

CHAPTER 3.

GEOLOGICAL AND SOIL RESOURCES

3.1 INTRODUCTION

This chapter describes the potential environmental impacts to geologic and soil resources associated with implementation of the alternatives within the region of influence (ROI). Geology describes the surface and subsurface materials of which a land area is composed, including soils and rocks. The characteristics of soils and underlying rocks include stability, slope, compatibility, shear strength, and agricultural productivity. This chapter assesses how the action alternatives would potentially affect geological and soil resources. Because the geology and soils relate to the physical foundation of Guam, the proposed land uses would affect characteristics of erosion and surface changes, such as land clearing and slope cuts, but not the overall geological and soil conditions. Instead, geology and soils are more likely to affect the placement or location of a land use; for example a sinkhole could provide an obstacle to establishing a housing land use.

For a description of the affected environment for all resources, refer to the respective chapters of Volume 2 (Marine Corps Relocation – Guam); those chapters are presented in the same order as the resource areas contained in this volume. The locations described in Volume 2 also include the ROI for the Army Air and Missile Defense Task Force (AMDTF) component of the proposed action.

This chapter first discusses existing conditions, then identifies impacts by alternatives and components, and concludes with identification and discussion of mitigation measures that apply to impacts.

3.2 ENVIRONMENTAL CONSEQUENCES

3.2.1 Approach to Analysis

3.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to geology and soil resources was established through review of geologic and soil studies, federal laws and regulations, state and local building codes, and grading ordinances. Previously published National Environmental Policy Act (NEPA) documents for actions in the Mariana Islands Range Complex (MIRC) and surrounding area were also reviewed. A site-specific geotechnical investigation was not undertaken for this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS).

Light Detection and Ranging (LIDAR) Contour Data was used to identify potential sinkholes on proposed sites. Development of road alignments were adjusted to avoid these potential sinkhole location and buffer areas of 100 feet (ft) (30 meters [m]) or more were established around the potential sinkhole sites. These buffer areas would be maintained in their current natural state and would not be used for any facility development. Analysis of topography, soil, and vegetation was completed during site characterization using LIDAR Contour Data, geotechnical reports, and site visits to ensure minimal impacts to geological and soil resources.

Geologic and soil impacts include any resulting effects that the proposed action would have on the geology and soils of each geographic area as described in the affected environment section. Effects can occur during construction or during operations, and may include:

Construction

- Cut and fill activities leading to soil erosion
- Removal of vegetation leading to soil erosion
- Use of heavy equipment resulting in soil compaction
- Impacts to karst topography (surface collapse)

Operation

The potential effects of these activities and their significance within the areas of occurrence under the proposed actions are described below. The analysis of potential impacts to geology and soils considers both direct and indirect impacts. Direct impacts result from physical soil disturbances or topographic alterations, while indirect impacts include risks to individuals from geologic hazards. Factors considered in determining whether an impact would be significant include the potential for substantial change in soil or slope stability. An impact to geologic resources would be considered significant if the action would have the potential to disrupt geologic features, or if actions were to be affected by potential geologic hazards.

Construction activities are major sources of karst collapse, which can occur as a result of excavation, change of drainage patterns, or lowering the groundwater table (Islam 2005). Soil disturbance from construction can cause deposits to form in openings near the bedrock surface, which get heavier when saturated causing the underlying structure to collapse.

Potential geology and soil impacts addressed in this chapter are limited to elements of the proposed actions that could affect onshore land forms or that could be affected by geologic hazards. Potential soil contamination issues are addressed in Chapter 17 (Hazardous Materials and Wastes). Increased soil erosion also may indirectly impact water quality and aquatic ecosystems. Potential impacts to these resources are described in Chapter 4, Water Resources and Chapter 10, Terrestrial Biological Resources.

Regulatory Standards

The United States (U.S.) Environmental Protection Agency (USEPA) Region 9 grants the Guam Environmental Protection Agency (GEPA) authority to enforce portions of federal statutes via a Memorandum of Agreement (MOA). Under this MOA, the Safe Drinking Water Program, Water Resources Management Program, and the Water Pollution Control Program are administered by GEPA. GEPA's Water Pollution Control Program is responsible for protecting Guam's resources from point and non-point source pollution that includes administration of the National Pollutant Discharge Elimination System (NPDES) program. NPDES permits are required for large and small construction activities. Requirements include a Notice of Intent, a Notice of Termination, and a construction site Stormwater Pollution Prevention Plan (SWPPP). Permits are required for projects that disturb greater than 1 acre (ac) (0.4 hectare [ha]) of soil, including lay-down, ingress and egress area. Phase I regulates construction activities disturbing 5 ac (2 ha) or more of total land area and Phase II regulates small construction activities disturbing between 1 and 5 ac (0.4 and 2 ha) of total land area. Erosion and sediment control plans would be typically included in the General Permits under NPDES for construction projects greater than 1 ac (0.4 ha).

3.2.1.2 Determination of Significance

For geology and soils, the significance of potential project impacts is determined by subjective criteria as well as regulatory standards. The following factors were considered in assessing the significance of impacts to geology and soils from proposed activities in each project area:

- Increased rate of erosion and soil loss from physical disturbance
- Reduced amounts of agriculturally productive soils
- Changes to the landscape due to alteration of topography and loss of vegetation
- Alteration of surrounding landscape and affect on important geologic features (including soil or rock removal and filling of sinkholes)
- Diminished slope stability
- Increased vulnerability to a geologic hazard (e.g., seismic activity, tsunamis, landslides, liquefaction), and the probability that such an event could result in injury

3.2.1.3 Issues Identified During Public Scoping Process

The following analysis focuses on possible effects to geologic and soils resources that could be impacted by the proposed actions. As part of the analysis, related concerns expressed by the public, including regulatory stakeholders, during scoping meetings were considered. These include:

- Implementing erosion control measures for construction and post-construction phases
- Ensuring the proper permitting and local government clearances are sought where applicable

3.2.2 Headquarters/Housing Alternatives

This description of environmental consequences addresses all components of the proposed actions for the Army AMDTF. This includes the headquarters/housing component and the munitions storage component, each of which has three alternatives. A full analysis of each alternative is presented beneath the individual headings of this chapter. The weapons emplacement component has four alternatives. Detailed information on the weapons emplacements is contained in a Classified Appendix (Appendix L). A summary of impacts specific to each set of alternatives (including an unclassified summary of weapons emplacement impacts) is presented at the end of this chapter.

3.2.2.1 Headquarters/Housing Alternative 1 (Preferred Alternative)

North

NCTS Finegayan

Construction. The proposed Alternative 1 development would disturb soil during construction. There is a risk of increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity; however, construction Standard Operating Procedures (SOPs) would be implemented to minimize impacts. Erosion potential for soils found at Finegayan is shown in Table 3.2-1.

Table 3.2-1. Soil Erosion Potential at Proposed Sites

<i>Soil Type</i>	<i>Location</i>	<i>Erosion Potential</i>
Guam Cobbly Clay Loam at 3-7% slope	Andersen AFB	slight
Guam Cobbly Clay Loam at 7-15% slope	Andersen AFB	slight
Guam Urban Land Complex at 0-3% slope	Andersen AFB	slight
Guam Urban Land Complex at 0-3% slope	NCTS Finegayan	slight
Guam Cobbly Clay Loam at 3-7% slope	NCTS Finegayan	slight
Guam-Yigo Complex at 0-7% slope	South Finegayan	slight
Guam Cobbly Clay Loam at 3-7% slope	South Finegayan	slight
Guam Urban Land Complex at 0-3% slope	South Finegayan	slight
Guam Cobbly Clay Loam at 7-15% slope	Andersen South	slight
Guam Cobbly Clay Loam at 7-15% slope	Andersen South	slight
Guam Urban Land Complex at 0-3% slope	Andersen South	slight
Guam Cobbly Clay Loam at 7-15% slope	Navy Barrigada	slight
Pulantat Clay at 3-7% slope	Navy Barrigada	slight
Pulantat Clay at 7-10% slope	Navy Barrigada	slight
Urban Land Coastal Fill at 0 -3% slope	Navy Barrigada	slight
Guam Cobbly Clay Loam at 3-7% slope	Air Force Barrigada	slight
Chacha Clay at 0-5% slope	Air Force Barrigada	slight
Pulantat-Kagman Clays at 0-7% slope	Air Force Barrigada	slight

Source: Young 1988.

Soil types disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or near shore waters that are not located near the proposed construction. Construction SOPs would be followed to minimize soil erosion. Therefore, Alternative 1 impacts to soil erosion, compaction, or loss of agriculturally productive soil would be less than significant.

Construction SOPs would include requirements for stormwater compliance and BMPs, including the use of hay bales and silt fences around disturbed soil areas, to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Implementation of measures noted in the geology and soils column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. Alternative 1 would result in less than significant impacts to soil compaction and agriculturally productive soil.

Construction activities under Alternative 1 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 1 would result in less than significant impacts to unique geologic resources by changing the landscape of the affected area.

There are at least ten sinkholes in the vicinity of the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around all sinkholes to prevent further erosion or expansion. The sinkholes would not be affected by construction activities. If deemed hazardous, sinkholes found in proximity to the planned headquarters/housing area could be fenced off and signs put in place to warn of the potential danger. Less than significant impacts are expected. Finegayan is

located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively level area that would not be subject to slope instability. This would result in less than significant impacts associated with geologic hazards during construction.

Operation. Topography and landscape features would not change substantively under Alternative 1. The topography is relatively level thus slope stability would not be diminished. The action area is located in an area with karst geologic features that are of concern for the operation of these facilities. Operations would not occur over unstable karst features. If deemed hazardous, sinkholes found in proximity to the planned headquarters/housing area could be fenced off and signs put in place to warn of the potential danger. Operations activities would not disturb or compact soil or cause an increase in erosion. Therefore, Alternative 1 would result in less than significant impacts to unique geologic resources or result in erosion or compaction.

NCTS Finegayan is located in a potentially active seismic zone. Hazards associated with earthquakes and fault ruptures would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively level area that would not be subject to slope instability. The predominant limestone bedrock is not subject to liquefaction. Therefore, Alternative 1 would result in less than significant impacts associated with geologic hazards during the operations phase of the proposed action.

South Finegayan

Construction. The proposed Alternative 1 development would disturb soil during construction. There would be a risk of an increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity; however, SOPs would be implemented to minimize impacts. Erosion potential for soils found at Finegayan is shown in Table 3.2-1.

Soil types disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or near shore waters that are not located near the proposed construction. Construction SOPs, including use of hay bales and silt fences to surround disturbed areas, would be followed to minimize soil erosion. Therefore, Alternative 1 impacts to soil erosion and loss of agriculturally productive soil would be less than significant.

Construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Implementation of measures noted in the geology and soils column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. Alternative 1 would result in less than significant impacts to soil compaction and agriculturally productive soil.

Construction activities under Alternative 1 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 1 would result in less than significant impacts to unique geologic resources by changing the landscape of the affected area.

South Finegayan is located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). This would result in less than significant impacts associated with geologic hazards.

Operation. Topography and landscape features would not change substantively under Alternative 1. The topography is level, thus slope stability would not be diminished. The action area would be located in an area with karst geologic features that are of concern for the operation of these facilities. Operations would not occur over unstable karst features. Operations activities would not disturb or compact soil or cause an increase in erosion. Therefore, Alternative 1 would result in less than significant impacts to unique geologic resources or result in erosion or compaction.

South Finegayan is located in a potentially active seismic zone. Hazards associated with earthquakes and South fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively level area that would not be subject to slope instability. The predominant limestone bedrock is not subject to liquefaction. Therefore, Alternative 1 would result in less than significant impacts associated with geologic hazards during the operations phase of the proposed action.

Central

Navy Barrigada

Navy Barrigada lands would not be used; therefore, there would be no impacts to those lands under Alternative 1.

Air Force Barrigada

Air Force Barrigada lands would not be used; therefore, there would be no impacts to those lands under Alternative 1.

Alternative 1 Potential Mitigation Measures

Since there would be less than significant impacts to geological and soil resources as a result of implementing Alternative 1, there are no proposed potential mitigation measures. Implementation of SOPs and BMPs including erosion and sedimentation controls and stormwater management would minimize impacts to geological and soil resources.

3.2.2.2 Headquarters/Housing Alternative 2

Under Alternative 2, the Army AMDTF HQ would be co-located with the unaccompanied housing at the 1,081-ac (438-ha) Navy Barrigada site.

North

NCTS Finegayan

Finegayan land would not be used; therefore, there would be no impacts to Finegayan under Alternative 2.

South Finegayan

South Finegayan would not be used under Alternative 2; therefore, there would be no impacts to South Finegayan under Alternative 2.

Central

Navy Barrigada

Construction. The proposed Alternative 2 at Navy Barrigada would disturb soil during construction. There is a potential for soil loss and an increased rate of erosion and/or compaction from physical disturbance caused by construction activity. SOPs would be implemented to minimize these impacts. Erosion potential for soils found at Barrigada is shown in Table 3.2-1.

The soil types disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or near shore waters that are not located near the proposed construction. Construction SOPs would be followed to minimize soil erosion. The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Implementation of measures noted in the geology and soils column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. Alternative 1 would result in less than significant impacts to soil compaction and agriculturally productive soil.

Construction activities under Alternative 2 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 2 would result in less than significant impacts to geologic resources by changing the landscape of the affected area.

There are no known sinkholes at Navy Barrigada. Therefore, Alternative 3 would result in less than significant impacts to geologic resources.

Navy Barrigada is located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 2 proposed developments would be located on a relatively level plateau that would not be subject to slope instability. No fault lines run directly through Barrigada. The predominant limestone bedrock is not vulnerable to liquefaction. This would result in less than significant impacts associated with geologic hazards.

Operation. Topography and landscape features would not change substantively under Alternative 2. The topography is level, thus slope stability would not be diminished. The action area is located in an area with karst geologic features that are of concern for the operation of these facilities. Operations would not occur over unstable karst features. Operations activities would not disturb or compact soil or cause an increase in erosion. Therefore, Alternative 2 would result in less than significant impacts to unique geologic resources and would not result in significant erosion or compaction.

Navy Barrigada is located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). This would result in less than significant impacts associated with geologic hazards. Although Navy Barrigada is located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture and slope instability would be minimized during construction. The Alternative 2 proposed developments would be located on a relatively level area that would not be subject to slope instability. The predominant limestone bedrock is not vulnerable to liquefaction. Therefore, Alternative 2 would result in less than significant impacts associated with geologic hazards.

Air Force Barrigada

Air Force Barrigada lands would not be used; therefore, there would be no impacts to those lands under Alternative 2.

Alternative 2 Potential Mitigation Measures

As indicated for potential mitigation measures under Alternative 1, since impacts on geological and soil resources are less than significant, there are no mitigation measures proposed. SOPs and BMPs for erosion and sedimentation controls would protect geological and soil resources during construction and BMPs such as sound stormwater management practices would minimize impacts to these resources during the operations phase of the proposed action.

3.2.2.3 Headquarters/Housing Alternative 3

Under Alternative 3, the Administration/HQ and Maintenance Facility would be co-located with Marine Corps facilities in the northern portion of NCTS Finegayan. The unaccompanied personnel housing facilities would also be located on NCTS Finegayan. Accompanied personnel housing would be co-located with Marine Corps housing at Navy Barrigada and Air Force Barrigada. Recreational and QOL facilities would be co-located within and adjacent to the housing areas.

North

NCTS Finegayan

Construction. The proposed Alternative 3 development would disturb soil during construction. There is a potential for an increased rate of erosion and soil loss from physical disturbance caused by construction activity; however, SOPs would be implemented to minimize impacts. Erosion potential for soils found at Finegayan is shown in Table 3.2-1.

Soil types disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or near shore waters that are not located near the proposed construction. Construction SOPs would be followed to minimize soil erosion. Therefore, Alternative 3 would not result in significant soil erosion, compaction, or loss of agriculturally productive soil.

Construction SOPs would include requirements for stormwater compliance, with BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures regularly done can be found in Volume 7. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Implementation of measures noted in the geology and soils column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. Alternative 1 would result in less than significant impacts to soil compaction and agriculturally productive soil.

Construction activities under Alternative 3 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 3 would result in less than significant impacts to unique geologic resources by changing the landscape of the proposed project area.

There are at least ten sinkholes in the vicinity of the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around all sinkholes to prevent further erosion or expansion. Therefore, Alternative 3 would result in less than significant impacts to a unique geologic resource.

NCTS Finegayan, Navy Barrigada and Army Barrigiada are located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 3 proposed developments would be located on a relatively level area that would not be subject to slope instability.

Operation. Topography and landscape features would not change substantively under Alternative 3. The topography is level thus slope stability would not be diminished. The action area is located in an area with karst geologic features that are of concern for the operation of these facilities. Operations would not occur over unstable karst features. If deemed hazardous, sinkholes found in proximity to the planned headquarters could be fenced off and signs put in place to warn of the potential danger. Operations activities would not disturb or compact soil or cause an increase in erosion. Therefore, Alternative 3 would result in less than significant impacts to unique geologic resources or result in erosion or compaction.

NCTS Finegayan, Navy Barrigada and Army Barrigiada are located in a potentially active seismic zone. Hazards associated with earthquakes and South fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively level area that would not be subject to slope instability. The predominant limestone bedrock is not subject to liquefaction. Therefore, Alternative 1 would result in less than significant impacts associated with geologic hazards during the operations phase of the proposed action.

South Finegayan

South Finegayan would not be developed under Alternative 3; therefore, there would be no impacts to South Finegayan.

Central

Navy Barrigada

Construction. The proposed Alternative 3 at Navy Barrigada would disturb soils during construction. There is a potential for soil loss and an increased rate of erosion from physical disturbance caused by construction activity. SOPs would be implemented to minimize these impacts. Erosion potential for soils found in the areas of proposed Alternative 3 is shown in Table 3.2-1.

Soil types disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or near shore waters that are not located near the proposed construction. Construction SOPs would be followed to minimize soil erosion. Therefore, Alternative 3 would result in less than significant impacts to unique geologic resources or result in significant soil erosion, compaction, or loss of agriculturally productive soil.

Construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures regularly undertaken can be found in Volume 7. Implementation of measures noted in the geology and soils column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. A more detailed explanation of regulatory permitting requirements is available in Volume 8.

Construction activities under Alternative 3 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 3 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

There are no known sinkholes at Navy Barrigada. Therefore, Alternative 3 would result in less than significant impacts to a unique geologic resource.

Operation. Impacts would be identical to those found under Alternative 2 at Navy Barrigada.

Air Force Barrigada

Construction. The proposed Alternative 3 at Air Force Barrigada would disturb soils during construction. There is a potential for soil loss and an increased rate of erosion from physical disturbance caused by construction activity. SOPs would be implemented to minimize these impacts. Erosion potential for soils found in the areas of proposed Alternative 3 is shown in Table 3.2-1.

Soil types disturbed would not be agriculturally productive soils. Soil erosion is primarily a concern for discharge into surface or near shore waters that are not located near the proposed construction. Construction SOPs would be followed to minimize soil erosion. Therefore, Alternative 3 would result in less than significant impacts to unique geologic resources.

Construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Implementation of measures noted in the geology and soils column would prevent erosion; therefore, the impacts from soil erosion would be less than significant. Alternative 3 would result in less than significant impacts to soil compaction and agriculturally productive soil.

Construction activities under Alternative 3 would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 3 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

There are no known sinkholes at Air Force Barrigada. Therefore, Alternative 3 would result in less than significant impacts to a unique geologic resource.

Navy Barrigada and Air Force Barrigada are located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 3 proposed developments would be located on a relatively level plateau that would not be subject to slope instability. This would result in less than significant impacts associated with geologic hazards.

Operation. Impacts would be identical to those found under Alternative 2 at Air Force Barrigada.

Alternative 3 Potential Mitigation Measures

No mitigation measures under Alternative 3 are proposed.

3.2.3 Munitions Storage Alternatives

3.2.3.1 Munitions Storage Alternative 1 (Preferred Alternative)

Construction

The proposed Alternative 1 magazine construction would occur near the Habitat Management Unit (HMU) (see Figure 2.3-1). Proposed construction would disturb 6.6 ac (2.7 ha) of soil during construction. Erosion potential for soils found at Andersen AFB is shown in Table 3.2-1. The type of soil

disturbed by the construction of the ECMs would be Guam Urban Land Complex. There is a risk of increased rate of erosion, compaction, and soil loss from physical disturbance caused by construction activity. However, construction Standard Operating Procedures (SOPs) would be implemented to minimize impacts.

Soil types disturbed near the HMU during construction of the ECMs would not be agriculturally productive soils. Construction SOPs would be followed to minimize soil erosion. The construction SOPs would include requirements for stormwater compliance and Best Management Practices (BMPs), including use of hay bales and silt fences, to ensure that all aspects of the project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of measures noted in the geology and soils column would prevent erosion, thus the impacts from soil erosion would be less than significant. A more detailed explanation of regulatory permitting requirements is available in Volume 8.

Construction activities under Alternative 1 would include clearing, grading, and grubbing. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, Alternative 1 would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

Andersen AFB is located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to Unified Facility Code (UFC) 3-310-04 Seismic Design for Buildings (U.S. Army Corps of Engineers [USACE] 2007). This would result in less than significant impacts associated with geologic hazards.

Operation

Under Munitions Storage Alternative 1, operations at Andersen AFB MSA 1 would be minimal since the magazines would be primarily used for storage. In accordance with established ammunition storage requirements, native grassy vegetation would be established on and around the magazines and would be maintained (e.g., periodically mowed) to minimize fire hazard. Operations would not impact soil or geological resources.

3.2.3.2 Munitions Storage Alternative 2

Existing conditions do not vary between the three munitions storage alternatives at Andersen AFB MSA 1. Therefore, impacts for Munitions Storage Alternative 2 are identical those described for Munitions Storage Alternative 1.

3.2.3.3 Munitions Storage Alternative 3

Existing conditions do not vary between the three munitions storage alternatives at Andersen AFB MSA 1. Therefore, impacts for Munitions Storage Alternative 3 are identical those described for Munitions Storage Alternative 1.

3.2.4 Weapons Emplacement Alternatives

Detailed information on the weapons emplacements is contained in a Classified Appendix (Appendix L). An unclassified summary of impacts specific to each set of alternatives is presented at the end of this chapter.

3.2.5 No-Action Alternative

Under the no-action alternative, the Army AMDTF would not be established on Guam. No construction or operation would occur. Existing activities on Guam would continue; therefore, the no-action alternative has no impacts to geology or soils.

3.2.6 Summary of Impacts

Tables 3.2-2, 3.2-3, and 3.2-4, summarize the potential impacts of each major component – headquarters/housing, munitions storage, and weapons emplacement, respectively. A text summary is provided below.

Table 3.2-2. Summary of Headquarters/Housing Impacts – Alternatives 1, 2, and 3

<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3</i>
Construction		
LSI <ul style="list-style-type: none"> • Less than significant impacts due to seismic hazards through adherence to UFC 3-310-04 Seismic Design for Buildings • Less than significant impacts to topography and slope stability • Less than significant impacts to erosion and compaction through use of construction SOPs and BMPs 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1
Operation		
LSI <ul style="list-style-type: none"> • Less than significant impacts due to seismic hazards through adherence to UFC 3-310-04 Seismic Design for Buildings • Less than significant impacts to topography and slope stability • Less than significant impacts to erosion and compaction 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1

Legend: LSI = Less than significant impact.

Table 3.2-3. Summary of Munitions Storage Impacts – Alternatives 1, 2, and 3

<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3</i>
Construction		
LSI <ul style="list-style-type: none"> • Less than significant impacts due to seismic hazards through adherence to UFC 3-310-04 Seismic Design for Buildings • Less than significant impacts to topography and slope stability • Less than significant impacts to erosion and compaction through use of construction SOPs and BMPs 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1
Operation		
<ul style="list-style-type: none"> • Less than significant impacts due to seismic hazards through adherence to UFC 3-310-04 Seismic Design for Buildings • Less than significant impacts topography and slope stability • Less than significant impacts to erosion or compaction 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1

Legend: LSI = Less than significant impact, NI = No impact.

Table 3.2-4. Summary of Weapons Emplacement Impacts – Alternatives 1, 2, 3 and 4

<i>Alternative 1</i>	<i>Alternative 2</i>	<i>Alternative 3</i>	<i>Alternative 4</i>
Construction			
LSI <ul style="list-style-type: none"> • Less than significant impacts due to seismic hazards through adherence to UFC 3-310-04 Seismic Design for Buildings • Less than significant impacts to topography and slope stability • Less than significant impacts to erosion and compaction through use of construction SOPs and BMPs 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1
Operation			
LSI <ul style="list-style-type: none"> • Less than significant impacts due to seismic hazards through adherence to UFC 3-310-04 Seismic Design for Buildings • Less than significant impacts topography and slope stability • Less than significant impacts to erosion and compaction 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1 	LSI <ul style="list-style-type: none"> • The impacts would be the same as for Alternative 1

Legend: LSI = Less than significant impact.

Construction

Construction activities under the proposed action would include clearing, grading and grubbing, demolition of existing road pavement, earthwork, and planting vegetation. Temporary loss of vegetation would occur however replanting and ground maintenance would promote regrowth. Therefore, the proposed action would result in less than significant impacts to unique geologic resources by changing the landscape of the affected area.

There are at least ten sinkholes in the vicinity of the proposed Main Cantonment area. The sinkholes would be avoided and a buffer zone of vegetation would be left around all sinkholes to prevent further erosion or expansion. The sinkholes would not be affected by construction activities of Alternatives 1 and 3. Therefore, the proposed action would result in less than significant impacts to geologic resources.

Finegayan, Navy Barrigada, and Air Force Barrigada are located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). This would result in less than significant impacts associated with geologic hazards.

Soil types disturbed during construction of the ECMs at Andersen AFB would not be agriculturally productive soils. Construction SOPs would be followed to minimize soil erosion. Replanting and ground maintenance would promote regrowth of vegetation would result in minimal impacts to unique geologic resources by changing the landscape of the affected area.

Operation

Topography and landscape features would not be changed substantively by the proposed action. The topography is level, thus slope stability would not be diminished. The action area is located in an area with karst geologic features that are of concern for the operation of these facilities. Operations would not occur over unstable karst features. If deemed hazardous, any sinkholes found in the headquarters/housing area could be fenced off and signs put in place to warn of the potential danger. No significant impacts relative to sinkholes are expected. Headquarters/housing activities would not disturb or compact soil or cause an increase in erosion. Therefore, the proposed action would result in less than significant impacts to unique geologic resources or result in significant erosion or compaction.

Andersen AFB, Finegayan, and Barrigada are located in a potentially active seismic zone. Hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). This would result in less than significant impacts associated with geologic hazards. Although Finegayan, Navy Barrigada, and Air Force Barrigada are located in a potentially active seismic zone, the hazards associated with earthquakes, fault rupture and slope instability would be minimized during construction. The proposed action would result in less than significant impacts associated with geologic hazards. In accordance with established ammunition storage requirements, native grassy vegetation would be established on and around the magazines and would be maintained (e.g., periodically mowed) to minimize fire hazard. Operations would have less than significant impacts to soil or geological resources. All of the four alternatives for the weapons emplacement component would have the same (less than significant) impact upon geological and soil resources.

3.2.7 Summary of Potential Mitigation Measures

Table 3.2-5 summarizes potential mitigation measures.

Table 3.2-5. Summary of Potential Mitigation Measures

<i>Headquarters/Housing Alternatives</i>	<i>Munitions Storage Alternatives</i>	<i>Weapons Emplacement Alternatives</i>
Topography		
• None	• None	• None
Geology		
• None	• None	• None
Soil		
• None	• None	• None
Geologic Hazards		
• None	• None	• None

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