scale- projects at Andersen AFB	RF						X		X		X	X			X	X	X		
N-14	GLUC ^{2,3}	Conditional Use Request	RF		X				X		X		X	X		X	X	X			B
N-15	GLUC ^{2,3}	Subdivision Variance Request	RF		X				X		X		X	X		X	X	X			B
N-16	GLUC ^{2,3}	Tentative Subdivision Approval	RF		X				X		X		X	X		X	X	X	X		
N-17	GLUC ^{2,3}	Wetland Permit	RF		X						X	X		X				X			
N-19	Private Development	Villa Pacita Estates	P		X				X		X		X	X	X	X	X	X	X		
N-21	Younex Enterprises	Workforce housing (See Section 4.3.4)	P		X	X	X		X		X		X	X		X	X	X	X		X
N-22	Air Force	BAMS	RF					X						X		X		X	X	X	X
N-23	Pacific International Guam Inc	Workforce housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
Guam - Central																					
C-2	Home Depot	Home Depot	RC						X		X		X	X		X	X	X	X		B
C-3	Access Development Company	Talo Verde Estates	RC						X	X	X		X	X	X	X	X	X	X		
C-4	TBD	Residential construction, Tamuning (private)	P						X	X	X		X	X	X	X	X	X	X		
C-5	Private Development	Talo Vista Tower	P						X	X	X		X	X	X	X	X	X	X		

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
C-6	Core Tech	Workforce housing (See Section 4.3.4)	P		X	X	X		X		X		X	X		X	X		X	X	X
C-7	Private Development	Ypao Resort	RF		X				X		X		X	X	X	X	X	X	X	X	X
C-8	Private Development	Emerald Ocean View Park	P		X				X		X		X	X	X	X	X	X	X		
C-9	Unknown	Veterans Clinic	P						X		X		X	X	X	X	X	B	X	B	B
C-10	Navy	Defense Access Road	RF								X		X			B	X				
C-12	Private Development	Hotel Construction Bayview 5 Luxury Project, Tumon Bay	P		X				X	X	X		X	X	X	X	X	X	X	X	X
C-13	BUMED	Bureau of Medicine Naval Replacement Hospital Project	P						X		X		X	X			X	X	X	B	
C-14	Private Development	Hemlani Apartments	RF						X		X		X	X	X	X	X	X	X		
C-15	Guam International Airport Authority (GIAA)	Guam International Airport Improvements	RF		X		X	X			X		X	X			B	X	X	X	
C-16	GovGuam and the U.S. Navy	Reforestation of Masso Reservoir	RF	B	B						B	B	X	B							
C-17	Private Development	Ino Corp Development	RF		X				X		X		X	X	X	X	X	X	X		
C-18	GLUC ^{2,3}	Conditional Use Request	RF			X			X		X		X	X		X	X	X			B
C-19	GLUC ^{2,3}	PUD - Amendment	RF			X			X	B	X		X	X		X	X	X			B

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
C-20	GLUC ^{2,3}	Seashore Clearance Request	RF	X	X					B	X	X	X	X			X	X			B
C-21	GLUC ^{2,3}	Subdivision Variance Request	RF		X	X			X		X		X	X		X	X	X			B
C-22	GLUC ^{2,3}	Tentative Development Plan Application	RF		X	X			X		X		X	X	X	X	X	X			B
C-23	GLUC ^{2,3}	Tentative Subdivision Approval	RF		X	X			X		X		X	X	X	X	X	X			
C-24	GLUC ^{2,3}	Wetland Permit	RF		X						X		X	X							
C-25	GLUC ^{2,3}	Zone Change Request	RF		X				X	B	X		X	X		X	X	X			B
C-27	Unknown	Subdivision	RF		X					X	X		X	X	X	X	X	X	X		
C-29	Chugach World Services	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X	X	X	X	X	X	X	X
C-30	S.K Construction Inc.	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-31	Black Construction Corp	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-32	DDT Konstract	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-33	Bob Salas	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-34	Bascon Corp	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X	X	X	X	X	X	X	X

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
Guam - Apra Harbor																					
AH-1	Navy	Kilo Wharf Improvements (P-451)	RC		X				X		X			X	X		X	X	X		
AH-4	CNM	Orote Magazines (P-425)	RF						X		X		X	X			X	X	B	X	
AH-8	Port Authority of Guam (PAG)	Modernization Program: Port Reconfiguration, Maintenance and Repair (See Section 4.3.1)	RF		X	B			X		X	X	X	X	B	X	X	B	X		
AH-10	CNM	Kilo Wharf Extension (P-502)	P		X				X		X		X	X			X	X	X		
AH-11	CNM	X-Ray Wharf Improvements (MILCON P-518)	RF		X				X		X	X		X	X		X	X	X		
AH-16*	MARFOR PAC	Amphibious Training, Dadi Beach (Marine Corps Proj. 10)	RF	X	X		X	X	X	X	X	X	X	X					X	X	
AH-17*	MARFOR PAC	Amphibious Training, Tupalao Beach (Marine Corps Proj. 11)	RF	X	X		X	X	X	X	X	X	X	X					X	X	
AH-18*	MARFOR PAC	Amphibious Training, Boat Ramp, Overland	RF		X		X		X	X	X	X	X	X		X			X	X	

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																		
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children	
AH-21	CNM	Mitigation for Kilo Wharf Extension	P	B	B						B	B	X	B			X					
AH-22	Army	Stationing and Operation of Joint High Speed Vessels (JHSV)	RF		X				X		X	X		X	X	X	X	X	X	X		
Guam - South																						
S-1	USFWS	Draft Safe Harbor Agreement, Cocos Island	P								B						X		X			
S-2	DPW	New Landfill, Dandan	RF	X	X		X		X		X		X	X		X	B	X	B	B		
S-7	GLUC ^{2,3}	Wetland permit	RF	X	X						X		X				X					
Number of recently completed projects potentially contributing to cumulative impacts					0	2	0	1	0	4	1	4	0	3	4	2	2	4	4	4	0	2
Number of present projects potentially contributing to cumulative impacts					2	9	5	4	1	11	3	15	4	14	11	8	11	12	14	14	7	6
Number of reasonably foreseeable projects potentially contributing to cumulative impacts					5	30	14	12	2	30	6	37	9	34	36	11	25	32	35	24	14	19
Summary Operation Impacts: Preferred Alternatives significant impacts (from Chapter 3)					SI-M	LSI (SI)	LSI	SI	LSI	SI	SI (SI)	SI-M	SI-M (SI-M)	SI-M	SI-M	LSI	SI	SI-M (SI)	SI (SI)	LSI	SI (SI)	SI (SI)
Preferred Alternatives impacts additive to past present and reasonably foreseeable future actions? yes[Y]/no[N]					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Degree of additive impact? S=strong; M=moderate; L= low					L	L	L	M	L	S	S	S	S	S	M	S	S	S	S	L	S	L

Legend: B = Beneficial impact, X = Adverse impact, Blank cell = No or minimal impact anticipated, SI = Significant impact, SI-M = Significant and mitigable to less than significant, **Bold** = project identified on Figure 4.3-5, RC= Recently completed; P = Present; RF = Reasonably foreseeable, () = Indirect (workforce population and induced) population impact

The final two lines of the table indicate if an additive impact on the resource is anticipated, and whether the additive impact from the preferred alternatives is strong, moderate, or low.

The cumulative impacts study area for each resource is the island of Guam and its waters out to 164 ft (50 m). The following is a summary of the cumulative impact analysis by resource.

Geological and Soil Resources

Current Health and Historical Context. The affect of pre-colonial populations on the current health of Guam's geological resources is difficult to ascertain. During the Spanish Period (1668-1899) introductions and increases of domesticated animals (water buffalo, pigs, goats, and deer) and farm crops likely denuded soils and contributed to erosion from vegetation loss and trampling. However, Guam's geological and soil resources have been most recognizably affected by human populations in the past century. Of particular note are impacts associated with WWII, during which time much of Guam's foliage was lost to bombings as the U.S. retook control of the island from Japan in 1944. In 1947, the U.S. military seeded the island from the air with tangantangan (*Leucaena leucocephala* - native to the Americas) to control erosion (Section 1.3.3.1). Additional WWII impacts to soils and geological resources resulted from construction of Japanese defensive positions and the compaction and grading resulting from a massive build-up of American forces, including the construction of five airfields, immediately after the U.S. reclaimed control of the island (Volume 2, Section 12.1.1.3).

More recently, soil loss due to erosion is largely attributed to human-induced wildfires, construction and development with inadequate erosion control systems, recreation with off-road vehicles, and introduced mammals (Sections 1.3.2 and 3.3.2). Prior to the arrival of humans, Guam seldom experienced wildfires due to environmental conditions unfavorable to fire ignition. Despite Guam's humid conditions, approximately 750 wildfires were reported annually between 1979 and 2001. Although open fires are prohibited under existing local codes, the majority of wildfires are caused by humans. During this time period, over 155 mi² of vegetation burned and Guam lost nearly a quarter of its total tree cover (Volume 2, Section 3.1.1.4). The burn areas are often invaded by non-native grasses or become "barrens." The replacement of forest with savanna vegetation contributes to elevated soil loss, as erosion in savanna areas may be 100 times higher than in scrub forest. During the rainy season, erosion is accelerated in sparsely vegetated or barren burn areas and sediment is carried by heavy rains into Fena Lake Reservoir and the Ugum River, leading to water quality problems for southern Guam. Eroded silt from these burn areas also destroys marine life in reefs around the island (Section 1.3.2). Popular use of off-road vehicles for recreation is also believed to be a major contributor to the development and persistence of erosion-prone cover types.

During construction, grading and filling are often required; this may reduce soil quality that in turn may affect plant growth and runoff. When topsoil is removed, biological activity decreases, as does the presence of organic matter and plant nutrients, thereby affecting plant nutrition, control of pests and disease, water infiltration, and resistance to erosion. Compaction also typically occurs at construction sites and can also increase erosion potential (Volume 2, Section 3.1.1.4). Once construction is complete, the addition of impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) can accelerate water flows and lead to further soil loss and erosion if appropriate storm water controls are not implemented.

There are no recently completed projects identified with the potential to contribute to a cumulative impact to geological and soil resources on Guam (Table 4.3-3). Two present projects with the potential to contribute to a cumulative impact to geological and soil resources on Guam were identified (Table 4.3-3): MIRC (4) and Mitigation for Kilo Wharf Extension (AH-21). Mitigation for Kilo Wharf Extension (AH-

21) is anticipated to have a beneficial effect on geological resources by reducing erosion and associated soil loss.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's geological and soil resources as listed in Table 3.3-2 (see Volume 7, Section 3.3.2; Volumes 2, 4, and 5, Section 3.2; Volume 6, Section 5.2). The impacts are related to sinkholes and liquefaction potential. The proposed action is not expected to unreasonably increase vulnerability to a geologic hazard (e.g., earthquake, tsunami). Geotechnical surveys would be completed prior to construction, and sinkholes would be avoided to the extent practicable. Temporary direct impacts to geological resources that could contribute to a cumulative impact would primarily occur to soils during the construction phase when vegetation would be temporarily cleared and topsoil graded. The effects would be localized and would not affect productive agricultural soils. BMPs included in the proposed action are expected to be effective at controlling soil erosion and storm water during temporary construction and long-term operations. However, there is always the potential for uncontrollable BMP failures. For example, storm water control systems could be overwhelmed during a typhoon, resulting in undesirable affects that could be cumulative, such as increased erosion from accelerated sheet flows across impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) added by the proposed action.

Reasonably Foreseeable Actions that Affect Geological and Soil Resources. Five reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to geological and soil resources on Guam (Table 4.3-3): New Landfill (Dandan; S-2), Amphibious Training (Tipalao Beach; USMC; AH-17), Amphibious Training (Dadi Beach; USMC; AH-16), Seashore Clearance Request (C-20), and the Reforestation of Masso Reservoir (C-16). Two of the projects would be in North Guam, two at Apra Harbor, and one in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on geological resources by reducing erosion and associated soil loss.

Potential Cumulative Impacts. Anticipated temporary impacts to geological resources during construction and long-term impacts associated with operations, although considered to be insignificant, would have an adverse cumulative impact when combined with the past, present, and reasonably foreseeable actions on Guam identified above. Uncontrolled human and natural factors (e.g., typhoons, tropical storms, earthquakes, tsunamis) outside the military base would continue to have an adverse impact on geological and soil resources. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the health of geological resources on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to geological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Water Resources

Current Health and Historical Context. The historical context of surface water, groundwater, nearshore water, and wetlands on Guam is difficult to ascertain. Soil erosion and stormwater runoff are largely responsible for degradation of surface and nearshore waters. As described above under Geological and Soil Resources, the introductions and increases of domesticated animals (water buffalo, pigs, goats, and deer) and farm crops likely denuded soils and contributed to erosion from vegetation loss and trampling. During WWII much of Guam's foliage was lost to bombings. When the U.S. retook control of the island

from Japan in 1944, Tangantangan (*Leucaena leucocephala* - native to the Americas) was planted to control erosion (Section 1.3.3.1).

More recently, soil loss (due to erosion) is largely attributed to human-induced wildfires, construction and development with inadequate erosion control systems, recreation with off-road vehicles, and introduced mammals (Section 1.3.2). As described under and Soil Resources above, the occurrence of wildfires has increased. Between 1979 and 2001, over 155 mi² of vegetation burned and Guam lost nearly a quarter of its total tree cover (Volume 2, Section 3.1.1.4). The burn areas are often invaded by non-native grasses or become barrens. The replacement of forest with savanna vegetation contributes to elevated soil loss, as erosion in savanna areas may be 100 times higher than in scrub forest. Eroded silt from these burn areas also destroys marine life in reefs around the island (Section 1.3.2). Popular use of off-road vehicles for recreation is also believed to be a major contributor to the development and persistence of erosion-prone cover types.

Once construction is complete, the addition of impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) can accelerate water flows and lead to further soil loss and erosion if appropriate storm water controls are not implemented. Past construction and development on Guam has resulted in the addition of approximately 12,280 acres (4,970 ha) of developed impervious surface area (Department of Commerce et al. 2007), representing approximately 1% of the island's total land area.

Threats to surface water would continue to be monitored by federal and Guam agencies, and appropriate regulatory action would continue to occur in order to maximize surface water quality and availability. In time, water resource impacts would be expected to slowly be reduced as point and non-point sources of pollution are identified, and pollution loading to surface waters is reduced.

The identified nearshore water quality concerns for the marine waters of Guam include copper, aluminum, nickel, *enterococci* bacteria, total residual chlorine, biochemical oxygen demand, and total suspended solids (Section 3.3.3.2). In time, nearshore water quality would be expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to nearshore waters is reduced.

As described in Section 3.3.3.2, threats to groundwater availability and quality (e.g., saltwater intrusion and leaky septic systems) would continue to exist. Monitoring for saltwater intrusion, coordination amongst water users, and fewer septic systems anticipated in the future are expected to ensure a dependable and safe supply of groundwater would be maintained for Guam. In time, groundwater quality would be expected to slowly improve on Guam as point and non-point sources of pollution are identified, and pollution loading to surface waters is reduced, all within the framework of increasing the understanding of the Northern Guam Lens Aquifer (NGLA).

Wetlands can also be impacted by soil erosion, but direct impacts (due to removal by construction projects) have reduced wetlands over time. These threats to wetland areas are monitored by federal and Guam agencies. Appropriate regulatory action would continue to occur to protect wetland areas. In time, wetland quality would be expected to slowly improve as point and non-point sources of pollution are identified; however, the extent of wetlands (by acreage) may not significantly increase because the focus is currently on reducing potential future losses.

Two recently completed projects with the potential to contribute to a cumulative impact to water resources on Guam were identified (Table 4.3-3): Kilo Wharf Improvements (AH-1), and Ironwood Estates (affordable housing; 1).

Nine present projects with the potential to contribute to a cumulative impact to water resources on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Kilo Wharf (AH-10), and Mitigation for Kilo Wharf Extension (AH-21). Mitigation for Kilo Wharf Extension has a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact.

The preferred alternatives would result in less than significant impacts to Guam's water resources (surface water, groundwater, nearshore water, and wetlands), as summarized in Volume 7, Section 3.3.3, Table 3.3-5. The details of the impact analysis for the preferred alternatives are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 4.2; Volume 6, Section 6.2). This assessment assumes BMPs are effective at controlling soil erosion, pollutants of concern, and stormwater flow. Low Impact Development (LID) measures would be implemented. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed per capita, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield. Monitoring groundwater chemistry and overlying sediments would ensure no harm to existing beneficial uses, and no damage to structures, utilities, or other facilities would result from potential soil settlement or saltwater intrusion. Wastewater treatment plant effluent discharges would be of the same or higher quality than current discharges, and would continue to meet discharge requirements in nearshore waters. An estimated 0.3 ac (0.12 ha) of wetlands could be impacted; mitigation measures would be required by the USACE to compensate for the loss. The uncontrolled human and natural factors outside the proposed actions would continue to have an adverse impact on water resources.

Reasonably Foreseeable Actions that Affect Water Resources. 30 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to water resources on Guam (see Table 4.3-3). 22 of the projects would be in North Guam, six at Apra Harbor, and two in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on water resources by reducing erosion and sedimentation. There is insufficient detail on the cumulative projects to know which ones may impact wetlands; however, it is likely some wetlands would be affected by projects such as N-17, C-24, and S-7 (GLUC wetlands permit), coastal projects such as the Marine Corps training (AH-16, AH-17, AH-18), wharf improvements such as X-Ray Wharf (AH-11), Port Authority Guam (AH-8), and JHSVs (AH-22). The remaining development projects that disturb soils have the potential to impact soils and increase impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) and consequently have the potential to impact surface waters. Additionally, development projects are likely to increase the demand on Guam's groundwater resources, particularly the NGLA. The new PDW Dandan landfill project (S-2) is listed as having the potential to impact water resources; however, landfills are heavily regulated and routinely monitored.

Potential Cumulative Impacts. Cumulative projects would involve construction activities that would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. For cumulative projects disturbing more than one acre during construction (including the preferred alternative), a Construction General Permit would be obtained and followed and a Stormwater Pollution Prevention Plan (SWPPP) would be prepared and implemented to minimize temporary increases in runoff and pollutant loading related to construction activities.

In addition, cumulative projects would result in an increase in impervious surface area in urban and industrial settings, resulting in a corresponding increase in stormwater runoff that has the potential to have elevated levels of contaminants, such as sediments, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. The increase in impervious surfaces would result in an associated increase in stormwater discharge intensities and volume. This increase would likely be accommodated by existing or new stormwater infrastructure to ensure the timely and low-impact flow of stormwater to minimize erosion and flooding concerns. In addition, cumulative actions would be expected to increase the amount of petroleum, oil, and lubricants (POLs), hazardous waste, pesticides, and fertilizers being stored, transported, and utilized. Increasing the storage, transportation, and use of these substances would increase the potential for releases to water resources. Implementation of BMPs associated with addressing site- and activity-specific water resource protection needs, provisions of facility-specific SWPPPs, and Spill Prevention, Control, and Countermeasure (SPCC) Plans would minimize potential impacts from facility operations, to include the transportation, storage, and use of fuel, on all water resources. In addition, adherence to surface water quality and volume control measures would also reduce pollutant loading to groundwater basins, nearshore waters, and wetlands. Many of the cumulative projects could potentially impact water resources. The preferred alternatives would increase the total existing development-related impervious surface area on Guam by approximately 7% (Section 3.3.3.1).

Reasonably foreseeable projects include connections to wastewater collection, treatment, and disposal systems that would reduce and/or ensure less reliance on septic systems for wastewater disposal; thereby resulting in a benefit to groundwater resources. Furthermore, identified sustainability measures associated with the preferred alternative (e.g., conserving water), when combined with similar measures for applicable cumulative actions, would benefit groundwater resources. These measures would also benefit nearshore waters by reducing the nutrient and bacteria load.

While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed per capita; thereby helping to minimize impacts to groundwater availability. Water managers would continue to proactively monitor groundwater chemistry and the depth to the freshwater/saltwater transition zone to ensure increased pumping does not adversely affect sources of drinking water. Careful monitoring of groundwater chemistry and overlying sediments would ensure no harm to existing beneficial uses; and no damage to structures, utilities, or other facilities would result from potential soil settlement.

Projects involving construction and/or dredging in Apra Harbor and the subsequent handling of the dredged material would have the potential for cumulative impacts to nearshore waters and wetlands. However, these projects would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE, and Water Quality Certification (WQC) from the GEPA. These permits would stipulate procedures and mitigation requirements in addition to dredging-related BMPs and potential impacts to nearshore waters and wetlands from these projects would be minimized.

There is the potential for the cumulative projects to have direct and indirect impacts to wetland areas possibly resulting in the loss of wetland area and/or function. Per USACE regulations, activities that are proposed in wetlands or that could potentially reduce wetland function, must be permitted and potentially mitigated to compensate for direct impacts to wetland areas. Therefore, any loss of wetland area or functionality would be potentially mitigated at a project and site-specific ratio, which would likely include creating or enhancing existing wetland habitat elsewhere. Indirect impacts to wetland areas (e.g.,

runoff, sediment loading, etc.) would be addressed on a project-specific level, and would likely be lessened with BMPs and associated short- and long-term stormwater runoff management measures.

The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the health of water resources on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed for avoiding or reducing impacts to resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Air Quality

Current Health and Historical Context. There are no comprehensive ambient background air quality levels from recent monitoring available for Guam. The existing background air quality conditions around Guam can be defined based on the current ambient air quality attainment status applicable to Guam, which is:

- Attainment for all criteria pollutants except SO₂.
- Two SO₂ nonattainment areas within a 2.1 mi (3.5 km) radius around Piti and Tanguisson power plants.

Except for power generating facilities, there are no significant stationary sources of air emissions on Guam. It can be assumed that prior to the non-attainment designation in the 1970s, historical ambient air quality was good before and after WWII.

The future traffic growth would likely result in an increase in mobile source emissions on Guam. However, the reduction of mobile source engine emissions in the future, per CAA requirements, would contribute to a reduction of the overall mobile source and greenhouse gas emissions. Therefore, the air quality conditions affected by mobile source operations would likely remain the same or improve slightly, as compared to the existing conditions.

There were no recently completed projects identified with the potential to contribute to a cumulative impact to air quality on Guam (Table 4.3-3).

Five present projects with the potential to contribute to a cumulative impact to air quality on Guam were identified (Table 4.3-3): Workforce housing (Core Tech, C-6), Workforce housing (Younex Enterprises, N-21), ISR/Strike Capability (Andersen AFB; N-7), Beddown of Training and Support Initiatives at NWF (N-6), and MIRC (4).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's air quality, as summarized in Volume 7, Section 3.3.4, Table 3.3-7. The details of the impact analysis for the proposed actions are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 5.2; Volume 6, Section 7.2). Operational air emissions originate from stationary and mobile sources. The basis of the air impact analysis was a significance criterion of 250 tons per year (TPY) for air pollutants. As summarized in Volume 7, Section 3.3-8, it is the on- and off-base vehicle traffic that could exceed the 250 TPY threshold of significance for CO. These impacts, however, would be temporary and localized at intersections. The proposed action would also increase the levels of greenhouse gases, but the overall impact on air quality would still be less than significant.

Reasonably Foreseeable Actions that Affect Air Quality. 14 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to air quality on Guam (see Table 4.3-3). One is a Guam general project, one would be in North Guam, 11 projects would be in central Guam, and one in Apra Harbor. One of the projects, programmed port improvements (AH-8), is anticipated to result in a benefit effect to air quality by increasing throughput efficiencies and reducing idling times.

Potential Cumulative Impacts. Current projects in Guam consist primarily of building developments, infrastructure upgrades and improvements, and military projects. There are several projects in the areas close to the Tanguisson nonattainment area, such as the Bayview 5 Luxury Project (C-12), Hemlani Apartments (C-14), and the Ino Corp. development (C-17). There are also a number of port improvement projects planned by GovGuam and the Navy close to the Piti nonattainment area. Additionally, a Guam general project (12) to add a 60 MW power plant would likely contribute to air emissions. These and other cumulative projects would contribute to man-made air emissions. However, the port improvement projects are expected to reduce air emissions in the Port. The GEPA has adopted the USEPA-established stationary source regulations discussed previously, and acts as the administrator to enforce stationary source air pollution control regulations in Guam. Current air quality regulations are applied to air emissions from new sources for the protection of human health. The cumulative projects would not necessarily result in increases in island-wide traffic and air emissions, but new destinations would shift the emissions from mobile sources.

Anticipated impacts to air quality, although considered to be less than significant, would have an adverse cumulative impact when combined with the past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the air quality on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to air quality resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Noise

Current Health and Historical Context. WWII bombings and air operations may represent the loudest period in Guam's history, however those noise impacts were temporary. Volume 7, Section 3.3.5.2, identifies existing sources that contribute to ambient noise, such as the commercial airport, Andersen Air Force Base airfield, industrial facilities, military training range activities, and traffic. Most of these noise impacts are temporary. Industrial noise, such as power generation, would emit noise for longer periods, but is subject to Occupational Safety and Health Administration (OSHA) regulations to protect the hearing of sensitive receptors, specifically workers. There is no island-wide noise level monitoring, and trends in noise are not documented island-wide. The assumption is there would be an increase in industrial activity, airfield activity, and traffic, resulting in a general increase in ambient noise levels with implementation of the proposed action, but increases in noise generation are only useful for impact analysis if the proximity of the noise sources to potential sensitive receptors is known.

One recently completed action with the potential to contribute to cumulative impacts to noise on Guam was identified (Table 4.3-3): Ironwood Estates (affordable housing; 1).

Four present projects with the potential to contribute to a cumulative impact to noise on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Workforce housing (Younex Enterprises; N-21), and Workforce housing (Core Tech; C-6).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to Guam's ambient noise, as summarized in Volume 7, Section 3.3.5, Table 3.3-14. The details of the impact analysis for the proposed actions are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 6.2; Volume 6, Section 8.2). Noise levels associated with the preferred alternatives would increase locally by one or two decibels (dB) at the day-night noise level (DNL) around the Andersen AFB airfield. Aviation operations would raise noise levels locally, but only as the aircraft fly overhead. The Andersen South Training and Route 15 ranges would result in noise levels that are considered incompatible with surrounding land uses that are within Zone II noise contours.

Reasonably Foreseeable Actions that Affect Noise. 12 reasonably foreseeable future projects are anticipated to contribute to a cumulative noise impact on Guam (see Table 4.3-3). One of the projects would be located in North Guam, seven projects in central Guam, three at Apra Harbor, and one in South Guam. Guam International Airport Improvements (C-15) could potentially facilitate a greater volume of air traffic and associated noise. The three Marine Corps amphibious training activities (AH-16, AH-17 and AH-19) could contribute to noise in Apra Harbor and south of Orote Peninsula. The new landfill (S-2) would result in more traffic and operational noise associated with heavy equipment.

Potential Cumulative Impacts. Operations of all the cumulative projects would generate some level of noise. The projects would be distributed across the island and different sensitive receptors would be impacted by the projects. There may be some that overlap geographically. Very few projects are likely to generate noise at levels that would be subject to regulation or harmful to human health. Military mission changes such as Redhorse/Commando Warrior Training (N-6), ISR/Strike (N-7), MIRC (4) would produce localized noise impacts. The ISR/Strike EIS identified noise encroachment in the non-DoD community and these noise levels were the baseline for the noise impact assessment of this EIS. Improvements to the commercial airport (C-15) and the port (AH-8) would likely facilitate an increase in throughput and associated noise. The cumulative projects and the preferred alternatives would impact noise in localized areas. The impacted areas would be at Andersen AFB and on roadways. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the ambient noise on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed for avoiding or reducing impacts to ambient noise are listed in Table 2.2-1. These mitigation measures would reduce or avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative noise impacts are proposed.

Airspace

A Current Health and Historical Context. As mentioned in Volume 7, Section 3.3.6.2, the commercial air traffic fluctuates based on tourism levels, and military use at Andersen AFB is mission-dependent. Training activities are addressed in the MIRC EIS/OEIS. Construction activities rarely impact airspace, but airspace is impacted by the resultant operations. Because there are multiple, and sometimes competing, demands, the Federal Aviation Administration (FAA) considers all aviation airspace requirements in relation to airport operations, federal airways, jet routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements. Significant impacts are avoided prior to FAA approval. While there may be a trend toward an increase in air traffic, the significant impacts are avoided through regulatory oversight.

There are no recently completed projects identified that have the potential to contribute to a cumulative impact to airspace on Guam (Table 4.3-3).

One present project with the potential to contribute to a cumulative impact to airspace on Guam was identified (Table 4.3-3): ISR/Strike Capability (Andersen AFB; N-7).

Direct and Indirect Impacts of the Preferred Alternative that Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's airspace as summarized in Volume 7, Section 3.3.6, Table 3.3-16. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 7.2; Volume 6, Section 9.2). A new Special Use Airspace (SUA) in the vicinity of Northwest Field would be required for training, but would not require any changes to existing arrivals or departures from the commercial airport. The SUA would have to be established to overlay the Surface Danger Zone (SDZ) footprint at the proposed Route 15 training range complex. It would also require a slight reduction in airspace surrounding the commercial airport. There would be no significant reduction in the amount of navigable airspace available for the commercial airport, and no change to en route airways. The impacts would be less than significant, until new procedures have been in effect for a few months.

Reasonably Foreseeable Actions That Affect Airspace. Two reasonably foreseeable future projects are anticipated to contribute to a cumulative airspace impact on Guam (see Table 4.3-3). Both projects would be located in North Guam: these are Guam International Airport Improvements (C-15) which could potentially facilitate a greater volume of air traffic, and the Broad Area Maritime Surveillance (BAMS) project (N-22).

Potential Cumulative Impacts. Andersen AFB projects (N-6, N-7) are present projects that are likely to impact airspace, and are included in the affected environment. BAMS (N-22) at Andersen AFB may also impact airspace, but it is un-programmed and not included in the affected environment. The FAA manages the cumulative impact of air traffic and special use airspace to ensure there are no significant impacts to airspace. There is an additive impact between the proposed actions and the cumulative projects, but the degree of additive impact resulting from the preferred alternative is considered to be low.

Need for Mitigation. No mitigation measures are proposed for the proposed action, and none are projected for the potential cumulative impacts.

Land and Submerged Land Ownership and Use

A Current Health and Historical Context. In 1950, DoD land ownership was estimated at 58% of Guam. As a result of the Guam Excess Land Act of 1994, and Base Closure and Realignment (BRAC) recommendations, DoD land control decreased to less than 30% over the past three decades. In the 1950s, Guam land use zoning was adopted to manage non-federally controlled land development; submerged lands ownership has not changed substantially since 1975. As lands were released through BRAC, adjacent submerged lands were not released, though there are a few exceptions such as DoD releasing nearshore submerged lands at Ritidian Point. There have and will continue to be zoning variances, conditional use permits, and changes to the zoning map. Historically, these were granted excessively, without consistent long range planning. The current and future trend is for increased management of land use to be consistent with community and master plans; however, it is difficult to correct historical zoning decisions. The accommodation of development that is inconsistent with zoning is occurring at a less rapid rate. It is difficult to ascertain if public access has become more restrictive over time outside of federal lands.

Four recently completed projects with the potential to contribute to a cumulative impact to land and submerged land use on Guam were identified (Table 4.3-3): Kilo Wharf Improvements (AH-1), Talo Verde Estates (C-3), Home Depot (C-2), and Ironwood Estates affordable housing (1).

11 present projects with the potential to contribute to a cumulative impact to land and submerged land use on Guam were identified (Table 4.3-3): Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Workforce housing (Core Tech; C-6), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), Bureau of Medicine Naval Replacement Hospital Project (C-13), and Kilo Wharf Extension (AH-18).

Direct and Indirect Impacts of the Preferred Alternative that Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to Guam's land use and ownership as summarized in Volume 7, Section 3.3.7, Table 3.3-18. The details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 8.2; Volume 6, Section 10.2). The summary of impacts from the preferred alternatives is described as significant for the land acquisition by the federal government. Impacts on land use were also described as significant because: 1) there would be access restrictions on submerged lands and acquired DoD lands to support the firing range complex near Route 15; and 2) the firing range complex land use would be incompatible with adjacent non-DoD low density residential properties, due to noise. The impact of the proposed increase in federal land would reverse the recent trend established through BRAC to reduce federally-controlled lands on Guam. Local zoning laws are not applicable to federally-controlled lands, but community master plans would change as a result of land acquisition.

Reasonably Foreseeable Actions That Affect Land and Submerged Land Use. 30 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to land and submerged land use on Guam (see Table 4.3-3). Six would be located in North Guam, 15 in Central Guam, seven at Apra Harbor, one in South Guam, and one project, the Territorial Prison (7) is considered a general action. It is difficult to determine if the existing land uses are consistent with current zoning. The housing and hotel projects (C-7, C-14) and other development would result in a loss of open space.

Potential Cumulative Impacts. None of the proposed cumulative projects appear to require acquisition of non-federally controlled land or submerged lands; therefore, no additive cumulative impact is anticipated on land ownership. Some of the cumulative projects are obviously requests for variance or conditional use (i.e., N-14, N-15, C-18, C-19, C-21, C-25), but others listed may also have required land use variances. The cumulative impacts of granting variances and conditional use permits could be significant over time.

There is a strong additive cumulative impact between the proposed actions and the cumulative projects with respect to land use inconsistency and incompatibility with existing and planned zoning, and access restrictions. The historical land use/zoning inconsistencies contribute to the additive cumulative impact.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to land ownership and use are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Recreational Resources

A Current Health and Historical Context. There is little historical information on recreational resource uses. Presumably, the boom in the tourist industry in the early 1990s resulted in an increase in conflicts among recreational users and physical deterioration of resources. Other human and natural factors, such as typhoons, coral bleaching, illegal harvesting of coral and fish, non-point source pollution, and insufficient funding for resource management, would continue to adversely impact recreational resources.

One recently completed project with the potential to contribute to a cumulative impact to recreational resources on Guam was identified (Table 4.3-3): Talo Verde Estates (C-3).

Three present projects with the potential to contribute to a cumulative impact to recreational resources on Guam were identified (Table 4.3-3): Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), Talo Vista Tower (C-5), and Residential construction (Tamuning; C-4).

Direct and Indirect Impacts of the Preferred Alternative that Might Contribute to a Cumulative Impact.

The preferred alternatives would result in significant impacts to Guam's recreational resources as summarized in Volume 7, Section 3.3.8, Table 3.3-20. The details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 9.2; Volume 6, Section 11.2). The impacts on recreational resources are significant because: 1) there would be changes to public access to resources and reduced recreational opportunities when land is acquired by the federal government; and 2) the increased population could result in conflict and competition among recreational users and deterioration of the resources. The proposed action would contribute to the declining trend in recreational resource health. Other factors unrelated to the project, such as coral bleaching, illegal harvesting of coral and fish, and non-point source pollution, would continue to adversely impact recreational resources.

Reasonably Foreseeable Actions that Affect Recreational Resources. Six reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to recreational resources on Guam (see Table 4.3-3). Three would be located in North Guam and three would be at Apra Harbor. Zone change request (C-25), seashore clearance request (C-20), and a PUD Amendment (C-19) could have beneficial effects. Coastal Marine Corps training activities (AH-16, AH-17, AH-18) could have an adverse affect.

Potential Cumulative Impacts. A few of the listed projects appear to have a recreational component, including PUD amendment (C-19), seashore clearance request (C-20, S-4, S-8), and a zone change request (C-21). Also planned are a 700-unit condominium in Tamuning (C-4); a 700-unit resort condominium proposed by Ypao Resort (C-7); a 396-unit resort condominium, and commercial uses proposed by Ino Corporation (C-17). The subdivisions listed are also likely to have playgrounds.

There are insufficient data to determine if the cumulative projects would alter access to recreational resources or reduce recreational opportunities. This could occur if a development, for example, replaces a baseball field or limits access to a beach. There are DoD mission changes on the cumulative project list that would also increase on-island population, such as Redhorse/Commando Warrior Training (N-6), and the ISR/Strike (N-7), which are included in the affected environment discussion of this EIS. Other potential mission changes, such as Army JHSV (AH-22) and BAMS (N-22), that might impact island population, were not included in the affected environment because there is insufficient detail on the project description.

Increases in recreational resources use would likely occur at beaches and parks, scenic points, historic and cultural sites, dive spots, trails, day use resorts, golf courses, sailing venues, on installations, and the rest of the island alike. Guam's tropical weather encourages year-round use of recreational resources by residents and visitors. Foreseeable impacts include inadequate or overly crowded facilities such as parking, picnic shelters, restrooms, showers, boat mooring facilities, etc. Moreover, an eroded sense of enjoyment, due to increased competition for opportunities among users, would result at most recreational facilities (e.g., golf courses on installations, popular dive spots, etc.). Lastly, an increase in the number of users would accelerate deterioration of existing facilities.

There is a strong additive cumulative impact between the proposed actions and the cumulative projects with respect to impacts on recreational resources. These impacts would accelerate the decline of recreational resource health.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to recreational resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternatives in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Terrestrial Biological Resources

A Current Health and Historical Context. As mentioned in Volume 7, Section 3.3.6.2, the terrestrial biological health on Guam is declining. The affect of pre-colonial populations on the current health of Guam's terrestrial biological resources is difficult to ascertain. During the Spanish Period (1668-1899) there were introductions and an increase of domesticated animals (i.e., water buffalo, pigs, goats, and deer). Introduced ungulates have significantly impacted native forests by consuming seeds, fruits and foliage and trampling plants. Feral pigs also cause additional damage by wallowing and rooting.

WWII physically destroyed extensive areas of habitat (due to war actions and construction) along with continued clearings associated with agriculture (i.e., crops and grazing). Shortly after WWII, BTS were inadvertently introduced to the island and by the late 1960s had spread throughout Guam (Section 1.3.3). In order to reduce erosion after WWII, tangantangan was planted and had spread to the point of replacing native plants in large areas.

Existing stressors (e.g., tropical storms, typhoons, non-native plants and animals, diseases, wildfires, and poaching) continue to degrade habitat quality and contribute to the trend of declining health of terrestrial biological resources. Ongoing efforts to manage terrestrial resources on military lands and non-federally controlled lands would continue to reduce the rate of decline.

Fewer than 1,000 threatened Mariana fruit bats were believed to live on Guam in 1972, and less than 100 bats from 1974 to 1977. During an intensive island-wide survey in 1978, it was concluded that fewer than 50 fruit bats survived. The most recent counts further confirm that fewer than 50 bats remain on Guam. Hunting pressure is largely responsible for the decline. Although hunting is illegal, it remains a threat.

The kingfisher population on Guam was federally listed as an endangered species in 1984, but by 1988, it was close to becoming extinct along with the majority of Guam's other avifauna as a direct result of predation by the introduced BTS. The remaining kingfishers were removed from the wild and placed in captivity, and in 2008, the captive population reached 100 individuals. Research and management efforts continue so that a wild population may eventually be reestablished on Guam.

Historically on Guam, the endangered Mariana crow was found throughout forested areas, and was considered common into the early 1960s. The current Mariana crow population on Guam is estimated at only two individuals, both males. Predation by BTS, rats, and monitor lizards prevents recovery.

Four recently completed projects with the potential to contribute to cumulative impacts to terrestrial biological resources on Guam (Table 4.3-3) are: Talo Verde Estates (C-3), Home Depot (C-2), Kilo Wharf Improvements (AH-1), and Ironwood Estates (Affordable Housing; 1).

Fifteen present projects with the potential to contribute to a cumulative impact to terrestrial biological resources on Guam were identified (Table 4.3-3): Mariana Islands Range Complex (4), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Workforce housing (Core Tech; C-6), Residential construction

(Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Beddown of Training and Support Initiatives at NWF (N-6), Mitigation for Kilo Wharf Extension (AH-21), and Draft Safe Harbor Agreement (Cocos Island; S-1). Mitigation for Kilo Wharf Extension and the Safe Harbor Agreement are considered to have beneficial cumulative impacts.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's terrestrial biological resources, specifically special status species, as summarized in Volume 7, Section 3.3.9, Table 3.3-22. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 10.2; Volume 6, Section 12.2). Section 3.3.9 quantifies impacts on special-status species habitat for the preferred alternatives. The total amount of primary limestone vegetation removed with implementation of the preferred alternative would be 29 ac (12 ha), and the total amount of ravine forest removed would be 17 ac (6.9 ha). Approximately 1,600 ac (647 ha) of disturbed limestone habitat would also be removed. Implementation of the preferred alternative would contribute to the trend in degradation of terrestrial biological resources, primarily through a loss of habitat. There is also the increased risk of invasive species introduction, but development of the Micronesia Biosecurity Plan (MBP) and implementation of biosecurity measures would minimize those risks. There are many acres of suitable habitat available on non-federally controlled land, but land is not the limiting factor. Unless other stressors are controlled, the listed species would not recover.

Reasonably Foreseeable Actions That Affect Terrestrial Biological Resources. 37 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to terrestrial biological resources on Guam (see Table 4.3-3). Twenty-eight would be located in North Guam, seven at Apra Harbor, and two in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on terrestrial biological resources. Most cumulative projects are presumed to impact terrestrial biological resources if there is ground disturbance. Insufficient details on each project are available to assess the total loss of habitat for the cumulative projects.

Potential Cumulative Impacts. Projects at Andersen AFB have been approved to remove 1.4 ac (0.6 ha) of primary limestone forest. Additional areas of disturbed limestone habitat would be removed at Andersen AFB. A private development project at Talo Verde Estates in east-central Guam near Pago Bay may remove as much as 35 ac (14 ha) of primary limestone forest, based on USFS (2006) mapping. The total amount of primary limestone forest that would be removed for recently completed, present, and foreseeable future projects on Guam is estimated at 61 ac (25 ha), and the total amount of ravine forest that would be removed is estimated at 16 ac (6.5 ha). Other projects throughout Guam, both military and commercial, are not proposed in areas known to have primary limestone forest. Due to the loss of primary limestone forest, there would be significant cumulative impacts to vegetation.

Native wildlife species that have been or would be impacted by recently completed, present, and foreseeable future actions include only several species that are widespread on Guam. There would be no significant impacts from cumulative projects.

Numerous past projects and military training on Guam have resulted in direct and indirect impacts to federally and Guam-listed terrestrial species and federal candidate species. The Mariana fruit bat has been impacted by past actions at Andersen AFB. The Biological Opinion (BO) for the ISR/Strike (N-7) identifies the following impacts: one Mariana fruit bat would be harmed, 21 bats would be killed, and two bat colonies would be harassed on Guam. Training at NWF from the NWF Beddown and ISR/Strike

actions, and Navy and U.S. Marine Corps training in Guam, would result in increased auditory and visual disturbance to fruit bats and to the few remaining Mariana crows.

Habitat loss for endangered species from various past actions at Andersen AFB (data from USFWS 2008), and the proposed action for the Guam and CNMI Military Relocation, are summarized in Table 4.3-4. Total essential habitat removed in the recently completed (since 2004), present, and foreseeable future are, at a minimum:

- 10.2% of the total habitat available for the Mariana fruit bat,
- 11.3% of the total habitat available for the Mariana crow,
- 9.9% of the total habitat available for the Guam Micronesian kingfisher, and
- 10.3% of the total habitat available for the Guam rail.

Table 4.3-4. Summary of Recently Completed Project Cumulative Impacts to Endangered Species Habitat

Resource	Foraging, Roosting, Breeding, or Sheltering Habitat (ac [ha])			
	Fruit Bat	Crow	Rail	Kingfisher
Baseline Habitat (USFWS 2008)				
Baseline of Essential Habitat* that was Available on Guam in 2004	12,026 (4,867)	10,774 (4,360)	12,172 (4,926)	12,026 (4,867)
Projects with Essential Habitat* Removal or Other Impacts (USFWS 2008)				
NW Field Beddown 2006 (N-6)	116 (47)	116 (47)	116(47)	116 (47)
Cell Tower at Tarague Beach Overlook 2006	2.5 (1.0)	2.5 (1.0)	2.5 (1.0)	2.5 (1.0)
Vegetation Clearing at Pati Point 2006	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)
Vegetation Removal AAFB 2007 (N-4)	62 (25)	62 (25)	62 (25)	62 (25)
ISR Strike 2007-2016 (N-7)	460 (186)	506(201)	57 (23)	477(193)
Multiple IRP Remedial Sites NW Field 2008	14 (5.7)	14 (5.7)	14 (5.7)	14 (5.7)
Site 12/Landfill 17 2008	1.0 (0.4)	1.0 (0.4)	1.0 (0.4)	1.0 (0.4)
Tarague Beach Improvement Project 2008 (N-12)	1.3 (0.5)	1.3 (0.5)	1.3 (0.5)	1.3 (0.5)
Totals	659 (267)	705 (285)	256 (104)	676 (274)
Guam Military Relocation (this EIS)				
Recovery Habitat* Removed	1,559 (631)	1,557 (630)	1,268 (513)	1,559 (631)
Total Past, Present and Foreseeable Future Habitat Removed Since Baseline of 2004				
Habitat Removed	2,218 (898)	2,262 (915)	1,524 (617)	2,235 (904)

Legend: *Essential habitat and recovery habitat are similar and for purposes of this analysis, they are treated similarly and are both assumed to represent suitable habitat; recovery habitat has only been recently identified on Guam by USFWS

The non-DoD cumulative projects are also likely to remove vegetation and adversely impact biological resources. There is a strong, additive cumulative impact between the proposed actions and the cumulative projects with respect to impacts on terrestrial biological resources. These impacts would accelerate the decline of terrestrial biological resource health.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to terrestrial biological resources are listed in Table 2.2-1. These mitigation measures would avoid, or reduce and mitigate impacts resulting from implementation of the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Marine Biological Resources

A Current Health and Historical Context. As described in Section 3.3.10.2, stressors on marine biological resources include human-induced (i.e., point source pollution, overfishing, industrial discharge) and natural events (i.e., storms and bleaching). Prior to Spanish conquest, the Chamorro and other Pacific societies retained property rights within the family that extended out to sea. Fishing occurred but was likely to occur at sustainable levels (see Volume 2, Section 16.1.6.9). Harvesting of sea turtles and their eggs also occurred. The effect of pre-WWII events on the current health of Guam's marine biological resources is difficult to ascertain. There was likely coral damage due to storm and wave events but low levels of human-induced stress because population and industry levels were much lower.

The creation of Inner and Outer Apra Harbor during WWII required extensive dredge and fill. The navigational approach to Inner Apra Harbor was dredged and this is an area proposed for dredging under the proposed action. In addition to the direct physical impact on marine resources due to the war, indirect impacts resulted from an increase in soil erosion as described under the terrestrial biological resources section. The sediment load in the coastal waters likely had an impact on the health of the reefs.

Since WWII, the health of marine biological resources has been affected by an increasing population, and associated recreational, industrial and commercial operations that impact the natural environment. Examples of stressors include overfishing, increased pollutants released directly to the marine environment, or indirectly from land, point and non-point source discharges of stormwater and wastewater treatment plant outfalls, invasive species, recreational activities, diseases, coral bleaching, and storms. Human disturbances also include deliberate harm to reefs by activities such as dynamite fishing and the harvesting of corals for the aquarium trade. Post-WWII dredging in Apra Harbor resulted in a decline of coral communities and compensatory mitigation proposals are being implemented to restore the ecosystem function in other watersheds.

Globally, coral health has been in decline due to human-caused stressors, and these same stressors are active in the Marianas Islands. Increased sedimentation is one of the most common and serious human-induced influences; however, sediment impact to coral can vary greatly depending on a broad spectrum of factors (Volume 4, Section 11.1.2.2). Additional stressors to coral include polluted runoff (input of nutrients), exposure to warm water (global warming and thermal effluents) leading to bleaching, overfishing, anchor damage, tourism-related impacts, ship groundings, and certain military activities (Volume 2, Section 11.1).

The vitality of many of Guam's reefs has declined over the past 40 years, consistent with a general global decline of this resource (Section 3.3.10.2 of this Volume). The average live coral cover was approximately 50% in the 1960s, but dwindled to less than 25% by the 1990s, with only a few areas having over 50% live cover. In the past, however, Guam's reefs have recovered after drastic declines. For example, an outbreak of the crown-of-thorns starfish in the early 1970s reduced coral cover in some areas from 50-60% to less than 1%. Twelve years later, live coral cover was restored to pre-1970s conditions (Section 1.3.3.1 of this Volume).

Recently eighty-two coral species have been the subject of petitions for listing under the ESA and have been classified as candidate species (Volume 2, Section 11.1). The determination to list these coral species is dependent upon ESA criteria currently under review by the NMFS. The effects of such a listing on future actions impacting waters around Guam are not currently known and would be determined when the species are listed. INRMPs covering NAVBASE Guam and Tinian are being updated to address conservation measures for all coral species.

The special-status species relevant to this EIS are the green and hawksbill sea turtles, common bottle nose dolphin, and spinner dolphin. Threats to green sea turtles include direct harvesting of eggs or adults, beach cleaning and replenishment, recreational activities, debris, incidental take from fishing, and seagrass degradation. The hawksbill sea turtle is subject to similar threats as the green sea turtle. The spinner dolphin is expected to regularly occur all around Guam, except at the mouth of Apra Harbor where there are rare occurrences of this species.

The conclusion of a recent *State of the Coral Reef Ecosystem on Guam* assessment was that the health of Guam's coral reefs varies significantly. Reefs unaffected by sediment and nutrient loading, such as those in the northern part of the island and some coastal areas in the south, have healthy coral communities. Guam's reefs have been spared from large-scale bleaching events and coral diseases which are prevalent in so many parts of the world. A number of Guam's reefs are impacted by land-based sources of pollution and over-fishing. Guam identified land-based sources of pollution as its number one priority focus area in 2002. Sedimentation, algal overgrowth due to decreased fish stocks, and low recruitment rates of both corals and fish are important issues that must also be addressed (see Volume 2, Section 16.1.6.9) Big Blue Reef in Apra Harbor is considered one of the healthiest reefs in the harbor due to the reef's protection from water quality factors associated with Inner Apra Harbor and ship-induced sediment resuspension that impact other reef systems in the harbor. Reefs off Dry Dock Island, which was artificially created during WWII, are considered to also be among the healthiest reefs in the harbor, primarily due to protection from stressors (Volume 4, Section 11.1.2.2). In contrast, the coral reef along Polaris Point, which was also constructed during WWII, is of marginal quality and has the greatest signs of stress, including high levels of total suspended solids (TSS) likely derived from watershed discharge. Recreational activities result in physical damage to coral reefs, and fish feeding by snorkelers and divers can alter fish behavior. Recent studies conducted in support of this EIS identify evidence of anchor and/or anchor chain damage to coral in Apra Harbor, including the formation of a rubble field on the southern side of the floating dry dock (Volume 4, Section 11.1.2.2). Movement of mooring chains on the southern side of the floating dry dock has produced a significant rubble field, although mooring chains on the northern (outer) side of the floating dry dock do not appear to have caused similar damage.

No recently completed projects with the potential to contribute to a cumulative impact to marine biological resources on Guam were identified (Table 4.3-3).

Four projects currently in progress with the potential to contribute to cumulative impacts to marine biological resources on Guam were identified and include the following (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Kilo Wharf Extension (AH-18), and Mitigation for Kilo Wharf Extension (AH-21). Mitigation for Kilo Wharf Extension has a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact.

The preferred alternatives would result in significant and mitigable impacts to Guam's marine biological resources during operations. The summary of impacts is in Volume 7, Section 3.3.10, Table 3.3-26. The impact assessment details are provided in Volumes 2 through 6 (Volumes 2, and 4, Section 11.2). The increase in marine traffic would result in localized, infrequent, minor impacts from the increased noise, re-suspension of sediment during vessel movements, and the potential for increased discharges of pollutants into the water column. Construction-phase impacts would be significant with respect to marine flora, invertebrates and associated essential fish habitat and special status species due primarily to the construction of a transient aircraft carrier wharf in Outer Apra Harbor. The dredging and pile driving activities would impact coral and live/hard bottom communities (EFH) and special-status species. The

DoD would provide compensatory mitigation measures for the ecological services lost and the compensatory mitigation plan would be reviewed during the USACE Section 10/404 permitting process.

Indirect cumulative impacts to EFH from induced growth may occur island-wide. These impacts would be significant and mitigable through an increase in coastal resource management from local and federal agencies. Additionally, DoN plans to educate its service members, dependants and construction workers on the importance of coastal ecosystems and the proper way to enjoy those resources while avoiding and minimizing damage to reefs that is typically caused by anchors, walking on the reef, overfishing, inadvertent damage to coral while SCUBA diving, snorkeling, and fishing. A summary of proposed mitigation measures, summarized in Chapter 2 of this Volume, would assist in minimizing potential future impacts.

Reasonably Foreseeable Actions that Affect Marine Biological Resources. Nine reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to marine biological resources on Guam (see Table 4.3-3). Three of the projects would be located in North Guam and six at Apra Harbor. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on marine biological resources by reducing erosion and sediment input into the nearshore environment. The DoD training projects that may contribute to a cumulative impact include the activities covered in MIRC EIS/OEIS (4) and the amphibious beach training projects (AH-16, -17, and -18). In-water projects include DoD's X-Ray Wharf (AH-11) and PAG modernization (AH-8).

Potential Cumulative Impacts. The reasonably foreseeable projects mentioned above and four present projects (such as Kilo Wharf Extension [AH-10]) would have direct and indirect impacts on marine resources. The dredging impacts to special aquatic sites (SAS) (e.g., coral reef removal) would be mitigated through implementation of a compensatory mitigation plan approved by the USACE. As described under Water Resources and Geological and Soil Resources, all development projects could contribute to increased sediment loading in stormwater flow. Cumulative projects would result in an increase in impervious surface area in urban and industrial settings, resulting in a corresponding increase in sediment laden stormwater runoff into coastal waters, which has the potential to have elevated levels of contaminants such as nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. Project and site-specific best management practices (BMPs), construction-related permits, and the provisions of construction- and facility-specific (industrial) Stormwater Pollution Prevention Plans (SWPPPs), and Spill Prevention, Control, and Countermeasure (SPCC) Plans would minimize potential impacts from industrial operations, including the transportation, storage, and use of fuel, on all water resources. There is a strong additive cumulative impact between the proposed actions and the cumulative projects with respect to impacts on marine biological resources (Table 4.3-3). These impacts may contribute to the decline of marine biological resource health.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to marine biological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed that have not already been identified.

Cultural Resources

Current Health and Historical Context. As described in Volume 2, Section 12.1.1.3, cultural resources include pre- (before European contact) and post-Contact archaeological resources, architectural resources and traditional cultural properties. The main Mariana Islands were settled before 1500 B.C. The Pre-Latte period was from 1500 B.C. to 1000 A.D.; evidence of residency and community composition is difficult

to identify. The Latte Period (1000 A.D. to 1300 A.D.) is distinguished by the presence of *latte* stone structures. The post-Contact period begins in 1521 A.D with Magellan's landing. Subsequently, disease and war decimated the local population, reducing it from 40,000 in 1668 to 1,800 in 1690. In the 20th century, Guam was ceded to the U.S. by Spain. Between 1898 and 1941, Guam served as a coaling and fueling station for Naval ships and as a landing place for the Pan-American transpacific air clippers. In 1941, Japan attacked Guam and in 1944, the U.S. commenced an intensive bombardment. After the U.S. captured the island there was a massive build-up of military forces - including construction of five new airfields. Since the 1960s, tourism has been an important industry.

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties. It is difficult to determine if there was active preservation of historic sites on Guam prior to the 1960s; the Guam Register of Historic Places has entries dating only as far back as 1974.

Adverse impacts on cultural resources may include the following:

- Physical destruction, damage, or alteration of all or part of the resources;
- Alteration of the character of the resource's use or of physical features within the resource's setting that contribute to the resource's qualifications for listing on the National Register of Historic Places;
- Removal of the resource from its historic location;
- Introduction of visual, audible, or atmospheric elements that are out of character with the resource or diminish its historic features;
- Neglect of the resource resulting in its deterioration or destruction; and
- Transfer, lease, or sale of the property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

The potential impacts on historic properties include vandalism (intentional or unintentional), intentional and inadvertent disturbance from construction activities, natural degradation and damage due to erosion. Many WWII-era historic structures remain on Guam; however the war itself resulted in the loss of many other culturally important sites. The trend since the conclusion of WWII is a decline in cultural resources due to the potential impacts listed.

Three recently completed projects with the potential to contribute to a cumulative impact to cultural resources on Guam are identified (Table 4.3-3): Talo Verde Estates (C-3), Home Depot (C-2), and Ironwood Estates (Affordable Housing; 1).

Present projects with the potential to contribute to a cumulative impact to cultural resources on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Workforce housing (Core Tech; C-6), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Beddown of Training and Support Initiatives at NWF (N-6), and Mitigation for Kilo Wharf Extension (AH-21).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's cultural resources, as summarized in Volume 7, Section 3.3.11, Table 3.3-29. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 12.2; Volume 6, Section 14.2). The summary of

impacts from the preferred alternatives are significant and mitigable for impacts on cultural resources because there would be 1) direct impacts to approximately 31 historic properties on Guam, 2) significant adverse indirect impacts to three traditional cultural properties, and 3) deterioration of archaeological resources due to natural degradation or damage due to weathering. The proposed action would contribute to the declining trend in preservation of cultural resources. Other factors unrelated to the project, such as vandalism and weathering, would continue to adversely impact cultural resources. Mitigation measures would be established through Section 106 consultation with the State Historic Preservation Office. Impacts and mitigations to Chamorro culture is discussed under Socioeconomics and General Services.

Reasonably Foreseeable Actions that Affect Cultural Resources. All of the reasonably foreseeable future projects could impact historic properties through ground disturbance. Thirty-four reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to cultural resources on Guam (see Table 4.3-3). Twenty-seven projects would be located in North Guam, five at Apra Harbor, and two in South Guam. There is insufficient information to determine if existing historic buildings would be removed or otherwise impacted by new development projects off of federally controlled property.

Potential Cumulative Impacts. In general, there will likely be cumulative effects associated with the proposed action and the actions of other federal agencies, local governments, and the private sector on historic properties in Guam. These effects may be linked to projects, developments, and actions that do not meet the criteria for a federal undertaking as defined in NHPA. Although the Final EIS does address some of these projects, developments and actions, such as the development of workforce housing in Volume 1, Chapter 4, many of these projects, developments, and actions, and their impacts on historic properties, cannot be determined with any specificity or certainty at this time. Therefore, it can reasonably be assumed that there may be various types of historic properties that could be affected by the proposed action, but with no specific details regarding the individual impacts or effects.

Implementation of the preferred alternatives, when considered in conjunction with specific projects on Guam would have a significant cumulative effect on historic properties. Recently completed, present, and reasonably foreseeable development would have an adverse effect on both pre-Contact and post-Contact properties along the coast and in the interior. Although projects would be coordinated with the Guam SHPO and mitigated in accordance with laws and regulations related to the management and preservation of cultural resources in Guam, loss of some historic properties, even with data recovery, cannot be completely mitigated. Disturbance or destruction of these cultural resources would further diminish the regional historic record, thus decreasing the potential of its overall research contribution.

Need for Mitigation. To mitigate these cumulative impacts, DoD would assist the Guam SHPO with the five-year update of their Historic Preservation Plan (HPP). DoD proposes to support updates of the HPP by providing information developed as part of DoD cultural resources investigations, updated project planning information, and logistical support for meetings with local, state, and other federal stakeholders. It is anticipated the Guam plan will address the long term, cumulative effects of the military build-up on historic properties. In addition to the HPP, proposed mitigation measures include the production of a Guam Synthesis or Cultural Landscape Reports to reduce impacts to historic properties from cumulative impacts.

Visual Resources

Current Health and Historical Context. It is difficult to ascertain the visual quality of Guam prior to WWII, but it was presumably high due to the prevalence of open space. As presented in Volume 7, Section 3.3.12.2, urban development is likely the most notable cause for change in visual environments; the physical characteristics of a development as well as where it is located, determine the resulting visual

effect. Natural disasters, such as typhoons and earthquakes, contribute to the degradation of the appearance of existing developments. Some developments are abandoned and fall into disrepair with an adverse impact on visual resources. When the economy is good, there is a tendency for increased development or property improvement. Conversely, during hard economic times, buildings are not maintained or are abandoned. The visual resources trend over time is not linear, but is influenced by critical events. In general, there is a trend toward degradation of visual resources.

Four recently completed projects with the potential to contribute to a cumulative impact to visual resources on Guam were identified (Table 4.3-3): Core Tech/Ironwood Estates (affordable housing) (1), Home Depot (C-2), Kilo Wharf Improvements (AH-1), and Talo Verde Estates (C-3).

11 present projects with the potential to contribute to a cumulative impact to visual resources on Guam were identified (Table 4.3-3): Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), and Mitigation for Kilo Wharf Extension (AH-21). The Mitigation for Kilo Wharf Extension would have a beneficial impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's visual resources, as summarized in Volume 7, Section 3.3.12, Table 3.3-31. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 13.2; Volume 6, Section 15.2). The significant and mitigable impacts on visual resources are due to proposed roadway improvements, increased urban development and loss of open space on military lands. The proposed action would contribute to the declining trend in visual resources. Other factors unrelated to the project, such as natural disasters and economic downturns, would continue to adversely impact visual resources.

Reasonably Foreseeable Actions That Affect Visual Resources. All of the reasonably foreseeable cumulative projects would likely remove some open space and result in an adverse impact on visual resources. Thirty-six reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to visual resources on Guam (see Table 4.3-3). One project is considered a general action (Core Tech /Ironwood Estates), eight of the projects would be located in North Guam, seven at Apra Harbor, nineteen in Central Guam, and one in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on visual resources.

Potential Cumulative Impacts. There would be minimal cumulative impacts related to the listed projects proposed on federally-controlled land because the projects are generally inside military bases and not visible to the public. The visual character at the cumulative project sites was not assessed. There is insufficient information on the cumulative projects to determine if they would have an adverse impact on visual resources. The development projects would likely remove open space and result in an adverse impact. There are other projects that may replace abandoned or deteriorated buildings that would result in an improvement to visual resources. There is a moderate, additive cumulative impact between the proposed actions and the northern Guam cumulative projects with respect to impacts on visual resources. The impact is due to proximity of the cumulative projects in the north to the proposed action's primary development areas. The other areas of Guam would not experience an additive cumulative impact.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to visual resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the

preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Marine Transportation

Current Health and Historical Context. It is difficult to ascertain if port capacity was an issue prior to WWII. Presumably, the Spanish and the Japanese improved port capacity as needed. During WWII, port capacity was greatly expanded. As new military ships are brought to Guam and military missions change, there is always the potential for an increase in military marine traffic. The commercial traffic is a function of population and general economic health of the island. The number of non-military vessels visiting the Port of Guam would continue to reflect the need to service the population and economic growth.

Two recently completed projects with the potential to contribute to a cumulative impact to marine transportation on Guam were identified (Table 4.3-3): Kilo Wharf Improvements (AH-1) and Talo Verde Estates (C-3).

Eight present projects with the potential to contribute to a cumulative impact to marine transportation at Guam were identified (Table 4.3-3): Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), and Kilo Wharf Extension (AH-18).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's marine transportation, as summarized in Volume 7, Section 3.3.13, Table 3.3-33. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 14.2; Volume 6, Section 16.2). There would be additional vessels visiting Apra Harbor as a result of the proposed relocation of Marines from Okinawa to Guam. Additional container ships would also be required to transport the equipment and supplies necessary to support the relocation. There would be approximately 145 container ships required in 2015 (the peak year of container shipments) above the annual average of 124 container ships. In addition, there would be about 127 trips over a period of six to nine months by a tug and scow to dispose of dredged material from Sierra Wharf. Because there has been a steady and substantial decline in the number of commercial vessels visiting the Port of Guam from 1995 through 2008 (2,924 to 1,022 vessels), the addition of up to 269 vessels is still well below the total number of vessels visiting the Port of Guam in 1995.

Reasonably Foreseeable Actions that Affect Marine Transportation. 11 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to marine transportation at Guam (see Table 4.3-3). Eight of the projects would be located in Central Guam and three would be located at Apra Harbor. One of the Apra Harbor projects would also result in a beneficial effect to marine transportation: Modernization Program: port reconfiguration, maintenance and repair (AH-8). It is assumed that development of housing (C-14, C-17, C-22, C-23, C-27, C-29, C-34) and resort (C-7) projects would result in a population increase and associated increased need for goods. The Port Authority of Guam modernization projects (AH-8), and military wharf improvements (AH-1, AH-11, AH-22) would facilitate an increase in marine traffic.

Potential Cumulative Impacts. There is an additive impact between the proposed actions and the cumulative projects, but the degree of additive impact resulting from the preferred alternative is considered to be low.

Need for Mitigation. No mitigation measures are proposed for the proposed action, and none are projected for the potential cumulative impacts.

Utilities and Roadways

Current Health and Historical Context. It is difficult to ascertain if roadway and utility capacity was an issue prior to WWII.

Periodic master plans and roadway studies have been prepared by GovGuam to assess roadway and traffic conditions to identify and prioritize roadway and traffic improvement projects. The most recent comprehensive planning effort is the *2030 Guam Transportation Plan*, published in December 2008. Forecasts for population and employment through the year 2030 were used to develop an integrated strategy for a multimodal (e.g., vehicle, pedestrian, mass transit) transportation system. According to the Plan, overall traffic levels on Guam would increase; some areas increased by as much as 80% between 2003 and 2008. The roadway conditions vary from acceptable (no major safety issues), to poor (minor safety issues) to unacceptable. There is a bus system that includes a fixed route, and service for the handicapped; however, there are concerns with scheduling that result in poor ridership. No designated bicycle lanes are available and sidewalks are limited to main routes in urbanized areas.

The traffic on roadways is driven by island population and employment related to land use development. Roadway condition is a function of construction material, age, vehicle type, traffic volume, and natural influences such as climate, typhoons and earthquakes. Since 1950, population has continued to increase on Guam. The future trends in population growth are expected to increase and continue through 2030; however, the Plan included increases related to the military relocation. Without the proposed action, the population projection was estimated to increase 26% from 2008 by 2030, assuming a steady increase of 1.5% annually. The roads serving Dededo and Tamuning are currently the most congested because they serve major residential and employment centers. Roadway improvements were identified to address projected 2030 traffic issues, and projects would be implemented as funds become available. Volume 6, Section 4.2.2.5 of this Final EIS describes the baseline conditions for the specific roadways that would be affected by the preferred alternatives, assuming the improvements identified in the Plan are implemented. Most of the roads are projected to be congestion-free in 2014 and 2030, with a few exceptions: Route 25 and the southern portion of Route 28 for both target years, and Route 10 for the year 2030 only. Island-wide there are an estimated 12 intersections in 2014 and 24 in 2030 that would have the poorest level of service. Although some projects are programmed for funding, traffic conditions are projected to deteriorate on Guam. The natural influences on roadway conditions would continue into the future.

There are private shopping and tour busses that operate among Micronesia Mall, KMART, Guam Premier Outlets and other destinations. The recently established Guam Regional Transit Authority (GRTA) is responsible for public transit functions. It approved the Guam Transit Business Plan in January 2010, which includes purchasing new buses, constructing a bus maintenance facility, and modifying the bus schedule. Pending funding, a future trend is for improvements to bus service. Guam public law (Bill 273) requires the consideration and construction of bicycle and pedestrian paths with all new road construction projects. The 2030 Guam Transportation Plan also identifies a plan for bicycle and pedestrian facilities. Although new developments and roadway projects would include pedestrian and bicycle facilities and improve pedestrian and bicycle options, without adequate funding the existing deficiencies in facilities are likely to continue.

Power demand forecasts, including all current and foreseeable projects, indicate that there would be sufficient power generation capacity during and after the proposed relocation with implementation of the preferred alternative, thus no mitigation measures are proposed for power. The Guam Power Authority's

Integrated Resource Plan indicates the need for a new base load power plant in 2017, however the assumptions for that need may or may not be realized. Alternative power sources (wind, solar, and geothermal) are forecast for 2015. The water distribution system is identified as poor; it does not meet basic flow and pressure requirements for all customers. The wastewater infrastructure has deteriorated over the years with frequent sewage spills at pump stations and collection piping, collapse of collection piping, and failure of treatment plant equipment. There have also been violations of National Pollutant Discharge Elimination System (NPDES) permit conditions. The water and wastewater systems would continue to degrade until capital improvements are made. A new GovGuam landfill is in construction and anticipated to open in July 2011. The Navy landfill at Apra Harbor would remain in use for waste streams that cannot be accepted by the new GovGuam landfill (such as construction and demolition debris and asbestos). Therefore sufficient capacity to meet solid waste demand would be provided.

Two recently completed projects with the potential to contribute to a cumulative impact to roadways on Guam were identified (Table 4.3-3): Talo Verde Estates (C-3) and Home Depot (C-2).

Eleven present projects with the potential to contribute to a cumulative impact to roadways on Guam were identified (Table 4.3-3): Beddown of Training and Support Initiatives at NWF (N-6), ISR/Strike Capability (N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), and Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12). The two workforce housing projects are considered to be temporary developments and the workers would be provided bus transport, but they are included because the workforce housing would add to roadway traffic and the facility may be reutilized in the future.

Four recently completed projects with the potential to contribute to a cumulative impact to utilities on Guam were identified (Table 4.3-3): Home Depot (C-2), Talo Verde Estates (C-3), Kilo Wharf Improvements (AH-1), and Ironwood Estates affordable housing (1).

Twelve present projects with the potential to contribute to a cumulative impact to utilities on Guam were identified (Table 4.3-3): Beddown of Training and Support Initiatives at NWF (N-6), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), Mitigation for Kilo Wharf Extension (AH-21), and Draft Safe Harbor Agreement (Cocos Island; S-1). Mitigation for Kilo Wharf Extension and the Safe Harbor Agreement would have beneficial cumulative impacts. All of these projects have been included in the estimation of future utility demands and are included in Volume 6 impact assessments.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The impact assessment details are provided in Volume 6. The summary of impacts from the preferred alternatives is described in Volume 7, Section 3.3.14, Table 3.3-34. (see Volume 6, Sections 3.2 and 4.2). Less than significant impacts were identified for power, water, and solid waste. Impacts to water and power would be less than significant because DoD proposes utility improvements to address potential impacts. Solid waste impacts assume the use of existing and planned landfills. Impacts on wastewater systems and on-base roadways are summarized as significant and mitigable. Improvements to the NDWWTP are proposed to address the direct impact of the increased population, but the Guam wastewater collection systems are in poor condition and indirect impacts due to the induced population

would be exacerbated. Impacts to off-base roadways are significant and roadway improvements are proposed to address the impacts. The proposed action would contribute to the demand on deteriorating infrastructure.

The utilities and off-base roadway impacts analysis in this EIS are island-wide and based on the total proposed population increase on Guam associated with the Marine Corps, Navy and Army preferred alternatives, including associated workforce and induced populations. The population during the peak construction period would have the greatest demand on utilities, therefore, utilities and roadways impacts represent peak year impacts. The preferred alternatives include utilities and roadways repairs, upgrades and improvements, which are designed to address peak year demands, as detailed in Volume 6.

The proposed action would adversely impact roadways in all geographic areas with roads serving DoD lands in the north and central portions of Guam projected to be the most congested. Volume 6 proposes roadway improvements specifically to mitigate for the proposed actions described in Volumes 2 through 5. Assuming the roadway improvements are funded and implemented as indicated in the project description, significant roadway capacity impacts identified for roadway capacity in the North and the other geographic areas would be mitigated (improved) to less than significant impacts. With respect to intersection capacity, there would be less than significant impacts in all geographic areas, assuming that all recommended intersection projects are funded and implemented.

Reasonably Foreseeable Actions that Affect Roadways and Utilities. 25 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to roadways on Guam (see Table 4.3-3). Five of the projects would be located in North Guam, 16 in Central Guam, three in Apra Harbor, and one in South Guam. The Defense Access Road (C-10) as a roadway project would have a beneficial impact on traffic. Development projects would cumulatively alter the traffic flow and they are predominantly proposed in areas already experiencing high traffic levels in the North and Central areas of Guam (N-14, N-15, N-16, N-23, C-7, C-14, C-17, C-18, C-19, C-21, C-22, C-23, C-25, C-29, C-30, C-31, C-32, C-33, C-34). Seven of these North and Central projects are workforce housing projects. As described above under present projects, there would be impacts associated with workforce housing even though they are considered temporary developments. Population inducing projects such as military mission changes would also increase traffic and these include BAMs (N-22), Amphibious training with an overland route (AH-18) and JHSVs (AH-22). The Port Authority of Guam is proposing modernization projects (AH-8) that include improved roadways onsite. The increased efficiency at the wharves may result in increased throughput and trucking traffic on public roadways. The new landfill (S-2) would induce new truck traffic in the southern part of Guam.

Thirty-two reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to utilities on Guam (see Table 4.3-3). Six of the projects would be located in North Guam, four at Apra Harbor, eighteen in Central Guam, and one in South Guam; Core Tech/Ironwood Estates (1) and the Territorial Prison (7) are considered general actions that would also have a cumulative impact on utilities on Guam. Guam International Airport Improvements (C-15) and AT/FP Perimeter Fence, Road Construction, and Main Gate Relocation at Andersen AFB (N-3) are expected to have a beneficial effect on utilities and traffic. Infrastructure improvement projects would have beneficial impacts such as, the Air Force AT/FP fencing and roadway project (N-3), Defense Access Road (C-10), Port Authority of Guam modernization program (AH-8), new landfill (S-2), new 60 MW power plant (12), and military wharf improvements (AH-11). Other reasonably foreseeable projects would facilitate or induce new demand on existing infrastructure through transient populations, such as the workforce housing projects (N-21, N-23, C-28, C-29, C-30, C-31) and the resort project (C-7). These would result in adverse impacts.

Potential Cumulative Impacts. Anticipated impacts from the preferred alternative are considered to be significant for roadways when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong.

Anticipated impacts from the preferred alternative are considered to be significant for power, water, and wastewater when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to roadways are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Mitigation measures proposed for avoiding and reducing impacts to utilities are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Socioeconomics and General Services

Current Socioeconomic and Historical Context. As summarized in Volume 2, Section 16.1.2 and Volume 7 Section 3.3.15, Guam's socioeconomic history is heavily influenced by Spanish rule, Pre-WWII American occupation, and the battles of WWII. The economic history of Guam post WWII is described in Volume 2, Section 16.1.2, and summarized below.

Guam's population experienced substantial increase – from a pre-war 1940 level of 22,900 (with a military and dependent population of 1,427) to 59,498 (with a military and dependent population of 26,617) in 1950. From 1950 to 2000 Guam's population grew at an average rate of 21% per decade (about 2.1% annually). However, the Census Bureau projects (without the proposed action) that this growth will taper off, possibly due to out-migration rates observed around 2002. The military population was highest in 1950 and declined through the 1980s with an increase from the later 1980s through 1990s. During the 1980s, military lands were released including Naval Station Agana, which corresponded to the reduction in military population. The increase in military population is attributed to cold war military spending and relocation of military personnel from the Philippines.

Guam's economy has experienced a volatile past. Super typhoon Karen in the 1960s left many residents homeless. The economy stagnated in the 1970s to early 1980s, partly due to the 1973 oil embargo. Tourism peaked between 1995 and 1997 but ended with the Japanese financial crisis in 1997. Super typhoon Pongsona as well as the September 11, 2001 terrorist attacks on the U.S. also affected the tourism market that was previously on the verge of recovery.

From 2000 through 2008, Guam's economy has continued to mirror this volatile recent past. From 2001 to 2003, Guam's economy contracted: unadjusted for inflation, total payroll declined by 2%, employment declined by 4%, and individual salaries increased by 1%. From 2004 to 2006, partially in response to the announcement of the proposed action, Guam's economy has once again showed signs of expansion. Using 2005 data, a study for the Guam Visitors Bureau found that tourism was the island's second largest private industry (following Finance, Insurance, and Real Estate) and both the primary Japanese and second Korean market were growing at that time.

As of the end of 2008, Guam's real estate market has shown signs of slowing. Commercial real estate on Guam has declined in value due to worldwide issues of tight credit and declines in consumer discretionary spending. Reports show that Guam real estate sales and construction activity have dropped from 2007 levels due to the global economic decline coupled with a moratorium on development in the Tumon Bay area that at the time of writing continues to be under debate. By the end of 2008, international economic conditions plus other market and demographic factors produced declining year-over-year trends for a variety of key tourism indicators, including total arrivals, hotel occupancy rates and taxes, and hotel room-nights sold.

Four recently completed projects with the potential to contribute to a cumulative impact to socioeconomics and general services on Guam were identified (Table 4.3-3): Home Depot (C-2), Talo Verde Estates (C-3), Ironwood Estates affordable housing (1), and Kilo Wharf Improvements (AH-1).

Fourteen present projects with the potential to contribute to a cumulative impact to socioeconomic conditions and general services on Guam were identified (Table 4.3-3): Beddown of Training and Support Initiatives at NWF (N-6), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), Mitigation for Kilo Wharf Extension (AH-21), and Draft Safe Harbor Agreement (Cocos Island; S-1). The Veterans Clinic has a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact.

The preferred alternatives would result in significant impacts to Guam's socioeconomic conditions and general services resources, as summarized in Volume 7, Section 3.3.15, Table 3.3-40. The impact assessment details are provided in Volumes 2, 4, and 5 (see Volume 2 and 4, Section 16.2; Volume 6, Section 17.2). Population impacts are considered mixed significant and beneficial, because population growth fuels economic expansion but sudden growth also strains government services and the social fabric. Economic impacts are considered beneficial. Public service, sociocultural, and land acquisition impacts are considered significant.

Reasonably Foreseeable Actions that Affect Socioeconomics and General Services. All of the reasonably foreseeable projects could impact socioeconomics by providing jobs and facilitating the flow of goods and services. Thirty-five reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to socioeconomic conditions and general services on Guam (see Table 4.3-3). Eight of the projects would be located in North Guam, seven at Apra Harbor, 17 in Central Guam, and two in South Guam; the Territorial Prison (7) is considered a general action. Three of the projects are anticipated to have a beneficial effect on Guam's socioeconomic conditions and general services: Territorial Prison (7), Modernization Program: Port Reconfiguration, Maintenance and Repair (AH-8), and New Landfill (Dandan, S-2).

Potential Cumulative Impacts.

The summary of preferred alternatives socioeconomic impacts would be significant and there would be an additive cumulative impact when combined with past, present, and reasonably foreseeable actions on Guam identified in Table 4.3-5. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Development projects, i.e., most of the cumulative projects, are generally a response to socioeconomic conditions. For example, new hotels and subdivisions could be a response or anticipation of increases in resident or tourist populations. Construction of these development projects generate jobs, resulting in beneficial impacts to the economy. However, adverse impacts could be associated with high numbers of construction workers on island at one time. The operation of new facilities, such as Home Depot (C-2) and hotels (C-12) would also generate jobs, with beneficial impact to the economy.

Population increases have inherently mixed impacts (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric. Such population increases could be fueled by the development projects mentioned above. In addition, there are DoD mission changes on the cumulative project list that would increase the on-island population, such as Redhorse/Commando Warrior Training (N-6) and ISR/Strike (N-7), which are included in the affected environment discussion of this EIS. Other mission changes, such as Army JHSV (AH-22) and BAMS (N-22), that might impact island population, were not included in the affected environment because there is insufficient detail on the project description.

Some projects would have beneficial impacts to public services available on Guam, such as a new prison (7), a new high school (N-20), a veteran's clinic (C-9), and a new landfill (S-2). The workforce housing projects would support a transient worker population, which is beneficial if support services are provided to the workers through the workforce housing.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to socioeconomic and general services are listed in Table 2.2-1. These proposed mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Hazardous Materials and Waste

Current Health and Historical Context. As presented in Volume 7, Section 3.3.16.2, there is little historical data on hazardous material, toxic substance, and hazardous waste handling; collectively referred to as hazardous substances. WWII established a high baseline of environmental releases; but overall, the trend in hazardous substance use is associated with increases in population and industrial activity. During the 1970s, there were numerous local and federal environmental regulations enacted to protect human health and the environment and to closely control and regulate the transport, storage, use and disposal of hazardous substances. While the trend in use of hazardous substances is expected to increase over time, regulations currently in place minimize the risk of release to the environment as well as the risk to human health. This trend would continue at a more gradual rate of increase. The impacts are largely related to human activities, but natural events such as typhoons and earthquakes can result in inadvertent releases of regulated hazardous substances.

Four recently completed projects with the potential to contribute to hazardous substance cumulative impacts on Guam were identified (Table 4.3-3): Ironwood Estates affordable housing (1), Home Depot (C-2), Talo Verde Estates (C-3), and Kilo Wharf Improvements (AH-1).

14 present projects with the potential to contribute to cumulative hazardous substance impacts on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon

Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), and Beddown of Training and Support Initiatives at NWF (N-6).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant hazardous materials management impacts as summarized in Volume 7, Section 3.3.16, Table 3.3-61. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 17.2; Volume 6, Section 18.2). The impacts would be less than significant because the transportation, storage, handling, use, and disposal of these substances is heavily documented, controlled, and regulated at the federal and local level in a “cradle to grave” comprehensive manner.

Reasonably Foreseeable Actions that Affect Hazardous Substances. Many of the reasonably foreseeable projects could potentially involve transportation, storage, handling, use, or disposal of hazardous substances during construction and operation. 24 reasonably foreseeable future projects are anticipated to contribute to cumulative hazardous substance impacts on Guam (see Table 4.3-3). Five of the projects would be located in North Guam, 10 in Central Guam, four at Apra Harbor, and one in South Guam. The Territorial Prison (7) is considered a general action that would also contribute to the cumulative impact. Orote Magazines (AH-4) is anticipated to have a beneficial effect on hazardous substance impacts. Residential developments (N-21, C-3, C-8, C-14, C-21, C-23, C-27, C-28, C-29, C-30, C-31) would use minor amounts of hazardous substances for maintenance. Hotels (C-7) also use hazardous substances. Industrial facilities such as commercial (AH-8) and military waterfront (AH-11) areas and airports (C-15) use hazardous substances and the cumulative projects would increase capacity at these facilities resulting in handling of more regulated waste materials.

Potential Cumulative Impacts. Anticipated impacts from the preferred alternative are considered to be less than significant when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of cumulative impact resulting from the preferred alternative is considered to be low. This additive impact is regarded as low because the existing environmental laws and regulations and associated BMPs and SOPs require that these hazardous substances are handled, used, and disposed of in a comprehensive “cradle to grave” manner that inherently reduces the overall risk to human health and the environment.

This projection is based on the assumption that existing hazardous materials, toxic substances, and hazardous waste transportation, handling, storage, use, and disposal procedures and protocols are properly implemented and modified as appropriate to address the increased hazardous substances demand. Most of the cumulative projects would increase the management of regulated hazardous substances on Guam. However, these impacts would not contribute appreciably to the increasing trend in the volume of regulated hazardous substances already being handled and managed on Guam.

Need for Mitigation. No mitigation measures are proposed for the proposed action, and none are proposed for the potential cumulative impacts.

Public Health and Safety

Current Status and Historical Context. The historical trends in public health and safety are difficult to determine. WWII is the most damaging recent event in Guam’s history impacting human health and safety. The trends in public health and safety are a function of changes in population and operations, or industries that involve dangerous materials (e.g., hazardous substances, live ammunition, electromagnetic energy, radiological substances). The socioeconomics section describes changes in population over time. From 1970 to 2000, the population on Guam increased, but declined in subsequent years. The number of

occupational and traffic accidents have increased gradually over the years. Aircraft mishaps are associated with economics, and are cyclical. The trend in notifiable diseases is increasing gradually, but is related to population. The increase in construction and ground disturbing activities would increase the risk of uncovering UXO; live ammunition is largely a military activity and changes with the military mission. Guam health and public services (i.e., lack of skilled professionals and lack of up-to-date equipment) are sub-standard due to lack of funding; this trend is likely to continue in the absence of economic development.

There are no recently completed projects identified with the potential to contribute to an adverse cumulative impact to public health and safety on Guam (Table 4.3-3).

Seven present projects with the potential to contribute to a cumulative impact to public health and safety on Guam were identified (Table 4.3-3): ISR/Strike Capability (Andersen AFB; N-7), Beddown of Training and Support Initiatives at NWF (N-6), Workforce housing (Core Tech; C-6), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), and Draft Safe Harbor Agreement (Cocos Island; S-1). The Veterans Clinic, Bureau of Medicine Naval Replacement Hospital Project, and Safe Harbor Agreement have a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to public health and safety on Guam, as summarized in Volume 7, Section 3.3.17, Table 3.3-62. The impact assessment details are provided in Volumes 2, 4, 5, and 6 (see Volumes 2, 4, and 5, Section 18.2; Volume 6, Section 19.2). The significant impacts on public health and safety are due to:

- potential increase in ambient noise.
- potential impacts on water quality.
- Staff shortage at Guam clinics and hospital.
- increases in notifiable diseases and mental illness as well as increases in public services requirements (e.g., health care services and protective services) proportional to increases in population.

Reasonably Foreseeable Actions that Affect Public Health and Safety. 14 reasonably foreseeable future projects are anticipated to contribute to a cumulative public health and safety impact on Guam (see Table 4.3-3). Three of the projects would be in North Guam, eight would be in Central Guam, two at Apra Harbor, and one in South Guam. The New Landfill (Dandan, S-2), Defense Access Road (C-10), and AT/FP Perimeter Fence, Road Construction, and Main Gate Relocation at Andersen AFB (N-3) are anticipated to have beneficial effects on public health and safety. Projects could potentially impact public health and safety because they would induce an increase in population (resorts, workforce housing [C-6, C-23, C-29, C-30, C-31, C-32, C-33, C-34]), military mission (AH-22, N-22) or they involve industrial increases (landfill [S-2]) (Table 4.3-5).

Potential Cumulative Impacts. Anticipated impacts to public health and safety would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong because impacts are related to increases in population (Table 4.3-5) and associated inadequate health care services to support this population.

Need for Mitigation. Compliance with statutes and regulations on hazardous materials and wastes would be adhered to and these materials would be secured within the military installation to deter unauthorized

access; therefore, no mitigation measures are proposed for avoiding and reducing impacts resulting from use of hazardous materials. Mitigation measures for cumulative impacts to health care services would be for the federal inter-agency task force to succeed in finding funding and/or other assistance to help Guam upgrade their capacity to care for increased incidences of illness.

Environmental Justice and the Protection of Children

Current Status and Historical Context. Environmental Justice is a relatively new concept that was introduced in 1994 by Executive Order 12898. It applies to federal actions. Guam has a higher percentage of racial minorities, low-income populations, and children, when compared with the continental U.S. Much of the island's population would likely continue to struggle with poverty and access to basic community services, especially when the social and health services are inadequate for the existing population. The existing inadequate roads and utilities would likely continue to deteriorate, having an adverse and disproportionate impact on disadvantaged residents of Guam. (Although it is noted that the proposed action would improve various roads and highways affected by the proposed action [Volume 6])

Two recently completed projects with the potential to contribute a cumulative environmental justice and protection of children impact on Guam were identified (Table 4.3-3): Home Depot (C-2) and Ironwood Estates (Affordable Housing; 1). These projects are considered to have a beneficial impact.

Six present projects with the potential to contribute to environmental justice and protection of children cumulative impact on Guam were identified (Table 4.3-3): Workforce housing (Core Tech; C-6), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Beddown of Training and Support Initiatives at NWF (N-6), ISR/Strike Capability (Andersen AFB; N-7), and Workforce housing (Younex Enterprises; N-21) would have adverse cumulative impacts. The Veterans Clinic would have a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. If a resource area did not have significant impacts, or impacts were mitigable to less than significant, as analyzed in each resource chapter in Volumes 2 through 6, then it was not further analyzed in the Environmental Justice and Protection of Children chapters. The preferred alternatives would result in significant direct impacts with regard to environmental justice and protection of children on Guam, as summarized in Volume 7, Section 3.3.18, Table 3.3-66. Details on the impact assessment are described in Volumes 2, 4, 5, and 6 (see Volumes 2, 4, and 5, Section 19.2; Volume 6, Section 20.2). Impacts associated with the construction workforce and induced development would result in significant indirect impacts that would disproportionately affect low-income populations and children. The impact would be significant for public health care services and socioeconomics (described in other resource sections), which could result in disproportionately high and adverse effects on low-income populations and children of low-income families. Significant indirect impacts on disadvantaged populations would result in the areas of potable water and wastewater utilities, and public health. To minimize adverse impacts on public health care and protective services associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. Proposed mitigation measures including the implementation of force flow reduction and/or APM measures (Volume 7, Section 2.3 and 2.4) would reduce significant indirect impacts associated with the construction workforce and induced population. However, the proposed action would contribute to the trend of increasing adverse impact on disadvantaged populations.

Reasonably Foreseeable Actions that Affect Environmental Justice and the Protection of Children. 19 reasonably foreseeable future projects are anticipated to contribute to a cumulative environmental justice and protection of children impact on Guam (see Table 4.3-3). Four of the projects would be in North

Guam, 13 projects would be on Central Guam, one at Apra Harbor, and one in South Guam. Nine of the projects are anticipated to have a beneficial affect with regard to environmental justice and protection of children on Guam: New Landfill (Dandan; S-2), Zone Change Request (C-25), Tentative Development Plan Application (C-22), Subdivision Variance Request (C-21), Seashore Clearance Request (C-20), PUD – Amendment (C-19), Conditional Use Request (C-18), Subdivision Variance Request (N-15), and Conditional Use Request (N-14). There is insufficient detail on the demographics surrounding the cumulative projects' sites to determine if there are disadvantaged populations near the project sites. In general, increases in population related to military mission changes (N-22, AH-22) or workforce housing to support the military (N-21, N-23, C-6, C-28, C-29, C-30, C-31) could impact disadvantaged populations through increases in traffic. Improvements to infrastructure (S-2), public services, and new affordable housing projects (1), are likely to have a beneficial impact on disadvantaged populations. Projects that create jobs, such as retail facilities (N-14, N-15, C-2, C-8, C-19, C-20, C-21, C-25) would have a cumulative beneficial impact on disadvantaged populations (Table 4.3-5).

Potential Cumulative Impacts. Anticipated direct impacts to environmental justice and the protection of children as a result of the preferred alternatives are considered to be significant; indirect impacts are also considered to be significant. Direct and indirect impacts would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Guam. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to environmental justice are listed in Table 2.2-1. These proposed mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

4.3.5.2 Tinian Cumulative Impacts Assessment

The Tinian cumulative projects that were retained following the initial screening are listed in Table 4.3-5. The criteria for dismissal are listed in Section 4.2. Based on the limited information available on the cumulative projects, a qualitative assessment was made regarding potential impacts of the cumulative projects on resources. Beneficial impacts are indicated by “B” and adverse impacts are indicated by “X.” No attempt was made to distinguish between less than significant and significant adverse impacts potentially resulting from these projects. The number of cumulative projects that potentially have an adverse impact on each resource is totaled at the bottom of the cumulative project list. The next line is the significant impact findings from Chapter 3 that summarized the preferred alternatives' impacts. The final two lines of the table indicate if the preferred alternative would have an additive impact on the resource and whether the additive impact from the preferred alternatives is strong, moderate or low.

Table 4.3-5. Summary of Potential Operations Impacts to Resource Area – Tinian Projects

#	Lead Agency or Proponent	Project Name/ Location	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
CNMI-Tinian																					
T-2*	Marine Corps	1,500/3,000 Man Base Camp, Phase 2 (Marine Corps Proj. 13B) /MLA	RF		X	X	X		X	X	X	X	X	X	X	X		X	X	X	X
T-3*	Marine Corps	Ammunition Storage (Marine Corps Proj. 14) /MLA	RF		X	X	X		X	X	X	X	X	X	X	X		X	X	X	X
T-4*	Marine Corps	Automated Multipurpose Range (Marine Corps Proj. 15)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
T-5*	Marine Corps	Combined Arms Live Fire Training Area (Marine Corps Proj. 16)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
T-6*	Marine Corps	Company Level Live-Fire and Movement Range (Marine Corps Proj. 17)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
T-7*	Marine Corps	Mortar and Artillery Ranges (Marine Corps Proj. 18)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
T-8*	Marine Corps	North Field Helicopter Operations (Marine Corps Proj. 19) /MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
T-9*	Marine Corps	Small Arms and Machine Gun Ranges (Marine Corps Proj. 20)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
T-10*	Marine Corps	Stationary Target Range (Marine Corps Proj. 21)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X

#	Lead Agency or Proponent	Project Name/ Location	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																			
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children		
T-11*	Marine Corps	Waterfront Upgrades (Marine Corps Proj. 22)/ non-MLA	RF		X	X	X		X	X	X	X	X	X	B	X	X	X	X	X	X		
T-12*	Marine Corps	Infrastructure Upgrades (Marine Corps Proj. 23)/ MLA	RF		X	X	X		X	X	X	X	X	X			X	X	X	X	X		
T-15	DPW	Marpo Valley Quarry (government)/non-MLA	RF	X		X	X		X		X	X	X			X		B	X	X	X		
T-16	Bridge Investment Group	Tinian Oceanview Resort/ non-MLA	RF		X	X	X	X		B	X	X	X	X	X	X	X	B	X	X	B		
T-17	Marianas Resort Development Group	Matua Bay Resort and Golf Course/ non-MLA	RF		X	X	X	X	X	B	X	X	X	X	X	X	X	B	X	X	B		
T-18	DPW	Landfill/MLA	RF	X		X	X		X		X	X	X			X		B	X	X	B		
T-19	CUC	Wastewater treatment plant/MLA	RF		X	X	X		X		X	X	X	X			X		X	X	B		
T-23	Neo Goldwings Paradise	Neo Goldwings Paradise Casino on /non-MLA	RF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	B	X	X	B		
T-27	Resources - Management International	Quarry	RF	X		X	X		X		X	X	X			X		B	X	X	X		
T-28	Department of Public Lands	Homesteads (various proposals)	RF		X	X			X		X	X	X	X		X	X	B	X	X	B		
Number of recently completed projects potentially contributing to cumulative impacts					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Number of present projects potentially contributing to cumulative impacts					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of reasonably foreseeable projects potentially contributing to cumulative impacts					4	16	19	18	10	18	14	19	19	19	19	13	8	16	18	19	19	19	

#	Lead Agency or Proponent	Project Name/ Location	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																	
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
Summary Operation Impacts: Preferred Alternatives significant impacts (from Chapter 3)				LSI	LSI	LSI	LSI	NI	SI	LSI	SI-M	LSI	LSI	SI-M	NI	LSI	LSI	SI	LSI	LSI	SI
Preferred Alternatives impacts additive to past present and reasonably foreseeable future actions? yes[Y]/no[N]				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Degree of additive impact? S-strong; M-moderate; L- low				L	L	L	M	S	S	S	S	L	S	L	L	L	L	S	L	L	S

Legend: B = Beneficial impact, X= Adverse impact, Blank cell = No or minimal impact anticipated, SI = Significant impact, SI-M = Significant and mitigable to less than significant, X= Potential adverse impact, RC= Recently completed, P = Present, RF= Reasonably foreseeable

The cumulative impacts study area for each resource is the island of Tinian and its waters extending out to 164 ft (50 m). The following is a summary of the cumulative impact analysis by resource.

Geological and Soil Resources

Current Health and Historical Context. The effects of pre-colonial populations on the current health of Tinian's geological resources is difficult to ascertain. During the Spanish Period (1668-1899) the introduction of cattle and farm crops likely denuded soils and contributed to erosion from vegetation loss and trampling. However, Tinian's geological and soil resources have been most recognizably affected by human populations in the early 20th century. Two primary influences affecting soils are intensive sugar cane cultivation in the 1920s and the subsequent rapid island-wide impacts of warfare and war-related development in the 1940s during WWII. In the 1920s, the Japanese intensively cultivated sugar cane on approximately 80% of Tinian's arable land (See Section 12.1.1.3 of Volume 3). Sugar cane production in tropical soils has been known to contribute to soil loss from erosion and reduction of soil fertility.

During WWII, military bombings and development contributed to soil loss and erosion from large-scale vegetation removal, grading activities that both removed stabilizing vegetation and further destabilized soils, and soil compaction reducing infiltration to groundwater. Large additions of impervious surfaces (i.e., roads, sidewalks, driveways and parking lots) accelerated sheet flow resulting in erosion from storm water. The strategically important island was developed for military uses by Japan, intensively bombed (essentially destroying the entire sugarcane operation, most Japanese military structures, and leaving behind a denuded forest) and then invaded by the U.S. in 1944. Upon being taken under U.S. control, the island underwent additional rapid development for military uses by the U.S. During WWII, Tinian briefly reached its largest recorded population of approximately 150,000, almost all of which were U.S. troops, and was the location of the largest WWII airfield, with six 8,500-ft long runways for B-29 bombers, in addition to repaired airstrips originally constructed by the Japanese. By 1945, a substantial portion of the northern one-third of the island had been graded and paved with air strips, and over 112 million cubic yards of coral had been used for fill. Given the current prevalence of tangantangan (a rapidly growing tree that is not native to the Marianas) across the island, the U.S. may have seeded the island with tangantangan, as they did on Guam, in order to slow erosion resulting from plant cover loss.

Immediately following WWII, Tinian's population shrank into the hundreds and it has slowly been re-populated and re-developed over the past 60 years. The human population increased most quickly following the agreement with the U.S. to become part of the CNMI in 1976 and reached a population of 3,540 by the time of the 2000 U.S. Census. Also, during this time period, vegetation cover has been returning, with open fields decreasing 11.6% and secondary forest coverage increasing 10.3% (Volume 2, Section 10.1.2.1). A casino and several hotels serve tourists, and the northern two-thirds of the island are now used for military training activities by the USMC.

There are no recently completed projects identified in the past six years with the potential to affect geological resources on Tinian (Table 4.3-5).

There are no preset projects identified in the past six years with the potential to affect geological resources on Tinian (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Direct impacts to geological resources that could contribute to a cumulative impact would primarily occur during the construction phase to soils, when a maximum of up to 225 acres (91 ha) of vegetation would be temporarily cleared and topsoil graded. These impacts would be localized and would not affect productive agricultural soils. Vegetation lost during construction would return when construction is completed. Since the topography of the proposed ranges is flat, the preferred alternative would not

diminish soil stability. Proposed range locations do not lie over Takapochao Limestone, so compaction of soils would not affect infiltration of surface water into groundwater. Sinkholes would be avoided if encountered and left with vegetation buffers to avoid further erosion and expansion.

Reasonably Foreseeable Actions that Affect Geological and Soils Resources. Four reasonably foreseeable actions with potential to affect geological resources were identified: Marpo Valley Quarry (T-15), Department of Public Works Landfill (T-18), Neo Goldwings Paradise Casino (T-23), and Quarry at Western Tinian (T-27) (see Table 4.3-5).

Potential Cumulative Impacts. Anticipated temporary impacts to geological resources during construction, although considered to be insignificant, would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to geological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Water Resources

Current Health and Historical Context. The effects of pre-colonial populations on the current health of Tinian's water resources is difficult to ascertain. Two primary events of the early 20th century impacting geological resources - intensive sugarcane production by the Japanese in the 1920s, and warfare and development during WWII - likely also had the greatest affect on Tinian's water resources. However, detailed information on the effects of these activities on Tinian's water resources is not readily available. Overall surface water quality data are limited on Tinian. In general terms, stormwater runoff is vulnerable to sewage disposal overflows, animal wastes, and sediment erosion carried into streams during periods of heavy rainfall. Historically, approximately 40 wells were drilled at an average depth of 230 ft (70 m); however, most of these have been abandoned. Currently, there are nine production wells on Tinian (Volume 3, Chapter 4). The municipal and agricultural wells are located in or near the Makpo wetland area, and the potable water is stored in tanks at Makpo Heights and Carolinas Heights.

The potential for high chloride levels resulting from saltwater intrusion into the freshwater lens due to excessive pumping of the freshwater aquifer is of concern on Tinian. While it is not currently a problem, it may be in the future if groundwater pumping rates exceed the recharge capacity of the aquifer. Located beneath the Makpo Wetland, the aquifer is considered to be groundwater under direct influence of surface water that must meet the same drinking water treatment technologies standards as surface water. Groundwater aquifers on Tinian are also vulnerable to contamination by substances introduced onto the soil surface because the thin soils and underlying permeable limestone do not significantly impede the passage of contaminants to the shallow aquifer.

All the nearshore waters surrounding Tinian are designated Class AA, except for the nearshore waters of San Jose Harbor that are designated Class A. Sewage outfalls, sewer collection overflows, sedimentation from unpaved roads and development, urban runoff, reverse osmosis discharges, and nutrients from golf courses and agriculture are the most significant stressors on the CNMI's marine water quality. Class AA waters should remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-related source or actions. The uses protected in these waters are the support and propagation of marine life, conservation of coral reefs and wilderness areas, oceanographic research, and aesthetic enjoyment and compatible recreation inclusive of whole body contact (e.g., swimming and snorkeling) and related activities. Only one nearshore area on Tinian,

Unai Chulu, did not support its designated use classification due to exceedances in *enterococci* bacteria violations. This beach is classified as being only partially supportive of its designated uses.

No recently completed or present actions with the potential to affect water resources have been identified (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact.

Direct construction and operation impacts from the preferred alternative are considered to be less than significant to surface water, groundwater, nearshore waters, and wetlands, except for impacts to approximately 0.3 acre (0.1 ha) of potential jurisdictional wetland. The Marine Corps would attempt to first avoid this impact by adjusting the layout of the proposed Platoon Battle Course layout to avoid the potential wetland. If avoidance is not possible, then potential impacts could be mitigated to be less than significant by replacement of the area filled or creating or improving existing wetland areas on Tinian.

Construction activities would temporarily increase stormwater runoff, erosion, and sedimentation, and operation impacts would include increased stormwater volume and intensity and training-related residual contaminants. The surface water impacts would increase the potential for local groundwater contamination. Construction and operations would also result in minor increases in runoff volume and loading potential for nearshore waters. In addition to fill of 0.3 acre (0.1 ha) of potential wetland during construction, operations would result in a minor increase in pollutant loading potential at wetlands from expended rounds. This would result in less than significant impacts to water resources. However, less than significant direct impacts might contribute to a cumulative impact.

Reasonably Foreseeable Actions that Affect Water Resources. 16 reasonably foreseeable actions with potential to affect water resources were identified: 1,500/3,000 Man Base Camp, Phase 2 (T-2), Ammunition Storage (T-3), Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), Stationary Target Range (T-10), Waterfront Upgrades (T-11), Infrastructure Upgrades (T-12), Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), Wastewater treatment plant (T-19), Neo Goldwings Paradise Casino (T-23), and Homesteads (T-28) (see Table 4.3-5).

Potential Cumulative Impacts. Cumulative projects would involve construction activities that would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. For cumulative projects disturbing more than one acre during construction (including the preferred alternative), a Construction General Permit would be obtained and followed and a Stormwater Pollution Prevention Plan (SWPPP) would be prepared and implemented to minimize temporary increases in runoff and pollutant loading related to construction activities.

In addition, cumulative projects would result in an increase in impervious surface areas (i.e., rooftops, sidewalks, roads, and parking lots) in urban and industrial settings, resulting in a corresponding increase in stormwater runoff that has the potential to have elevated levels of contaminants, such as sediments, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. The increase in impervious surfaces would result in an associated increase in stormwater discharge intensities and volume. This increase would likely be accommodated by existing or new stormwater infrastructure to ensure the timely and low-impact flow of stormwater to minimize erosion and flooding concerns. In addition, cumulative actions would be expected to increase the amount of petroleum, oil, and lubricants (POLs), hazardous waste, pesticides, and fertilizers being stored, transported, and utilized. Increasing the storage, transportation, and use of these substances would increase the potential for releases to water resources. Implementation of BMPs associated with addressing site- and activity-specific water resource

protection needs, provision of facility-specific SWPPPs and Spill Prevention, Control, and Countermeasure (SPCC) Plans would minimize potential impacts from facility operations, including the transportation, storage, and use of fuel, on all water resources. In addition, adherence to surface water quality and volume control measures would also reduce pollutant loading to groundwater basins, nearshore waters, and wetlands. Many of the cumulative projects would potentially impact water resources.

There is the potential for the cumulative projects to have direct and indirect impacts to wetland areas, potentially resulting in the loss of wetland area and/or function. Per USACE regulations, activities that are proposed in wetlands or that could potentially reduce wetland function, must be permitted and potentially mitigated to compensate for direct impacts to wetland areas. Therefore, any loss of wetland area or functionality would be potentially mitigated at a project and site-specific ratio, which would likely include creating or enhancing existing wetland habitat elsewhere. Indirect impacts to wetland areas (e.g., runoff, sediment loading, etc.) would be addressed on a project-specific level, and would likely be lessened with BMPs and associated short- and long-term stormwater runoff management measures.

Anticipated temporary impacts to water resources during construction and long-term operations impacts from the preferred alternative, although considered to be less than significant or able to be mitigated to less than significant in the case of wetlands, would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the health of water resources on Tinian over time (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to water resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Air Quality

Current Health and Historical Context. Given the generally temporary nature of air quality conditions and impacts, historical air quality impacts are not expected to contribute to current and future cumulative air quality impacts (for global warming and climate change assessment see Section 4.3.4.3). The following brief discussion is therefore only intended to provide a historical context for air quality on Tinian.

The effects of pre-colonial and colonial populations on the current health of Tinian's air quality are difficult to ascertain, but they likely consisted of particulate emissions associated with the use of wood-fueled fires for food preparation, hunting, warmth, and religious purposes. Emissions from unfiltered and open burning fires, particularly within structures, is a primary source of air pollution-related illnesses worldwide today. However, air quality on Tinian was likely at its worst during WWII as warfare and war-related activities contributed to air pollution on the island. As noted above in the discussion of geological resources and earlier in this EIS (Section 1.4.2), for a period of time Tinian was the largest airfield during WWII, and emissions from aircraft landings and departures from Tinian were likely substantial. Following WWII, the island's human population rapidly diminished into the hundreds and for decades the relative absence of emissions sources likely resulted in relatively good ambient air quality conditions.

Today, except for power generating facilities, there are no significant sources of air emissions on Tinian. However, military training vessels, on-road vehicles, and open burnings are sources of emissions that impact existing ambient air quality conditions on the island. While there are no air monitoring stations on Tinian, it can be assumed that ambient air quality is good, has remained constant in recent years, and is in

compliance with air quality standards. The relatively small number and density of emission sources, absence of geologic features (e.g., active volcanoes) that would create or trap air pollutants, and the circulation of air across the island contribute to Tinian's good ambient air quality. The island is currently designated as an attainment area for all criteria pollutants (Section 3.3.4 and Volume 3, Section 5.1).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Emissions resulting from the preferred alternatives would contribute to cumulative impacts on Tinian. Emissions would consist of SO₂, CO, PM₁₀, NO_x, VOC, CO₂, and particulates resulting from both construction and operations. These emissions are considered to be insignificant (Section 3.3.4.1).

Reasonably Foreseeable Actions That Affect Air Quality. Construction of all 19 reasonably foreseeable future projects listed in Table 4.3-5 would impact air quality, but the air quality impacts from construction would be temporary. Operational emissions would likely consist of increased emissions from power generation and vehicles. The two quarry projects, two resorts (Tinian Oceanview Resort [T-16] and Matua Bay [T-17]) and, and the Marine Corps helicopter training project would likely impact air quality during operations. The two resorts would also indirectly increase the air and ground traffic emissions by increasing the tourism-related population and activities.

Potential Cumulative Impacts. Emissions from the proposed action in combination with past, present, and reasonably foreseeable future actions would contribute to a cumulative impact to air quality on Tinian. Emissions from the preferred alternatives would be greatest during construction when a maximum of up to 225 acres (91 ha) of topsoil would be graded (Volumes 3, Chapter 5); however, project-related emissions would not be significant (Section 3.3.4.1 and Table 3.3-7). Operational air emissions from vehicles would be well below the significance threshold of 250 TPY. The significance threshold was developed in order to control cumulative impacts to air quality (i.e., each project in an air basin is required to meet the threshold in order to avoid an unacceptable level of cumulative emissions). Therefore, the cumulative impact resulting from the proposed action would be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to air quality are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Noise

Current Health and Historical Context. WWII bombings and air operations likely represent the loudest period in Tinian's history, but the noise impacts were temporary. A historical tuna trans-shipment facility at the port generated localized temporary noise as an industrial facility. Today, the main sources of noise on Tinian are daily commercial airport operations, infrequent military activities in the MLA, and civilian traffic (Section 3.3.5.2).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Noise levels (if any) experienced by sensitive receptors would be low and associated with operations. Noise potentially perceptible by sensitive receptors would be concentrated on the days the airlift is transporting Marines to and from Tinian's West Field or North Field. Similarly, live-fire exercises would generate noise, but at locations too far away from the nearest human receptor(s) to be heard; consequently, the preferred alternatives would not create an incompatible noise zone that would extend past the boundary of military controlled lands on Tinian. Likewise, temporary construction noise generated by the preferred alternatives would likely not be perceptible by sensitive receptors because it would be located well within the boundary of the MLA and beyond audible range. Therefore, noise from

the airlift of Marines to and from West Field and North Field is the most likely impact with the potential to contribute to a cumulative impact on Tinian (Section 3.3.5.1).

Reasonably Foreseeable Actions that Affect Noise. 18 projects listed in Table 4.3-5 are expected to impact ambient noise on Tinian: 1,500/3,000 Man Base Camp, Phase 2 (T-2), Ammunition Storage (T-3), Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), Stationary Target Range (T-10), Waterfront Upgrades (T-11), Infrastructure Upgrades (T-12), Marpo Valley Quarry (T-15), Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), Landfill (T-18), Wastewater Treatment Plant (T-19), Neo Goldwings Paradise Casino (T-23), and the DPW Quarry (T-27).

Temporary noise impacts are anticipated to occur from construction. Long-term operational noise impacts are expected to occur from additional traffic and population increases, including from tourism, associated with reasonably foreseeable future actions. Operations of two future resorts (Matua Bay and Tinian Oceanview Resort) and a casino (Neo Goldwings Paradise) would directly generate noise at their sites and they would also increase tourist air and ground traffic, which would indirectly generate additional noise on Tinian.

Potential Cumulative Impacts. Although the preferred alternatives' noise impacts would be less than significant individually, there would be an additive cumulative impact on Tinian when combined with past, present, and reasonably foreseeable future actions identified above. Operations of all the cumulative projects would generate some level of noise, and although the noise would be localized, the human-induced noise levels experienced across the island would cumulatively increase. There would be less area on Tinian unaffected by human-caused noise. The Marine Corps cumulative project training ranges could result in substantial increase of noise to sensitive receptors, primarily if ranges are used concurrently. Most of the noise would be in the MLA, but noise modeling would be required to determine impacts to sensitive receptors. The industrial quarries would also generate noise during operations. The degree of additive impact resulting from the preferred alternative, in combination with past, present, and reasonably foreseeable future actions is considered to be moderate (Table 4.3-5).

Need for Mitigation. No mitigation measures to reduce or avoid noise impacts are proposed for the preferred alternatives.

Airspace

Current Health and Historical Context. As mentioned in Volume 7, Section 3.3.6.2, since WWII, the Tinian Airport (West Field) air traffic fluctuates based on tourism levels. The military use at North Field is training mission-dependent and addressed in the MIRC EIS/OEIS. Airspace impacts would not occur during construction, and are only applicable to operations. Because there are multiple, and sometimes competing demands, the FAA considers all aviation airspace requirements in relation to airport operations, federal airways, jet routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements. Significant impacts are avoided prior to FAA approval.

Direct and Indirect Impacts of the Preferred Alternatives That Might Contribute to a Cumulative Impact. There would be no impact from the preferred alternatives on airspace. (Section 3.3.6 and Volume 3, Chapter 7). There would be no new SUA, and existing arrival and departures from either the Tinian or Saipan airports would not require any changes. There are no en-route low-altitude airways, so no Instrument Flight Rule procedures would have to be changed. Access to, and the approach and departure patterns associated with the airports and airfields would not be restricted, nor would they be required to

change. Airspace management procedures would be implemented. Well-established procedures and rules governing flight operations, in both controlled and uncontrolled navigable airspace and existing SUA, make future adverse impacts on public health and safety unlikely. Aircrews for military participants and non-participating aircraft would be responsible for using see-and-avoid techniques to avoid hazards.

Reasonably Foreseeable Actions that Affect Airspace. 10 projects listed in Table 4.3-5 are expected to impact airspace on Tinian. The Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), and Stationary Target Range (T-10) on the cumulative project list would need to be evaluated for potential direct impacts on airspace. The two resorts, Tinian Oceanview Resort (T-16) and Matua Bay (T-17), and Neo Goldwings Paradise Casino (T-23) would indirectly increase the volume of air traffic to support tourists, which could also indirectly impact airspace.

Potential Cumulative Impacts. The notional concept of operations for a more robust training complex on Tinian (T-2 to T-12, Table 4.3-5) relies on ship or high speed vessel transport of troops, not aircraft; therefore, there would be minimal impacts on air traffic volume due to training. There is a periodic review of MIRC airspace requirements that would address future airspace needs should the training mission requirements change. The FAA manages the cumulative impact of air traffic and special use airspace to ensure there are no significant impacts to airspace. The anticipated impacts on airspace are less than significant; the preferred alternatives would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to reduce or avoid impacts to airspace are proposed for the preferred alternatives.

Land and Submerged Land Ownership and Use

Current Health and Historical Context. Prior to WWII, the land use on Tinian was primarily agricultural with sugar cane being the predominant crop. During WWII, the island was transformed into a military base by the Japanese and the local population was relocated off island and later the U.S. expanded the military base. After WWII, the population gradually returned to Tinian. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. Military leasing of land began in 1975; some lands were ceded back to the CNMI but generally the acreage of federally-controlled land and submerged land has remained constant. In the 1990s, there was a tuna trans-shipment industry on the island. Cattle grazing and crop production have occurred on-island since WWII and continue today. There is interest in improving the agricultural productivity in the future and the casino may be closing. The land uses on non-federally controlled land are managed by the CNMI government. The Department of Public Lands is required to designate Tinian public lands for homestead villages, and there are other proposals to create additional homestead villages. A master plan is currently being prepared for Tinian so that planned land uses are consistent with community values and zoning requirements.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in significant for impacts on agricultural land use, and less than significant impacts on land ownership/management (Section 3.3.7 and Volume 3, Section 8.1). The land use impacts are assumed to occur over the long-term during the operations phase of the projects; therefore, no construction-phase impacts are identified. There would be no impact to the acreage of federally-controlled land and submerged land. Agricultural permits that are located within the proposed

SDZ would be terminated, causing a less than significant impact to land ownership, but a significant impact to agricultural land use. The decrease in public access to the MLA is an adverse land use impact, but it is considered less than significant because it is within the authority of the federal government to restrict access during training events for public safety. In addition, access to the northern portion of the island would be provided via 8th Avenue during training, and unlimited access to the training ranges SDZs would be permitted during non-training periods.

Reasonably Foreseeable Actions that Affect Land and Submerged Land use. 18 reasonably foreseeable future actions have the potential to affect land use on Tinian (Table 4.3-5). These projects include the establishment of two new resorts (T-16 and T-17), a new casino (T-23), and the utilization of existing federal lands for additional training ranges by the USMC. The Marine Corps training complex projects (T-2 through T10, and T-12) would further restrict access to the MLA and result in termination of additional agricultural permits, representing an impact on recreational and agricultural land use. Many of the development projects listed that are located on non-federally controlled land are not consistent with the designated agricultural land use areas on Tinian, including the resort developments (T-17, T-23). None of the projects would result in an addition of federally-controlled land or a change in use of submerged land area.

Potential Cumulative Impacts. The preferred alternatives, in combination with past, present, and reasonably foreseeable future actions identified above would result in a substantial cumulative impact on land use on Tinian, primarily from the loss of land for agriculture and recreational activities. The degree of additive impact resulting from the preferred alternatives is considered to be strong (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to land and submerged land use are proposed for the preferred alternatives.

Recreational Resources

Current Health and Historical Context. There is little detailed data on historical recreational resource uses on Tinian. The island has struggled for decades to promote tourism activity, with one of the greatest challenges being its isolation from major population centers. As stated above, immediately following WWII, Tinian's population shrank to the hundreds and the island has slowly been re-populated and re-developed over the past 60 years. The human population increased most quickly following the agreement with the U.S. to become the CNMI in 1976 and reached a total of 3,540 by the time of the 2000 U.S. Census. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. Most establishments catering to the community and tourism activities are in the coastal San Jose village to the southwest. Much of Tinian's coastline consists of precipitous cliffs; however, there are pockets of cove and beach areas. Notable recreational resources include trails, historic and cultural attractions, scenic points, and SCUBA diving (Volume 3, Section 9.1.2). Human and natural factors, such as typhoons, coral bleaching, illegal harvesting of coral and fish, non-point source pollution, and insufficient funding for resource management have adversely impacted Tinian's recreational resources in the past and are anticipated to remain challenges to Tinian's recreational resources in the future. No present projects currently under construction are anticipated to contribute to a cumulative impact to Tinian's recreational resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts to Tinian's recreational resources (Section 3.3.8 and Volume 3, Section 9.1). Impacts resulting from implementation of the preferred alternatives would primarily consist of changes to public access to resources and reduced recreational activities when ranges would be used. During training, tourists could be inconvenienced

when access by Broadway is denied and traffic is diverted to 8th Avenue. Additionally, although proposed structures are not located in proximity to existing recreational resources, the preferred alternatives would potentially inconvenience some tourists traveling on roads that would also be temporarily used by construction-related vehicles. These impacts are considered to potentially contribute to the declining trend in recreational resource health on Tinian.

Reasonably Foreseeable Actions that Affect Recreational Resources. 14 reasonably foreseeable actions with the potential to affect recreational resources were identified (Table 4.3-5): 1,500/3,000 Man Base Camp, Phase 2 (T-2), Ammunition Storage (T-3), Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), Stationary Target Range (T-10), Waterfront Upgrades (T-11), Infrastructure Upgrades (T-12), Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), and Neo Goldwings Paradise Casino (T-23). In particular, the Marine Corps training range complex projects are anticipated to have an adverse impact by changing public access to recreational resources and reducing recreational activities when the ranges are in use. The two resort projects (T-16 and T-17) and casino (T-23) are expected to have a generally positive impact on recreational resources by expanding recreational opportunities available on the island.

Potential Cumulative Impacts. There would be an additive impact on recreational resources from the preferred alternatives and the additional projects identified above. The reasonably foreseeable future resort and casino projects would provide recreational opportunities, representing a beneficial impact. The Marine Corps training projects would have an adverse impact on recreational resources because there would be limited access to the MLA, where many of the recreational resources are located. The degree of additive impact (beneficial and adverse) resulting from the preferred alternatives, in combination with past, present, and reasonably foreseeable future actions could be strong and contribute to the declining trend in recreational resource health on Tinian (Table 4.3-5). Other factors unrelated to the project, such as coral bleaching, illegal harvesting of coral and fish, and non-point source pollution, are anticipated to continue adversely impacting the island's recreational resources.

Need for Mitigation. No mitigation measures to avoid or reduce impacts to recreational resources are proposed for the preferred alternatives.

Terrestrial Biological Resources

Current Health and Historical Context. Existing human-induced stressors (e.g., non-native, invasive plants, animals and diseases, wildfires, and poaching) that degrade habitat quality contribute to the trend of declining terrestrial biological resources on Tinian. Heavy disturbance of native forests began in the 18th century when the Spaniards used Tinian as a supply island for Guam, and maintained large herds of cattle and other ungulates on the island (Fosberg 1960). In 1926, a Japanese company leased the entire island and cleared additional forested lands for sugarcane production, cultivating approximately 80% of the island's total arable land. During WWII, sugarcane plantations and most of the remaining native vegetation were destroyed by military campaigns and construction (Baker 1946). After the war, the U.S. may have seeded the island (similar to Guam) with tangantangan, a rapidly growing tree that is not native to the Marianas, in order to slow erosion resulting from plant cover loss. Currently, the vegetation on Tinian is highly disturbed, with tangantangan thickets being an abundant habitat type. Based on the most recent vegetation mapping, it is estimated that only 2.6% of the island is still dominated by native limestone vegetation.

Non-native animal species introduced by humans over time have contributed to the ecological decline of Tinian and have spurred the tightening of restrictions and monitoring of shipments to the island, particularly from Guam where BTS have decimated the island's bird populations and inflicted enormous ecological damage (see discussion of BTS above for cumulative impacts on Guam). Introduced animal species on Tinian include, but are not limited to rats, mice, shrews, cats, dogs, monitor lizards, marine toads, mangrove crabs, cattle, goats and other domesticated animals. Potentially most significant, eight unconfirmed sightings of BTS have been reported on Tinian since 1990, with three sightings reported in 2003. If BTS became established on Tinian, impacts to Tinian's ecology are anticipated to be similar to the impacts of BTS on Guam (Volume 3, Section 10.1.2.3).

The Tinian monarch, an endemic species, was federally delisted in 2004 and delisted by the CNMI government in 2009. Native tree species are preferred monarch nesting sites. The population of this species may be in decline (USFWS 2009). The monarch currently inhabits approximately 62% of the land area on Tinian, of which approximately 70% is secondary and tangantangan vegetation, and less than 3% is native limestone forest.

Three surveys conducted between 1982 and 2008 indicate mixed results for bird population trends. During that time period, the reported abundance of collared kingfisher, white-throated ground-dove, rufous fantail, Micronesian starling, and yellow bittern increased while the abundance of Tinian monarch, Mariana fruit dove, and Micronesian honeyeater decreased (Volume 3, Section 10.1.2.2). The Micronesian gecko is endemic to Micronesia, is native to Tinian, and is the only CNMI-listed gecko in the CNMI. It was believed to be extirpated from Tinian after 1946, but was again collected in 2003, was sighted in 2007, and collected (a single specimen only) in limestone forest during 2008 studies (Volume 3, Section 10.1.2.4).

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's terrestrial biological resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternative would individually result in impacts to Tinian's terrestrial biological resources, particularly to wildlife and special-status species, and these impacts are anticipated to also contribute to cumulative impacts on Tinian. Under the preferred alternative, Tinian monarch habitat would be removed and approximately 1% of the Tinian monarch population would be impacted. Loss of habitat would also impact other native birds. As no primary limestone forest would be removed, the impact to vegetation is assessed as less than significant. However, indirect significant impacts could result from termination of existing grazing leases and the relocation of grazing animals to other locations on Tinian (Section 3.3.9 and Volume 3, Section 10.2).

Reasonably Foreseeable Actions that Affect the Resource. All 19 of the reasonably foreseeable future actions identified in Table 4.3-5 have the potential to affect terrestrial biological resources because each project involves ground disturbances that may result in both temporary and permanent habitat loss. There is insufficient detail on each project site to determine if the areas are already disturbed, and the assumption is habitat would be lost at most project sites.

Potential Cumulative Impacts. Anticipated impacts to terrestrial biological resources with implementation of the preferred alternative are adverse but are not considered significant and would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5). The preferred alternative would contribute, primarily through a loss of habitat, to the trend of

degradation of terrestrial biological resources on Tinian, while other natural and human factors unrelated to the project would continue to adversely impact biological resources.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to terrestrial biological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Marine Biological Resources

Current Health and Historical Context. Although not well-documented specifically for Tinian, anthropogenic stressors to marine biological resources that are known to have increased locally and globally are likely to have also increased on Tinian's marine biological resources over time. These stressors generally coincide with human population growth and include overfishing, increased pollutants released directly to the marine environment, or indirectly from land, point and non-point source discharges of stormwater and wastewater treatment plant outfalls, invasive species, recreational activities, and introductions of diseases.

Impacts to the island's surrounding marine biological resources during WWII were substantial. As indicated above, during WWII Tinian was briefly home to the largest airfield in the world and a human population of approximately 150,000 military personnel. Over 112 million cubic yards of coral were used for fill, primarily for the airfield's runways. WWII military bombings and development also likely contributed to soil runoff into the ocean, particularly resulting from widespread loss of vegetation cover across the island. Invasive species, pollutants, and pathogens may have been introduced in ballast water of marine vessels. Additional releases that may have occurred from point and non-point sources during rapid war-related construction and operations, and warfare conducted across the island, are not well-documented.

Green and hawksbill sea turtles, common bottlenose dolphin, and spinner dolphin are the special status marine species relevant to the preferred alternatives. Green sea turtles nest on Tinian beaches, but the hawksbill has not been observed nesting. Recent threats to these species from humans have included direct harvesting of eggs or adults, beach cleaning and replenishment, recreational activities, debris, incidental take from fishing, and seagrass degradation. A new non-native species of algae (*Gracilaria*) has been intentionally introduced into Tinian Harbor and an abalone species has also been introduced. Algae reproduce vegetatively and are highly competitive. Although *Gracilaria* is preferred forage by green sea turtles, fish don't seem to prefer it as forage. Organisms and pollutants released by ship ballast water are in greatest concentration within 6 km (3 nautical miles) of Tinian's coast (Volume 3, Section 11.1.4.3).

Coral health around U.S. waters has been in decline and on a global scale increased sedimentation is one of the most common and serious anthropogenic influences (Volume 3, Section 11.1.2.2). The trend in resource decline has spurred a petition to list 82 coral species as threatened and endangered under the ESA, including coral species found in waters around Tinian (Volume 2, Section 11.1.1.3). The determination to list the coral species would be dependent upon the outcome of NMFS review of information submitted. The affects of such a listing on future actions impacting waters around Tinian are not currently known and would be determined when the species are listed. INRMPs covering NAVBASE Guam and Tinian are being updated to address conservation measures for coral species.

No present projects currently under construction are anticipated to contribute to a cumulative impact to Tinian's marine biological resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts to Tinian's marine biological resources (Section 3.3.10 and Volume 3, Section 11.2). However, there is the potential from the preferred alternatives to impact the quality and quantity of the surface runoff on Tinian, which could contribute to a cumulative impact to marine biological resources in combination with past, present, and reasonably foreseeable future actions on the island. Long-term training activities may cause erosion and sedimentation that can degrade coastal waters and potentially indirectly impact nearshore marine biological resources. In addition, the preferred alternatives would increase the potential for leaks and spills of petroleum, oil, and lubrications (POL), hazardous waste, pesticides, and fertilizers. These potential impacts may indirectly and cumulatively affect the coastal waters and, in turn, the biological resources and habitats.

Reasonably Foreseeable Actions that Affect Marine Biological Resources. All 19 of the reasonably foreseeable actions have the potential to affect marine biological resources because they involve ground disturbances that may result in increased runoff into nearshore waters (Table 4.3-5). The Marine Corps training ranges (T-2 to Y-10) would likely have surface danger zones that extend into the water, but the potential impacts on marine resources would be minimal. Waterfront upgrades (T-11), resorts (T-16 and T-17), and the wastewater treatment plant (T-19) may have direct impacts on marine resources. Additionally, the two resort and casino projects would attract additional population to the island, in the form of tourists, therefore increasing stressors associated with recreation and releases into waters.

Potential Cumulative Impacts. Cumulative projects that occur in the water that would have direct impact on the marine environment include those that are located in or near surface water that connects to the ocean or in the ocean. Project and site-specific BMPs and the provisions of facility-specific SWPPPs and SPCC Plans would minimize potential impacts from facility operations, including the transportation, storage, and use of fuel on all water resources. However, all of the cumulative projects listed would result in an increase in impervious surface area and increase in erosion potential, resulting in a corresponding additive increase in stormwater runoff into coastal waters. Stormwater runoff has the potential to have elevated levels of contaminants such as sediments, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. Operations associated with the preferred alternatives and shipping traffic associated with reasonably foreseeable future actions would increase the potential for leaks and spills of POL, hazardous waste, pesticides, and fertilizers. The effects of such leaks and spills can be additive in nature. Anticipated impacts to marine biological resources during construction and operations of the preferred alternatives, although considered to be less than significant, would have a cumulative impact when combined with the past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from construction and operation of the preferred alternatives is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to marine biological resources are proposed for the preferred alternatives.

Cultural Resources

Current Health and Historical Context. Many WWII cultural sites were established on Tinian, but the war itself resulted in the loss of cultural sites. Few archaeological and architectural resources show evidence of the area's status as a colony of Spain and Germany while numerous structures and relics attest to the island's role in WWII (Volume 3, Section 12.1.1.3). The stressors on cultural resources include vandalism (intentional or unintentional), intentional and inadvertent disturbance from construction activities, and deterioration due to erosion. The trend since the conclusion of WWII is a decline in historic properties

due to the stressors listed. No present projects currently under construction are anticipated to contribute to a cumulative impact to Tinian's cultural resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternative would individually result in significant but mitigable impacts to Tinian's historic properties (Section 3.3.11 and Volume 3, Section 12.2). Impacts to archaeological resources resulting from implementation of the preferred alternative would include significant adverse direct impacts to 9 historic properties and indirect impacts to one historic property in the SDZ. These impacts could contribute to cumulative impacts to cultural resources on Tinian by furthering the declining trend in cultural resources on the island. Other factors unrelated to the project, such as vandalism and weathering, are expected to continue to adversely impact historic properties.

Reasonably Foreseeable Actions that Affect Cultural Resources. All 19 of the reasonably foreseeable actions identified in Table 4.3-5 have the potential to affect historic properties because each of the actions would involve ground disturbance.

Potential Cumulative Impacts. Implementation of the preferred alternatives, when considered in conjunction with past, present, and reasonably foreseeable future actions on Tinian would have a significant cumulative effect on h. There are hundreds of historic properties throughout Tinian. Recently completed, present, and reasonably foreseeable development would have an adverse effect on both pre-contact and post-contact sites along the coast and in the interior. Although projects would be coordinated with the CNMI HPO and mitigated in accordance with laws and regulations related to the management and preservation of cultural resources in the CNMI, loss of some historic properties, even with data recovery, cannot be completely mitigated. Disturbance or destruction of these cultural resources would further diminish the regional archaeological record, thus decreasing the potential of its overall research contribution. The significant mitigable impacts of the preferred alternatives would have a cumulative impact when combined with the past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Need for Mitigation. To mitigate these cumulative impacts, DoD would assist the CNMI SHPO with the five-year update of their Historic Preservation Plan (HPP). DoD proposes to support updates of the HPPs by providing information developed as part of DoD cultural resources investigations, updated project planning information, and logistical support for meetings with local, state, and other federal stakeholders. It is anticipated the CNMI plan will address the long term, cumulative effects of the military build-up on historic properties. In addition, mitigation to reduce cumulative impacts to historic properties may include implementing the Cultural Landscape Report for the North Field National Historic Landmark or production of a thematic synthesis.

Visual Resources

Current Health and Historical Context. Visual resources on Tinian declined due to activities at the beginning of the 20th century, with the worst point being the immediate aftermath of the WWII bombings by the U.S. to take control of the island. There has been improvement of the island's overall visual resources in the decades following WWII, but this improvement has been negatively impacted by a trend of development and abandonment of developments, along with the degradation of developments from natural events.

The visual setting of Tinian underwent dramatic visual changes in the early 20th century when intensive agriculture and WWII-related activities altered the natural and built environments of the island. In the 1920s a large-scale agricultural initiative by the Japanese resulted in the planting of sugarcane crops on

approximately 80% of the island's arable land. Not long after, the visual setting became increasingly influenced by development associated with WWII. In 1944 the entire sugarcane operation and most Japanese war-related structures were destroyed by U.S. bombings; only a denuded forest was left behind. The U.S. may have later seeded the island with tangantangan -similar to Guam- in order to slow erosion resulting from plant cover loss resulting from bombings. The island then underwent additional rapid development for military uses by the U.S. During WWII, Tinian briefly reached its largest recorded population of approximately 150,000, almost all of which were U.S. troops, and was the location of the largest WWII airfield, with six 8,500-ft long runways for B-29 bombers, in addition to repaired airstrips originally constructed by the Japanese. By 1945 a substantial portion of the northern third of the island had been graded and paved with air strips. Historical aerial views of Tinian are provided in Volume 3 of Northwest Field in 1945 (Figure 12.1-2), Northern Tinian (Figure 13.1-1), and North Field (Figure 13.1-2).

Natural revegetation and the abandonment and development of structures likely represent the most notable changes to Tinian's visual setting following WWII. Immediately following the war, Tinian's population shrank to the hundreds and the island has slowly been re-populated and re-developed over the past 60 years. Over that time period, some developments were abandoned and fell into disrepair, particularly during times of economic hardship, and new developments were constructed during times of increased economic activity. Natural disasters, such as typhoons and earthquakes, contribute to the degradation of the appearance of existing developments. A casino and several hotels serve tourists. The Dynasty Hotel and Casino development is the largest post-WWII development on the island. Some of the WWII facilities remain today as historic sites. The northern two-thirds of the island are now used for military training activities, primarily conducted by the USMC, and landing strips from WWII are still present. Since the early 1980s, vegetation cover has been documented to be returning across the island. Open fields have decreased 11.6% and secondary forest coverage increased 10.3%; however, only 2.6% of the island is still dominated by native limestone vegetation (Volume 3, Section 10.1.2.1).

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's visual resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact.

The preferred alternatives would individually result in significant and mitigable impacts to visual resources on Tinian (Section 3.3.12 and Volume 3, Section 13.2). Implementation of the preferred alternative would result in significant and mitigable impacts on views from Mount Lasso, along Broadway, and along 8th Avenue. The proposed action would contribute to the declining trend in visual resources from development. Other factors unrelated to the project, such as the effect of natural disasters on developments, would continue to adversely impact visual resources.

Reasonably Foreseeable Actions that Affect Visual Resources. All 19 reasonably foreseeable actions have the potential to affect visual resources because the actions involve increased human development, which is generally considered to degrade the natural visual setting of the island. The two new resorts, Tinian Oceanview Resort (T-16) and Matua Bay (T-17) and the Neo Goldwings Paradise Casino (T-23) would be the largest land development proposals in both area and mass, and would have an impact on visual resources and scenic viewpoints. Village homesteads, infrastructure improvements and minor facilities would have less impact on the visual landscape. Although not on the cumulative project list, the closure of the Dynasty Hotel could result in abandonment of Tinian's largest most recent development, which would degrade the visual setting of the surrounding area.

Potential Cumulative Impacts. All of the cumulative projects would likely remove some open space and result in an adverse impact on visual resources, contributing to the decline of Tinian's natural visual

setting since the beginning of the 20th century. If all the Marine Corps ranges are constructed, then there would likely be no public access to the MLA and the scenic viewpoints located there. Anticipated long-term and temporary impacts to visual resources, although considered to be less than significant, would have a cumulative impact when combined with the past, present, and reasonably foreseeable future actions on the island identified above. The degree of additive impact resulting from the preferred alternatives is considered to be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to visual resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Marine Transportation

Current Health and Historical Context. The Inner Tinian Harbor was built in 1944 by U.S. Navy Engineers. Marine transportation to and from Tinian was at its peak during WWII when approximately 150,000 U.S. military personnel briefly populated the island. Immediately following WWII and the departure of U.S. troops, marine transportation to and from the island likely almost stopped altogether and resulted in the total island population dropping to several hundred people. The harbor was a center for fish transshipment in the 1990s, an operation that ended with the bankruptcy of the owner of the tuna transshipment and freezer facility later that decade (Volume 3, Section 16.1.1.2). The number of vessels (military and non-military) visiting Tinian Harbor varies with the economy. The Tinian Dynasty Hotel & Casino (item T-23 on Table 4.3-5) operates Tinian's shipping and the ferry service between Saipan and Tinian. Currently, there are only one to two trips per day, which is a decrease over the peak six trips per day in the 1970s. Marine transportation to and from Tinian is expected to decline, or remain at about the current level, unless there are increases in tourism, military mission, or other industry.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's marine transportation resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in a less than significant impact to marine transportation resources on Tinian (Section 3.3.13 and Volume 3, Section 14.2). For the proposed monthly Marine training, if the training equipment is moved by barge, one single barge would be able to carry the equipment necessary to support the estimated 200 to 400 Marine training evolution. Tinian Harbor currently accommodates this type of marine vessel activity on a regular basis. The addition of one barge per month would result in a less than significant impact to marine transportation in Tinian Harbor.

Reasonably Foreseeable Actions that Affect Marine Transportation. 13 reasonably foreseeable actions with the potential to affect marine transportation were identified (Table 4.3-5) including the Marine Corps range complex projects (T-2 through T-11), two new resorts, Tinian Oceanview Resort (T-16) and Matua Bay resort and Golf Course (T-17), and the Neo Goldwings Paradise Casino (T-23). These projects would primarily affect marine transportation temporarily during construction, when materials and equipment would arrive in Tinian Harbor. Additional longer term impacts would result from movements of people and supplies to support the additional population, primarily tourists, associated with the reasonably foreseeable actions.

Potential Cumulative Impacts. The military training complex projects (T-2 through T-10) are not programmed, but the concept was to develop a training range complex on Tinian that would include as many of the ranges listed as practical. Military forces and equipment would arrive largely by sea. Waterfront upgrades (T-11) would provide the improvements required to increase the wharf capacity. The

resort and casino projects would indirectly impact marine transportation by increasing the need for goods and services that would arrive by ship and attracting tourists who could opt to arrive by ship rather than by air. If these cumulative projects were to operate concurrently, the port could exceed capacity. Anticipated impacts to marine transportation, although considered to be less than significant, would have a remote possibility of cumulatively impacting Tinian's marine transportation resources when combined with the past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to marine transportation are proposed for the preferred alternatives.

Utilities and Roadways

Current Health and Historical Context. Most of Tinian's roads were paved during WWII or shortly thereafter when the island was under U.S. military control. A new power plant was built in 1998 and power and water meet the existing and near future demand (but not all reasonably foreseeable projects have been considered). However, outdated and inefficient power equipment has been identified as resulting in high utility rates that drain consumer expenditures from other normal activity (Volume 3, Section 16.1.1.1). Wastewater management has historically and currently relied on septic systems and leachfields, with the exception of the Dynasty Hotel, which has a tertiary treatment system. There are plans to construct a centralized wastewater treatment plant co-located with a proposed solid waste landfill (cumulative project T-18). The municipal solid waste disposal site is operated as an open burning dump; therefore, it does not comply with the Resource Conservation and Recovery Act, Subtitle D, regulations for municipal solid waste landfills (40 Code of Federal Regulations Part 258). Power and wastewater are anticipated to continue to meet the current trend in demand, but the wastewater and solid waste management systems are inadequate.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's utilities and roadways (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in a less than significant impact to wastewater treatment and potable water systems, and no impact to solid waste and power, on Tinian (Section 3.3.14 and Volume 3, Sections 14.2 and 15.2). The proposed action would contribute to deteriorating infrastructure. The additional traffic proposed by transporting equipment and ammunition from the airport to the ranges would not exceed the existing capacity of the roadways and the impact would be less than significant.

Reasonably Foreseeable Actions that Affect Roadways and Utilities. 16 reasonably foreseeable actions with potential to affect utilities were identified, and eight projects affecting off-base roadways were identified. These include municipal projects for a new wastewater treatment plant (T-19) and landfill (T-18), two new resorts (Matua Bay and Tinian Oceanview Resort) and a casino (Neo Goldwings Paradise), and the Marine Corps training range complex (T-2 through T-10; Table 4.3-5). The new resorts and casino are expected to have the greatest impact on utilities and roadways by increasing the tourist population, and thus demand, on infrastructure. The Marine Corps training range complex includes a proposal for infrastructure upgrades (T-12) to meet the additional military demand on utilities. Municipal projects for a new wastewater treatment plant (T-19) and landfill (T-18) are beneficial projects. The off-base roadway improvements would be required to support the cumulative projects.

Potential Cumulative Impacts. All reasonably foreseeable future development projects would have some cumulative impact on utility and roadway infrastructure by increasing demand and deterioration,

respectively; but population growth-inducing projects would have the greatest impact, including the new resorts (T-16 and T-17) and casino (T-23). Anticipated impacts to utilities and roadways from the preferred alternatives, although considered to be insignificant, would have a cumulative impact when combined with past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to utilities and roadways are proposed for the preferred alternatives.

Socioeconomics and General Services

Current Socioeconomic and Historical Context. Refer to Volume 3, Section 16.2 for more detailed information regarding Tinian's socioeconomic history. Tinian's population was temporarily at its highest during WWII, when the island was populated by 150,000 U.S. military personnel and contained the largest airfield during WWII. Immediately following WWII, Tinian's population shrank to several hundred and the island has slowly been re-populated and re-developed over the past 60 years. The population increased most quickly following the agreement with the U.S. to become the CNMI in 1976 and reached a population of 3,540 by the time of the 2000 U.S. Census. By 2005 the population had declined to 2,829.

During the Spanish Period (1668-1899) the economy was based on agriculture, cattle and farm crops. In the 1920s, the Japanese intensively cultivated sugar cane on approximately 80% of Tinian's arable land (Volume 3, Section 12.1.1.3). With the return of the population after WWII, subsistence farming resumed and eventually allowing cattle and crop production for export to Saipan. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. In the 1990s, there was a tuna transshipment industry on the island. There is interest in improving the agricultural productivity in the future, but the casino may be closing, resulting in an adverse impact to the island's economy. Tinian's economy is currently dominated by the casino, a small tourism trade centered on the island's role in WWII, and marine activities such as diving.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's socioeconomics and general services (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant economic impacts to Tinian due to the termination of agricultural leases and loss of access to wild chili plants at the proposed training areas and associated SDZs. There would be slight beneficial impacts to on-island employment during construction. The preferred alternatives may require the addition of a police officer during construction (Section 3.3.15 and Volume 3, Sections 16.2).

Reasonably Foreseeable Actions that Affect Socioeconomic Resources. Eighteen (18) reasonably foreseeable actions with the potential to beneficially impact socioeconomics were identified (Table 4.3-5), including two new resorts and a casino: Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), and the Neo Goldwings Paradise Casino (T-23). Beneficial socioeconomic impacts would largely result from increased employment and economic activity associated with these development projects. The quarry projects (T-15 and T-27) and landfill (T-18) could also have beneficial impacts on the economy and infrastructure of the island. Beneficial socioeconomic impacts could also result from the waterfront (T-11) and infrastructure upgrades (T-12). The Marine Corps projects (T-2 through T-10), if developed concurrently as planned, to create a training complex, would have an adverse impact on the socioeconomics because there would be no access to key tourist sites and the agricultural leases in the

LBA are likely to be terminated. There would be some full time employment on-island to support the range complex.

Potential Cumulative Impacts. Anticipated impacts to socioeconomics resulting from the preferred alternatives are significant and would have a cumulative impact when combined with the past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce socioeconomic and general services impacts are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Hazardous Materials and Waste

Current Health and Historical Context. There are few historical data on hazardous material, toxic substance, and hazardous waste handling, collectively referred to as hazardous substances handling, on Tinian. World War II established a high baseline of environmental releases; but overall, the trend in hazardous substance use is associated with increases in population and industrial activity on the island. During the 1970s, there were numerous local and federal environmental regulations enacted to protect human health and the environment and to closely control and regulate the transport, storage, use and disposal of hazardous substances. While the trend in use of hazardous substances is expected to increase over time, regulations in place minimize the risk of release to the environment as well as to human health. This trend would continue at a more gradual rate of increase. The impacts are largely related to human activities, but natural events, such as typhoons and earthquakes, can result in inadvertent releases of regulated hazardous substances. The CNMI Department of Environmental Quality (DEQ) Hazardous and Solid Waste Management Branch regulates hazardous substances generated within the CNMI. In 1984, the CNMI DEQ adopted the federal hazardous waste regulations under RCRA and the hazardous and solid waste amendments. The CNMI does not have hazardous waste regulations that are more stringent than USEPA regulations.

There are three hazardous waste sites being managed on Tinian that overlap or are near the proposed project footprint (Sites L-4, L-7, and L-12). These sites are shown on Figure 17.2-1 and discussed on Table 17.1-1 in Volume 3. When DoD hazardous waste is generated on Tinian it is transported to DRMO facilities on Guam in accordance with DOT regulations. Once on Guam, the DRMO arranges for the subsequent transfer and disposal of the hazardous waste off-island at licensed hazardous waste facilities. In the case of asbestos containing materials, these materials are disposed of at federal facilities on Guam.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's hazardous substances (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts related to regulated hazardous substances because the transportation, storage, handling, use, or disposal of these substances would occur in accordance with strict federal and local regulations in a "cradle to grave" comprehensive manner (Section 3.3.16 and Volume 3, Section 17.2).

Reasonably Foreseeable Actions that Affect Hazardous Substances. All 19 of the reasonably foreseeable future actions could potentially involve transportation, storage, handling, use, or disposal of hazardous substances during construction and operation (Table 4.3-5). The Marine Corps training range complex

projects (T-2 through T-12) and possibly the new quarries (T-15 and T-27) would use explosives. The proposed resorts (T-16 and T-17) and casino (T-23) would use hazardous substances to maintain the recreational activities, landscaping, air conditioning, wastewater, and other engineering support functions. The homestead villages are also likely to handle minor amounts of hazardous substances.

Potential Cumulative Impacts. Anticipated impacts from the preferred alternative are considered to be less than significant when combined with the past, present, and reasonably foreseeable actions on Tinian identified above. The degree of cumulative impact resulting from the preferred alternative is considered to be low (Table 4.3-5) because existing environmental laws and regulations and associated BMPs and SOPs require that these hazardous substances are handled, used, and disposed of in a comprehensive “cradle to grave” manner that inherently reduces the overall risk to human health and the environment.

This assessment is based on the assumption that existing hazardous materials, toxic substances, and hazardous waste transportation, handling, storage, use, and disposal procedures and protocols are properly implemented and modified as appropriate to address the increased hazardous substances demand. Most of the cumulative projects would increase the management of regulated hazardous substances on Tinian. However, these impacts would not contribute appreciably to the increasing trend in volume of regulated hazardous substances already being handled and managed on Tinian.

Need for Mitigation. No mitigation measures to avoid or reduce hazardous materials impacts are proposed for the preferred alternatives.

Public Health and Safety

Current Health and Historical Context. The trends in public health and safety on Tinian are a function of changes in population and operation, or industries that involve dangerous materials (e.g., hazardous substances, live ammunition, electromagnetic energy, radiological substances). WWII is the most damaging recent human-caused event in Tinian’s history impacting human health and safety. The socioeconomics section describes changes in population over time. From 1970 to 2000, the population on Tinian increased, but then declined in subsequent years. Occupational and traffic accidents, along with increases in incidents of disease, have gradually increased with population. Aircraft mishaps are associated with economics, and are cyclical. The Tinian health and public services are sub-standard due to lack of funding; this trend is likely to continue in the absence of economic development.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts to public health and safety for the following reasons (Section 3.3.17 and Volume 3, Section 18.2):

- The potential increase in noise and air quality emissions would be less than significant; therefore, overall potential impacts to human health and safety would be less than significant.
- Health care professionals and public service personnel are anticipated to maintain existing service conditions; therefore, no impact to health care, police, or fire service is anticipated.
- No impact to public health and safety are anticipated from water quality concerns and management of hazardous substances.
- Excavation for building foundations, roads, underground utilities, and other infrastructure could encounter unexploded military munitions; however, qualified UXO personnel would perform surveys to identify and remove potential MEC items prior to the initiation of ground-disturbing activities. Additionally, UXO supervision would be provided during earth moving activities and MEC awareness training would be provided to construction workers.

The increase in construction and ground disturbing activities associated with the preferred alternatives would increase the risk of uncovering UXO; live ammunition is largely a military activity and changes with the military mission.

Reasonably Foreseeable Actions that Affect Public Health and Safety. All 19 of the reasonably foreseeable future actions could potentially impact public health and safety on Tinian because each action would induce an increase in Tinian population (resorts and casino) or they involve industrial (quarries, landfill wastewater treatment plants) or other potentially dangerous activities (military training, construction; Table 4.3-5). All projects that involve excavation could encounter unexploded military munitions during construction, but only the quarry (T-15, T-27) and landfill (T-18) projects would be likely to encounter UXO during operations. The two new planned resorts and casino (T-16, T-17, T-23) would provide employment that may lead to increases in the Tinian population with proportionate increases in notifiable disease and accidents, and pressure on public services, such as fire and police departments. The Marine Corps training range complex would impact noise levels and fire protection service, but the permanent population would be limited to maintenance staff.

Potential Cumulative Impacts. Anticipated impacts to public health resulting from the preferred alternatives, although considered to be less than significant, would have a cumulative impact when combined with past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low because impacts are primarily related to increases in population, and the proposed action would have a minimal impact on the population trend on the island (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce public health and safety impacts are proposed for the preferred alternatives.

Environmental Justice and the Protection of Children

Current Health and Historical Context. Environmental Justice is a relatively new concept; it was introduced in 1994 by Executive Order 12898 and applies to federal actions. Tinian's population, when compared to a village on Guam with a similar demographic profile (Dededo), and the U.S. population as a whole, has a high percentage of racial minorities and households living in poverty. The trend is expected to remain the same or possibly worsen in the absence of economic development on Tinian.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in significant impacts associated with environmental justice and protection of children (Section 3.3.18 and Volume 3, Section 19.2). The preferred alternatives would have disproportionate impacts to racial minorities on the island of Tinian in terms of recreational and cultural resources, socioeconomics, and terrestrial biological resources. People with low incomes relative to the average U.S. population are likely to be adversely affected by restricted access to the currently leased areas of the island. Significant impacts could occur to Tinian ranchers and locals who pick and sell wild chili-peppers from the leased land; they could be restricted from accessing the land needed to perform their work.

Reasonably Foreseeable Actions that Affect Environmental Justice and the Protection of Children. All 19 of the reasonably foreseeable projects listed in Table 4.3-5 could potentially have an environmental justice impact. Some projects provide economic opportunities, such as new resorts (T-16 and T-17) and the casino (T-23). The infrastructure improvement projects (waterfront improvements [T-1] and landfill [T-18]) would also have a beneficial cumulative impact. Homestead Villages (t-28) would have a beneficial impact to disadvantaged populations. The Marine Corps training range complex (T-2 through T-10) projects would have an overall adverse impact on the Tinian population (Table 4.3-5). Increases in

population related to military mission changes (T-2 through T-10) could impact disadvantaged populations through increases in traffic and noise, and additional limitations on access to recreational and cultural sites in the MLA. Improvements to infrastructure (T-18), public services, and homestead villages (T-28) are likely to have a beneficial impact on disadvantaged populations. Projects that create jobs, such as new hotels (T-16, T-17, T-23) could have a cumulative beneficial impact on disadvantaged populations through employment opportunities. This advantage may be offset by increases in traffic with a potential adverse impact on disadvantaged populations.

Potential Cumulative Impacts. Anticipated impacts to environmental justice and the protection of children resulting from the preferred alternatives are considered to be significant and would have a cumulative impact when combined with the past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to environmental justice are listed in Table 2.2-1. These proposed mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

4.4 CLIMATE CHANGE AND GLOBAL WARMING

Greenhouse gases (GHGs) are compounds that contribute to the greenhouse effect. The greenhouse effect is a natural phenomenon where these gases trap heat within the surface-troposphere (lowest portion of the earth's atmosphere) system, causing heating (radiative forcing) at the surface of the earth. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities (USEPA 2009a). The climate change associated with this global warming is predicted to produce negative environmental, economic, and social consequences across the globe. The average global temperature since 1900 has risen by 1.5°F and is predicted to increase by up to 11.5°F by 2100 (Karl et al. 2009).

Predictions of long-term negative environmental impacts due to global warming include sea level rise, changing weather patterns with increases in the severity of storms and droughts, changes to local and regional ecosystems including the potential loss of species, shrinking glaciers and sea ice, thawing permafrost, a longer growing season, and shifts in plant and animal ranges.

Climate change is likely to negatively impact Pacific islands, including Guam and Tinian. The degree to which climate change and variability would affect Guam and Tinian depends upon a variety of factors, including the geology, area, height above sea level, extent of reef formation, and the size of the freshwater aquifer (USEPA 2009c). Guam, as other small islands, is considered extremely vulnerable to climate change because extreme events can have major impacts on small islands (USEPA 2009c). The climate studies conducted are global in focus or centered on particular regions or the earth. However, studies specific to Guam are not currently available. The Water and Environmental Research Institute plans to complete studies specific to Guam. Studies specific to Guam would presumably be more relevant to predictions of future impacts on the NGLA because the characteristics and hydrogeology of the aquifer can be considered.

In 2007, the U.S. generated about 7,150 Tg CO₂ Eq (USEPA 2009b). This total includes emissions from Guam and Tinian; after 2002 the United Nations no longer reports energy statistics for Guam separately (Marland et al. 2008) and emissions from Tinian were never reported separately. Since the U.S. inventory does not provide a baseline for Guam, using the U.S. baseline condition for a comparison is considered appropriate for current conditions. The 2007 inventory data (USEPA 2009b) show that CO₂, CH₄, and

N₂O contributed from fossil fuel combustion processes from mobile and stationary sources include approximately:

- 5,736 teragrams (Tg) (or million metric tons) of CO₂
- 9 Tg CH₄
- 45 Tg N₂O

This section begins by providing the background and regulatory framework for GHGs (Section 4.4.1). It then provides a quantitative evaluation of the increase in GHG emissions based on the preferred alternatives and cumulative GHG air quality impacts (Section 4.4.2). The remaining section provides a qualitative discussion on climate change adaptation (Section 4.4.3).

4.4.1 Background and Regulatory Framework

GHGs trap heat in the atmosphere by absorbing infrared radiation. These emissions occur from both natural processes and human activities. The primary long-lived GHGs directly emitted by human activities are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). Although CO₂, CH₄, and N₂O occur naturally in the atmosphere, their concentrations have increased by 38, 149, 23 percent, respectively, from the preindustrial era (1750) to 2007/2008 (USEPA 2009a). Further information on GHGs is provided in Volume 2, Section 5.1.1.6.

Federal agencies address emissions of GHGs by reporting and meeting reductions mandated in laws, EOs and policies. The most recent of these are EOs 13514 federal Leadership in Environmental, Energy, and Economic Performance of October 5, 2009 and EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management of January 26, 2007.

EO 13514 shifts the way the government operates by: 1) establishing GHGs as the integrating metric for tracking progress in federal sustainability; 2) requiring a deliberative planning process; and 3) linking to budget allocations and OMB scorecards to ensure goal achievement.

The targets for reducing GHG emissions discussed in EO 13514 for Scope 1 - direct greenhouse gas emissions from sources that are owned or controlled by a federal agency - and Scope 2 - direct greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency - have been set for DoD at a 34% reduction of GHG from the 2008 baseline by 2020. Scope 3 targets - greenhouse gas emissions from sources not owned or directly controlled by a Federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting - were set at a 13.5% reduction. The EO 13514 Strategic Sustainability Performance Plan (SSPP) was submitted to CEQ on June 2, 2010 and contains a guide for meeting these goals.

GHGs for the proposed action would be reduced by incorporating the Leadership in Energy and Environmental Design (LEED) program into the proposed action. LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO₂ emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. There are four levels of certification in LEED and Navy/Marine Corps policy support and facilitate silver certification for bases. Buildings constructed for actions associated with the proposed action would qualify for LEED silver. Low impact land development (LID) would also be used during design to save water and energy to meet the targets

established under EO 13514.

EO 13423 established a policy that federal agencies conduct their environmental, transportation, and energy-related activities in support of their respective missions in an environmentally economic way. It included a goal of improving energy efficiency and reducing GHG emissions of the agency, through reduction of energy intensity by 3% annually through the end of fiscal year 2015, or 30% by the end of fiscal year 2015, relative to the baseline of the agency's energy use in fiscal year 2003.

CEQ Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions (CEQ, 2010) states that *"if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO₂-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public."* These recommendations are consistent with the Mandatory Reporting of Greenhouse Gases rule (40 CFR Parts 86, 87, 89 et al.) effective December 29, 2009, applies to fossil fuel suppliers and industrial gas suppliers, direct greenhouse gas emitters and manufacturers of heavy-duty and off-road vehicles and engines. Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric TPY of GHG emissions are required to submit annual reports to the USEPA. The Mandatory Reporting rule for the proposed action applies to DoD stationary sources. GHG emissions for GPA Power and Layon Landfill sources would require separate annual reports to the USEPA. Construction emissions are relatively short in nature, and as such, are not listed in these rules, which were designed primarily for tracking and regulating stationary sources. The rule provides accurate and timely data to inform future climate change policies and programs, but does not require control of GHGs. Monitoring begins January 1, 2010 and the first electronic reports are due March 31, 2011.

On May 13, 2010 the USEPA finalized the Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule to address GHG under stationary sources. This final rule "tailors" the requirements of these CAA permitting programs to limit which facilities would be required to obtain PSD and Title V permits. The USEPA is phasing in the CAA permitting requirements for GHGs in two initial steps. The first step will occur from January 2, 2011 – June 30, 2011 and covers only sources currently subject to the PSD permitting program (i.e., those that are newly-constructed or modified in a way that significantly increases emissions of a pollutant other than GHGs) that would be subject to permitting requirements for their GHG emissions under PSD. For these projects, only GHG increases of 75,000 TPY or more of total GHG, on a CO₂eq basis, would need to determine the Best Available Control Technology (BACT) for their GHG emissions. Similarly for the operating permit program, only sources currently subject to the program (i.e., newly constructed or existing major sources for a pollutant other than GHGs) would be subject to Title V requirements for GHG. During the first step, no sources would be subject to CAA permitting requirements due solely to GHG emissions. Step 2 will occur from July 1, 2011 to June 30, 2013 and build on Step 1. In this phase, PSD permitting requirements will cover for the first time new construction projects that emit GHG emissions of at least 100,000 TPY, even if they do not exceed the permitting thresholds for any other pollutant. Modifications at existing facilities that increase GHG emissions by at least 75,000 TPY will be subject to permitting requirements, even if they do not significantly increase emissions of any other pollutant. In Step 2, operating permit requirements will, for the first time, apply to sources based on their GHG emissions even if they would not apply based on emissions of any other pollutant. Facilities that emit at least 100,000 TPY CO₂eq will be subject to Title V permitting requirements. The emissions with potential to result from the proposed action at affected existing stationary sources discussed in this EIS are below the permitting thresholds covered by the

Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule, as shown in Table 7.2-5 of Volume 6.

4.4.2 Proposed Action and Cumulative GHG Impacts

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. In keeping with CEQ guidance, the focus of the cumulative air quality GHG analysis is on GHG emissions that are affected by the proposed action and its significance on climate change as compared to the no action alternative. The impact of proposed GHG emissions as they pertain to climate change is discussed in the context of the combined impacts as compared to the total amount of GHG emissions that the U.S. produces.

To estimate total GHG emissions, each GHG is assigned a global warming potential (GWP). The GWP is the ability of a gas or aerosol to trap heat in the atmosphere. The GWP rating system is standardized to CO₂, which has a value of one. For example, CH₄ has a GWP of 21, which means that it has a global warming effect 21 times greater than CO₂ on an equal-mass basis (Intergovernmental Panel on Climate Change [IPCC] 2007). To simplify GHG analyses, total GHG emissions from a source are often expressed as CO₂ equivalents (CO₂ Eq). The CO₂ Eq is calculated by multiplying the emissions of each GHG by its GWP and adding the results together to produce a single, combined emission rate representing all GHGs. While CH₄ and N₂O have much higher GWPs than CO₂, CO₂ is emitted in much higher quantities, so that it is the overwhelming contributor to CO₂ Eq from both natural processes and human activities. GWP-weighted emissions are presented in terms of equivalent emissions of CO₂, using units of teragrams (1 million metric tons, or 1 billion kilograms) of carbon dioxide equivalents (Tg CO₂ Eq).

The total GHG emissions in terms of CO₂ Eq for the preferred alternatives were predicted for the following three source categories:

- Mobile fossil fuel combustion sources including construction equipment,
- Stationary fossil fuel combustion sources, and
- Solid waste landfill.

Among the primary long-lived GHGs directly emitted by human activities, only CH₄ and N₂O have the potential to be produced from fossil fuel combustion sources (USEPA 2009b). CH₄ could also be produced during landfill operations in addition to production from combustion sources.

Although the USEPA final rule on Mandatory Reporting of Greenhouse Gases (October 30, 2009) provides various methodologies to estimate CO₂ equivalencies based on fuel test and consumption data, this rule is essentially designed for specific stationary facility reporting purposes and cannot be directly implemented in this EIS to address various source categories. Most of the USEPA tools that are widely used for NEPA study purposes (e.g., AP-42, NONROAD [USEPA 2008] and Mobile6 emissions factor models [USEPA 2003]) do not provide emission factors for CO₂ Eq other than for CO₂. Therefore, given the lack of regulatory tools to provide reasonable estimates of CO₂ Eq, this report utilizes the inventory ratios among CO₂, CH₄ and N₂O summarized in the most recent USEPA inventory report (USEPA 2009b) as the basis for approximating and prorating CH₄ and N₂O emission levels.

The 2007 inventory data (USEPA 2009b) show that CO₂, CH₄, and N₂O contributed from fossil fuel combustion processes from mobile and stationary sources include approximately:

- 5,736 teragrams (Tg) (or million metric tons) of CO₂
- 9 Tg CH₄

- 45 Tg N₂O

The ratios among CO₂, CH₄ and N₂O based on the above inventory levels were used to predict CH₄ and N₂O equivalencies from mobile and stationary combustion sources as follows:

- CH₄ = (tons per year [TPY] of CO₂) * (9 / 5,736) = 0.16% TPY of CO₂.
- N₂O = (TPY of CO₂) * (45 / 5,736) = 0.78% TPY of CO₂.

Based on these ratios, the GHG contribution from CH₄ and N₂O is less than 1% of the total CO₂ equivalency for fossil fuel combustion sources. CH₄ emissions from the landfill were predicted directly using the Landfill Gas Emissions Model (LandGEM) (USEPA 2005), as described in Volume 9, Section 2.5.

Table 4.4-1 provides the CO₂ Eq from combustions sources and the landfill under the preferred alternatives (Volume 7, Section 3.3.4) under both construction and operational years.

Table 4.4-1. Preferred Alternatives CO₂ Emissions Equivalents (TPY)

Year	Combustion from Construction	Combustion from Operation	Landfill		Total
	CO ₂	CO ₂	CO ₂	CH ₄	CO ₂ Eq*
2011	16490.5	-	164.4	59.9	18079.4
2012	20317.8	-	571.8	208.4	25474.9
2013	31464.8	-	1194.8	435.5	42131.8
2014	18516.7	-	1903.0	13.9	20915.3
2015	6375.2	52032.2	2900.0	21.1	62363.6
2016	1591.9	52032.2	3664.9	26.7	58422.6
2017 and on	-	52032.2	4055.3 –	29.6 –	57269.9 –
			8235.0	60.0	62129.8

Legend: * CO₂ Eq = Combustion CO₂ (1+0.01) + Landfill CO₂ + Landfill CH₄ (GWP of 21)

The alternatives discussed in the Preliminary Final EIS are unlikely to vary substantially in the quantity of CO₂ emissions from stationary and mobile combustion sources and landfill locations. For example, the same amount of construction activities would occur regardless of the different locations (alternatives), resulting in essentially the same amount of GHG emissions. Therefore, the GHG emissions for the different alternatives would be similar to those of the preferred alternatives.

In 2007, the U.S. generated about 7,150 Tg (million metric tons) CO₂ Eq (USEPA 2009b). This total includes emissions from Guam and Tinian, as after 2002 the United Nations no longer reports energy statistics for Guam separately (Marland et al. 2008) and emissions from Tinian were never reported separately. As the U.S. inventory does not provide a baseline for Guam, using the U.S. baseline condition for a comparison is considered appropriate for current conditions. The total maximum quantities of GHG emissions from the preferred alternatives comprise less than 0.00085% of the annual U.S. emissions.

The change in climate conditions caused by GHG resulting from the burning of fossil fuels from both stationary and mobile sources and landfilling is a global effect, and requires that the emissions be assessed on a global scale. Therefore, the disclosure of localized increments has limited or no weight in addressing climate change. The proposed action mainly involves the relocation of the military operations that are already occurring in the West Pacific region; therefore, fossil fuel burning activities in the West Pacific region are unlikely to change significantly. Consequently, overall global GHG emissions are likely to remain near the current level on a regional or global scale under the proposed action, resulting in an insignificant cumulative impact to global climate change. No specific GHG emission mitigation measures are warranted.

4.4.3 Climate Change Adaptation

Climate change is a global issue for DoD. As is outlined in the Quadrennial Defense Review Report (QDR) of February 2010, DoD would need to adjust to the impacts of climate change on our facilities and military capabilities. The Department already provides environmental stewardship at hundreds of DoD installations throughout the United States and around the world, working diligently to meet resource efficiency and sustainability goals as set by relevant laws and executive orders. Although the United States has significant capacity to adapt to climate change, it will pose challenges for civil society and DoD alike, particularly in light of the nation's extensive coastal infrastructure. In 2008, the National Intelligence Council judged that more than 30 U.S. military installations were already facing elevated levels of risk from rising sea levels. DoD's operational readiness hinges on continued access to land, air, and sea training and test space. Consequently, the Department must complete a comprehensive assessment of all installations to assess the potential impacts of climate change on its missions and adapt as required.

The QDR goes on to illustrate that DoD will work to foster efforts to assess, adapt to, and mitigate the impacts of climate change. Domestically, the Department will leverage the Strategic Environmental Research and Development Program, a joint effort among DoD, the Department of Energy, and the Environmental Protection Agency, to develop climate change assessment tools. Abroad, the Department will increase its investment in the Defense Environmental International Cooperation Program not only to promote cooperation on environmental security issues, but also to augment international adaptation efforts. On the Navy operational side, the Office of the Vice Chief of Naval Operations published on May 21, 2010 the Task Force Climate Change Roadmap, which building off the QDR, focuses on the naval operational challenges of a changing climate. Although the document does not address compliance issues, the roadmap also recognizes the need to address sea level rise impacts on infrastructure and real estate through strategic investments and installation adaptation strategies to address water resource challenges.

Guam and the CNMI would have some unique adaptation issues to evaluate and consider. The U.S. Global Climate Research Program (USGCRP) report, "Global Climate Change Impacts in the U.S." reviewed the unique impacts of Climate Change on Islands. According to the report, climate change presents U.S.-affiliated islands with unique challenges. Small islands are vulnerable to sea-level rise, coastal erosion, extreme weather events, coral reef bleaching, ocean acidification, and contamination of freshwater resources with saltwater. The islands have experienced rising temperatures and sea level in recent decades. Projections for the rest of this century suggest continued increases in air and ocean surface temperatures in both the Pacific and Caribbean, an overall decrease in rainfall in the Caribbean, an increased frequency of heavy downpours nearly everywhere, and increased rainfall during the summer months (rather than the normal rainy season in the winter months) for the Pacific islands. Hurricane wind speeds and rainfall rates are likely to increase with continued warming. Island coasts would be at increased risk of inundation due to sea-level rise and storm surge with major implications for coastal communities, infrastructure, natural habitats, and resources.

The report goes on to illustrate that island communities, infrastructure, and ecosystems are vulnerable to coastal inundation due to sea-level rise and coastal storms. Flooding would become more frequent and coastal land would be permanently lost as the sea inundates low-lying areas and the shorelines erode. Loss of land would affect living things in coastal ecosystems. Hurricanes and other storm events cause major impacts to island communities including loss of life, damage to infrastructure and other property, and contamination of freshwater supplies. With further warming, hurricane and typhoon peak wind intensities and rainfall are likely to increase, which, combined with sea-level rise, would cause higher storm surge levels.

4.4.3.1 Climate Change and Impacts on Waterfront Facilities

Until 1900, there was little change in sea level, but during the last century, sea level rose gradually and is currently rising at an increased rate (IPCC 2007). The average rate of sea level rise measured by tide gauges from 1961 to 2003 was 0.071 ± 0.02 inches (in) (0.18 ± 0.05 centimeters [cm]) per year, with an annual increase of 0.12 ± 0.03 in (0.31 ± 0.07 cm) seen between 1993 and 2003, and a total increase of 6.7 ± 2 in (17 ± 5 cm) during the 20th century (Bindoff et al. 2007). This increase is due to thermal expansion (indicating increased heat content) and the exchange of water between oceans and other reservoirs (glaciers, ice, etc.). By the end of this century, sea level is predicted to rise 7-23 in (18-59 cm), with an additional 4-8 in (10-20 cm) rise possible due to the melting of land ice sheets in Greenland (IPCC 2007).

Projections made for Guam indicate that sea level rises of up to 39 in (100 cm) would result in a few low lying areas of Apra Harbor being inundated (DoD and DOE 2010). The Navy acknowledges there is the potential for their existing and future coastal facilities to be adversely affected by sea level rise, inundations from more extreme storm events and other consequences of climate change. However, predictive models on future sea level rise are subject to variability, due in part to unknown future greenhouse gas emissions. The variability increases with the period of time being assessed. Risk assessment methodologies and technologies are being developed to predict the potential impacts of climate change on existing Navy coastal facilities. As new design criteria relevant to climate change are adopted by the Navy, they will be incorporated into project design. Projects in Guam are designed to include tsunamis, typhoon, wind, and earthquake conditions. The preferred aircraft carrier wharf deck elevation of 14 ft (4 m) is higher than the adjacent Alpha and Bravo Wharves' elevation of 10 ft (3 m). This elevation was designed to withstand anticipated storm surge events, not sea level rise; however, the design elevation may accommodate a change in sea level if the projected 39 in (100 cm) rise mentioned above is realized (NAVFAC Pacific 2010). The Inner Apra Harbor wharf improvements do not alter the original wharf design; the elevations are not altered. These facilities could be at risk from sea level rise. No mitigation measures are proposed.

No waterfront facilities are proposed on Tinian and no additive impact or risk to waterfront facilities is anticipated.

4.4.3.2 Climate Change and Impacts on Aquifers

The availability of freshwater is likely to be reduced, with significant implications for island communities, economies, and resources. Most island communities in the Pacific and Caribbean have limited sources of freshwater. Many islands depend on freshwater lenses below the surface, which are recharged by precipitation. Changes in precipitation, such as the significant decreases projected for the Caribbean, are thus a cause of great concern. Sea-level rise also affects island water supplies by causing salt water to contaminate the freshwater lens and by causing an increased frequency of flooding due to storm high tides. Water pollution (such as from agriculture or sewage), exacerbated by storms and floods, can contaminate freshwater supplies, affecting public health. The proposed action, specifically the additional population, could have an additive cumulative impact with climate change impacts on aquifer yield.

4.4.3.3 Climate Change and Impacts on Coral Reefs

Coral reefs are particularly sensitive to the impacts of climate change as even small increases in water temperature can cause coral bleaching. As concentrations of atmospheric CO₂ increase, more CO₂ is absorbed at the surface of water bodies. Elevated CO₂ concentrations are resulting in ocean acidification, which changes the chemistry of ocean water, including a decrease in the saturation state of calcium

carbonate. Marine calcifiers, such as corals, use calcium carbonate to form shells, skeletons, and other protective structures and reduced availability of it can slow or even halt calcification rates in these organisms.

The proposed action on Guam, specifically dredging coral communities, would have an additive cumulative impact in conjunction with the climate change impacts on the future health of corals and other marine resources in Guam. Volume 7, Chapter 3, Table 3.3-27 lists the historical dredging projects and their direct impacts on coral. The loss of coral ecosystem due to recently completed and present dredging projects are subject to Section 404 of the Clean Water Act compliance, and compensatory mitigation measures have been proposed to replace the coral, generally in other watersheds. In addition to dredging, there are other potential impacts to marine resources associated with the proposed action (i.e., increased marine recreational use) that would contribute to the cumulative impact; however, mitigation measures such as awareness training could offset these impacts to some degree.

There would be no additive cumulative impact associated with the proposed actions on Tinian.

4.4.3.4 Conclusions

Given these potential climate change impacts to Guam and the CNMI, the following adaptation strategies have been explored for the proposed action. As climate science advances, the DON would regularly reevaluate climate change risks and opportunities on Guam and in the CNMI to develop policies and plans to manage its effects on the DON's operating environment, missions, and facilities. Volume 6, sections 2.1.2 (screening process for renewable energy) and 2.1.5 (energy efficiency impacts) and Volume 8, Chapter 6 (sustainability) discuss renewable energy projects under the proposed action and additional renewable energy opportunities. Managing the national security effects of climate change would require DON to work collaboratively, through a whole-of-government approach, with both GovGuam and the government of the CNMI.