Revised Draft Environmental Impact Statement

Commonwealth of the Northern Mariana Islands Joint Military Training

Appendix M: Part 2

June 2025
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Appendix M - Part 2
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Wastewater Analysis

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The appendices of this Revised Draft EIS are compliant with Section 508 of the Rehabilitation Act. This allows assistive technology to be used to obtain the available information from the document. However, accessibility is limited to a descriptive title for some graphics, figures, tables, images, and attachments. Individuals who require assistance may submit a request through the Section 508 link on the project website at CNMIJointMilitaryTrainingEIS.com

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WASTEWATER ANALYSIS
IN SUPPORT OF THE COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS JOINT MILITARY TRAINING REVISED DRAFT ENVIRONMENTAL IMPACT STATEMENT

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June 2025

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1 PURPOSE

The purpose of this evaluation is to identify existing conditions and estimate the wastewater to be generated with the Proposed Action analyzed in the Commonwealth of the Northern Mariana Islands (CNMI) Joint Military Training Revised Draft Environmental Impact Statement (EIS). This assessment evaluates existing wastewater facilities and wastewater treatment facilities resulting from the Proposed Action.

1.1 DESCRIPTION OF PROPOSED WASTEWATER INFRASTRUCTURE

1.1.1 Base Camp

The Proposed Action includes construction of a Base Camp at the United States (U.S.) Agency for Global Media (USAGM) site on Tinian. As envisioned, Administration, Range Control, and Training Support functions proposed in the Base Camp would use the existing operation and administration building, and warehouse requirements would be partially met with the existing warehouse facilities. Other previously disturbed, cleared areas within the site would accommodate other proposed Base Camp new construction needs. Wastewater infrastructure would be constructed at the Base Camp as described in the subsequent sections.

The USAGM site does not appear to be within either a Class I or II Aquifer Recharge Area/Groundwater Protection Zone on Tinian (Captain B. Bearden, U.S. Public Health Service, Personal Communication, March 3, 2025). No changes in wastewater infrastructure are proposed for the USAGM site on Saipan.

1.1.2 Port of Tinian

A biosecurity facility is proposed to be constructed at the Port of Tinian. Military vehicles would be washed there after training is complete and prior to loading on vessels for transport off-island. The wash facility would be a contained concrete facility where multiple vehicles can be washed simultaneously using permanently mounted cleaning equipment. Wash water would be contained and not discharged. Wash water would be pumped out and disposed of per CNMI regulations as described in the subsequent sections below. No wastewater infrastructure is proposed at the Port of Tinian.

1.1.3 Francisco Manglona Borja/Tinian International Airport

The Proposed Action includes construction of an aircraft shelter to be located at Tinian Divert facility at the Francisco Manglona Borja/Tinian International Airport. The shelter would be sized and constructed to provide protection for aircraft from inclement weather, including typhoon force winds. No wastewater infrastructure is proposed at the aircraft shelter.

1.1.4 Other Facilities

The Proposed Action includes construction of various other facilities including ranges, landing zones, and a drop zone. No wastewater infrastructure is proposed for any of these facilities. Portable toilets may be placed temporarily as required for construction, operation, or training activities.

1.2 COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS WASTEWATER REGULATIONS

The Northern Mariana Islands Administrative Code defines two different types of wastewater treatment systems (Northern Mariana Islands Administrative Code 2017a). The first type is an Individual Wastewater Disposal System, which consists of a septic tank and leach field. An Individual Wastewater Disposal System is typically used for a single residence or business. The second type is an Other Wastewater Treatment System, which includes all treatment methods other than a septic tank.

1.2.1 Individual Wastewater Disposal System Regulations

The following is a summary of the Northern Mariana Islands Administrative Code as it pertains to Individual Wastewater Disposal System design:

- Average daily wastewater flow rates are calculated per Northern Mariana Islands Administrative Code section 65-120-500.
- Septic tank sizing and design are determined per Northern Mariana Islands Administrative Code section 65-120-600.
- Percolation testing is required per Northern Mariana Islands Administrative Code section 65-120-700.
- Leaching field sizing and design are determined per Northern Mariana Islands Administrative Code section 65-120-800.

1.2.2 Other Wastewater Treatment System Regulations

CNMI regulations require construction and operation of an Other Wastewater Treatment System for average daily wastewater flows greater than 5,000 gallons per day (Northern Mariana Islands Administrative Code section 65-120-110). These regulations also state the maximum discharge limits for various effluent constituents, including a total nitrogen limit of 1.0 milligrams per liter (Northern Mariana Islands Administrative Code section 65-120-010). Total nitrogen is removed from wastewater by using bacteria that digest the various forms of nitrogen (e.g., nitrate and nitrite).

1.3 EXISTING WASTEWATER INFRASTRUCTURE

1.3.1 Existing Individual Wastewater Disposal System Infrastructure

Various Public and Private Systems

Tinian has no centralized municipal wastewater collection and treatment system. Residences, businesses, and municipal facilities use Individual Wastewater Disposal Systems that consist of a septic tank and leach field. The Commonwealth Utilities Corporation has awarded a contract to an engineering consultant to prepare a preliminary engineering report for a wastewater treatment plant (Bureau of Environmental and Coastal Quality, Personal Communication, September 12, 2024). Until such a system is funded and constructed, residents and visitors would continue to rely on Individual Wastewater Disposal Systems.

United States Agency for Global Media

The USAGM, formerly International Broadcasting Bureau, operates an Individual Wastewater Disposal System, constructed in 1997, consisting of a packaged wastewater treatment system for aerobic digestion (Figure 1). Treated wastewater is disposed of in a leach field without a septic tank.

Figure 1. Existing Individual Wastewater Disposal System at USAGM

Camp Tinian

A U.S. military Individual Wastewater Disposal System was constructed on Tinian in 1999 to support military training personnel at Camp Tinian (Figure 2). The septic tank and leach field system are sized for 6,640 gallons per day (Department of Environmental Quality 1999). Using the Unified Facilities Criteria 3-240-02, "Domestic Wastewater Treatment" (Department of Defense [DoD] 2012), unit demand of 50 gallons per capita per day for military training camps, this system can support approximately 133 personnel. This Individual Wastewater Disposal System is not currently in use (Senior Chief Petty Officer, U.S. Navy, Personal Communication, September 10, 2024).

Figure 2. Existing Individual Wastewater Disposal System at Camp Tinian

Commonwealth Utilities Corporation Tinian Power Plant

The Commonwealth Utilities Corporation power plant on Tinian has an Individual Wastewater Disposal System with a small aeration tank similar to the USAGM facility. No information was made available regarding this system (Bureau of Environmental and Coastal Quality, Personal Communication, September 12, 2024).

1.3.2 Existing Other Wastewater Treatment System Infrastructure

Tinian Dynasty Hotel and Casino

The Tinian Dynasty Hotel and Casino operated 500 rooms, a casino, several restaurants, and dwelling units for staff accommodation until it closed in 2016. The hotel had its own Other Wastewater Treatment System, a tertiary treatment plant that was permitted to treat 240,000 gallons per day. The condition of this facility is not known. Figure 3 shows the condition of the entrance to the facility in September 2024; the Other Wastewater Treatment System is not visible through the vegetation.

Figure 3. Entrance to the Tinian Dynasty Hotel and Casino

Note: The Other Wastewater Treatment System is located within the vegetation to the right and was not visible at the time this photo was taken.

Tinian Diamond Hotel and Casino

The Tinian Diamond Hotel and Casino operated a hotel, a casino, and a restaurant until it closed in December 2024. The facility had its own Other Wastewater Treatment System, a tertiary treatment plant that consists of membrane bioreactors with denitrification (Figure 4). The Bureau of Environmental and Coastal Quality stated that the Other Wastewater Treatment System had not operated due to a lack of minimum wastewater flow (Bureau of Environmental and Coastal Quality, Personal Communication, September 12, 2024).

Figure 4. Other Wastewater Treatment System at Tinian Diamond Hotel and Casino

1.4 PROPOSED WASTEWATER DEMAND AND WASTEWATER INFRASTRUCTURE

1.4.1 Design Population

The maximum number of personnel on island at any one time from the Proposed Action would be 1,070 (estimates for this study used 1,100 to be conservative) and consists of the following types:

- Up to a maximum of 1,000 military personnel participating in training.
- Between 30 and 50 permanent support personnel, who would maintain and operate the facility. It is assumed that 20 individuals would relocate to Tinian and that the on-island local workforce could fill 30 positions.
- Up to 50 construction workers, who are assumed to relocate to Tinian from off-island. Construction would occur in phases over approximately 10 to 15 years.

Dependents are not included in the estimates above based on the experience of other U.S. DoD construction projects on Tinian.

1.4.2 Proposed Wastewater Demand

Wastewater demand is determined using the requirements of Unified Facilities Criteria 3-240-01 based on population. Wastewater demand for both Alternatives 1 and 2 is the same. Table 1 summarizes the estimated wastewater demands for the Proposed Action.

Table 1. Peak Proposed Wastewater Demand

Personnel Type	*Use Category [a]*	*Unit Flow (gpcd)*	*Population*	*Wastewater Flow (gpd)*
Military Personnel	Military Training Camps	50	1,000	50,000
Construction Workers (8-hour shift)	Nonresident Personnel and Civilian Employees (per 8-hour shift)	30	50	1,500
Permanent Support Personnel (8-hour shift)	Nonresident Personnel and Civilian Employees (per 8-hour shift)	30	50	1,500
			Total	**53,000**

Legend: gpcd = gallon(s) per capita per day; gpd = gallon(s) per day.
Notes: [a] Data per Table 3.1 of Unified Facilities Criteria 3-240-01.

Wastewater infrastructure is designed to accommodate the peak flow. Actual flow will vary significantly between training events and non-training periods. During non-training periods, wastewater flow could be 1,500 gallons per day or less.

1.4.3 Proposed Wastewater Infrastructure

The Proposed Action includes construction of new wastewater infrastructure at the Base Camp, which would be operated and maintained by the U.S. Marine Corps (USMC). The new wastewater infrastructure could include a sanitary sewer collection system, a sewer lift station, and one or more Individual Wastewater Disposal Systems. Individual Wastewater Disposal Systems are proposed because the USAGM site does not appear to be within either a Class I or II Aquifer Recharge Area/Groundwater Protection Zone on Tinian (Captain B. Bearden, U.S. Public Health Service, Personal Communication, March 3, 2025).

Wastewater service outside of the Base Camp would be met using portable toilets. These portable toilets would be periodically emptied by licensed haulers and disposed of at the new Individual Wastewater Disposal System, at the existing U.S. Department of the Navy (DON) Individual

Wastewater Disposal Systems, or at a septage disposal site approved by the Bureau of Environmental and Coastal Quality per Northern Mariana Islands Administrative Code section 65-120-1405.

Sludge from the CNMI Joint Military Training septic tanks would also be emptied by licensed haulers and disposed of at a septage disposal site approved by the Bureau of Environmental and Coastal Quality per Northern Mariana Islands Administrative Code section 65-120-1405.

Septic Tank Size

Per Northern Mariana Islands Administrative Code section 65-120-605, septic tanks shall be sized using the following equation when the average daily sewer flow is greater than 1,500 gallons per day:

Liquid volume = 1,125 gallons + (75% × Average daily sewage flow in gallons per day)

Liquid volume = 1,125 gallons + (75% × 53,000 gallons per day) = 40,875 gallons

Per Northern Mariana Islands Administrative Code section 65-120-625, the minimum septic tank dimensions are 6 feet in length, 4 feet wide, and 6 feet deep. Tanks are also required to include scum storage for 15 percent of the liquid depth and 1 inch of air space at the top of the tank. Conceptual tank dimensions that would meet these requirements are:

- *Width:* 20 feet
- *Length:* 42 feet
- *Depth:* 8 feet
- *Tank Volume:* 50,272 gallons (42,208 gallons of liquid)

The calculation above assumed a single septic system for the Proposed Action. Multiple smaller systems or parallel tanks that provide the same capacity could also be used instead.

Leach Field Size

Leach fields for septic systems are sized based on the percolation rate of the soil per Northern Mariana Islands Administrative Code section 65-120-820, Table 800-1. Below are calculations for leach field size using the smallest allowable percolation rate (largest required area).

Assuming percolation at 0.67 inches per hour:

53,000 gallons per day / 0.5 gallons per square foot per day = 106,000 square feet of leach field

To be conservative, it is estimated that the leach field would be 106,000 square feet, which is approximately 2.4 acres. Percolation tests would be done per Northern Mariana Islands Administrative Code section 65-120-700 prior to starting engineering design of the leach field.

1.5 WASH RACK

Wash water from the vehicle wash facility would be periodically emptied by licensed haulers and disposed of at the new Individual Wastewater Disposal System, at the existing DON Individual Wastewater Disposal System, or at a septage disposal site approved by the Bureau of

Environmental and Coastal Quality per Northern Mariana Islands Administrative Code section 65-120-1405.

1.6 VEHICLE MAINTENANCE

Under the Proposed Action, vehicle maintenance activities would not be conducted at the Base Camp. The training unit would bring on-island all vehicles used during training and remove the vehicles following the completion of training. No drainage or drywells would be constructed or used.

1.7 SUMMARY

Wastewater generated on the Military Lease Area as a result of the Proposed Action can be collected and treated in accordance with Northern Mariana Islands Administrative Code. Below is a summary of the anticipated wastewater system to be constructed at the Base Camp:

- **Wastewater Demand:** 53,000 gallons per day
- Total Septic Volume: 50,272 gallons
- Leach Field Size: 2.4 acres

Operation and maintenance of the wastewater system in accordance with Unified Facilities Criteria 3-240-03 is anticipated to include the following:

- Maintain vegetation over the leach field by cutting grass and removing trees, shrubs, and larger plants.
- Monitor sludge depth within septic tanks and remove sludge when the system is no longer working efficiently in accordance with the equipment manufacturer's recommendations.
- The quantity and frequency of sludge removal is based on the amount the system is used. Generally, it is expected that a septic tank is pumped every 3 to 5 years. If the tank is half full of sludge, then removal could consist of 25,000 gallons or approximately 100 tons.

The wastewater generated by new populations residing outside the Military Lease Area in existing housing, including wastewater generated by construction workers and permanent support personnel outside shift hours, would not exceed the capacity of the Individual Wastewater Disposal Systems. Each private property owner is responsible for maintenance and compliance with the CNMI regulations for their Individual Wastewater Disposal System. Thus, no indirect impact is anticipated from the construction workers or permanent support personnel living outside of the Military Lease Area in support of the Proposed Action.

2 REFERENCES

Department of Environmental Quality. 1999. *Individual Wastewater Disposal System Certification for Use of Septic System*. CNMI Department of Environmental Quality. March 10.

Department of Defense, United States (DoD). 2019. *Unified Facilities Criteria (UFC), Operation and Maintenance (O&M): Wastewater Treatment.* UFC 3-240-03. April 1.

Department of Defense, United States (DoD). 2024. *Unified Facilities Criteria (UFC), Wastewater Collection and Treatment*. UFC 3-240-01. October 1.Northern Mariana Islands Administrative Code. 2017a. *Wastewater Treatment and Disposal Rules and Regulations*. Chapter 65-120.

Northern Mariana Islands Administrative Code. 2017b. *Water Quality Standards*. Chapter 65-130.

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SOLID WASTE AND HAZARDOUS WASTE STUDY UPDATE

IN SUPPORT OF THE

COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS JOINT MILITARY TRAINING ENVIRONMENTAL IMPACT STATEMENT

NAVFAC
Naval Facilities Engineering Command
NAVFAC PACIFIC

Department of the Navy

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June 2025

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this study is to present solid and hazardous waste management requirements associated with the construction and operational phases of the Proposed Action presented in the Revised Draft Commonwealth of the Northern Mariana Islands (CNMI) Joint Military Training (CJMT) Environmental Impact Statement (EIS).

1.2 STUDY GOALS AND OBJECTIVES

This *Solid and Hazardous Waste Study* was prepared to evaluate waste management and disposal options for all solid and hazardous waste streams generated by the Proposed Action. The study objectives are summarized as follows:

- Identify existing and planned CNMI waste management options.
- Characterize and quantify waste streams of the Proposed Action.
  - Municipal Solid Waste
  - Construction and Demolition Waste
  - Green Waste
  - Hazardous Waste, Non-Hazardous Industrial Wastes, Universal Waste and E-waste
- Evaluate solid and hazardous waste management/disposition options for the Proposed Action.

The Proposed Action anticipates that approximately 30-50 permanent staff will be required to maintain and operate the facility. Table 1 summarizes the facilities to be developed and the anticipated construction timeframe.

Table 1. Proposed Action Project Phasing

Year	*Description*
2026	Helicopter Landing Zones Cleared (1/3 of total area cleared)
	North Field Drop Zone Cleared (1/3 of total area cleared)
	Landing Zones Access Roads Cleared (1/3 of total area cleared)
2027	Helicopter Landing Zones Cleared (1/3 of total area cleared)
	North Field Drop Zone Cleared (1/3 of total area cleared)
	Landing Zones Access Roads Cleared (1/3 of total area cleared)
2028	Helicopter Landing Zones Cleared (1/3 of total area cleared)
	North Field Drop Zone Cleared (1/3 of total area cleared)
	Landing Zones Access Roads Cleared (1/3 of total area cleared)
	Base Camp Potable Water Services Facilities
	Communications Area Distribution Node (ADN)
	Electrical Distribution Building / Switching Station
	Fuel Storage and Distribution Facility
	Potable Water Well Field
	Combined Electrical and Communication Lines Inside and Outside of the Military Lease Area
	Water line from Well Field (final field location TBD; assume largest area disturbed with Option A)
2030	Two Surface Radar Tower
	Base Camp Ammunition Holding Area
	Multi-Purpose Maneuver Range Ammunition Holding Area
	Multi-Purpose Maneuver Range Water Wells and Tanks
	Multi-Purpose Maneuver Range: Center Access Road/UKD Range (vegetation clearing and regular maintenance)
	Multi-Purpose Maneuver Range: Interim Firebreak
	Multi-Purpose Maneuver Range: Perimeter Road and Firebreak
	Multi-Purpose Maneuver Range: Target/Objective Areas
2031	Range Support Maintenance Shop
	Port Biosecurity/Wash Rack
2033	General Purpose Warehouse and Hazardous Materials Storage and Transfer Building
2036	Aircraft Shelter
2038	Camping Concrete Tent Pads
	Base Camp Biosecurity/Wash Rack
	Base Camp Motor Pool
	Base Camp Public Works Shop
	Base Camp Security Fencing
	Base Camp Training Unit Vehicle Parking
2039	Explosives Training Range (ETR)
	Explosives Training Range Access Road
	Wastewater/Restrooms/Showers

2 EXISTING AND PLANNED CNMI WASTE DISPOSAL OPTIONS

The purpose of this section is to evaluate the existing conditions of solid and hazardous waste management infrastructure on Tinian. This section describes the existing solid waste infrastructure, the potential future solid waste management options on Tinian, and the current tonnage of solid waste generated.

In this study, solid waste generation refers to the quantities of solid waste generated that requires management. Management is composed of two parts:

- Diversion/recycling; and
- Disposal – landfilling and incineration.

The solid waste quantities associated with each of these two management components will produce an impact on the existing solid waste infrastructure. Successful implementation of local re-use/diversion/recycling programs will positively impact final disposal facilities by reducing waste quantities requiring management. The Tinian diversion/recycling infrastructure currently consists of the newly constructed Tinian Transfer Station.

The existing CNMI disposal infrastructure consists of the unpermitted and non-compliant Tinian Puntan Diablo disposal facility located on Tinian and the permitted Marpi Landfill located on Saipan. The permitted landfill on Saipan would be utilized to dispose of waste that cannot be diverted from disposal. The estimated solid waste quantities of the Proposed Action are compared to recent CNMI solid waste generation quantities to evaluate the impacts of the Proposed Action on the existing solid waste infrastructure. The recent annual disposal tonnage estimated at the Tinan Puntan Diablo disposal facility, and the Marpi Landfill are discussed in subsequent sections.

To ensure the United States (U.S.) Marine Corps' (USMC's) waste management plans align with the CNMI's local waste management goals and their Integrated Solid Waste Management Plan, the USMC will develop an integrated waste management plan (ISWMP) in accordance with Marine Corps Order (MCO) 5090.2, Volume 17 for the CJMT project, in coordination with the CNMI municipal government. The ISWMP would be developed to address both construction activities and the ongoing training activities, and would be prepared prior to the commencement of construction.

If it is determined that the local solid waste infrastructure is not adequate to permit proper management of the Proposed Action-generated waste, the alternative to transport the waste to one or more off-island facilities where the recyclables could be recovered and the residual waste disposed of in compliant disposal facilities authorized to accept Department of Defense (DoD) waste.

2.1 TINIAN PUNTAN DIABLO DISPOSAL FACILITY

Solid waste on Tinian is currently transported by residents and business entities to the Tinian Puntan Diablo disposal facility located adjacent to 8th Avenue near San Jose and the southwest coast. The facility is operated by the CNMI Department of Public Works. The existing disposal facility is unlined and not presently in compliance with the design and operating requirements of the Resource Conservation and Recovery Act Subtitle D regulations (40 Code of Federal Regulations [CFR] Part 258) governing municipal solid waste landfills. The facility also does not comply with the CNMI regulations (Title 65, Division of Environmental Quality, Chapter 65-80, Solid Waste Management Regulation), which substantially follow the Subtitle D regulations.

CNMI intends to convert the disposal facility to a permitted landfill by demonstrating compliance with the small community exemption available in Resource Conservation and Recovery Act Subtitle D regulations 40 CFR Part 258.1(f)(1) (CNMI 2023). The anticipated timeline to complete the permitting process is 6 to 12 months. See Section 6.2.1. for a summary of the small community exemption. To receive this permit, the state-owned Small Community Exempt Landfill will still require a Closure and Post-Closure Plan that includes a Final Cover Design developed with Bureau of Environmental and Coastal Quality per 40 CFR 258.60. All components of 40 CFR 258 – Subpart C – Operating Criteria will need to be designed, constructed, and fully operational. The Facility Operations Plan, or other comparable documents, will include the following operating requirements or demonstrations that fully implement the 40 C.F.R. 258 – Subpart C – Operating Criteria:

- Demonstrated compliance with Resource Conservation and Recovery Act Subtitle D Regulation 40 CFR Part 280.1(f)(1)
- Hazardous waste exclusion;
- Landfill cover material requirements;
- Disease vector control;
- Explosive gases control;
- Demonstrate compliance with the Clean Air Act;
- Facility access control requirements;
- Run-On/Run-Off control systems;
- Surface water requirements; and
- Recordkeeping requirements.

Additionally, any future permitted Tinian Puntan Diablo Landfill will require the revised Facility Operations Plan to include other content/requirements so that staff can be trained to operate the facility and maintain compliance with the applicable sections of 40 CFR 258.

Conversion of the disposal facility and operation of the new landfill under the small community exemption would be for 10 years or until a new Atgidon Landfill can be permitted, constructed, and opened (CNMI 2023). The Puntan Diablo landfill will only be utilized to manage CJMT solid waste if the site is permitted as a landfill and in compliance with Resource Conservation and Recovery Act Subtitle D regulations (40 CFR Part 258) and local regulations. Reference to the Tinian Puntan Diablo Landfill in subsequent Chapters 3 through 5 is to the planned, permitted, and compliant landfill and not the current unpermitted disposal facility.

The Tinan Puntan Diablo disposal facility is operated without scales and, as a result, definitive historical disposal tonnage records are not available. The Integrated Solid Waste Management Plan assumes an average daily waste disposal rate of 3.8 pounds per person for the Tinian population (CNMI 2023). The 2020 population for Tinian is reported as 2,044 in the Integrated Solid Waste Management Plan (CNMI 2023). The 2010 population was reported in the Integrated Solid Waste Management Plan as 3,136, indicating a reduction of approximately 34 percent. For the purposes of estimating the 2023 annual disposal tonnage, it is assumed that the population has remained flat/unchanged since 2020. Table 2 presents the estimated average annual and average daily disposal tonnage at the disposal facility (CNMI 2023).

Table 2. Estimated 2023 Tinian Puntan Diablo Disposal Tonnage

	Disposal Tonnage
Population[a]	2,044
Solid Waste Generation Rate[a] (pound (lb) /Person/Day)	3.8
Annual Solid Waste Generation[a] (Tons/Year)	1,418
Average Daily Generation (Tons/Day)[b]	3.9

Notes: [a] – 2023 CNMI Draft Comprehensive ISWMP
[b] – Assumes site is open 365 days/year

2.2 PROPOSED ATGIDON LANDFILL

CNMI is initiating permitting efforts for a new landfill at the Atgidon site, located north of 86th Street and between Riverside Drive and 10th Avenue (CNMI 2023). The CNMI plans to permit this new site under the small community exemption as discussed previously. CNMI anticipates permitting will take 5 years to complete, with site development commencing shortly thereafter to ensure disposal capacity at the new Atgidon Landfill is available prior to cessation of operations at Puntan Diablo (CNMI 2023). The design capacity for this landfill is not known at this time.

2.3 MARPI LANDFILL

The Marpi Landfill is located on the island of Saipan and is the only active disposal facility in Saipan. The Marpi Landfill operating permit was renewed by the Bureau of Environmental and Coastal Quality in 2016, subject to the completion of site upgrades and remedial measures. Per the CNMI Department of Public Works Solid Waste Management Feasibility Study, December 2019 (GHD, Inc./Gershman, Brickner, & Bratton, Inc. 2019), the 26-acre permitted and lined disposal area of the Marpi Landfill had an estimated remaining operational life of approximately 29 years (approximately 2045). Lined disposal Cells 1 and 2 were constructed with an estimated remaining cell life of approximately 6.7 years at the time of the 2019 study. Therefore, the next disposal cell will need to be operational in 2025 to ensure available disposal capacity for continued use. At this time, CJMT has not received formal authorization from CNMI to utilize the Marpi Landfill.

The Marpi Landfill annual disposal tonnage records for the period of 2020 through 2022 is reported in the Integrated Solid Waste Management Plan (CNMI 2023). Annual average disposal tonnage can be calculated from the tonnage reported in the Integrated Solid Waste Management Plan. According to US Census data, the island of Saipan has experienced a reduction in population between 2010 and 2020. As stated in the Integrated Solid Waste Management Plan, the 2010 population was reported as 48,220 and the 2020 population was 43,385, indicating a reduction of approximately 10 percent. For purposes of estimating the current (2023) annual disposal tonnage disposed of at Marpi Landfill, it is assumed the population has remained unchanged since 2020. Table 3 presents the average annual and average daily disposal tonnage at the Marpi Landfill.

Table 3. Estimated Existing (2023) Marpi Landfill Disposal Tonnage

Year	*2020*	*2021*	*2022*	*Average*
Annual Disposal Tonnage[a]	32,810	30,241	32,206	31,752
Average Daily Disposal Tonnage[b]	90	83	88	87

Notes: [a] – 2023 CNMI Draft Comprehensive Integrated Solid Waste Management Plan
[b] – Assumes site is open 365 days/year

The operational capacity of the landfill was evaluated to determine whether the landfill has the equipment and personnel required to accept additional waste from the Proposed Action. The term operational capacity refers to the daily landfill operation requirements and not the overall site life capacity of the landfill. The average daily disposal tonnage for the 2020 through 2022 time period is 87 tons/day and ranges between 83 and 90 tons/day (CNMI 2023). It is assumed that the landfill is operating sufficiently within this capacity range.

Based on population data, it is reasonable to assume that past annual and daily average disposal tonnage was higher than current levels due to the population decline of approximately 10 percent between 2010 and 2020. To estimate the upper level of the landfill's operational capacity, an additional 10 percent was added to the current annual disposal rates. The 2010-era annual disposal quantity based on the population at the time would have been approximately 35,000 tons/year (96 tons/day). The 96 tons/day represents a daily operational capacity for the landfill, which is higher than its current operating range. The ability of the landfill to manage larger volumes of waste historically indicates that the landfill may have a daily operational capacity to support solid waste disposal generated by the Proposed Action.

2.4 TINIAN TRANSFER STATION

The Tinian Transfer Station is currently permitted to receive only source-separated recyclable materials such as cardboard/paper, plastic bottles, and aluminum cans (CNMI 2023). These materials are shipped off the island for processing and sale, and the cost of handling and transportation exceeds the revenue generated by the sale of the recyclables.

The facility was originally designed to function as a transfer station to receive municipal solid waste generated on Tinian and package it and transport it to the Marpi Landfill on Saipan (CNMI 2023). If disposal capacity is available on Tinian, the facility will continue its current operational scope of handling source-separated recyclables. If no disposal option is available on Tinian, the transfer station operation could be expanded, with the appropriate solid waste permit modification, to receive, package, and transport both recyclables and municipal solid waste. Municipal solid waste would be transported to Marpi Landfill for disposal.

Currently, there is no historical data available regarding the quantities or composition of materials diverted at the transfer station. Contractors take possession of recycled materials collected at the Tinian Transfer Station under a CNMI contract. Details of this contract are not available; it is assumed the recyclables are being transported and sold to off-island industries. At this time, CJMT has not received formal authorization from CNMI to utilize the Tinian Transfer Station.

2.5 CONSTRUCTION AND DEMOLITION WASTE

There is currently no permitted construction and demolition landfill on Tinian or Saipan. There are no current efforts to segregate or divert construction and demolition waste; hence, construction and demolition waste is currently disposed of at the Tinian Puntan Diablo disposal facility.

The CNMI is planning to develop and operate a municipally-owned site to accept construction and demolition waste generated on Tinian. Site assessment and planning stages of development were projected to begin in late 2023 (CNMI 2023). If permitted and available, this facility will be considered a potential management option for construction and demolition waste generated by the Proposed Action that is not recycled or diverted.

2.6 GREEN WASTE

Green waste generated by residents on Tinian is managed at the Tinian Organics Processing Site operated by the Department of Public Works. The site does not accept green waste from commercial generators. It was permitted in June 2022 for green waste disaster debris. It is equipped with a wheel loader and a chipper for green waste processing and storage. It receives approximately 660 cubic yards per year (CNMI 2023). The Tinian Organics Processing Site will not be evaluated as a solution for green waste diversion for CJMT.

2.7 HAZARDOUS, INDUSTRIAL, UNIVERSAL WASTES AND E-WASTES

There are an estimated 70—80 generators of hazardous waste within the CNMI. It is unknown how many reside on Tinian. The majority of these generators are Resource Conservation and Recovery Act very small quantity generators or small quantity generators. Hazardous waste generators on Tinian contract with certified hazardous waste contractors to meet disposal requirements. Hazardous waste generators must procure disposal services off-island because CNMI does not have a permitted disposal facility for hazardous, industrial, universal, and electronic waste (CNMI 2023).

Hazardous, industrial, and universal wastes and e-waste generated by CJMT activities on Tinian will be disposed of off-island by DoD per applicable U.S. Environmental Protection Agency regulations.

3 PROPOSED ACTION WASTE GENERATION AND CHARACTERIZATION

The CJMT Proposed Action would generate solid waste associated with construction, maintenance, and operational training concurrently because some training would commence upon the Record of Decision. Training would be conducted while improvements are being made to the training infrastructure. Waste generation would be a combination of construction wastes and wastes generated from training activities. The waste generated would vary depending on the level of training and the construction activities for a given year. This chapter only covers waste generated during construction. This section describes the solid waste generation from construction, which includes solid waste, construction and demolition waste, and green waste.

Waste management practices will be developed with an emphasis on source reduction to minimize the generation of waste thereby reducing the dependence on landfill or incineration for final management. The USMC would develop the CJMT Training Manual and other standard operating procedures to implement waste minimization through source reduction, to mandate and enforce segregation and diversion of recyclables from the waste stream to minimize disposal, to include all waste management requirements as outlined in the CNMI integrated waste management plan, and to include waste management policies and procedures that reference the CNMI zero waste proclamation and applicable regulations. The CJMT Training Manual will address the USMC requirement to ensure municipal solid waste is managed in accordance with USMC Environmental Management and Range Sustainability requirements, which are based on applicable laws, rules, and policies which prohibit illegal dumping. The CJMT Training Manual will address identification of hazardous materials and measures and methods to be employed to prevent improper disposal of these materials with the non-hazardous solid waste.

The USMC will comply with all laws, regulations, and executive orders in the management of solid waste as required.

3.1 SOLID WASTE

Under the Proposed Action, the estimated population increase due to off-island construction workers and support staff is projected to be no more than 50 people at any one time.

Solid waste generation is based on the rates cited for Tinian in the CNMI Draft Integrated Solid Waste Management Plan of 3.8 pounds/person/day. Table 4 presents the estimated solid waste generated for the project construction period.

Table 4. Estimated Solid Waste Generation – Construction Phase

	Input	*Total Tonnage*	*Diverted/Recycled[b]*	*Disposal*
Population (estimated construction-related personnel)	50	N/A	N/A	N/A
Solid Waste Generation Rate (lbs/person/day)[a]	3.8			
Daily Solid Waste Generation (tons/day)	N/A	0.10	0.01	0.08
Annual Solid Waste Generation (tons/year)		35	4	31

Notes: [a] – 2023 CNMI Draft Comprehensive ISWMP
[b] – Assumes site is open 365 days/year
Legend: N/A = Not Applicable

3.1.1 Construction Waste

The construction waste would be produced from the construction or renovation of structures and is estimated from the square footage of the proposed pavement and building footprints (i.e., impervious areas). The estimated generation is derived from the total area of impervious surfaces developed, less areas surfaced with asphalt concrete, in the Proposed Action multiplied by the construction generation rate. Asphalt concrete pavement construction generates essentially no debris or waste and therefore is excluded from the impervious areas that will generate construction waste. Proposed developments, representing those impervious surfaces, which will generate construction waste are summarized in Table 3.1-2. Development areas that do not create impervious surfaces and generate no construction waste or negligible construction waste are also summarized in Table 5.

Construction activities are expected to occur during the 2026 through 2039 timeframe. Table 5 presents the construction phasing of the planned facilities and the projected construction waste generation. The construction waste generation for structures/buildings during the period of project construction is estimated to be 4.34 pounds per square foot (21 kilograms per square meter) of structure/building area, multiplied by the total newly created structure/building square footage (U.S. Environmental Protection Agency 2018). Concrete surfaced areas are estimated to generate approximately 1.09 pounds. square foot (5.3 kilograms per square meter), approximately 25 percent of the generation rate for structures/buildings. The total generated construction waste is summarized in Table 3.1-2.

Table 5. Projected Construction Waste Generation

Year	*Description*	*New Impervious Areas*		*Construction Waste Generated (tons)[e, f]*
		New Structure/Building Construction (sf)	*New Concrete Surfacing (sf)*	
2026	Helicopter Landing Zones Cleared (1/3 of total area cleared)[a]	0	0	0
	North Field Drop Zone Cleared (1/3 of total area cleared)[a]	0	0	0

Year	*Description*	*New Impervious Areas*		*Construction Waste Generated (tons)*[e, f]
		New Structure/Building Construction (sf)	*New Concrete Surfacing (sf)*	
	Landing Zones Access Roads. Cleared (1/3 of total area cleared)[a]	0	0	0
2027	Helicopter Landing Zones Cleared (1/3 of total area cleared)[a]	0	0	0
	North Field Drop Zone Cleared (1/3 of total area cleared)[a]	0	0	0
	Landing Zones Access Roads. Cleared (1/3 of total area cleared)[a]	0	0	0
2028	Helicopter Landing Zones Cleared (1/3 of total area cleared)[a]	0	0	0
	North Field Drop Zone Cleared (1/3 of total area cleared)[a]	0	0	0
	Landing Zones Access Roads. Cleared (1/3 of total area cleared)[a]	0	0	0
	Base Camp Potable Water Services Facilities[b]	7,270	0	16
	Communications Area Distribution Node (ADN)	2,700	0	6
	Electrical Distribution Building / Switching Station	900	0	2
	Fuel Storage and Distribution Facility	0	18,000	10
	Potable Water Well Field	7,200	0	16
	Combined Electrical and Communication Lines Inside and Outside of the Military Lease Area	0	0	0
	Water Line from Well Field (final field location TBD; assume largest area disturbed with Option A)[c]	0	0	0
2030	Two Surface Radar Tower	1,800	0	4
	Base Camp Ammunition Holding Area	0	27,000	15
	Multi-Purpose Maneuver Range Ammunition Holding Area	0	27,000	15
	Multi-Purpose Maneuver Range Water Wells and Tanks[d]	6,210	0	13
	Multi-Purpose Maneuver Range: Center Access Road/UKD Range (vegetation clearing and regular maintenance)	0	0	0
	Multi-Purpose Maneuver Range: Interim Firebreak	0	0	0
	Multi-Purpose Maneuver Range: Perimeter Road and Firebreak	0	0	0
	Multi-Purpose Maneuver Range: Target/Objective Areas	0	0	0
2031	Range Support Maintenance Shop	1,260	0	3
	Port Biosecurity/Wash Rack	0	26,000	14
2033	General Purpose Warehouse and Hazardous Materials Storage and Transfer Building	36,000	0	78
2036	Aircraft Shelter	16,200	40,000	57
2038	Camping Concrete Tent Pads	0	10,120	5
	Base Camp Biosecurity/Wash Rack	0	5,400	3

Year	Description	New Impervious Areas		Construction Waste Generated (tons)[e, f]
		New Structure/Building Construction (sf)	New Concrete Surfacing (sf)	
	Base Camp Motor Pool	0	0	0
	Base Camp Public Works Shop	8,700	0	19
	Base Camp Security Fencing	0	0	0
	Base Camp Training Unit Vehicle Parking	0	0	0
2039	Explosives Training Range (ETR)	320	0	1
	Explosives Training Range Access Road	0	0	0
	Wastewater/Restrooms/Showers	3,200	0	7

Notes: a Assume 1/3 of activities conducted each year (2026-2028).
b New structure/building area includes 2-42' diameter tanks (2,770 sf) and assumed 3,600 sf for other structures.
c Two well field location options currently being considered. For purposes of estimating land clearing waste generation the option with the largest impact (Option A) has been assumed.
d New structure/building area includes 2-33' diameter tanks (1,710 sf) and assumed 3,600 sf for other structures.
e Construction waste generation for new impervious surface areas associated with structure/building construction is estimated to be 4.34 pounds per square foot (21 kilograms per square meter)(USEPA 2003).
f Construction waste generation for new impervious surface areas associated with concrete surfaced areas is estimated to be 1.09 lbs per square foot (5.3 kg per square meter).

Construction and demolition waste will be mainly generated from construction activities associated with new development. Construction and demolition waste associated with new structures/buildings is anticipated to be composed primarily of concrete, wood, drywall/plaster, and smaller quantities of other wastes. The average composition of non-residential construction-related construction and demolition waste is presented in Table 6 (United States Environmental Protection Agency 2018).

Table 6. Estimated Construction and Demolition Composition for New Structures/Buildings – Construction Phase

Material Type	*Estimated Percent[a]*
Concrete	77
Wood Products	10
Drywall and Plasters	10
Steel	-
Brick and Clay Tile	1
Asphalt Shingles	3
Asphalt Concrete	-
Total	**100**

a – U.S. Environmental Protection Agency 2018.

New areas of development that will be surfaced with concrete pavement will generate debris consisting primarily of residual concrete and wood used to make concrete forms with negligible quantities of other material types. The composition of the construction debris is based on the percentages of concrete and wood presented in Table 7 with all other waste types removed. The resulting estimated composition of construction debris generated in the construction of new concrete surfaced areas is presented in Table 7.

Table 7. Estimated Construction and Demolition Composition for New Concrete Surfaced Areas – Construction Phase

Material Type	***Estimated Percent***
Concrete	89
Wood	11
Total	**100**

Based on the construction debris material composition presented in Tables 6 and 7, concrete and wood represent 87 percent of the overall construction and demolition waste stream associated with new structures/buildings and 100 percent of construction and demolition waste associated with new concrete paved areas.

For typical construction projects, concrete and wood materials can be diverted from disposal with reasonable efforts by the contractor. Concrete waste, when properly sized, can be used for structural fill, as road base, and for road surfacing. Wood debris can be chipped, similar to green waste, and used as mulch and ground cover. All construction project contracts should establish requirements for the contractor to divert these and other recyclables generated from disposal.

Current DoD Integrated Solid Waste Management policy sets a minimum diversion from landfilling or non-waste to energy incineration of 60 percent for construction and demolition waste (Office of the Assistant Secretary of Defense 2020). Given the majority of construction and demolition is anticipated to be concrete and wood, the mandated diversion rate of 60 percent should be practically and economically achievable if diversion and reuse requirements are included in the construction contracts.

Table 8 presents the estimated annual construction and demolition waste quantities to be generated during the multi-year construction period. Also presented are the estimated recycled/diverted quantities and disposal quantities based on the 60 percent diversion mandate. Generation is assumed to occur over 365 days.

Table 8. Estimated Construction and Demolition Waste Generation, Diversion and Disposal – Construction Phase

Year	***Construction and Demolition Waste***					
	Total Generated		***Total Diverted/Recycled***		***Total Disposal***	
	Annual (tons)	***Daily Average (tons)***	***Annual (tons)***	***Daily Average (tons)***	***Annual (tons)***	***Daily Average (tons)***
2026	0	0	0	0	0	0
2027	0	0	0	0	0	0
2028	49	0.13	29	0.08	20	0.05

Year	Construction and Demolition Waste					
	Total Generated		Total Diverted/Recycled		Total Disposal	
	Annual (tons)	*Daily Average (tons)*	*Annual (tons)*	*Daily Average (tons)*	*Annual (tons)*	*Daily Average (tons)*
2030	47	0.13	28	0.08	19	0.05
2031	17	0.05	10	0.03	7	0.02
2033	78	0.21	47	0.13	31	0.09
2036	57	0.16	34	0.09	23	0.06
2038	27	0.07	16	0.04	11	0.03
2039	8	0.02	5	0.01	3	0.01

CJMT will need to obtain CNMI authorization to dispose of construction and demolition waste at the Marpi Landfill, the permitted Tinian Puntan Diablo Landfill, the future/planned Atgidon Landfill, and/or the planned hardfill site.

3.1.2 Green Waste

The construction contractor will clear vegetation during facility construction from the 2026 through 2039 timeframe. The projected quantities of green waste to be generated are presented in Table 9.

Table 9. Projected Green Waste Generation During Construction

Year	*Description*	*Area Cleared (sf)*	*Green Waste Volume Generated[b] (cy)*	*Green Waste Tonnage Generated[b] (tons)*
2026	Helicopter Landing Zones Cleared (1/3 of total area cleared)[a]	2,280,000	50,667	12,667
	North Field Drop Zone Cleared (1/3 of total area cleared)[a]	1,292,280	28,717	7,179
	Landing Zones Access Roads. Cleared (1/3 of total area cleared)[a]	139,224	3,094	773
2027	Helicopter Landing Zones Cleared (1/3 of total area cleared)[a]	2,280,000	50,667	12,667
	North Field Drop Zone Cleared (1/3 of total area cleared)[a]	1,292,280	28,717	7,179
	Landing Zones Access Roads. Cleared (1/3 of total area cleared)[a]	139,224	3,094	773
2028	Helicopter Landing Zones Cleared (1/3 of total area cleared)[a]	2,280,000	50,667	12,667
	North Field Drop Zone Cleared (1/3 of total area cleared)[a]	1,292,280	28,717	7,179
	Landing Zones Access Roads. Cleared (1/3 of total area cleared)[a]	139,224	3,094	773
	Base Camp Potable Water Services Facilities	0	0	0
	Communications Area Distribution Node (ADN)	0	0	0
	Electrical Distribution Building / Switching Station	0	0	0

Year	*Description*	*Area Cleared (sf)*	*Green Waste Volume Generated[b] (cy)*	*Green Waste Tonnage Generated[b] (tons)*
	Fuel Storage and Distribution Facility	0	0	0
	Potable Water Well Field	412,460	9,166	2,291
	Combined Electrical and Communication Lines Inside and Outside of the Military Lease Area	1,205,820	26,796	6,699
	Water Line from Well Field (final field location TBD; assume largest area disturbed with Option A)	336,000	7,467	1,867
2030	Two Surface Radar Tower	51,200	1,138	284
	Base Camp Ammunition Holding Area	0	0	0
	Multi-Purpose Maneuver Range Ammunition Holding Area	27,000	600	150
	Multi-Purpose Maneuver Range Water Wells and Tanks	65,340	1,452	363
	Multi-Purpose Maneuver Range: Center Access Road/UKD Range (vegetation clearing and regular maintenance)	108,000	2,400	600
	Multi-Purpose Maneuver Range: Interim Firebreak	302,880	6,731	1,683
	Multi-Purpose Maneuver Range: Perimeter Road and Firebreak	504,000	11,200	2,800
	Multi-Purpose Maneuver Range: Target/Objective Areas	531,200	11,804	2,951
2031	Range Support Maintenance Shop	0	0	0
	Port Biosecurity/Wash Rack	0	0	0
2033	General Purpose Warehouse and Hazardous Materials Storage and Transfer Building	0	0	0
2036	Aircraft Shelter	0	0	0
2038	Camping Concrete Tent Pads	0	0	0
	Base Camp Biosecurity/Wash Rack	0	0	0
	Base Camp Motor Pool	0	0	0
	Base Camp Public Works Shop	0	0	0
	Base Camp Security Fencing	313,400	6,964	1,741
	Base Camp Training Unit Vehicle Parking	0	0	0
2039	Explosives Training Range (ETR)	108,900	2,420	605
	Explosives Training Range Access Road	67,200	1,493	373
	Wastewater/Restrooms/Showers	0	0	0

Notes: [a]–Assume 1/3 of activities conducted each year (2026-2028).
[b]–Green Waste Generation: Total square yards of cleared area was multiplied by 2 yards (1.85 meters) (the average height of vegetation); then 10 percent of the volume was used to estimate the amount of green waste generated (based on the site visit to Tinian in December 2013). Average density of green waste is assumed to be 500 pounds per cubic yard (DON 2017).

Table 10 summarizes annual green waste quantities to be generated during the multi-year construction period.

Table 10. Estimated Annual Green Waste Generation - Construction Phase

Year	*Volume (cubic yards)*	*Weight (tons)*
2026	82,478	20,619
2027	82,478	20,619
2028	125,906	31,477
2030	35,325	8,831
2031	0	0
2033	0	0
2036	0	0
2038	6,964	1,741
2039	3,913	978

Green waste generated during construction will be chipped by the contractor. The contractor will be responsible for determining size and location of the chipping area and obtain local permits as required. The contractor will utilize mulch as needed to complete construction. Mulch remaining after completion of construction will be stockpiled and utilized by facility maintenance managers to control vegetation growth and/or for erosion and dust control. Excess mulch will be made available for use by residents of Tinian for the benefit of enriching the island soils and reducing erosion.

Mulched green waste is widely used as alternative daily cover, in place of soil daily cover, in landfill operations in the continental United States; if permitted, the option of using mulch as alternative daily cover would be available to the operator of the local landfill.

The coconut rhinoceros beetle has been reported to have been found in the CNMI. Inspection of green waste generated during the land clearing phase of the work would be conducted to prevent the spread of this invasive species. If inspection of the work area indicates the presence of coconut rhinoceros beetle, methods to control it would include chipping/grinding which kills the majority of the insects during the mechanical size reduction process. If it is determined that additional control is required, enhanced control can be done by subjecting the mulched material to elevated temperatures for a defined period of time which will kill the insects. Elevated temperatures in excess of 130 degrees F for a period of 15 days have been shown to be effective in destroying coconut rhinoceros beetle. Placing the mulched material, with appropriate moisture levels, in windrows and turning them periodically through the 15 day period will produce the required elevated temperatures. Upon completion of the elevated temperature process, the mulch may be utilized.

3.1.3 Hazardous, Industrial, Universal Wastes and E-Wastes

Hazardous, industrial, universal wastes and e-wastes may be generated during the construction phase of the Proposed Action. Quantities of wastes generated cannot be estimated at this time. The types of wastes generated during the construction phase may consist of, but not be limited to the following:

- Used oil from construction equipment maintenance and operation;
- Antifreeze from construction equipment maintenance and operation;

- Diesel and gasoline; and
- Expired or unused paint and paint-related materials.

All construction-related hazardous, industrial, universal wastes, and e-wastes would be stored, collected, shipped off-island, and managed in accordance with applicable regulations. Transportation of all hazardous wastes would be conducted in compliance with U.S. Department of Transportation regulations and CFR Title 49. Since all generated hazardous wastes would be removed from the island and disposed of according to relevant laws and regulations, the proposed construction activities would have no impact with respect to hazardous waste disposal on Tinian.

4 PROPOSED ACTION WASTE GENERATION AND CHARACTERIZATION—TRAINING OPERATIONS

Training operations will generate solid waste due to the presence of personnel undergoing training and permanent facility staff. Ongoing facility maintenance activities will also result in waste during the training operations period.

This chapter presents the following estimated values:

- Solid waste quantities and composition projected to be generated during training operations;
- Construction waste quantities generated from maintenance activities;
- Green waste generation from ongoing grounds maintenance;
- Quantities of waste that will be diverted/recycled;
- Quantities of waste requiring disposal; and
- Types of hazardous wastes generated.

Training operations will vary from year-to-year due to variations in the number and type (i.e., large, medium, or small) of training events and the number of personnel participating in training events. Solid waste generation estimates present quantities of waste for an estimated average training tempo, representing approximately mid-range of number of events/year and mid-range of minimum and maximum personnel per event, and high-range training tempo representing maximum training events permitted per year with maximum number of permitted participants. The range of waste generation presented provides information necessary for evaluating options and selecting final management methods/facilities to manage wastes generated by the Proposed Action.

Waste management practices will be developed with an emphasis on source reduction to minimize the generation of waste thereby reducing the dependence on landfill or incineration for final management. The USMC will develop the CJMT Training Manual and other standard operating procedures to implement waste minimization through source reduction, to mandate and enforce segregation and diversion of recyclables from the waste stream to minimize disposal, to include all waste management requirements as outlined in the CNMI integrated waste management plan, and to include waste management policies and procedures that reference the CNMI zero waste proclamation and applicable regulations. The Training Manual will address the USMC requirement to ensure municipal solid waste is managed in accordance with USMC Environmental Management and Range Sustainability requirements, which are based on applicable laws, rules, and policies which prohibit illegal dumping. The Training Manual will address identification of hazardous materials and measures and methods to be employed to prevent improper disposal of these materials with the non-hazardous solid waste.

4.1 SOLID WASTE

4.1.1 Solid Waste Generation Rates

This section describes the anticipated solid waste generation rates for two different conditions on Tinian. One condition would be during training periods where both permanent on-island staff are present and training personnel are present. The second condition is in-between training events when only permanent personnel are on island.

Solid waste generated from active training operations is estimated based on documented waste generation data collected over a 6-month period by the Army at the Pohakuloa Training Area (Pohakuloa) in Hawaii County, Hawaii, from November 2013 through April 2014 (Duwall, L., Pohakuloa Solid Waste Contract Program Evaluator 2014). The Pohakuloa operation involves military personnel conducting temporary-duty training similar to that planned for CJMT. The Pohakuloa solid waste generation rate is 7.0 pounds (lbs) per person per day which is higher than the non-training generation rate of 4.9 lbs per person per day described below. During active training periods, CJMT will host personnel undergoing active training in addition to the permanent staff. The number of active training events per year, training event sizes, and training event duration will vary.

Solid waste generation for permanent personnel is expected to be 4.9 lbs per person per day (USEPA 2020). Only permanent staff will be present during non-training periods. The population during these periods will vary little and will be considered the baseline population. Solid waste generated during these periods is very low compared to active training periods.

4.1.2 Solid Waste Composition and Diversion

Waste composition data from US military bases in Guam (NAVFAC Marianas 2013) is a reasonable approximation of the composition of solid waste generated by the Proposed Action because it is based on solid waste data from similar types of activities, climate conditions, and geographical location. Waste composition data is presented in Table 11.

Table 11. Tinian Training Area - Solid Waste Composition During Training

Material Type[a,b]	*Estimated Percent by Weight*[a,b]
Paper/Cardboard	30.4
Glass	4.0
Plastics/Polystyrene	21.0
Metal	6.0
Organics/Food Waste	37.2
Remaining/Composite municipal solid waste	1.4
Total	**100.0**

Notes: [a]–NAVFAC Marianas 2013.
[b]–Composition modified to remove non-municipal solid waste components of construction and demolition, electronic waste, and hazardous waste.

The current DoD Integrated Solid Waste Management policy sets a minimum diversion from landfilling or non-waste to energy incineration of 40 percent for non-hazardous waste, excluding construction and demolition debris (Office of the Assistant Secretary of Defense 2020). CJMT is unlikely to meet the 40 percent solid waste diversion goal due to its remote location, which has limited recycling services and no domestic consumption of diverted materials. An estimated waste diversion rate for the project will be based on an estimated recovery rate from the waste stream for the recyclable materials received and processed at the Tinian Transfer Station. Currently, the Tinian Transfer Station receives and processes source-separated cardboard/paper, plastic bottles, and aluminum cans (CNMI 2023).

The Tinian Transfer Station receives and processes source-segregated cardboard/paper, plastic bottles, and aluminum. Therefore, if the Tinian Transfer Station is utilized, CJMT will be required to segregate these recyclable materials prior to delivery to the Tinian Transfer Station. Recycling facilities that receive source-separated materials, such as the Tinian Transfer Station, have a low tolerance for unsorted materials and material contamination because they lack material sorting equipment and site capacity for sorting. Contaminated recyclables will likely be rejected by the transfer station, which would necessitate landfill disposal.

The requirement to segregate the recyclables with minimal contamination will impact the degree of recovery of recyclables at CJMT. Segregation is a labor-intensive process and will be largely dependent upon the sorting of materials by the individual generator which, in this case, is the individual soldier undergoing training, unless personnel, space, and equipment are dedicated to the sorting/segregation process. Diversion of recyclables can be maximized by educational programs and recycling receptacles that are clearly labeled and protect recyclables from contamination. However, even at established military bases and military housing units where training is frequent and oversite is more consistent, observations of recycling and diversion programs indicate modest to low rates of segregation and capture of recyclable materials with the majority of recyclables being discarded into the waste receptacles rather than the recyclables collection containers. For this reason it is not unreasonable to expect a relatively low rate of diversion for any recycling/diversion program implemented at CJMT.

Estimated recovery rates for the targeted recyclables is based on the 2018 averages for the United States (USEPA 2020) with an adjustment of these rates to reflect the site-specific challenges to recycling, outlined above. A conservative adjustment of 50 percent reduction from the 2018 US average (USEPA 2020) for the CJMT diversion rates is utilized based on the assumption of CJMT implementing a recycling program for the targeted materials. Table 12 presents the assumed waste composition, the 2018 average diversion rate for the United States, and the adjusted diversion rate for the project.

Table 12. Tinian Training Area – Estimated Recyclable Diversion Rates

Material Type	*Estimated Percent of Total Waste Stream*[a,b]	*2018 US Average Diversion Percentage*[c]	*Adjusted CJMT Diversion Percentage*	*Overall CJMT Diversion Percentage*
Paper/Cardboard	30.4	64	32	10
Glass	4.0	N/A	N/A	N/A
Plastics/Polystyrene	21.0	14	7	1
Metal	6.0	35	17	1
Organics	37.2	N/A	N/A	N/A
Remaining/Composite municipal solid waste	1.4	N/A	N/A	N/A
Total	100.0			12

Notes: [a] – NAVFAC Marianas 2013
[b] – Composition modified to remove non-municipal solid waste components of construction and demolition, electronic waste, and hazardous waste
[c] – USEPA 2020

Based on the above outlined assumptions, the overall aggregate diversion rate for the solid waste stream is estimated to be 12 percent.

These modest diversion rates for the individual material types are based on assumed low levels of diversion due to the following reasons:

- Frequent turnover of participating personnel can result in difficulty implementing an effective segregation program;
- Potential contamination of paper products due to food residue and other contamination; and
- Portions of the plastics, polystyrene, and metal categories cannot be recycled at the Tinian Transfer Station.

The following sections use a 12 percent diversion rate to estimate the overall municipal solid waste diversion for the project.

4.1.3 Solid Waste Quantities

The quantities of solid waste generated are dependent upon the frequency of training events, total personnel participating in the training, the presence of construction workers, as well as the permanent facility staff. Table 13 presents Alternative 1, which entails the highest expected training intensity, with the projected training frequencies, the expected population of various sizes of training sessions, and the anticipated population of permanent staff and construction workers.

Table 13. Alternative 1 Training Events, Duration, Frequency and Projected Headcount

Description	*Projected Personnel Headcount*	*Event Duration*	*Estimated Training Frequency*
Permanent Staff	50	365	
Construction Workers	50	365	
Training Events			
Small Training Events	up to 100	1-2 Weeks	Routinely occurring throughout the year
Medium Training Events	up to 250	1-2 Weeks	Once per quarter
Large Training Events	up to 1,000	2-4 Weeks	2-4 times per year

Notes: [1] 30 of the 50 permanent staff positions area expected to be filled by Tinian residents, with the balance being filled by off-island personnel. For estimation solid waste impacts, only the additional 20 off-island positions will be considered.
[2] For estimation of solid waste impacts associated with small training events, and annual total number 12 of events is assumed (average of one event per month, year round).
[3] Maximum personnel participating in training at any one time is 1,000.

Permanent staff is projected to be 50 persons with approximately 30 of those positions to be filled by current Tinian residents. Solid waste generation projections for the project will include the 20 additional positions that will be filled by personnel not presently residing on Tinian.

The range of training frequency, total training days, and personnel headcount is presented in Table 14.

Table 14. Training Event Frequency and Personnel Headcount

Activity Description	*Personnel Headcount/Event*		*Event Frequency (events/year)*		*Event Duration (days)*		*Total Maximum Training Days/Year*	*Personnel Days/Year*
	Event Size Range	*Maximum Headcount*	*Frequency Range*	*Maximum*	*Duration Range*	*Maximum*		*Maximum*
Permanent Staff		20			365			7,300
Construction Workers		50			365			18,250
Training Personnel								
Small Training Events	up to 100	100	12	12	7-14	14	168	16,800
Medium Training Events	up to 250	250	4	4	7-14	14	56	14,000
Large Training Events	up to 1,000	1,000	2-4	4	14-28	28	112	112,000
Total Training Personnel				20		56	336	142,800
Average Training Personnel Headcount/Training Day (Training Personnel Days/Year, Maximum ÷ Total Maximum Training Days/Year)								425

Notes: [1] Assumed small training event frequency to be 12 events/year (average of one per month, year round).
[2] Maximum personnel participating in training at any one time is 1,000.

The maximum personnel participating in training at any one time is 1,000. For the maximum projected annual training events under Alternative 1, the average number of personnel participating in training throughout the course of the training year, total personnel days averaged over the maximum number of training days, is 425, which is shown in Table 14.

The maximum estimated annual solid waste generation is calculated using the estimated personnel days per year, the estimated solid waste generation rates, and estimated diversion rate. Table 15 presents this range.

Table 15. Maximum Solid Waste Generation (per year)

Description	*Solid Waste Generation Rate*	*Personnel Days/Year*	*Solid Waste Generated*
	(lbs/person/day)[a,b]		*(tons/year)*
Permanent Staff	4.9	7,300	18
Construction Workers	4.9	18,250	45
Small Training Events	7.0	16,800	59
Medium Training Events	7.0	14,000	49
Large Training Events	7.0	112,000	392
Solid Waste Generated/Year			562
Solid Waste Diverted/Year[c]			67
Solid Waste Disposal/Year			495

Notes: [a] SW generation rate for permanent staff and construction workers = 4.9 pounds/person/day.
[b] SW generation rate for training personnel = 7.0 pounds/person/day.
[c] Estimated 12 percent diversion rate.

The solid waste generation rates of 4.9 lbs/person/day for permanent staff and construction workers and 7.0 lbs/person/day for training participants were applied to the headcount ranges representative of three population conditions that estimate the range of solid waste generation and associated diversion and disposal occurring over the course of a training year:

1) Minimum daily waste generation – periods during which no training is occurring, and only permanent staff and construction workers are present;
2) Maximum daily waste generation - periods when the maximum training population of 1,000 is present with the permanent staff and construction workers; and
3) Average daily waste generation – represents an overall average disposal tonnage per day for the entire training year under Alternative 1. Average training population over the course of the training year is noted in Table 14 and is used to estimate solid waste generation in the training population which is added to that generated by the permanent staff and construction workers.

The daily solid waste generation, solid waste diversion, and disposal tonnage for these 3 conditions are presented in Table 16.

Table 16. Solid Waste Generation (per day)

Description	*Permament Staff*[a]	*Construction Workers*[a]	*Training Personnel*[b]	*Daily Solid Waste Tonnage*
Solid Waste Generation (lbs/person/day)	4.9	4.9	7.0	
Minimum Daily Waste Generation	20	50	0	
Solid Waste Generation (tons/day)	0.05	0.12	0.00	0.17
Solid Waste Diversion (tons/day)[c]	0.01	0.01	0.00	0.02
Solid Waste Disposal (tons/day)	0.04	0.11	0.00	0.15
Average Daily Waste Generation	20	50	425	
Solid Waste Generation (tons/day)	0.05	0.12	1.49	1.66
Solid Waste Diversion (tons/day)[c]	0.01	0.01	0.18	0.20
Solid Waste Disposal (tons/day)	0.04	0.11	1.31	1.46
Maximum Daily Waste Generation	20	50	1,000	
Solid Waste Generation (tons/day)	0.05	0.12	3.50	3.67
Solid Waste Diversion (tons/day)[c]	0.01	0.01	0.42	0.44
Solid Waste Disposal (tons/day)	0.04	0.11	3.08	3.23

Notes: [a] SW generation rate for permanent staff and construction workers = 4.9 pounds/person/day.
[b] SW generation rate for training personnel = 7.0 pounds/person/day.
[c] Estimated 12 percent diversion rate.

Solid waste tonnage estimates for the three population conditions, outlined above, are summarized in Table 17. Average and maximum training period estimates provide a reasonable range of solid waste generation per day during the varying training periods during the training year. The average daily generation rate can be viewed as the typical average anticipated waste loading over the entire training year, and the maximum generation rate can be viewed as the highest anticipated daily waste loading during training periods with the maximum participating headcount (1,000 persons). The maximum daily condition represents the highest impact on recycling and final disposal facilities utilized. While the average daily solid waste generation rate based on the average training day population is useful in assessing the average daily impact to the local solid waste management infrastructure, it is not used to estimate the annual loading as that is based on the maximum personnel training days for the entire year.

Table 17. Solid Waste Generation

Description	*Permanent Staff and Construction Workers[a]*	*Maximum Training Population Generation[b]*	*Estimate Annual Solid Waste Generation*
Solid Waste Generation (tons/day)[c]	0.17	3.67	
Solid Waste Diversion (tons/day)[d]	0.02	0.44	
Solid Waste Disposal (tons/day)	0.15	3.23	
Annualized MSW Generation, Diversion, and Disposal			
Solid Waste Generation (tons/year)[c]	63	500	562
Solid Waste Diversion (tons/year)[d]	8	60	67
Solid Waste Disposal (tons/year)	55	440	495

Notes: [a] SW generation rate for permanent staff and construction workers = 4.9 pounds/person/day.
[b] SW generation rate for training personnel = 7.0 pounds/person/day.
[c] Estimated 12 percent diversion rate.

Expended ammunition casing metals, aluminum, and brass are projected to be generated in the amount of 1.45 lbs/person/day during active training, and quantities are presented in Table 18 (NAVFAC Marianas 2013).

Table 18. Expended Ammunition Casing Metals

	Average Daily Waste Quantity (tons/day)	*High-Range Daily Waste Quantity (tons/day)*	*Average Annual Tonnage (tons/year)*	*High-Range Annual Tonnage (tons/year)*
Expended Aluminum & Brass Cartridges [a]	0.49	0.72	25	75

Notes: [a] Estimated aluminum and expended brass cartridges occur during training - 1.45 pounds/person/day of training.

Solid waste generation at the ranges is expected to be minimal during operation. Collection bins would be provided at appropriate locations and periodically emptied, with solid waste taken to the most convenient transfer station or recycling center for processing and transfer to the appropriate disposal or recycling facility.

All expended ammunition casings will be collected by training units and returned to be recycled off island, per USMC MCO 4400.201-V7, and not be managed at CNMI municipal recycling or disposal sites.

4.1.4 Construction Waste

During training operations, construction waste would be produced from capital improvements and regular maintenance of the facilities. Documented operational conditions at bases on Guam indicate construction and demolition waste is generated each year by regular maintenance of facilities (NAVFAC Marianas 2013) and has been found to average approximately 5.6 percent of the annual solid waste tonnage. The estimated construction and demolition waste generated through facility maintenance for Alternative 1 is calculated by applying this generation rate to the estimated annual solid waste tonnage. The results of this calculation for the Tinian facility are presented in Table 19.

Table 19. Projected Construction and Demolition Waste Generation During Training Operations

Annual Solid Waste (tons/year)	*Operational C&D Waste*	
	Annual *(tons/year)*	***Daily*** *(tons/day)*
562	31.5	0.09
C&D Tons Diverted (60%)	18.9	0.05
C&D Tons Disposed (40%)	12.6	0.03

Notes: [1] C&D waste generation as a percentage of overall annual solid waste = 5.60%, NAVVFAC Marianas 2013.

4.1.5 Green Waste

Green waste resulting from the ongoing grounds maintenance of the training facilities will be minimal. Areas cleared of vegetation during the construction will be maintained by regular mowing with the cuttings being left on the ground to decompose with no appreciable quantities of green waste generated. Through regular mowing, vegetative growth will be limited to grasses, and re-establishment of larger woody shrubs and trees will be prevented.

4.1.6 Hazardous Waste, Industrial, Universal Wastes, and E-Wastes

Hazardous, industrial, and universal wastes and e-waste may be generated during the training operations. Quantities of wastes generated cannot be estimated based on the information known at this time. The types of wastes generated during the construction phase may consist of, but not be limited to, the following:

- Used oil and grease from equipment maintenance and operation;
- Antifreeze from equipment maintenance and operation;
- Off-spec or contaminated diesel and gasoline;
- Expired, unused, or off-spec paint and paint-related materials;
- E-wastes;
- Mercury-containing equipment;
- Batteries; and
- Fluorescent light bulbs.

Operational-related hazardous wastes, universal wastes (i.e., fluorescent lamps, mercury-containing instruments, batteries), electronic waste (e.g., computer equipment, monitors, televisions, etc.), and non-hazardous industrial waste (i.e., oil, and paint, antifreeze, expired commercial chemical products, etc.) would be collected and transported off the island in accordance with applicable laws and regulations. These wastes would also be managed and stored in accordance with applicable regulations. The proposed operational activities would have no impact with respect to hazardous waste disposal on Tinian.

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5 SOLID AND HAZARDOUS WASTE MANAGEMENT DISPOSAL OPTIONS

This chapter discusses the three proposed solid waste disposal options and the proposed management method for non-hazardous solid waste being considered for the Proposed Action, which are summarized as follows:

1. Landfill Disposal in the future Tinian Puntan Diablo Landfill, then Future Atgidon Landfill

   The CNMI intends to permit the existing Tinian Puntan Diablo disposal facility by demonstrating compliance with the small community exemption available in Resource Conservation and Recovery Act Subtitle D regulations (40 CFR Part 258.1(f)(1)). Once permitted, the Tinian Puntan Diablo Landfill would qualify as an acceptable disposal site for the Proposed Action.

   The CNMI recognizes the permitted Tinian Puntan Diablo Landfill is not a long-term solution for ensuring ongoing local solid waste disposal. As a result, CNMI intends to proceed with permitting and constructing a replacement landfill at the Atgidon site, located north of 86th Street, between Riverside Drive and 10th Avenue. The CNMI plans to permit this new site under the small community exemption (40 CFR Part 258.1(f)(1)). CNMI anticipates permitting the Atgidon Landfill will take up to 5 years to complete, with site development commencing shortly thereafter. Once operational, the landfill at Atgidon would be an acceptable disposal site for the Proposed Action.

   At this time, CJMT has not received formal authorization to use either of the future permitted landfills on Tinian.

2. Marpi Landfill, Saipan

   In the event landfill disposal is not available on Tinian, the Marpi Landfill on Saipan could be used if approved by CNMI and would require a solid waste accumulation, storage, and transfer facility on Tinian. At this time, CJMT has not received formal authorization to use the Tinian Transfer Station.

3. Incineration

   The final option being considered for the management of CJMT solid waste is the use of an incinerator in the event a local landfill is not available, or if it is determined solid waste volumes need to be further minimized prior to being landfilled. If an incinerator is ultimately selected, it would be a decision by the DoD to manage all DoD solid waste, excluding construction and demolition and green waste, generated on Tinian. Incineration typically decreases the volume of solid waste by 80 to 90 percent.

   DoD Integrated Solid Waste Management policy establishes a hierarchy of preferred methods for solid waste management with incineration of waste preferred over land disposal because of the significant volume reduction.

The incinerator residual/ash will be accumulated in sealed storage containers and periodically transported to the Marpi Landfill, or other permitted Resource Conservation and Recovery Act Subtitle D landfill for final disposal. Based on the anticipated composition of the solid waste, the ash would be expected to be non-hazardous. Ash residue would be required to be periodically sampled and analyzed prior to disposal, and would be managed as hazardous waste in compliance with appropriate regulations if necessary.

If it is determined that use of an incinerator on Tinian is the best solution for management of residual waste, the incinerator will be one which is permitted and approved by the U.S. Environmental Protection Agency and the CNMI in accordance with applicable regulations. The incinerator unit will be tested as required to demonstrate its compliance with all operational and emissions standards.

5.1 SOLID WASTE MANAGEMENT REQUIREMENTS

This section summarizes the estimated daily solid waste management requirements for the construction period and the operational period. Solid waste management facilities supporting diversion/recycling and final disposal used for the Proposed Action must have the capacity to efficiently receive, process, and/or dispose of this range of materials on a daily basis in addition to any other quantities of waste received from other sources not associated with the Proposed Action. The following was estimated with the solid waste data analysis for the Proposed Action:

- The maximum daily solid waste generated under Alternative 1, including solid waste associated with operational training, permanent staff, and construction workers (3.67 tons/day), and the highest average daily construction and demolition waste (0.21 tons/day), is 3.89 tons/day.
- After diversion, the maximum daily solid waste disposal tonnage under Alternative 1 is projected to be 3.32 tons/day.
- Required average daily solid waste recycling for the Alternative 1 operational period to achieve 12 percent diversion is 0.44 tons.
- Required average daily construction and demolition waste recycling to achieve 60 percent diversion is 0.13 tons/day.

Recycling of construction and demolition waste primarily is conducted by the contractor and does not significantly impact local recycling facilities. Small amounts of paper/cardboard, plastics, and aluminum cans may be processed through the Tinian Transfer Station.

5.2 IMPACTS TO EXISTING AND PLANNED SOLID WASTE MANAGEMENT FACILITIES

The above-outlined disposal and diversion/recycling requirements for the construction period and operational period of the Proposed Action can be used to evaluate the impact on the existing and planned solid waste facilities and their capacity to absorb such quantities.

Table 20 presents the current daily disposal at the local landfills and the estimated past daily disposal during recent periods of higher population.

Table 20. Existing Disposal Capacity vs. Required Capacity

Landfill	Current Daily Diposal	Past Estimated Daily Disposal	Assumed Excess Daily Capacity	Project Required Daily Disposal	Capacity Excess/(Deficit)
	(tons)	(tons)	(tons)	(tons)	(tons)
Tinian	3.9	5.2	1.4	3.32	(1.96)
Marpi	87.0	95.7	8.7		5.38

5.2.1 Tinian Puntan Diablo Landfill

The Puntan Diablo Landfill operation may require additional operational assets, equipment and personnel, to supplement the existing daily operational capacity and ensure the facility is capable of efficiently managing the additional disposal tonnage from the Proposed Action. The additional disposal tonnage from the Proposed Action represents an increase of approximately 85 percent over the current average daily disposal tonnage and would be expected to result in a decrease of remaining operational life.

According to the Integrated Solid Waste Management Plan, the remaining disposal capacity at Tinian Puntan Diablo Landfill, once permitted, will be 10 years. The proposed Atgidon Landfill daily operational capacity and permitted disposal capacity should be designed in anticipation of the additional disposal needs presented in this study.

The projected maximum daily solid waste generation of 3.67 tons/day, before any reduction through recycling and diversion, when added to the current average daily disposal tonnage at the Puntan Diablo disposal facility of 3.9 tons results in a total average daily disposal tonnage of 7.57 tons. The small community exemption, under which the CNMI plans to permit the Puntan Diablo facility, limits daily average disposal tonnage to less than 20 tons. The combined Proposed Action waste tonnage and the average daily disposal tonnage at Puntan Diablo of 7.57 tons is significantly below this threshold.

5.2.2 Marpi Landfill

The Marpi Landfill operation has more than adequate daily operational capacity to absorb the additional disposal tonnage from the Proposed Action.

The remaining operational life of the landfill, as previously noted, is approximately 26 years at current disposal rates (GHD, Inc./Gershman, Brickner, & Bratton, Inc. December 2019). The additional disposal tonnage from the Proposed Action, if accepted at Marpi, represents an increase of approximately 3.8 percent and would be expected to result in a decrease of remaining operational life by approximately 1 year from approximately 26 years to 25 years.

5.2.3 Tinian Transfer Station

The Tinian Transfer Station will be impacted in different ways depending on the landfill utilized for disposal. Regardless of which landfill may be used for disposal, only acceptable recyclable materials and municipal solid waste would be processed through the Tinian Transfer Station. If the Tinian/Atgidon Landfill option is utilized, the transfer station could receive up to 0.44 tons/day of additional recyclables generated by the Proposed Action.

If the Marpi Landfill option is utilized, the facility would be required to be re-permitted to operate as a transfer station and acquire additional equipment and waste transport containers to receive, store, and transport up to 3.32 tons/day of solid waste. The station could also receive up to 0.44 tons/day of additional recyclables.

Additionally, utilization of the Tinian Transfer Station to enable use of the Marpi Landfill for disposal needs will require logistical coordination and equipment for the following tasks associated with the transfer of filled waste containers to the landfill and return of empty containers from the landfill back to Tinian:

- Transport trucks to move filled waste containers to the port of Tinian for loading onto barges/ships outbound to Port of Saipan;
- Barge/ship service to transport the containers to Port of Saipan:
- Transport trucks to receive waste containers at the Port of Saipan and transfer them to the Marpi Landfill;
- Equipment at the landfill to unload the incoming waste containers from the transfer trucks and to load up outgoing empty containers to be returned to Tinian; and
- Trucks and equipment at the landfill to discharge waste at the active landfill face.

5.3 INCINERATION

Development and operation of a new landfill on Tinian has been proposed in the past and to date has not yet been successfully implemented. Uncertainty about adequate funding sources and the adequacy of CNMI government resources to support the planning, design, construction and operation of a new landfill continues. If landfill disposal is not available to support the Proposed Action, an on-site incinerator may be utilized as the method for solid waste disposal which will minimize the volumes of waste requiring landfill disposal. Residual ash volume will be 80 to 90 percent less than the original volume of waste, thus landfill disposal volume required will be reduced by 80 to 90 percent as well.

The incinerator would be sized to process the anticipated daily disposal tonnage (3.32 tons/day), and additional or redundant capacity may be required to accommodate all solid waste estimated to be generated (3.89 tons/day) in the event of a disruption in diversion of solid waste. This may entail the facility being designed with two incinerators to provide the desired capacity and to provide operational flexibility when lower quantities of waste are being generated. The projected daily tonnage is the same as those estimated for landfill disposal and assume 12 percent diversion/recycling of solid waste before incineration.

The quantities of solid waste will often be less than the maximum daily for which the incinerator will be sized because the maximum daily tonnage will only be generated during peak training activities. As a result, during periods of lower waste generation, the incinerator will not be operated regularly. During periods of lower waste generation, waste will be received on a daily basis and will be stored in sealed containers (to control vectors and odors) until adequate quantity is accumulated to operate the incinerator.

The typical waste incinerator will be composed of a waste in-feed system, closed combustion chamber(s), exhaust/air pollution control system, and ash handling system. Small scale waste incinerators typically require supplemental fuel to start up and to supplement the basal thermal unit-value of the waste to maintain minimum and stable combustion temperatures.

The incinerator facility will be an enclosed or partially enclosed building to shelter the incinerator equipment from the elements. The waste-receiving portion of the building should be sized to receive and store several days of incoming waste in the event of incinerator downtime. The waste handling area will require rolling-stock equipment capable of handling the incoming waste, placing the waste into the incinerator feed system, and placing the waste into storage containers. The facility will need an all-weather access road and staging area for the waste storage containers. The building will require a concrete floor capable of supporting the incoming waste collection vehicles and the rolling-stock operational equipment; the floor should be water-tight and equipped with a sump to collect and manage liquids seeping from the waste.

An on-site incinerator will require local land use and environmental permits issued by the governing CNMI agencies. The incineration and air pollution control equipment design will be required to satisfy the applicable environmental regulations. Ash residue generated by the incinerator will be collected, stored and periodically transported to a lined Resource Conservation and Recovery Act Subtitle D landfill permitted to accept solid waste incinerator ash. If the incinerator ash tests positive for hazardous constituents, it will be managed as hazardous waste and disposed of at an U.S. Environmental Protection Agency permitted hazardous waste disposal facility.

5.4 HAZARDOUS, INDUSTRIAL, UNIVERSAL, AND ELECTRONIC WASTE

Hazardous wastes, non-hazardous industrial wastes, universal wastes (i.e., fluorescent lamps, mercury-containing instruments, batteries), and electronic waste (e.g., computer equipment, monitors, televisions, etc.) will be collected, shipped off the island, and managed in accordance with applicable regulations.

Training will be implemented to address identification of hazardous materials and measures and methods to be employed to prevent improper disposal of these materials with the non-hazardous solid waste.

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6 REGULATORY SETTING

Solid waste management on Tinian is governed by several federal and CNMI regulations and agencies, as described below.

6.1 COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS

6.1.1 Bureau of Environmental and Coastal Quality

The Bureau of Environmental and Coastal Quality is the lead regulatory agency for solid waste management within the CNMI. Solid waste management regulations have been promulgated and are found in Title 65 Chapter 80 of the CNMI Administrative Code. In this documentation, the municipal solid waste disposal requirements, presented in Part 201, state that the following regulations apply:

- Section 65-80-201, "Municipal Solid Waste Criteria."
- Section 65-10, "Air Pollution"
- 40 CFR section 258 (1999), which is adopted by reference in its entirety and attached as Appendix I to Title 65 Chapter 80. All municipal solid waste Landfills must comply with the provisions of 40 CFR section 258 (1999).

The purpose of the regulations is to establish requirements and criteria for new and existing solid waste management activities and facilities, including municipal solid waste landfills and other landfilling operations, incineration, solid waste collection and transfer, recycling, composting, and salvage. The Solid Waste Management Regulations further require a municipal solid waste landfill to comply with Part 258 ("Criteria for Municipal Solid Waste Landfills") of Title 40 CFR, which the Solid Waste Management Regulations (Northern Mariana Islands Administrative Code 2004) have adopted and incorporated by reference.

6.1.2 Coastal Resources Management

The Bureau of Environmental and Coastal Quality promotes the conservation and wise development of coastal resources. One of the Bureau of Environmental and Coastal Quality functions is to coordinate the site selection permit process, thereby ensuring that permit decisions are consistent with Coastal Resource Management regulations.

A site selection permit process occurs when any proposed project has the potential to affect coastal resources directly and significantly. In accordance with CNMI Administrative Code Title 15, Chapter 10, "Coastal Resources Management Rules and Regulations," the selection of a municipal solid waste landfill site would fall within the purview of this regulation.

An Area of Particular Concern is a geographically delineated area with special management requirements enforced by the Coastal Resource Management Office. There are five areas of particular concern:

- *Shoreline:* The area between the mean high-water mark and 150 feet [46 meters] inland.
- *Lagoon and reef:* The area extending seaward from the mean high-water mark to the outer slope of the reef.

- *Wetlands and mangroves:* Areas that are permanently or periodically covered with water and where wetland or mangrove vegetation can be found.
- *Port and industrial:* Land and water areas surrounding the commercial ports of Saipan, Tinian, and Rota.
- *Coastal hazards:* Areas identified as coastal flood hazard zones.

When siting any on-island municipal solid waste facilities, the Municipality of Tinian must avoid areas of particular concern or, if these areas are unavoidable, must ensure that proposed facilities situated within an Area of Particular Concern would comply with the requirements of the Coastal Resource Management coastal permit.

6.1.3 Division of Fish and Wildlife

The CNMI Division of Fish and Wildlife is one of several agencies within the CNMI Department of Land and Natural Resources tasked with ensuring the long-term survival and sustainability of the CNMI's natural resources. Department of Fish and Wildlife reviews development proposals submitted to the Bureau of Environmental and Coastal Quality (e.g., applications for major site location permits and associated environmental assessments) to ensure that the proposed developments would minimize, mitigate, or avoid negative impacts on endangered or threatened species. Additionally, Department of Fish and Wildlife consults with the U.S. Fish and Wildlife Service pursuant to the federal Endangered Species Act (16 U.S. Code [U.S.C.] section 1536) as warranted.

6.1.4 Historic Preservation Office

The CNMI Historic Preservation Office was established by the Commonwealth Historic Preservation Act of 1982 (Northern Mariana Islands Administrative Code 1982) to identify and protect significant archaeological, historic, and cultural resources in the CNMI. Under Public Law 3-39, the Historic Preservation Office is mandated to review proposed developments pursuant to Section 106 of the National Historic Preservation Act of 1982 (Northern Mariana Islands Administrative Code 1982). A Section 106 review must be performed for projects that involve a direct, indirect, or an adverse impact on a property that is included or eligible for inclusion in the National Register of Historic Places. The proponent of a Proposed Action is responsible for initiating and ensuring completion of the Section 106 review. The Historic Preservation Office assists the Coastal Resource Management Office in evaluating applications for major site location permits as well as environmental assessments.

The Historic Preservation Office's input is intended to ensure either that significant prehistoric, historic, and cultural resources at or near a proposed municipal solid waste landfill would be protected from damage, or that sufficient site data would be compiled before such resources are altered or destroyed. The proponent of a Proposed Action may also be required to complete an Application for Historic Preservation Review to include construction plans and location maps.

6.2 UNITED STATES GOVERNMENT

6.2.1 United States Environmental Protection Agency

Subtitle D of the Resource Conservation and Recovery Act, incorporated into the CNMI Solid Waste Management Regulations by reference, uses a combination of design and performance standards for regulating municipal solid waste landfills and solid waste management facilities in general. It also establishes facility design and operating standards, groundwater monitoring, corrective action measures, and conditions, including financial requirements, for landfill closure and post-closure care as enforced by the United States Environmental Protection Agency.

Owners/operators that dispose of less than 20 tons/day based on an annual average, are exempt from subparts D and E of 40 CFR 258, so long as the requirements of 40 CFR 258.1(f) are met. Subpart D -provides liner design criteria where the requirement for a composite liner and leachate collection/removal system is found and Subpart E - provides groundwater monitoring and corrective action requirements. The exemption provided by 40 CFR 258.1(f) is available under the following conditions:

- There is no evidence of groundwater contamination from the landfill, and either of the following is satisfied:

  2.a. The community served by the landfill experiences annual interruptions of at least 3 consecutive months of surface transportation that prevent access to a regional waste management facility or

  2.b. The community has no practical waste management alternative, and the landfill unit is located in an area that annually receives less than or equal to 25 inches of precipitation.

Other Resource Conservation and Recovery Actregulations that apply for management of potential waste streams are as follows:

- Hazardous wastes must be managed per Resource Conservation and Recovery Actregulations are contained in title 40 of the C.F.R. parts 260 through 273.
- Standards for the management of used oil are contained in 40 C.F.R. 279.
- Guidelines for the thermal processing of solid wastes in 40 C.F.R. 240 will be applicable if waste is incinerated.

The management of solid waste through an incinerator will be subject to air pollution emission limitations, air pollution control equipment, and operating permits as required by the Clean Air Act as implemented through 40 C.F.R. Subchapter C.

6.2.2 Federal Aviation Administration

Improved reporting, studies, documentation, and statistics clearly show that aircraft collisions with birds and other wildlife are a serious economic and public safety problem. Section 503 of the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (U.S. Congress 2000), enacted in April 2000, addresses this hazard. This law prohibits construction or establishment of a new municipal solid waste landfill within 6 miles (9.7 kilometers) of certain public-use airports, as measured between the property lines of the airport and the landfill. Federal Aviation

Administration Advisory Circular AC No.: 150/5200-34A provides compliance guidance with this law.

In its National Plan of Integrated Airport Systems (2001–2005) (Department of Transportation 2002), the Federal Aviation Administration lists Francisco Manglona Borja / Tinian International Airport as a primary commercial service facility, thus requiring compliance with the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (U.S. Congress 2000, 49 U.S.C. Section 44718).

Advisory Circular AC No.: 150/5200-34A, Section 7 provides the following statement in regard to landfills that would be located within 6 miles of an airport:

> "If it is determined that a new municipal solid waste landfill would be located within six miles of such a public airport, then either the municipal solid waste landfill should be planned for an alternate location more than 6 miles from the airport, or the municipal solid waste landfill proponent should request the appropriate state aviation agency to file a petition for an exemption from the statutory restriction. Presumably, the CNMI aviation agency would be responsible and assist in the preparation and submittal of the required exemption request."

7 REFERENCES

CNMI. 2023. *DRAFT Comprehensive Integrated Solid Waste Management Plan for the Commonwealth of the Northern Mariana Islands.*

Department of Environmental quality . 2010. *Cease and Desist/Administrative Order.* Prohibition of Burning of Wastes and Requirement to Maintain Landfill Cover at the Tinian Dump. CASE NO. DEQ SWM 2010-01.

DoN. 2018. *Solid Waste Study Update V2a1 Final in Support of the Commonwealth of the Northern Mariana Islands Joint Military Training Environmental Impact Statement/Overseas Environmental Impact Statement.* JBPHH, HI: Prepared for NAVFAC Pacific. April.

GHD, Inc./Gershman, Brickner, & Bratton, Inc. December 2019. *CNMI Department of Public Works Solid Waste Management Feasibility Study.*

NMIAC. 1982. *Commonwealth Historic Preservation Act of 1982.* Public Law 3-39. December.

Office of the Assistant Secretary of Defense, 2020. *Memorandum for Deputy Assistant Secretary of the Army (Energy and Sustainability) Deputy Assistant Secretary of the Navy (Installations and Facilities) Deputy assistant Secretary of the Air Force (Environment, Safety and Infrastructure) Staff Director, Defense Logistics Agency (Environmental Management). Subject: Revision to the Department of Defense Integrated Sollid Waste Management Metrics.* March 16, 2020.

U.S. Army. 2014. Email from Ms. Lisa Duwall, Pohakuloa Training Area (PTA) Solid Waste Contract Program Evaluator, Solid Waste Generation Rate at PTA. 22 May 2014.

U.S. Congress. 2000. *Wendell H. Ford Aviation Investment and Reform Act for the 21st Century.* 49 U.S.C. Section 44718.

USEPA 2003. *Estimating Building-Related Construction and Demolition Material Amounts.*

USEPA 2018. *Construction and Demolition Generation in the United States.*

USEPA 2020. *Advancing Sustainable Materials Management: 2018 Fact Sheet.*

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STORMWATER STUDY
IN SUPPORT OF THE
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
JOINT MILITARY TRAINING ENVIRONMENTAL IMPACT STATEMENT

Department of the Navy
Naval Facilities Engineering Systems Command, Pacific
258 Makalapa Drive, Suite 100
JBPHH HI 96860-3134

June 2025

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1 INTRODUCTION

1.1 PURPOSE

The purpose of this study is to provide planning-level concepts for stormwater management in support of the Commonwealth of the Northern Mariana Islands (CNMI) Joint Military Training (CJMT) Environmental Impact Statement. This comprehensive assessment encompasses existing site hydrology and hydraulics and potential impacts of the Proposed Action. Cut and fill required for construction activities would be balanced on each site, eliminating the need for import or export of soil. Mitigation includes Low Impact Development integrated management practices to manage stormwater. This analysis is based on applicable United States (U.S.) and local regulations governing the collection, conveyance, storage, treatment, infiltration, and/or disposal of stormwater.

The following design storms are analyzed in this study:

- 1-year recurrence interval, 24-hour storm event
- 25-year recurrence interval, 24-hour storm event
- 24-hour detention time, including sediment storage volume
- 95th percentile storm event

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2 REGULATORY FRAMEWORK

This chapter provides a brief overview of the pertinent regulations that apply to the Proposed Action and discusses how each is used in the stormwater study.

2.1 ENERGY INDEPENDENCE AND SECURITY ACT OF 2007 SECTION 438

The Energy Independence and Security Act of 2007 requires "the sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow." This statutory requirement promotes the use of sustainable stormwater management strategies—such as green infrastructure and Low Impact Development to reduce runoff impacts from federal projects.

Section 438 was previously supported and reinforced by Executive Order 13693, *Planning for Federal Sustainability in the Next Decade* (signed in 2015). However, Executive Order 13693 was revoked by Executive Order 13834 in 2018. Despite these changes in Executive Orders, the requirements of Section 438 remain in effect as federal law and continue to guide agency compliance related to stormwater management on federal properties.

Technical guidance issued by the United States (U.S.) Environmental Protection Agency for implementing Section 438 remains applicable and is still used by federal agencies to inform project planning and design in accordance with the law

2.2 TECHNICAL GUIDANCE FOR THE ENERGY INDEPENDENCE AND SECURITY ACT SECTION 438 IMPLEMENTATION

This document recommends that projects reduce hydrologic impacts by implementing green infrastructure or Low Impact Development techniques designed to either retain the 95th percentile storm event on-site or maintain pre-development runoff conditions through site-specific hydrologic analysis (U.S. Environmental Protection Agency 2009). The 95th percentile storm event is used as a design criterion, as discussed in Chapter 5.

2.3 DEPARTMENT OF THE NAVY LOW IMPACT DEVELOPMENT POLICY FOR STORMWATER MANAGEMENT

This policy document aligns with federal mandates on Efficient Federal Operations, emphasizing stormwater management through a Low Impact Development approach. The goal is to prevent any net increase in stormwater volume, sediment, or nutrient loading from major renovation and construction projects. To achieve this, the policy mandates that Low Impact Development be incorporated into the design of all projects with a stormwater management component (Department of Defense [DoD] Unified Facilities Criteria 3-210-10, 2023).

This requirement is also based on the Department of the Navy's 2007 Low Impact Development Policy for Stormwater Management, issued by the Assistant Secretary of the Navy (Installations and Environment), which mandates no net increase in stormwater volume, sediment, or nutrient loading from construction and major renovation activities

This policy provides guidance for reviewing and selecting Low Impact Development strategies for proposed stormwater management systems, ensuring compliance with the Energy Independence and Security Act Section 438 and Executive Order on Efficient Federal Operations. Further details are included in Chapter 6.

2.4 DEPARTMENT OF DEFENSE IMPLEMENTATION OF STORM WATER REQUIREMENTS UNDER THE ENERGY INDEPENDENCE AND SECURITY ACT SECTION 438

This DoD requirement is the overall design objective for each project and should maintain pre-development hydrology and prevent any net increase in stormwater runoff. The design requirement further states if this design objective cannot be met within the project footprint, Low Impact Development measures may be applied at nearby locations on DoD land. (DoD 2023). This policy further supports the evaluation of Low Impact Development, as described in Chapter 6.

2.5 UNIFIED FACILITIES CRITERIA 3-201-01, CIVIL ENGINEERING

This document provides requirements for all aspects of civil site development for proposed U.S. military facilities, including grading and drainage (DoD 2022).

2.6 UNIFIED FACILITIES CRITERIA 3-210-10, LOW IMPACT DEVELOPMENT

This document provides guidelines for planning, designing, constructing, and maintaining Low Impact Development strategies for stormwater management. The manual presents basic guidance for Low Impact Development design with an overview of the associated operation, cost, and maintenance considerations (DoD 2023).

2.7 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT ADMINISTRATION

The U.S. Environmental Protection Agency (EPA) Region 9 retains primary responsibility for administering and enforcing the National Pollutant Discharge Elimination System (NPDES) permit program in the CNMI. While CNMI agencies may assist in permit compliance activities, the EPA is the permitting authority and has ultimate oversight over all NPDES permitting and enforcement actions in the territory.

2.8 CNMI AND GUAM STORMWATER MANAGEMENT MANUAL

The *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006) provides additional stormwater guidance and standards. Applicable standards for CJMT include:

- **Standard 1.** Site designers shall strive to reduce the generation of stormwater runoff and use pervious areas for stormwater treatment. For development sites over 1 acre, impervious cover shall not exceed 70 percent of the total site area. Impervious areas are hard surfaces that prevent water from infiltrating into the ground and include paved and coral surfaces such as roads, driveways, parking lots, and yards, as well as rooftops.

- **Standard 2.** Stormwater management shall be provided through a combination of structural and non-structural practices.
- **Standard 3.** All stormwater runoff generated from new development shall be adequately treated prior to discharging into jurisdictional wetlands or inland and coastal waters of CNMI and Guam.
- **Standard 4.** Pre-development annual groundwater recharge rates and runoff rates to coastal waters shall be maintained by promoting infiltration using structural and non-structural methods.
- **Standard 5.** New development shall use structural best management practices designed to remove 80 percent of the average annual post-development total suspended solids load and match or exceed pre-development infiltration rates, as possible. It is presumed a best management practice complies with the standard if it is:
  - Sized to capture the prescribed water quality volume.
  - Designed to match or exceed pre-development infiltration rates.
  - Designed according to the specific performance criteria outlined in the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006).
  - Constructed properly.
  - Maintained regularly.
- **Standard 6.** The post-development peak discharge rate frequency shall not exceed the pre-development peak discharge rate for the 25-year frequency storm event.
- **Standard 7.** To protect stream channels from degradation, channel protection shall be provided by means of 24 hours of extended detention storage for the 1-year frequency storm event.
- **Standard 8.** Stormwater discharges to critical areas with sensitive resources (i.e., coral reefs, swimming beaches, wellhead protection areas, designated sensitive ecosystems) would be subject to additional performance criteria, and would need the use or restriction of certain best management practices.
- **Standard 9.** All best management practices shall have an enforceable operation and maintenance agreement to ensure the system functions as designed. In addition, every best management practice shall have an acceptable form of water quality pretreatment.
- **Standard 10.** Redevelopment projects are governed by special stormwater sizing criteria depending on the amount of increase or decrease in impervious area created by the redevelopment. Redevelopment projects that reduce impervious cover (from existing conditions) by at least 40 percent are deemed to meet both the recharge and water quality requirements (Standards 4 and 5, above). Where site conditions prevent the reduction in impervious cover, stormwater management practices shall be implemented to provide stormwater controls for at least 40 percent of the site's impervious area. When a combination of impervious area reduction and stormwater management practice implementation is used for redevelopment projects, the combination of impervious area reduction and the area controlled by a stormwater management practice shall equal or exceed 40 percent.

- **Standard 11.** For sites meeting the definition of an "infill development project," the stormwater management requirements would be the same as for other new development projects with the important distinctions that the applicant can meet those requirements either on-site or at an approved off-site location and that the 70 percent impervious cover requirement may be waived. An approved off-site location must be identified in accordance with CNMI/Guam review. The applicant must also demonstrate that no downstream drainage or flooding impacts would occur as a result of not providing on-site management. The intent of this provision is to allow flexibility to meet the goals of improved water quality and channel protection to receiving waters while still promoting infill development.
- **Standard 12.** Certain industrial sites are required to prepare and implement a stormwater pollution prevention plan. All sites with disturbance over 1 acre are required to prepare and implement a stormwater pollution prevention plan in accordance with the National Pollutant Discharge Elimination System Phase II Stormwater Program.
- **Standard 13.** Stormwater discharges from land uses or activities with higher potential pollutant loadings, defined as hotspots, are required to use specific structural best management practices and pollution prevention practices. In addition, stormwater from a hotspot land use may not be recharged to groundwater without pretreatment of 100 percent of the water quality volume or the recharge volume, whichever is greater.

2.9 RANGE ENVIRONMENTAL VULNERABILITY ASSESSMENT

The Range Environmental Vulnerability Assessment program is a proactive and comprehensive initiative that serves as a baseline assessment of operational ranges across U.S. Marine Corps installations. The Range Environmental Vulnerability Assessment program operates outside of regulatory requirements, aiming to proactively address potential environmental concerns and to promote sustainable range practices. This aligns with the DoD Instruction 4715.14, *Operational Range Assessments*, which outlines key requirements for responsible range management.

3 EXISTING CONDITIONS

3.1 TOPOGRAPHY

Tinian consists of a series of limestone plateaus separated by steep slopes and cliffs. The major plateaus are generally level. Tinian consists of four major surface geologic units (physiographic regions) (Gingerich 2002) (Figure 1):

- **Tinian Pyroclastic (Volcanic) Rock.** These fine-grained to coarse-grained ash and angular fragments represent explosive materials ejected from an ancient volcano that forms the core of the island. These rocks are exposed on the North-central Highland and Southeastern Ridge and cover approximately 2 percent of the surface of the island. These materials generally appear to be highly weathered and altered in surface exposures. This rock unit has low permeability due to its texture and density.
- **Tagpochau Limestone.** These highly weathered rocks are exposed on about 15 percent of the island's surface and are generally located in the North-central Highland and the southern part of the Southeastern Ridge. These rocks reach up to 600 feet in thickness. Surface exposures are composed of fine- to coarse-grained, partially recrystallized broken limestone fragments, and about 5 percent are reworked volcanic fragments and clays. This unit consists of highly permeable and fractured material.
- **Mariana Limestone.** These rocks cover approximately 80 percent of the island's surface forming nearly all of the North Lowlands, the Central Plateau, and the Marpo Valley. These rocks reach up to 450 feet in thickness and are composed of fine- to coarse-grained fragmented limestone, with some fossil and algal remains and small amounts of clay particles. Small voids and caverns are common in surface exposures. The Mariana Limestone has a higher coral content than the Tagpochau Limestone; however, is also highly permeable.
- **Beach Deposits, Alluvium, and Colluvium.** These deposits cover less than 1 percent of the island's surface and reach up to 15 feet in thickness. The deposits consist of poorly consolidated sediments, mostly sand and gravel deposited by waves; however, they contain clays and silt deposited inland beside Lake Hagoi and Makpo Marsh as well as loose soil and rock material at the base of slopes.

3.2 EXISTING SLOPE

Much of the relatively flat land across the Military Lease Area was previously used for agriculture and then for military facilities during World War II. Steeper-graded areas are primarily limited to coastal bluffs, native limestone forests, and a few steep areas in and around localized depressions.

Figure 1. Island of Tinian – Physiographic Regions

3.3 SOILS

Soils are divided into four different hydrologic soil groups (Hydrologic Soil Groups A through D) based on a soil's runoff potential and infiltration capabilities. Generally, soils composed of limestone upland soils in relatively flat areas are classified as Hydrologic Soil Group A and infiltrate well, resulting in less runoff. Hydrologic Soil Group B is classified as soils having moderate infiltration rates when thoroughly wetted. Soils that belong to the Hydrologic Soil Group C have a moderate potential for runoff when they are completely wet and include silt loam, sandy clay loam, clay loam, and silty clay loam. Soils composed of basalt are classified as Hydrologic Soil Group D and infiltrate poorly, resulting in greater runoff. Soils in the project area are entirely Hydrologic Soil Group B. The Hydrologic Soil Group regions are shown in Figure 2.

The U.S. Department of Agriculture Soil Conservation Service identified soil classes across Tinian in 1985 (U.S. Department of Agriculture Soil Conservation Service 1989).

3.4 CLIMATE AND HYDROLOGY

Rainfall on Tinian averages 83 inches per year, based on the 50-year rainfall database (Lander and Guard 2003). The wet season, which typically occurs between July and November, receives 65 percent of the annual precipitation, while 16 percent typically occurs during the dry season from January to April (Lander and Guard 2003). The remaining transitional months (November, December, January, May, and June) receive approximately 19 percent of the rainfall (Carruth 2008). Tropical storms comprise a significant percentage of the total annual rainfall. Most of the precipitation on Tinian evaporates, transpires, or percolates into openings in the limestone and volcanic rock beneath the thin soil surface (Gingerich 2002).

The surface hydrology on Tinian includes minimal overland flow, except during intense rainfall events. The drainage is primarily groundwater transport with precipitation percolating quickly into porous rock. As a result, there are no permanent streams or major overland conveyance systems, and no particular drainage problems (Doan et al. 1960).

Figure 2. Island of Tinian – Hydrologic Soil Groups

4 STORMWATER CONSIDERATIONS

This chapter describes the design assumptions including grading, drainage, and Low Impact Development, as well as existing physical conditions, used in evaluating stormwater quantity.

4.1 ASSUMPTIONS

- Comply with Unified Facilities Criteria 03-201-01, *Civil Engineering* (DoD 2022) for minimum and maximum grading slopes.
- Apply Low Impact Development Integrated Management Practices in accordance with Unified Facilities Criteria 3-210-10 (DoD 2023).
- Comply with design-level guidance for grading and drainage systems in accordance with Unified Facilities Criteria 03-201-01 (DoD 2022).
- Use Section 3 of Unified Facilities Criteria 03-201-01, *Civil Engineering* (DoD 2022), for storm drainage system design criteria.
- Convey drainage primarily via overland sheet and channelized flow; avoid the use of culverts and gray infrastructure (pipes and inlets), if feasible.
- Avoid/minimize impacts to depressional areas and karst/fractured surface geology due to the potential for conduits for stormwater flow and contamination of freshwater lens.
- Avoid/minimize impacts to wellhead protection areas and associated buffers.
- Avoid/minimize impacts to ecologically sensitive areas (marine environments, wetlands, and protected habitat) and associated buffers.
- Avoid/reduce impacts to culturally sensitive areas and areas of historical significance.
- Avoid downstream impacts on existing non-DoD areas.
- Avoid/minimize impacts to existing operational facilities and associated utilities, including any communications sites, Francisco Manglona Borja/Tinian International Airport, and other facilities, as applicable.
- Expand the existing stormwater berm on the east, north, and south sides of the main transmitter building to increase runoff containment and peak flow reduction. The scope also includes a new berm along the northern edge of the support facilities area to redirect offsite water flows eastward, away from the warehouse and maintenance facility. Modifications include an increase in crest elevation and possibly additional armoring for erosion protection.
- Expand engineered stormwater berms to prevent external runoff from impacting the project area along the perimeter of key training areas, such as the Multi-Purpose Maneuver Range and Explosives Training Range. These berms would redirect off-site flows away from operational areas, ensuring that runoff modeling focuses solely on project-specific impervious area increases. Additionally, channelized flow systems would be integrated in identified high-concentration drainage pathways to reduce erosion and peak discharge rates.

4.2 DEPRESSIONAL AREAS

Landlocked and/or isolated depressional areas potentially contain direct conduits to the underlying freshwater lens aquifer. As a result of the high soil porosity and karst, fractured surface geology, these depressions are believed to facilitate rapid stormwater infiltration, preventing stormwater from staging up and spilling downstream. The specific history of geologic creation of these depressions is unknown, but they are believed to be manmade. The depressions are treated as closed basins/sinkholes with respect to stormwater, and these depressional areas should be avoided. Preliminary analysis indicates that stormwater would not have any detrimental impact on depressional areas.

4.3 PROTECTED SURFACE WATERS

All new development projects must treat stormwater runoff properly before discharging it into CNMI and Guam waters or wetlands, per Standard 3 (*CNMI and Guam Stormwater Management Manual*). For stormwater management purposes, surface waters in freshwater areas, ephemeral ponds, potential wetlands, or non-delineated wetlands are considered wetlands. Any potential impacts on these areas, such as those caused by grading, drainage, disturbance, or stormwater conveyance elements, should be avoided or minimized. Three potential wetland areas in Hagoi, the Mahalang Complex, and Bateha would fall under this protection. Stormwater runoff would be captured and treated before reaching these wetland habitats of Tinian to avoid any adverse effects.

4.4 FAULT LINES

Fault lines may act as direct conduits for surface water runoff to drain directly to the freshwater lens aquifer. For this reason, fault lines would be buffered and proposed stormwater management facilities would be kept a reasonable distance away. Typically, best management practices for setbacks include 150 feet for stormwater ponds and infiltration devices and 250 feet for permanent, critical facilities.

5 WATER QUANTITY ANALYSIS

To simulate stormwater runoff within the representative sub-basins, the analysis followed the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006) and used HydroCAD Version 10.00-20 stormwater modeling software published by HydroCAD Software Solutions LLC. The HydroCAD model was used to determine peak discharge rates and preliminarily size various types of surface, subsurface, and conveyance best management practices. Using the Natural Resources Conservation Service Technical Release No. 20: Project Formulation – Hydrology procedures, the model provided hydrograph generation and routing for a given rainfall event. Runoff hydrographs were developed from rainfall using the dimensionless unit hydrograph, drainage areas, times of concentration, and Natural Resources Conservation Service runoff curve numbers.

The initial runoff analysis used the third quartile 24-hour storm event based on National Oceanic and Atmospheric Administration Atlas 14 (2011) assuming soil type Hydrologic Soil Group B. Natural Resources Conservation Service curve number values were selected based on soil group and land use category. The soil groups and land uses were categorized for each sub-basin in the project area.

5.1 DIGITAL ELEVATION MODEL DEVELOPMENT

A digital elevation model is a grid of geospatially referenced coordinates used to create three-dimensional representations of the earth's surface. The software ArcGIS version 10.8.1 by Esri, Inc., was used to create a grid with 3.28-foot on-center spacing using the 5-foot contour interval topographic survey (Geodatabase V1).

The following steps were involved in the development of the digital elevation model:

1. Shapefiles for the 5-foot and 50-foot contours were extracted from the geodatabase.
2. An elevation of 0 was not found in either the 5-foot or 50-foot contours. To resolve this issue, a boundary line was used to separate the gap zone where the 50-foot contours were applied. Everywhere else, the 5-foot elevation line was extended by 5 feet and designated an elevation value of 0. This method ensures there is no overlap between the 5-foot and 0-foot values.
3. Once all the lines were cleaned and ready, a triangulated irregular network was created using the 5-foot contours, 50-foot contours (tied in), and boundary line (the new boundary from the 5-foot contour buffer set to 0-foot elevation) as the elevation data. The new boundary line was converted to a polygon and was used as a hard clip.
4. The triangulated irregular network was converted to a digital elevation model and the cell size was set to 1 meter.
5. For the proposed conditional analysis, a modified digital elevation model was generated by integrating a balanced cut-and-fill analysis with the existing conditions digital elevation model. This combined raster represents the proposed post-project topography.

5.2 FLOW PATH DETERMINATION AND SUB-BASIN DELINEATION

Arc Hydro was used to perform ponding analysis, flow path analysis, and sub-basin area delineation. Arc Hydro typically uses a "fill sinks" approach to identify drainage flow paths. In this approach, flow paths are created by analyzing the elevation of each 1-meter-square digital elevation model cell compared to its eight neighboring cells in the grid and the direction established toward the lowest cell. Because of the karst geology and expansive ponding areas, disabling the "fill sinks" feature in Arc Hydro and establishing unobstructed drainage routes for water to collect and flow toward the location was practical. Ponding and flow path identification does not identify underground conduits or infiltration.

For accurate runoff modeling, two scenarios were considered: (1) assuming off-site flows bypass the study area via engineered berms, and (2) considering off-site contributions where natural depressions and uncontained drainage patterns allow infiltration. Off-site runoff contributions were excluded from primary sub-basin calculations given engineered berm placements along perimeter zones. Consequently, curve number values in Section 5.4 reflect post-development conditions only for on-site impervious areas, aligning with CNMI and Naval Facilities Engineering Systems Command guidelines. The analysis accounted for both pre- and post-development conditions, incorporating expanded impervious areas, revised outflow points, and updated detention storage to optimize stormwater control and to minimize impacts to adjacent areas.

5.3 LAND USE AND LAND COVER

According to the U.S. Forest Service's vegetation mapping of Tinian, updated by the U.S. Fish and Wildlife Service, approximately 90 percent of the island is covered in vegetation. The exceptions are developed areas in San Jose, the Port of Tinian, the airport, roads, and small sections of rock outcroppings, sand, and soil. Most of this vegetation includes non-native tangantangan (*Leucaena leucocephala*), mixed introduced forest, native limestone forest, and herbaceous-scrub. Other vegetation types, wetland habitats, and agricultural areas comprise the remainder. This report focuses on land use cover to understand current and future stormwater flows. Areas with dense vegetation cover are called mixed forest, including tangantangan trees and other species with dense cover, while areas without trees are called shrubs and grassland. Figure 3 shows the general land cover on Tinian.

Figure 3. Land Cover on the Island of Tinian

5.4 TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Table 1. Curve Numbers Used for Post-project Land Cover and Soil on Tinian

Land Cover ID	*Hydrologic Soil Group B*
Barren	75.6
Other Scrub/Grassland	51.1
Scrub/Shrub	38.5
Leucaena Forest	45.2
Limestone Degraded Forest	45.2
Limestone Native Forest	45.2
Wetland Herbaceous	81.6
Wetland Shrub-Herb	81.6
Developed	98.0

Legend: ID = identification.
Source: AECOM 2014.

5.5 INITIAL ABSTRACTION/STORAGE TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

The Natural Resources Conservation Service methodology estimates precipitation excess as a function of cumulative precipitation, soil cover, land use, and antecedent moisture content. The maximum retention and the initial abstraction are related through an intermediate parameter, the curve number. The calculation of runoff amount in HydroCAD was completed using Table 2-2

(U.S. Department of Agricultural Soil Conservation Service 1986), which takes into account factors such as soil type, land use, and curve number.

5.6 TIME OF CONCENTRATION TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

The time of concentration of a watershed is defined as the time required for a drop of water to travel from the most hydraulically distant part of a watershed to the point of discharge or outlet. Time of concentration is computed by summing all the travel times for consecutive drainage system components. The time of concentration for each sub-basin was developed using the TR-55 equations (U.S. Department of Agricultural Soil Conservation Service 1986).

For sheet flow of fewer than 300 feet, Manning's kinematic solution (Overton and Meadows 1976) is used to compute travel time. After 300 feet, sheet flow usually becomes a shallow, concentrated flow. The average velocity for this flow can be determined from the equation shown below, in which average velocity is a function of the watercourse slope and type of cover.

$$T(t) = \frac{L}{60\,k\sqrt{S}}$$

Where:

$T(t)$	=	Travel time for open channel flow segments
L	=	Length of flow segment
k	=	Intercept coefficient per Table 3-3 of the Federal Highway Administration Hydraulic Engineering Circular No. 22, Third Edition (Federal Highway Administration 2009)
S	=	Slope of the ground surface as a percentage

5.7 DESIGN STORM FREQUENCY TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Pre- and post-development hydrology were analyzed for the following design storm events:

- 1-year and 25-year recurrences, 24-hour storm events
- 95th percentile storm event

These storm events were selected to meet the design requirements established in the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006).

5.8 DESIGN RAINFALL DEPTHS AND DISTRIBUTION TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the
lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

The *Rainfall Data Verification Memorandum*, prepared by the University of Guam, U.S. Department of Agriculture, and National Oceanic and Atmospheric Administration, summarizes precipitation data, distribution curves, and intensity duration frequency curves for Tinian (National Oceanic and Atmospheric Administration 2011). No additional applicable rainfall data that would supersede these values have been published since the *Rainfall Data Verification Memorandum*. Table 2 provides design storm event rainfall depths.

Table 2. Rainfall Data per Design Storm

Location	*Mean Annual Rainfall (in)*	*Water Quality Storm Events*	*24-Hour Rainfall (in) per Recurrence Interval (years)*	
		95th Percentile	*1 yr*	*25 yr*
Tinian	83.4	2.2	4.25	14.88

Legend: in = inch; yr = year.
Source: Lander and Guard 2003.

Temporal distributions of precipitation are provided with precipitation frequency estimates from the National Oceanic and Atmospheric Administration Atlas 14 Volume 5 (National Oceanic and Atmospheric Administration 2011) for the 6-hour, 12-hour, 24-hour, and 96-hour durations. The temporal distributions are expressed in probability as cumulative percentages of precipitation totals at various time steps. For this study, the third quartile 24-hour duration rainfall distribution curve was selected based on data indicating that third quartile distribution occurs most frequently with 24-hour storm events.

5.9 RESULTS OF ANALYSIS TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Following the mapping and calculation of baseline hydrologic conditions, the proposed conditions were evaluated to assess the impact of changes in impervious surfaces, land use, and curve numbers. The analysis encompassed the proposed Base Camp (former U.S. Agency for Global Media site), Ammunition Holding Area, Explosives Training Range, and supporting infrastructure, including roads and utility corridors. Stormwater runoff was modeled for the 1-year, 25-year, and 95th percentile storm events to determine changes in runoff volume, peak flow rates, and time of concentration.

The hydrologic model was structured to reflect distinct drainage basins within the Base Camp footprint, accounting for variations in topography, soil permeability, and flow paths. The Base Camp area was delineated based on drainage direction and existing stormwater infrastructure. Each sub-basin was assigned updated curve numbers to reflect the expansion of impervious surfaces, new detention areas, and the revised stormwater berm configuration.

HydroCAD modeling outputs were generated to analyze changes in peak flows and runoff volumes under post-development conditions. The results, summarized in Table 3, highlight adjustments to stormwater parameters based on updated land use classifications, while Table 4details the pre- and post-development peak discharge rates and runoff volume changes for each design storm event. The purpose of these analyses is to define stormwater routing, detention capacity, and best management practice implementation, aligning with regulatory requirements and site-specific hydrologic conditions.

The drastic decrease in time of concentration is primarily due to the increase in impervious area, which reduced infiltration and accelerated runoff. The replacement of dense vegetation with paved surfaces substantially lowered surface roughness, increasing flow velocity. Additionally, the introduction of engineered drainage features, steeper slopes, and channelized flow paths further expedited runoff travel time. These changes are typical in developed areas, where stormwater moves much faster compared to natural landscapes.

The areas shown in Table 3and Table 4 reflect total acreages with potential off-site runoff contributions removed, ensuring that the analysis only considers site-generated stormwater flows. The new impervious areas of the Surface Radar Site and the Explosives Training Range were excluded because their combined impervious area (< 0.05 ac) is below the CNMI SW Manual threshold for quantitative analysis; however, the Ammunition Holding Area, supporting roads, and utility corridors are included in the composite curve number and HydroCAD models. The Surface Radar Site was screened out of the quantitative model due to its remote location and <0.05 ac of impervious cover, resulting in a de minimis runoff contribution; therefore it is not listed in Attachment A HydroCAD. However, due to the unique operational nature of the Explosives Training Range, small-scale stormwater management options should still be considered to address localized runoff and potential water quality impacts in training areas.

The HydroCAD software has a built-in function that rounds curve numbers to the nearest whole number. This information is displayed in the table provided in the HydroCAD output.

Table 3. HydroCAD Stormwater Parameters

Parameter	***Base Camp***		***MPMR***	
	Existing	***Proposed***	***Existing***	***Proposed***
95th Percentile Rainfall Depth (in)	2.2		2.2	
1-yr 24-yr Rainfall Depth (in)	4.25		4.25	
25-yr 24-hr Rainfall Depth (in)	14.88		14.88	
Area (ac)	12.63		0.78	
Curve Number	22.5	98	22.5	98
Flow length (ft)	842		233	
Time of Concentration (min)	86.9	7.1	66.7	2.9

Legend: ac = acre; ft = foot or feet; hr = hour; in = inch; min = minute; MPMR = Multi-Purpose Maneuver Range; yr = year.

Table 4. HydroCAD Stormwater Results

Parameter		***Base Camp***			***MPMR***		
		Existing	***Proposed***	***Change***	***Existing***	***Proposed***	***Change***
95th % Water Quality Storm	Runoff Volume (acre-ft)	0.00	2.08	2.08	0.00	0.13	0.13
	Peak Flow (cfs)	0.00	3.29	3.29	0.00	0.20	0.20
1-yr 24-hr	Runoff Volume (acre-ft)	0.00	4.22	4.22	0.00	0.26	0.26
	Peak Flow (cfs)	0.00	6.46	6.46	0.00	0.40	0.40
25-yr 24-hr	Runoff Volume (acre-ft)	1.69	15.40	13.71	0.11	0.95	0.85
	Peak Flow (cfs)	4.13	22.73	18.60	0.26	1.41	1.15

Legend: % = percent; acre-ft = acre-foot or acre-feet; cfs = cubic feet per second; hr = hour; MPMR = Multi-Purpose Maneuver Range; yr = year.

6 STORMWATER BEST MANAGEMENT PRACTICES/INTEGRATED MANAGEMENT PRACTICES

6.1 STORMWATER MANAGEMENT PRACTICES TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

This chapter identifies stormwater quantity management alternatives for the Proposed Action and explains the application of Low Impact Development, best management practices, and integrated management practices within the stormwater management strategy. Low Impact Development, best management practices, and integrated management practices for the Proposed Action are summarized as follows:

- Low Impact Development focuses on minimizing runoff and promoting infiltration by integrating stormwater controls into the natural landscape through measures such as bioretention basins, vegetated swales, and permeable pavements. Low Impact Development is primarily used to restore pre-development hydrology by reducing runoff at the source and enhancing groundwater recharge.
- Best management practices serve as standardized stormwater control measures that reduce pollution, manage runoff flow, and prevent erosion. Best management practices include detention basins, hydrodynamic separators, sediment traps, and vegetation buffers, which help maintain compliance with environmental standards and prevent sediment transport into water bodies.
- Integrated management practices combine both Low Impact Development and best management practice components to create site-specific stormwater solutions. Integrated management practices are applied in areas with complex stormwater challenges, such as training ranges, and refueling areas, , where standard best management practices alone may not be sufficient. These solutions are designed to accommodate operational constraints while maximizing stormwater treatment efficiency.

This report applies all three approaches of Low Impact Development for runoff reduction, best management practices for pollution control, and integrated management practices for site-specific integration to create a comprehensive, adaptive stormwater management plan at the Base Camp and Multi-Purpose Maneuver Range.

6.2 WATER QUALITY/LOW IMPACT DEVELOPMENT TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Conceptual-level stormwater management capabilities were assessed by quantifying various treatment components based on approximate Low Impact Development, best management practice, and integrated management practice footprints. The estimated stormwater capture volume potential was compared to anticipated post-development runoff to determine the most effective treatment solutions. Low Impact Development placement prioritizes on-site stormwater retention, ensuring that infiltration areas do not interfere with critical infrastructure or military operations. By integrating Low Impact Development-based infiltration and structural best management practices, the design balances water quality improvement, groundwater recharge, and flood control, particularly in the high-rainfall CNMI region.

The high-rainfall CNMI region necessitates an approach that balances water quality improvement, groundwater recharge, and peak flow attenuation. Low Impact Development measures would be strategically positioned in high-infiltration areas to promote on-site runoff absorption, while best management practices would be employed to regulate stormwater movement and to prevent excessive flow velocities. In areas with high pollutant loads, such as ammunition holding and refueling zones, integrated management practices would be used to integrate advanced filtration and containment systems to capture contaminants like heavy metals and hydrocarbons before runoff enters natural waterways.

Balancing water quality, groundwater recharge, and 25-year design storm event management necessitates a dual approach that combines integrated management practices with traditional detention basins. While detention basins are necessary for peak flow reduction, integrated management practices ensure that stormwater in high-risk areas receives adequate filtration and pollutant removal. By incorporating these strategies, the project achieves a resilient stormwater management plan that meets operational and environmental requirements.

6.3 WATER QUALITY AND RECHARGE VOLUMES TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

To determine the appropriate size for the facilities and treatment, the Unified Stormwater Sizing Criteria in the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006) recommends the use of the 95th percentile storm event to calculate the water quality and recharge volumes (Table 5). The water quality volume is intended to improve water quality by capturing and treating 90 percent of the average annual storm events for high-quality resource areas and hotspots and 80 percent for land uses that drain to moderate-quality resource areas. The recharge volume must be achieved through a structural practice like infiltration, bioretention, or filters. According to the *CNMI and Guam Stormwater Management Manual*, any infiltration facility must have a sedimentation basin containing 25 percent of the water quality volume must be provided for sediment. Among the available options, a grass channel or stilling basin would be the most advisable choice depending on the location and preferences. The equation for water quality volume is as follows:

$$WQ_V = \frac{(P)(A)(I)}{12}$$

Where:

WQ_v	=	Water quality volume in acre-feet
P	=	90 percent rainfall event (1.5 inches) for hotspots/high-quality resource areas; 80 percent rainfall event (0.8 inches) for moderate-quality resource areas
A	=	Site area in acres
I	=	Impervious area percentage of site area as a decimal

A minimum water quality volume value of 0.0167 feet × total area in acres (also referred to as 0.2 watershed inches) is required to fully treat the runoff from pervious surfaces. Because both the Base Camp drainage unit (≈ 96 percent impervious) and the MPMR pad (≈ 100 percent impervious) exceed the 80-percent impervious threshold described in Section 4-4 of the CNMI & Guam Stormwater Management Manual, the impervious fraction (I) was conservatively set to 1.0 for sizing Water-Quality (WQv) and Recharge (Rev) volumes.

Table 5. Water Quality Volumes

Water Quality Criteria, WQ_v	***90% of Average Annual Storm Events – High-quality Resource Areas and Hotspots***	
Precipitation (in), P	1.5	1.5
Parameters	***Basecamp***	***MPMR***
Area (acres), A	12.63	0.78
Impervious area (acres)	12.63	0.78
Impervious area (decimal percent), I	1.00	1.00
WQ_v (90%) (acre-ft)	1.58	0.10
min WQ_v (acre-ft)	0.21	0.01
Sedimentation Volume (acre-ft)	0.40	0.03

Legend: % = percent; acre-ft = acre-foot or acre-feet; in = inch; min = minimum; MPMR = Multi-Purpose Maneuver Range; N/A = not applicable; WQ_v =water quality volume limestone dominated areas.

$$Re_V = \frac{(P)(A)(I)}{12}$$

Where:

Re_v = Recharge volume in acre-feet

P = 90 percent rainfall event (1.5 inches)

A = Site area in acres

I = Impervious area percentage of site area as a decimal

This criterion applies primarily to limestone-dominated recharge areas within the Base Camp footprint, except for locations where soil profiles extend at least 3 feet below the bottom of proposed stormwater facilities. Recharge volume calculations have been updated to account for the full extent of impervious areas due to the increased development footprint and the proximity of potential hotspot locations. Given the reduced extent of pervious surfaces, the entire site has been incorporated into the recharge volume analysis to ensure compliance with stormwater management requirements and to maintain effective infiltration and runoff mitigation strategies.

Table 6 presents these calculations, incorporating changes based on the revised site layout and stormwater management strategy. The impervious surface analysis accounts for new facility footprints, vehicle access routes, and structural best management practices, affecting infiltration potential and runoff patterns. The stormwater infiltration system has been updated to align with these modifications, incorporating engineered recharge zones and additional bioretention basins to support stormwater absorption and groundwater recharge capacity.

The Base Camp stormwater plan incorporates detention and infiltration strategies suited to site-specific hydrology and land use changes.

Table 6. Recharge Volumes

Recharge Criteria, Re_v	*Criterion for Limestone Regions of CNMI Requiring Infiltration of 1.50 Inches of Rainfall*	
Precipitation (in), P	1.5	
Parameters	***Base Camp***	***MPMR***
Area (acres), A	12.63	0.78
Impervious area (acres)	12.63	0.78
Impervious area (decimal percent), I	1.00	1.00
Recharge criteria, Re_v (acre-ft)	1.58	0.10

Legend: acre-ft = acre-foot or acre-feet; in = inch; MPMR = Multi-Purpose Maneuver Range; Re_v = recharge volume.

6.4 LOW IMPACT DEVELOPMENT APPLICATION TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Improving drainage in the proposed areas requires creating conceptual integrated management practices for its basins. Drainage basins were identified and conceptual integrated management practices were developed for each. Roof downspout runoff is directed to flow to dry conveyance swales. These swales lead to bioretention cells or dry wells before entering perimeter swales (where applicable). The final design phase should finalize the capture/conveyance scheme of the perimeter swales.

6.5 INTEGRATED MANAGEMENT PRACTICES TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Recommendations in this section are adapted from the *CNMI and Guam Stormwater Management Manual* (Horsley Witten Group, Inc. 2006). This discussion explores integrated management practices tailored to address the specific challenges of treating stormwater for an operational Base Camp.

6.6 BASE CAMP TREATMENT OPTIONS TINIAN CURVE NUMBER VALUES

The CNMI Stormwater Management Manual and Naval Facilities Engineering Systems Command guidance guided curve number selection. Pre-development curve numbers were assigned based on Hydrologic Soil Group B, with a base curve number of 22 for undisturbed pervious areas, the lowest possible curve number on Tinian, which is typically associated with Hydrologic Soil Group A, ensuring a conservative pre-development estimate that assumes high infiltration capacity even though Tinian's soils are primarily classified as Hydrologic Soil Group B. Post-development curve numbers for impervious areas used a worst-case value of 98, reflecting new hardscapes. Because off-site flow was explicitly bypassed, external drainage areas were excluded from the composite curve number calculation. This ensures that runoff projections reflect project-specific modifications without artificially inflating results. Post-project sub-basins were included in the composite curve number calculations (Attachment A). Table 1 displays the curve number values selected for Hydrologic Soil Group B and land use cover identification.

Stormwater management at the Base Camp is designed to reduce runoff impacts, enhance on-site infiltration, and can reduce pollutant loadings.

Key Stormwater Treatment Components:

- **Erosion Control Measures (Best Management Practices).** Vegetative buffers, reinforced swales, and sediment traps would stabilize disturbed areas and prevent sediment transport.
- Stormwater Diversion and Containment (Integrated Management Practices and Best Management Practices).
- Engineered drainage swales and perimeter berms to control velocity and route flows to treatment areas.
- **Detention and Infiltration Basins (Low Impact Development and Best Management Practices).** Shallow detention basins would be strategically placed to capture peak storm events, store runoff temporarily, and allow gradual infiltration, preventing erosion and excessive flow velocities.
- **Hydrodynamic Separators and Filtration Systems (Best Management Practices).** These would be installed at key discharge points to capture suspended solids, hydrocarbons, and other pollutants before runoff enters receiving environments.
- **Permeable Ground Surface Integration (Low Impact Development and Integrated Management Practices).** Selective use of permeable surfaces in high-impact areas would enhance infiltration, reduce runoff velocity, and limit sediment transport.
- **Stormwater Berm Expansion (Integrated Management Practices and Best Management Practices).** Raise and extend the existing berm on the north, south, and east

flanks of the transmitter building, plus a new berm along the northern edge of support facilities to redirect flows eastward toward controlled treatment corridors.

- **Operational controls for vehicle refueling & equipment maintenance (BMP**) Conduct refueling ≥ 50 ft from water bodies or stormwater pathways. Perform routine equipment leak inspections; repair before entering storm-sensitive areas. Provide drip pans, spill-response kits, and secondary containment at all fueling areas.
- **Adaptive Management (Best Management Practices and Integrated Management Practices).** Routine visual inspections of LID structures would be conducted after major storm events to confirm performance; corrective maintenance would follow CNMI SW Manual guidelines.

Best Management Practices for Vehicle Refueling and Equipment Maintenance:

To further reduce stormwater contamination risks from training vehicles and equipment, additional best management practices would be enforced, including:

- **Vehicle and equipment refueling** would occur at least 50 feet from water sources or designated stormwater pathways, following established military environmental protection guidelines.
- **Routine equipment inspections** would be conducted to identify leaks of hydraulic fluid, oil, and lubricants, with corrective actions taken before vehicles enter stormwater-sensitive areas.
- **Secondary containment measures** such as drip pans and spill response kits would be deployed at fueling areas to contain accidental leaks and prevent stormwater contamination.

The stormwater management strategy for the Base Camp incorporates a hybrid approach that combines best management practices, Low Impact Development-based infiltration strategies, and site-specific integrated management practices. By expanding the existing stormwater berm, integrating natural drainage features, and using cost-effective stormwater treatment solutions, these measures collectively support a resilient, effective, and low-maintenance stormwater management plan, safeguarding water quality and environmental integrity at the Base Camp.

6.6.1 Multi-Purpose Maneuver Range and Explosives Training Range Treatment

The Multi-Purpose Maneuver Range and Explosives Training Range require an effective stormwater management strategy that minimizes runoff, controls erosion, and prevents potential contamination from training activities. Given the site’s unique operational and environmental challenges, the most cost-effective and efficient solution is a hybrid approach that integrates natural drainage features with targeted treatment measures to ensure effective stormwater control with minimal maintenance and cost.

Key Stormwater Treatment Components:

- **Vegetated Swales and Permeable Surfaces (Low Impact Development and Integrated Management Practices).** Grass-lined swales would be used along drainage paths to slow runoff, encourage infiltration, and reduce erosion. Permeable surfaces (e.g., gravel-based training areas) would minimize direct runoff and sediment transport while maintaining operational flexibility**.**

- **Detention Basins (Best Management Practices and Low Impact Development).** Shallow, strategically placed dry detention basins would capture peak storm events, temporarily store runoff, and allow gradual infiltration, reducing flow velocity and preventing downstream erosion without excessive maintenance.
- **Hydrodynamic Separators at High-Risk Areas (Best Management Practices and Integrated Management Practices).** Pretreatment separators would be installed at key outfalls near ammunition impact zones to filter out suspended solids, sediment, and heavy metals before runoff enters receiving environments.
- **Minimal Grading and Firebreak Integration (Integrated Management Practices).** Drainage solutions would be aligned with existing terrain features to minimize earthwork costs while using firebreaks. Firebreaks would serve a dual purpose by acting as linear infiltration zones, slowing runoff and reducing sediment transport while maintaining wildfire prevention capabilities.
- **Targeted Monitoring and Compliance (Best Management Practices and Integrated Management Practices).** Regular inspection and adaptive management would ensure stormwater quality aligns with military environmental protection standards while allowing for adjustments based on site performance.

By integrating best management practices for erosion control with Low Impact Development-based infiltration strategies, the Multi-Purpose Maneuver Range and Explosives Training Range stormwater plan would optimize water management while ensuring cost-effectiveness and ease of implementation. The stormwater berm extension, combined with vegetated swales, detention basins, and hydrodynamic separators, would provide a comprehensive solution that minimizes long-term maintenance requirements, mitigates potential contamination risks, and supports uninterrupted training operations and environmental best practices. This multi-layered approach would help to manage stormwater effectively and sustainably, reducing environmental impact while maintaining training functionality.

7 CONCLUSIONS

The Proposed Action incorporates stormwater management strategies to mitigate the effects of increased impervious surfaces while maintaining pre-development hydrology. The expanded stormwater berm, detention basins, and integrated best management practices would effectively manage runoff by capturing and regulating peak storm events, diverting and containing stormwater, and preventing sediment transport through vegetative buffers and swales. Water quality protection measures, such as hydrodynamic separators and oil-water separators at fueling areas, would help remove contaminants before discharge, while bioswales, bioretention basins, and permeable surfaces would enhance infiltration and groundwater recharge. These measures would collectively support effective stormwater control, reduce runoff velocity, and protect depressional areas, nearshore waters, and wetlands from potential impacts.

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8 REFERENCES

AECOM. (2014). *CJMT Task 11M Stormwater – Design Criteria Revised*.

Assistant Secretary of the Navy (Installations and Environment). (2007). *Department of the Navy low impact development (LID) policy for stormwater management.* Memorandum, November 16.

Carruth, Robert L. (2008). *Ground-Water Resources of Saipan, Commonwealth of the Northern Mariana Islands*. U.S. Geological Survey Water-Resources Investigations Report 03-4178. Honolulu, HI.

DoD. (2013). *Instruction 4715.14, Operational range assessments.* Department of Defense, Under Secretary of Defense for Acquisition, Technology, and Logistics. November 15.

DoD. (2022). *Unified Facilities Criteria (UFC), Civil Engineering*. UFC 3-201-01. December 20.

DoD. (2023). *Unified Facilities Criteria (UFC), Low Impact Development*. UFC 3-210-10. June 1, 2015. Change 3, August 1, 2023.

Doan, D.B., H.W. Burke, H.G. May, and C.H. Stensland. (1960). *Military Geology of Tinian, Mariana Islands*. Prepared under the direction of the Chief of Engineers, U.S. Army by the Intelligence Division, Office of the Engineer Headquarters United States Army Pacific with personnel of the United States Geological Survey.

DON. (2010). *Capital Improvements, Engineering, and Construction Bulletin*. Vol. Issue No. 2011-01. Naval Facilities Engineering Command.

Federal Highway Administration. (2009). *Federal Highway Administration Hydraulic Engineering Circular No. 22, Third Edition*. FHWA-NHI-10-009, Department of Transportation.

Gingerich, S. B. (2002). "Geohydrology and Numerical Simulation of Alternative Pumping Distributions and the Effects of Drought on the Ground-Water Flow System of Tinian, Commonwealth of the Northern Mariana Islands." Report 2002–4077. Water-Resources Investigations Report. USGS Publications Warehouse.

Horsley Witten Group, Inc., Horsley Witten Group, Inc. (2006). *CNMI and Guam Stormwater Management Manual*. Volumes I & II. Prepared for Commonwealth of the Northern Mariana Islands and the Territory of Guam. October.

Lander, Mark A., and Charles P. Guard. (2003). *Creation of a 50-Year Rainfall Database, Annual Rainfall Climatology, and Annual Rainfall Distribution Map for Guam*. WERI Technical Report No. 102. Mangilao, GU: Water and Energy Research Institute of the Western Pacific (WERI), University of Guam. June.

National Oceanic and Atmospheric Administration. (2011). *Precipitation-Frequency Atlas of the United States*. Vol. Volume 5 Version 3.0: Selected Pacific Islands. NOAA Atlas 14. Silver Spring, MD: 2009, Revised 2011.

Overton, D. E., and M. E. Meadows. (1976). *Storm Water Modeling*. New York, NY: Academic Press.

U.S. Department of Agriculture Soil Conservation Service. (1986). *Urban Hydrology for Small Watersheds*. Technical Release 55. Washington, DC. June.

U.S. Department of Agriculture Soil Conservation Service. (1989). *Soil Survey of the Islands of Aguijan, Rota, Saipan, and Tinian, Commonwealth of the Northern Mariana Islands*. Prepared by Fred J. Young in cooperation with the Commonwealth of the Northern Mariana Islands. July.

U.S. Environmental Protection Agency. (2009). *Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act*. EPA 841-B-09-001. Washington, DC: Office of Water. December.

ATTACHMENT A
SUPPORTING CALCULATIONS

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ATTACHMENT A.1
BASE CAMP HYDROCAD RESULTS

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1S
Base Camp Analysis 2
Existing
2S
Base Camp Analysis 2
Proposed
Subcat
Reach
Pond
Link
Routing Diagram for CJMT_Tinian_BaseCamp
Prepared by AECOM, Printed 3/12/2025
HydroCAD® 10.20-6a s/n 01723 © 2024 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	Tinian 1 year 24 hour	Tinian 1 year 24 hour		Default	24.00	1	4.25	2
2	Tinian 25 year 24 hour	Tinian 25 year 24 hour		Default	24.00	1	14.88	2
3	Tinian 95th percentile	Tinian 95th percentile		Default	24.00	1	2.20	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
12.626	23	(1S)
12.626	98	(2S)
25.252	**61**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
25.252	Other	1S, 2S
25.252		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	25.252	25.252		1S, 2S
0.000	**0.000**	**0.000**	**0.000**	**25.252**	**25.252**	**TOTAL AREA**	

Time span=1.00-40.00 hrs, dt=0.01 hrs, 3901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Base Camp Analysis 2 Runoff Area=12.626 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=842' Tc=86.9 min CN=23 Runoff=0.00 cfs 0.000 af

Subcatchment 2S: Base Camp Analysis Runoff Area=12.626 ac 100.00% Impervious Runoff Depth=4.01"
Flow Length=892' Tc=7.1 min CN=98 Runoff=6.46 cfs 4.224 af

Total Runoff Area = 25.252 ac Runoff Volume = 4.224 af Average Runoff Depth = 2.01"
50.00% Pervious = 12.626 ac 50.00% Impervious = 12.626 ac

Summary for Subcatchment 1S: Base Camp Analysis 2 Existing

[45] Hint: Runoff=Zero

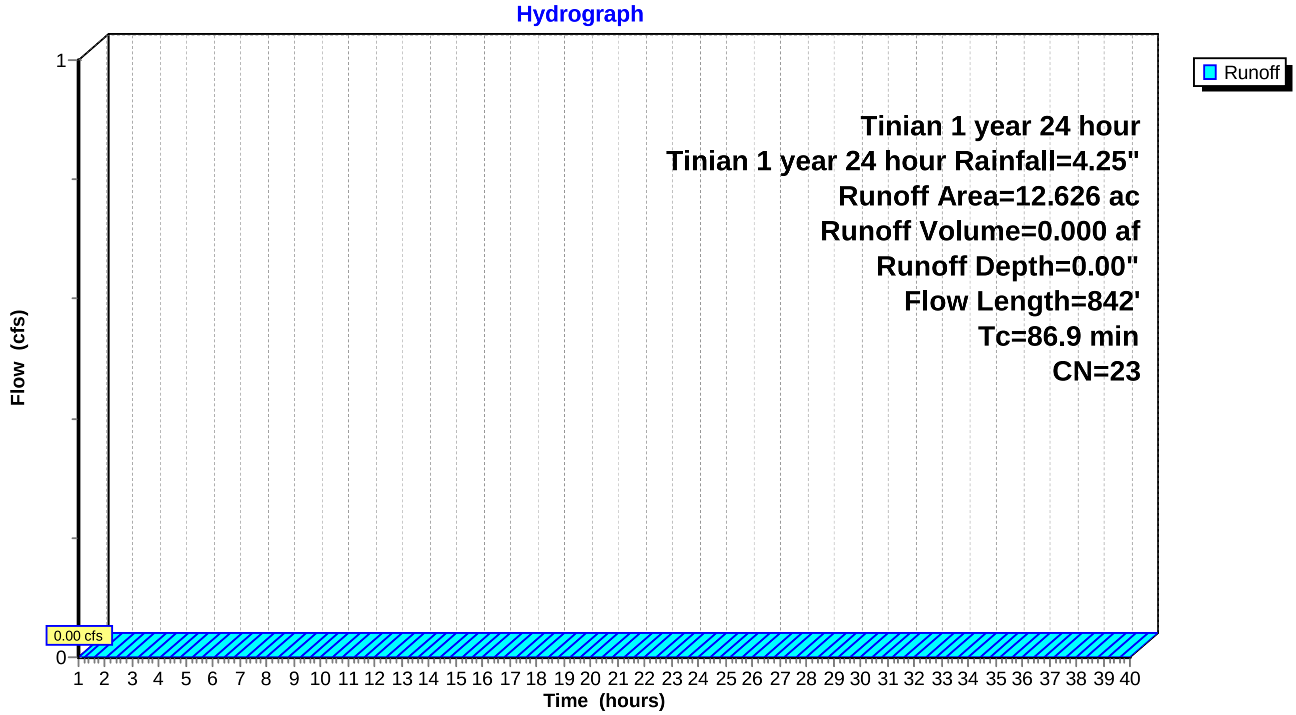
Runoff = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Tinian 1 year 24 hour Tinian 1 year 24 hour Rainfall=4.25"

	Area (ac)	CN	Description
*	12.626	23	
	12.626		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9	150	0.0120	0.06		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
44.0	692	0.0110	0.26		**Shallow Concentrated Flow, Shallow Concentrated Flow Proposed** Forest w/Heavy Litter Kv= 2.5 fps
86.9	842	Total			

Subcatchment 1S: Base Camp Analysis 2 Existing



Summary for Subcatchment 2S: Base Camp Analysis 2 Proposed

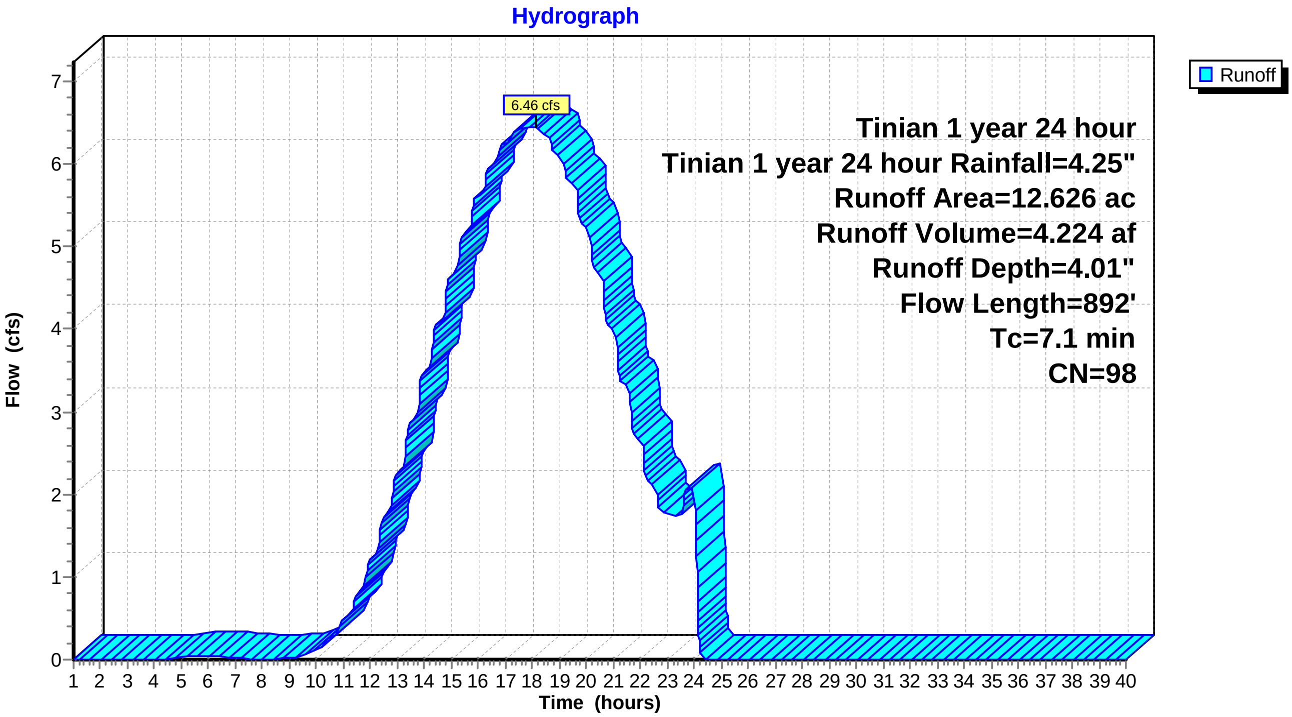
Runoff = 6.46 cfs @ 18.12 hrs, Volume= 4.224 af, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Tinian 1 year 24 hour Tinian 1 year 24 hour Rainfall=4.25"

	Area (ac)	CN	Description
*	12.626	98	
	12.626		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	150	0.0100	1.67		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
5.6	742	0.0120	2.22		**Shallow Concentrated Flow, Shallow Concentrated Flow Proposed** Paved Kv= 20.3 fps
7.1	892	Total			

Subcatchment 2S: Base Camp Analysis 2 Proposed



Time span=1.00-40.00 hrs, dt=0.01 hrs, 3901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Base Camp Analysis 2 Runoff Area=12.626 ac 0.00% Impervious Runoff Depth=1.61"
Flow Length=842' Tc=86.9 min CN=23 Runoff=4.13 cfs 1.692 af

Subcatchment 2S: Base Camp Analysis Runoff Area=12.626 ac 100.00% Impervious Runoff Depth>14.64"
Flow Length=892' Tc=7.1 min CN=98 Runoff=22.73 cfs 15.401 af

Total Runoff Area = 25.252 ac Runoff Volume = 17.093 af Average Runoff Depth = 8.12"
50.00% Pervious = 12.626 ac 50.00% Impervious = 12.626 ac

Summary for Subcatchment 1S: Base Camp Analysis 2 Existing

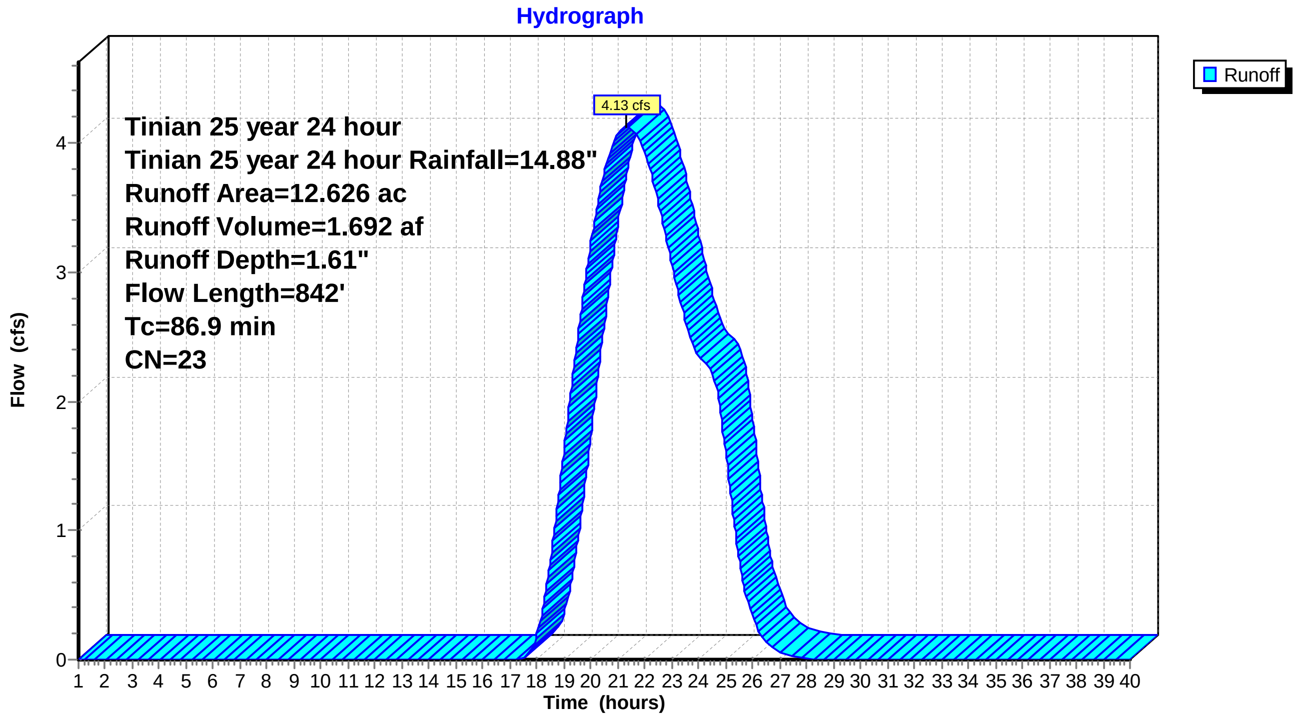
Runoff = 4.13 cfs @ 21.34 hrs, Volume= 1.692 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Tinian 25 year 24 hour Tinian 25 year 24 hour Rainfall=14.88"

	Area (ac)	CN	Description
*	12.626	23	
	12.626		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9	150	0.0120	0.06		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
44.0	692	0.0110	0.26		**Shallow Concentrated Flow, Shallow Concentrated Flow Propose** Forest w/Heavy Litter Kv= 2.5 fps
86.9	842	Total			

Subcatchment 1S: Base Camp Analysis 2 Existing



Summary for Subcatchment 2S: Base Camp Analysis 2 Proposed

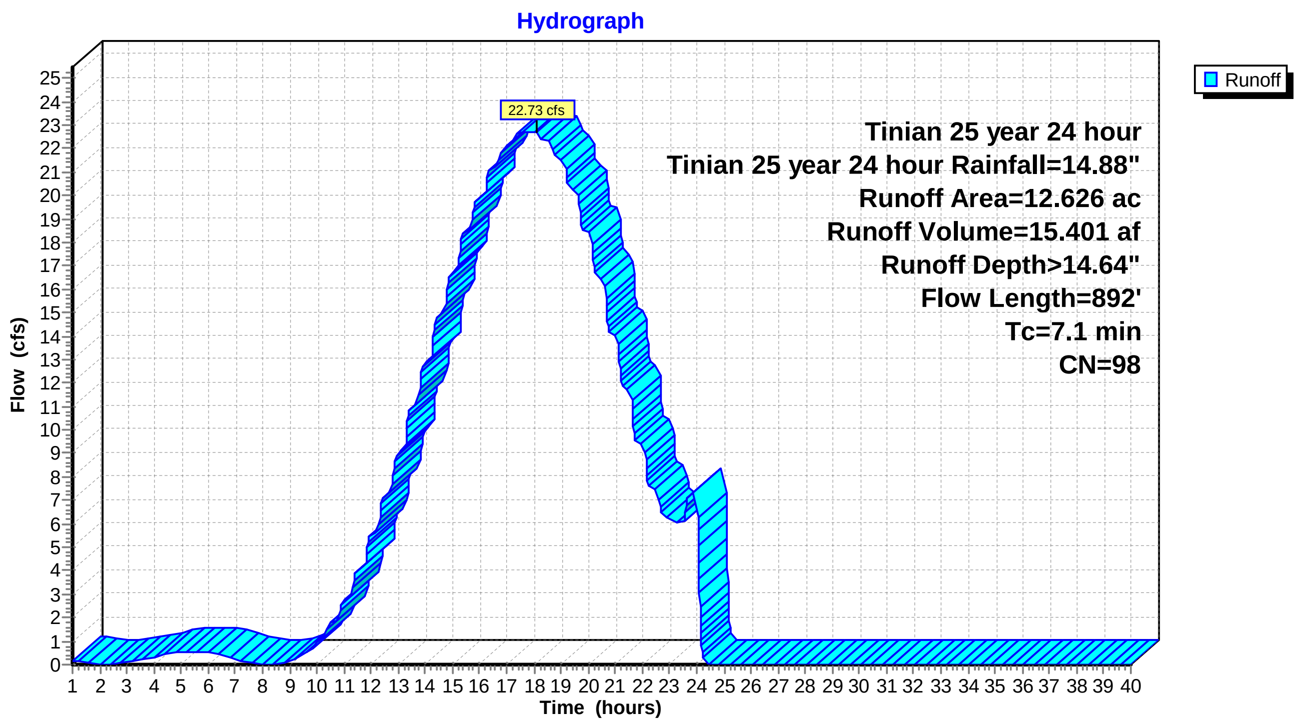
Runoff = 22.73 cfs @ 18.12 hrs, Volume= 15.401 af, Depth>14.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Tinian 25 year 24 hour Tinian 25 year 24 hour Rainfall=14.88"

	Area (ac)	CN	Description
*	12.626	98	
	12.626		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	150	0.0100	1.67		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
5.6	742	0.0120	2.22		**Shallow Concentrated Flow, Shallow Concentrated Flow Proposed** Paved Kv= 20.3 fps
7.1	892	Total			

Subcatchment 2S: Base Camp Analysis 2 Proposed



Time span=1.00-40.00 hrs, dt=0.01 hrs, 3901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Base Camp Analysis 2 Runoff Area=12.626 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=842' Tc=86.9 min CN=23 Runoff=0.00 cfs 0.000 af

Subcatchment 2S: Base Camp Analysis Runoff Area=12.626 ac 100.00% Impervious Runoff Depth=1.97"
Flow Length=892' Tc=7.1 min CN=98 Runoff=3.29 cfs 2.076 af

Total Runoff Area = 25.252 ac Runoff Volume = 2.076 af Average Runoff Depth = 0.99"
50.00% Pervious = 12.626 ac 50.00% Impervious = 12.626 ac

Summary for Subcatchment 1S: Base Camp Analysis 2 Existing

[45] Hint: Runoff=Zero

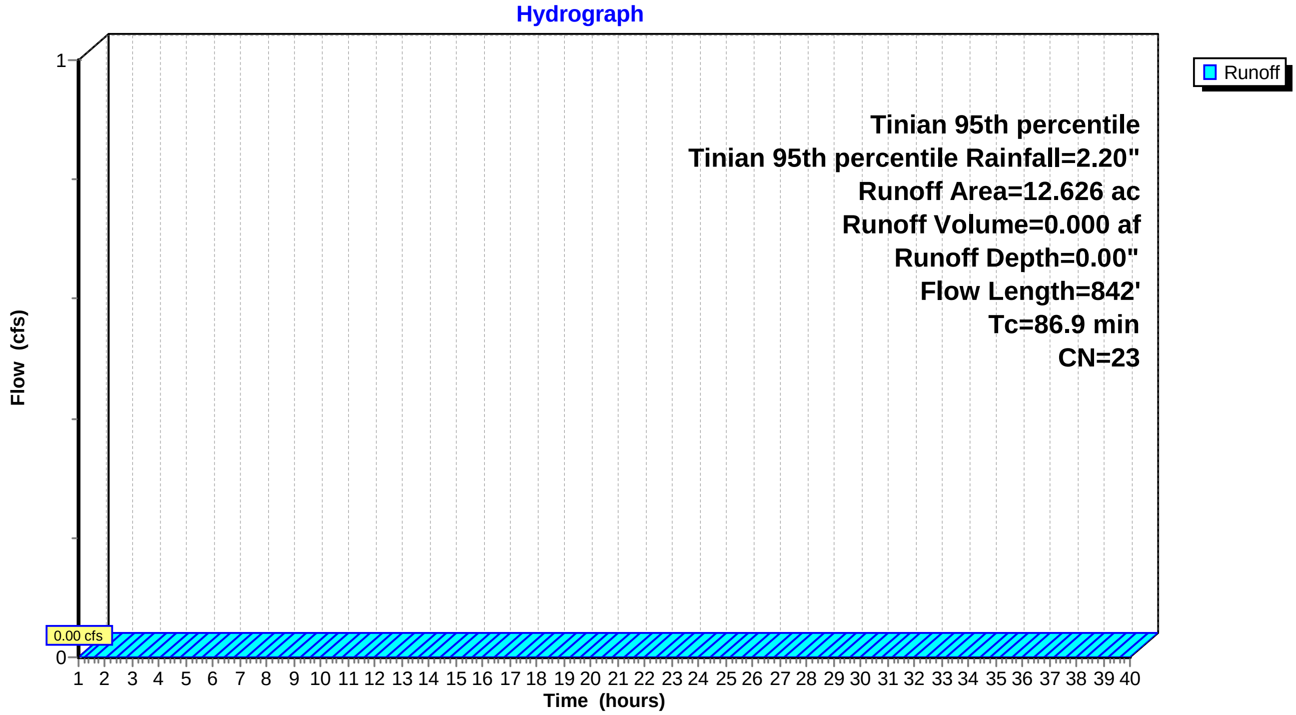
Runoff = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Tinian 95th percentile Tinian 95th percentile Rainfall=2.20"

	Area (ac)	CN	Description
*	12.626	23	
	12.626		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.9	150	0.0120	0.06		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
44.0	692	0.0110	0.26		**Shallow Concentrated Flow, Shallow Concentrated Flow Proposed** Forest w/Heavy Litter Kv= 2.5 fps
86.9	842	Total			

Subcatchment 1S: Base Camp Analysis 2 Existing



Summary for Subcatchment 2S: Base Camp Analysis 2 Proposed

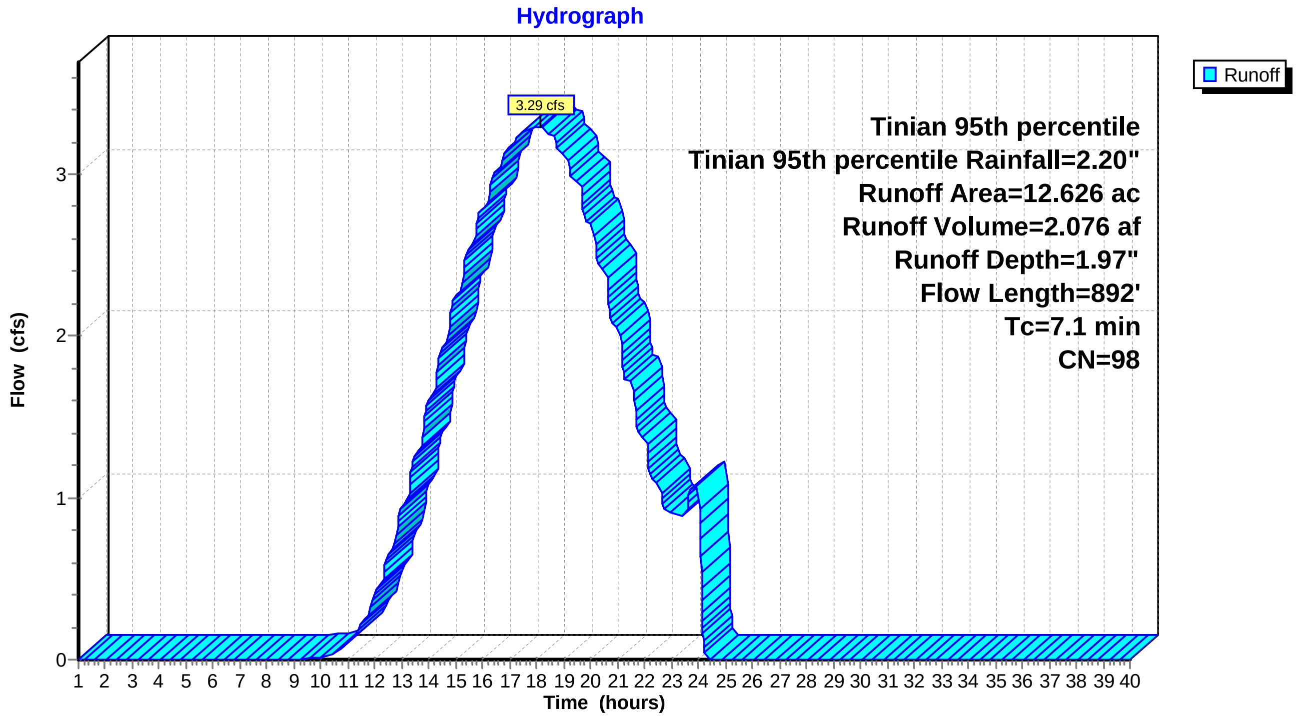
Runoff = 3.29 cfs @ 18.12 hrs, Volume= 2.076 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-40.00 hrs, dt= 0.01 hrs
Tinian 95th percentile Tinian 95th percentile Rainfall=2.20"

	Area (ac)	CN	Description
*	12.626	98	
	12.626		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	150	0.0100	1.67		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
5.6	742	0.0120	2.22		**Shallow Concentrated Flow, Shallow Concentrated Flow Proposed** Paved Kv= 20.3 fps
7.1	892	Total			

Subcatchment 2S: Base Camp Analysis 2 Proposed



ATTACHMENT A.2
ETR AND MPMR HYDROCAD RESULTS

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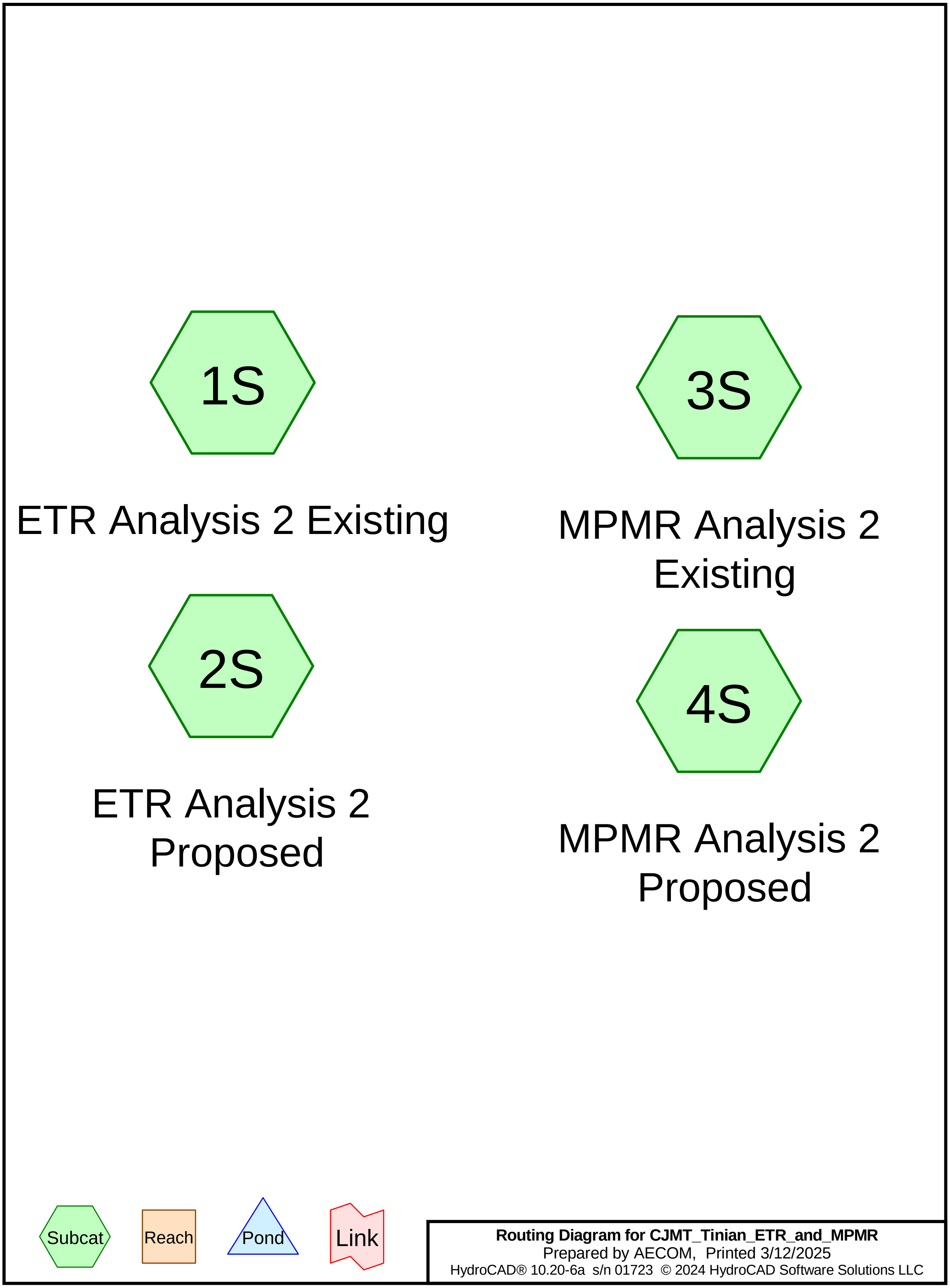

1S
ETR Analysis 2 Existing
3S
MPMR Analysis 2 Existing
2S
ETR Analysis 2 Proposed
4S
MPMR Analysis 2 Proposed
Subcat
Reach
Pond
Link
Routing Diagram for CJMT_Tinian_ETR_and_MPMR
Prepared by AECOM, Printed 3/12/2025
HydroCAD® 10.20-6a s/n 01723 © 2024 HydroCAD Software Solutions LLC

Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	Tinian 1 year 24 hour	Tinian 1 year 24 hour		Default	24.00	1	4.25	2
2	Tinian 25 year 24 hour	Tinian 25 year 24 hour		Default	24.00	1	14.88	2
3	Tinian 95th Percentile	Tinian 95th percentile		Default	24.00	1	2.20	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
3.181	23	(1S, 3S)
3.181	98	(2S, 4S)
6.362	**61**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
6.362	Other	1S, 2S, 3S, 4S
6.362		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	6.362	6.362		1S, 2S, 3S, 4S
0.000	**0.000**	**0.000**	**0.000**	**6.362**	**6.362**	**TOTAL AREA**	

Time span=1.00-60.00 hrs, dt=0.01 hrs, 5901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ETR Analysis 2 Existing Runoff Area=2.400 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=402' Tc=59.1 min CN=23 Runoff=0.00 cfs 0.000 af

Subcatchment 2S: ETR Analysis 2 Runoff Area=2.400 ac 100.00% Impervious Runoff Depth=4.01"
Flow Length=402' Tc=3.7 min CN=98 Runoff=1.23 cfs 0.803 af

Subcatchment 3S: MPMR Analysis 2 Existing Runoff Area=0.781 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=233' Tc=66.7 min CN=23 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: MPMR Analysis 2 Runoff Area=0.781 ac 100.00% Impervious Runoff Depth=4.01"
Flow Length=233' Slope=0.0050 '/' Tc=2.9 min CN=98 Runoff=0.40 cfs 0.261 af

Total Runoff Area = 6.362 ac Runoff Volume = 1.064 af Average Runoff Depth = 2.01"
50.00% Pervious = 3.181 ac 50.00% Impervious = 3.181 ac

Summary for Subcatchment 1S: ETR Analysis 2 Existing

[45] Hint: Runoff=Zero

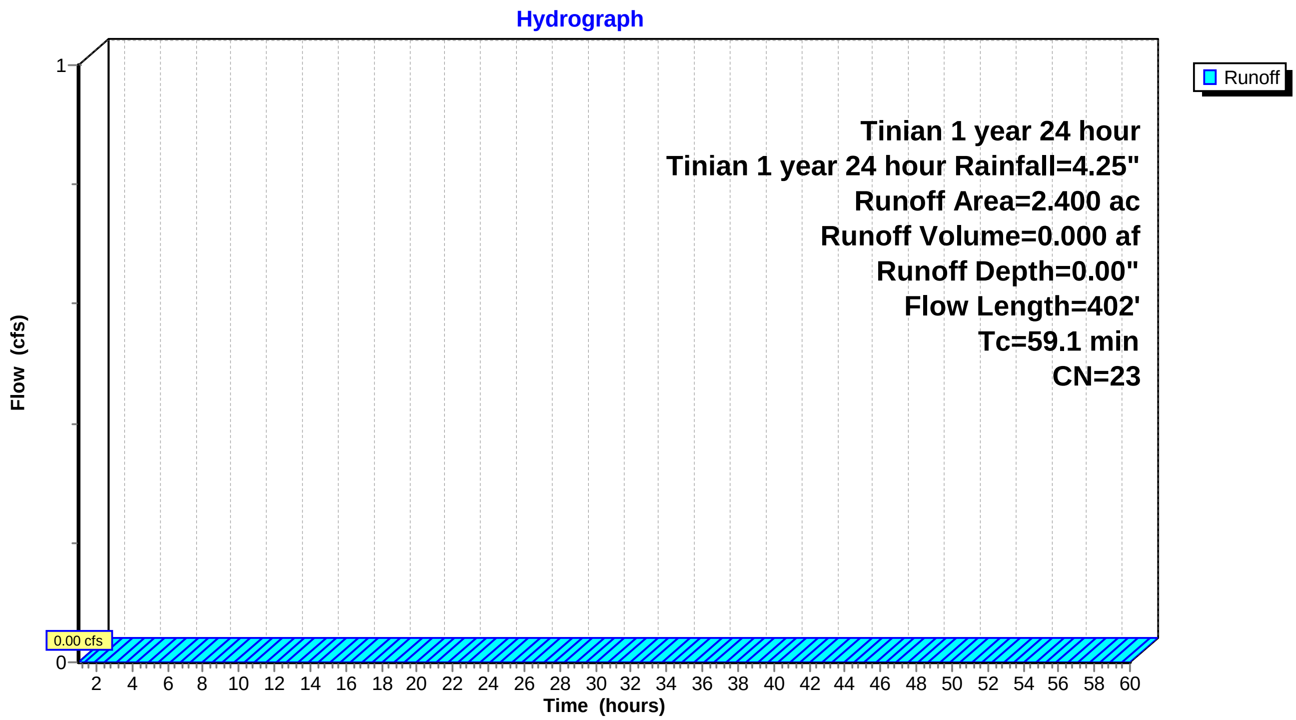
Runoff = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 1 year 24 hour Tinian 1 year 24 hour Rainfall=4.25"

	Area (ac)	CN	Description
*	2.400	23	
	2.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.3	150	0.0140	0.06		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
18.8	252	0.0080	0.22		**Shallow Concentrated Flow, Shalloe Concentrated Flow Existing** Forest w/Heavy Litter Kv= 2.5 fps
59.1	402	Total			

Subcatchment 1S: ETR Analysis 2 Existing



Summary for Subcatchment 2S: ETR Analysis 2 Proposed

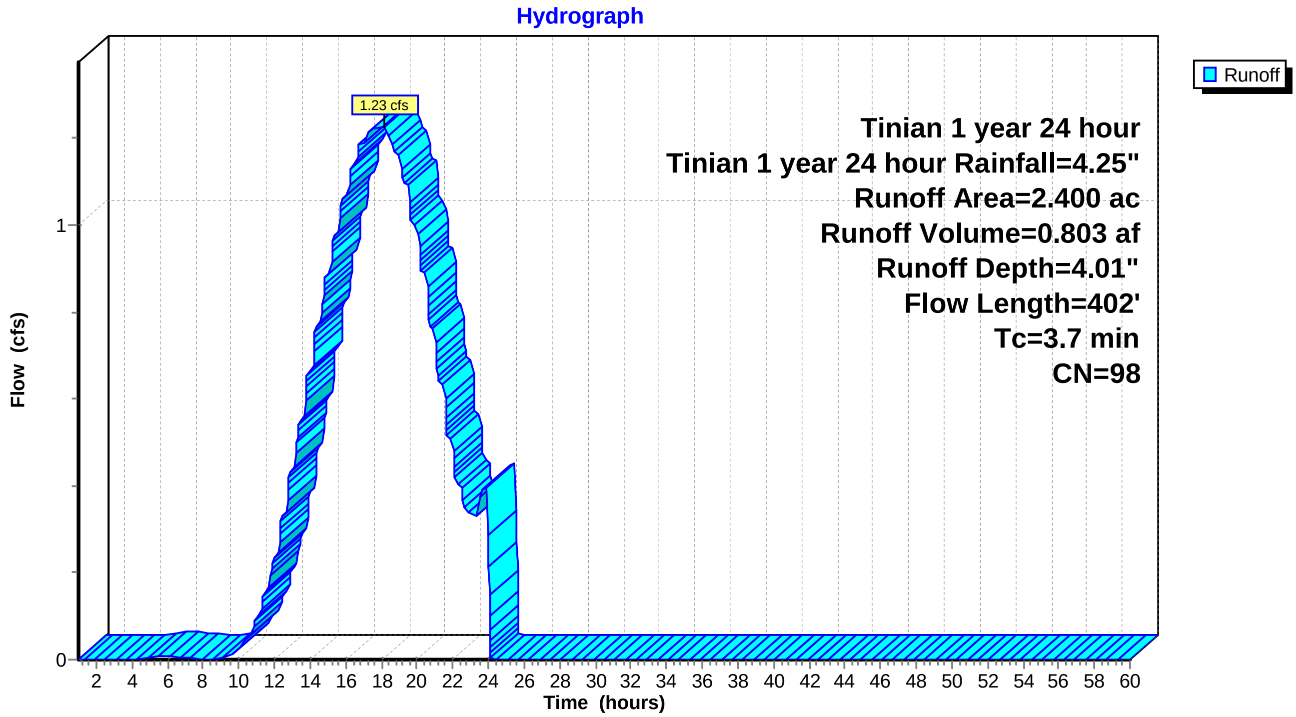
Runoff = 1.23 cfs @ 18.13 hrs, Volume= 0.803 af, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 1 year 24 hour Tinian 1 year 24 hour Rainfall=4.25"

	Area (ac)	CN	Description
*	2.400	98	
	2.400		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0170	1.91		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
2.8	302	0.0080	1.82		**Shallow Concentrated Flow, Shalloe Concentrated Flow Proposed** Paved Kv= 20.3 fps
3.7	402	Total			

Subcatchment 2S: ETR Analysis 2 Proposed



Summary for Subcatchment 3S: MPMR Analysis 2 Existing

[45] Hint: Runoff=Zero

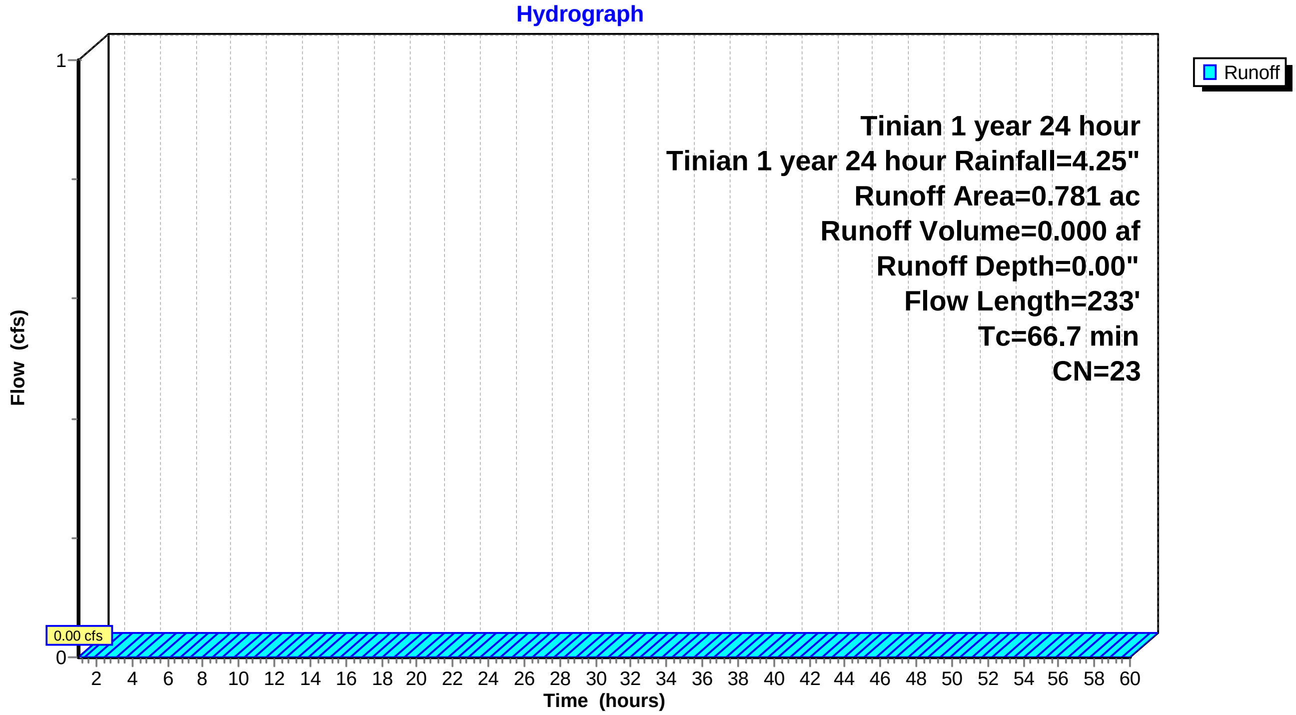
Runoff = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 1 year 24 hour Tinian 1 year 24 hour Rainfall=4.25"

	Area (ac)	CN	Description
*	0.781	23	
	0.781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.6	150	0.0060	0.04		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
10.1	83	0.0030	0.14		**Shallow Concentrated Flow, Shallow Concentrated Flow** Forest w/Heavy Litter Kv= 2.5 fps
66.7	233	Total			

Subcatchment 3S: MPMR Analysis 2 Existing



Summary for Subcatchment 4S: MPMR Analysis 2 Proposed

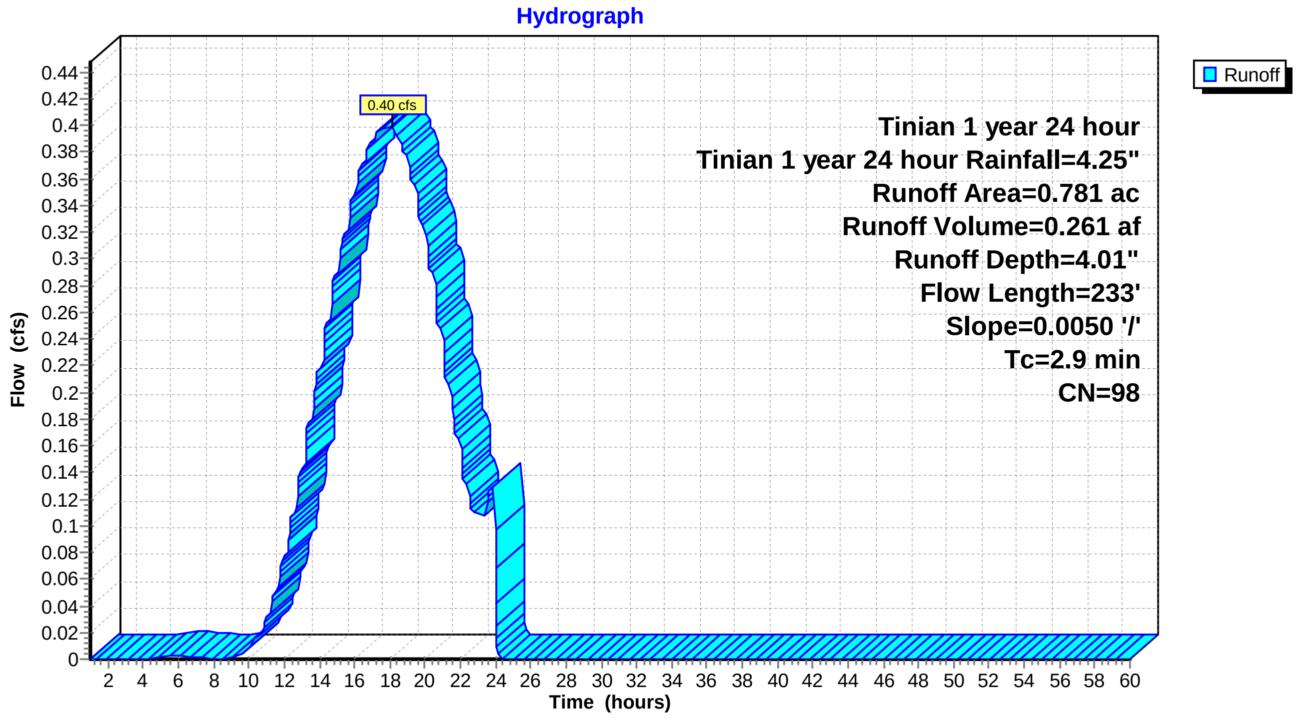
Runoff = 0.40 cfs @ 18.09 hrs, Volume= 0.261 af, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 1 year 24 hour Tinian 1 year 24 hour Rainfall=4.25"

	Area (ac)	CN	Description
*	0.781	98	
	0.781		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0050	1.17		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
1.5	133	0.0050	1.44		**Shallow Concentrated Flow, Shalloe Concentrated Flow Proposed** Paved Kv= 20.3 fps
2.9	233	Total			

Subcatchment 4S: MPMR Analysis 2 Proposed



Time span=1.00-60.00 hrs, dt=0.01 hrs, 5901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ETR Analysis 2 Existing Runoff Area=2.400 ac 0.00% Impervious Runoff Depth=1.61"
Flow Length=402' Tc=59.1 min CN=23 Runoff=0.81 cfs 0.322 af

Subcatchment 2S: ETR Analysis 2 Runoff Area=2.400 ac 100.00% Impervious Runoff Depth>14.64"
Flow Length=402' Tc=3.7 min CN=98 Runoff=4.32 cfs 2.927 af

Subcatchment 3S: MPMR Analysis 2 Existing Runoff Area=0.781 ac 0.00% Impervious Runoff Depth=1.61"
Flow Length=233' Tc=66.7 min CN=23 Runoff=0.26 cfs 0.105 af

Subcatchment 4S: MPMR Analysis 2 Runoff Area=0.781 ac 100.00% Impervious Runoff Depth>14.64"
Flow Length=233' Slope=0.0050 '/' Tc=2.9 min CN=98 Runoff=1.41 cfs 0.953 af

Total Runoff Area = 6.362 ac Runoff Volume = 4.306 af Average Runoff Depth = 8.12"
50.00% Pervious = 3.181 ac 50.00% Impervious = 3.181 ac

Summary for Subcatchment 1S: ETR Analysis 2 Existing

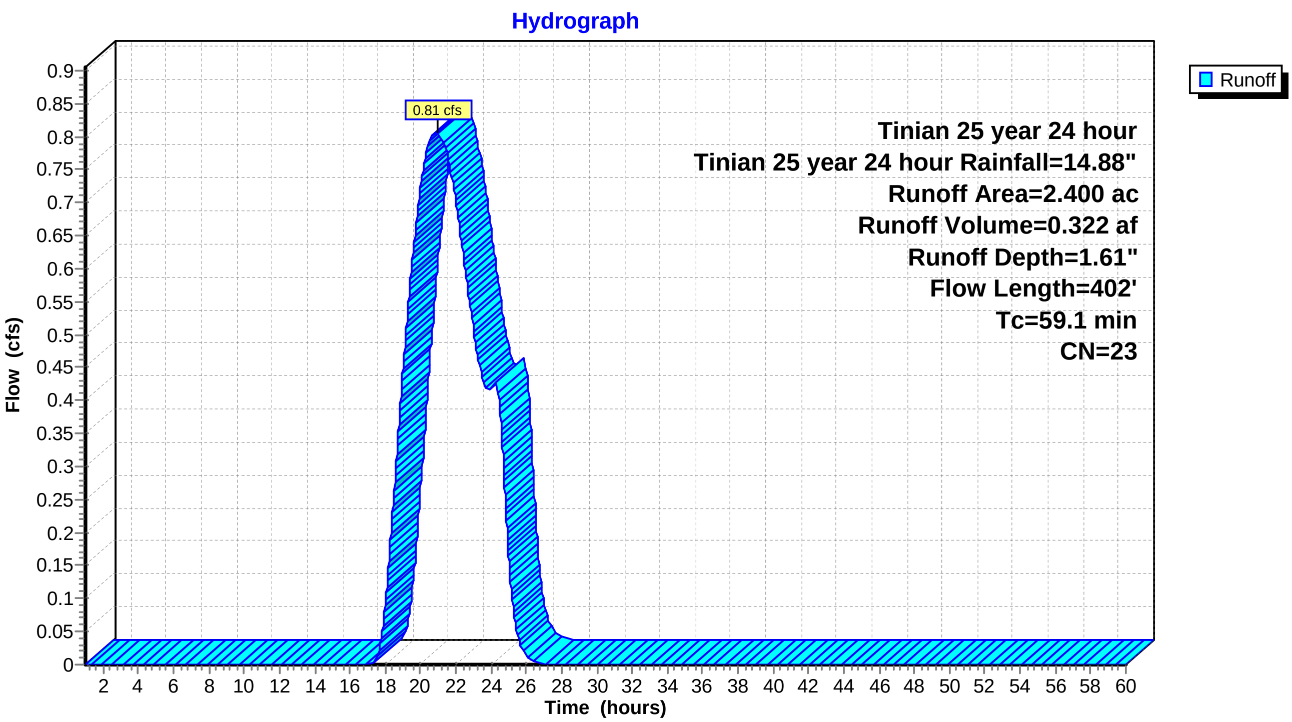
Runoff = 0.81 cfs @ 20.95 hrs, Volume= 0.322 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 25 year 24 hour Tinian 25 year 24 hour Rainfall=14.88"

	Area (ac)	CN	Description
*	2.400	23	
	2.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.3	150	0.0140	0.06		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
18.8	252	0.0080	0.22		**Shallow Concentrated Flow, Shalloe Concentrated Flow Existing** Forest w/Heavy Litter Kv= 2.5 fps
59.1	402	Total			

Subcatchment 1S: ETR Analysis 2 Existing



Summary for Subcatchment 2S: ETR Analysis 2 Proposed

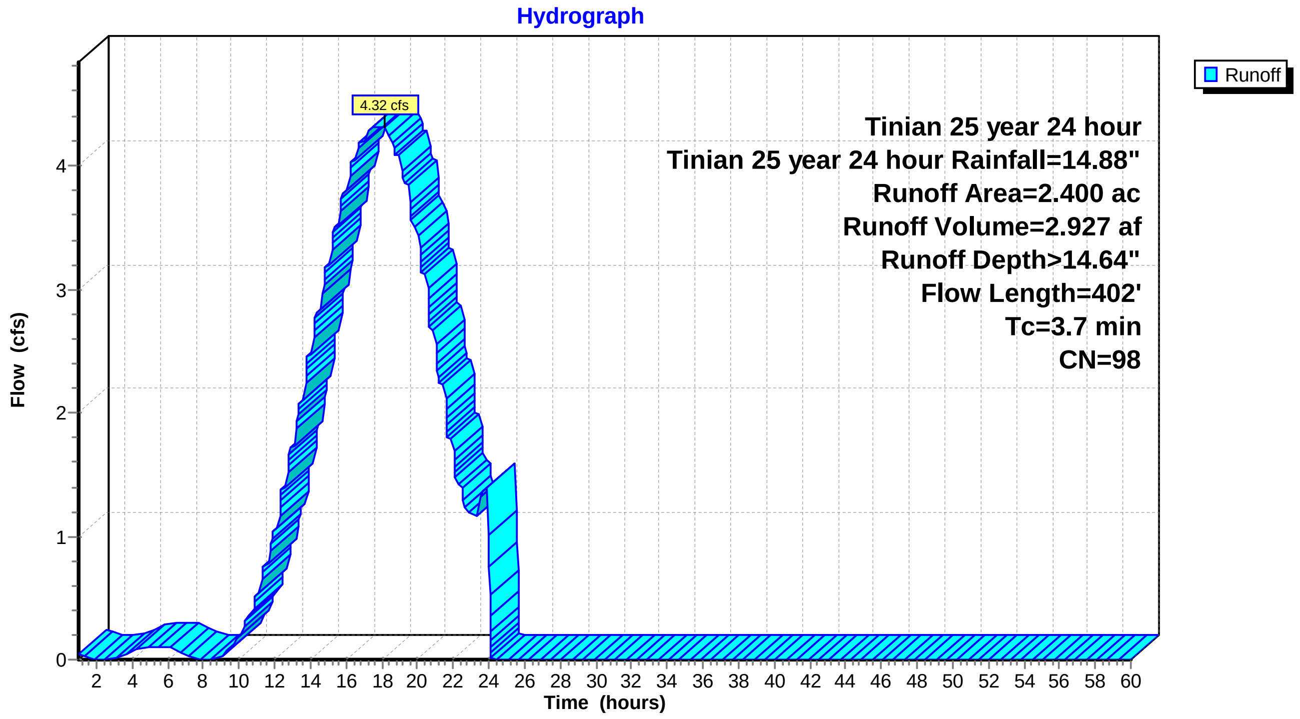
Runoff = 4.32 cfs @ 18.13 hrs, Volume= 2.927 af, Depth>14.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 25 year 24 hour Tinian 25 year 24 hour Rainfall=14.88"

	Area (ac)	CN	Description
*	2.400	98	
	2.400		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0170	1.91		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
2.8	302	0.0080	1.82		**Shallow Concentrated Flow, Shalloe Concentrated Flow Proposed** Paved Kv= 20.3 fps
3.7	402	Total			

Subcatchment 2S: ETR Analysis 2 Proposed



Summary for Subcatchment 3S: MPMR Analysis 2 Existing

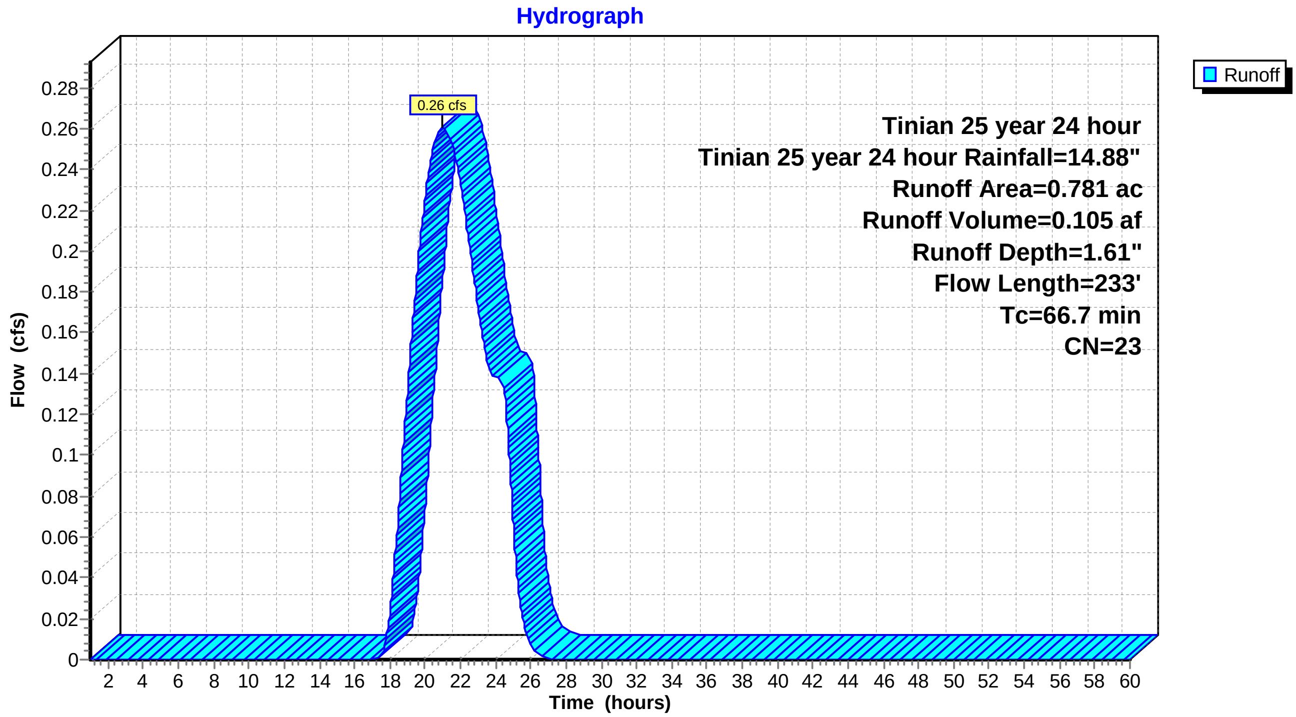
Runoff = 0.26 cfs @ 20.98 hrs, Volume= 0.105 af, Depth= 1.61"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 25 year 24 hour Tinian 25 year 24 hour Rainfall=14.88"

	Area (ac)	CN	Description
*	0.781	23	
	0.781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.6	150	0.0060	0.04		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
10.1	83	0.0030	0.14		**Shallow Concentrated Flow, Shallow Concentrated Flow** Forest w/Heavy Litter Kv= 2.5 fps
66.7	233	Total			

Subcatchment 3S: MPMR Analysis 2 Existing



Summary for Subcatchment 4S: MPMR Analysis 2 Proposed

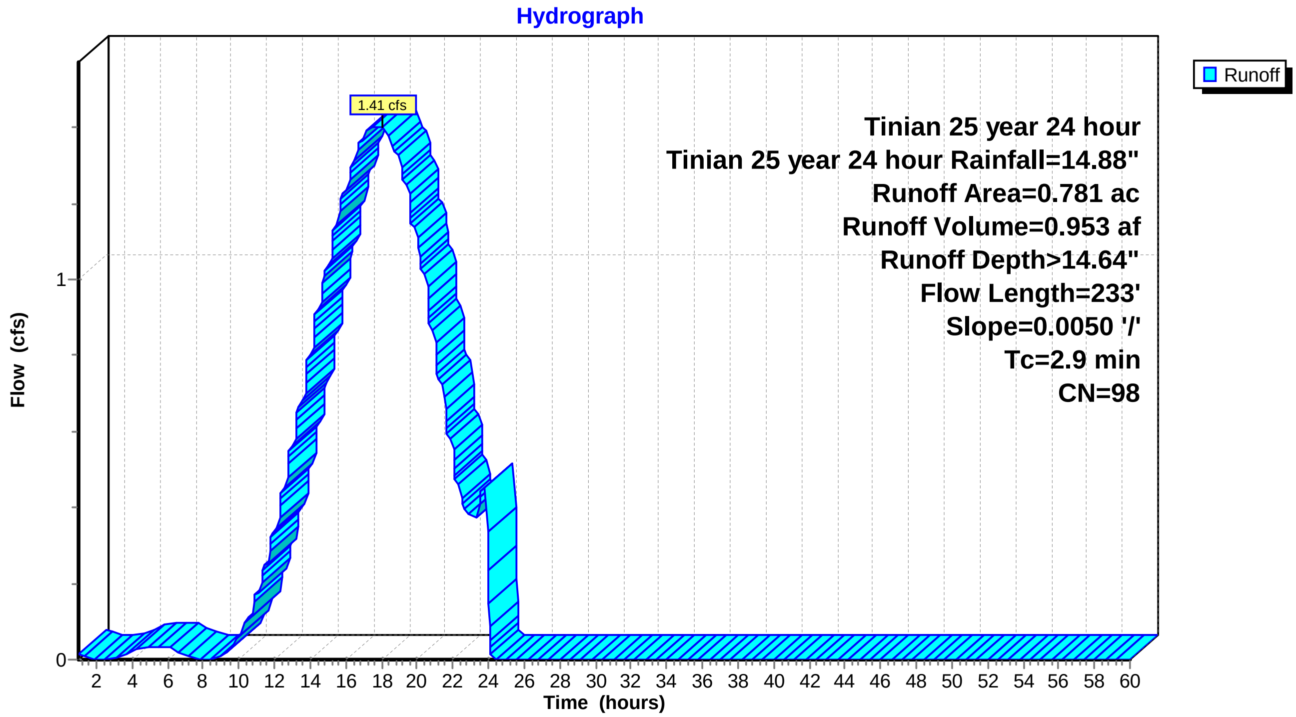
Runoff = 1.41 cfs @ 18.07 hrs, Volume= 0.953 af, Depth>14.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 25 year 24 hour Tinian 25 year 24 hour Rainfall=14.88"

	Area (ac)	CN	Description
*	0.781	98	
	0.781		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0050	1.17		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
1.5	133	0.0050	1.44		**Shallow Concentrated Flow, Shalloe Concentrated Flow Proposed** Paved Kv= 20.3 fps
2.9	233	Total			

Subcatchment 4S: MPMR Analysis 2 Proposed



Time span=1.00-60.00 hrs, dt=0.01 hrs, 5901 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: ETR Analysis 2 Existing Runoff Area=2.400 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=402' Tc=59.1 min CN=23 Runoff=0.00 cfs 0.000 af

Subcatchment 2S: ETR Analysis 2 Runoff Area=2.400 ac 100.00% Impervious Runoff Depth=1.97"
Flow Length=402' Tc=3.7 min CN=98 Runoff=0.63 cfs 0.395 af

Subcatchment 3S: MPMR Analysis 2 Existing Runoff Area=0.781 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=233' Tc=66.7 min CN=23 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: MPMR Analysis 2 Runoff Area=0.781 ac 100.00% Impervious Runoff Depth=1.97"
Flow Length=233' Slope=0.0050 '/' Tc=2.9 min CN=98 Runoff=0.20 cfs 0.128 af

Total Runoff Area = 6.362 ac Runoff Volume = 0.523 af Average Runoff Depth = 0.99"
50.00% Pervious = 3.181 ac 50.00% Impervious = 3.181 ac

Summary for Subcatchment 1S: ETR Analysis 2 Existing

[45] Hint: Runoff=Zero

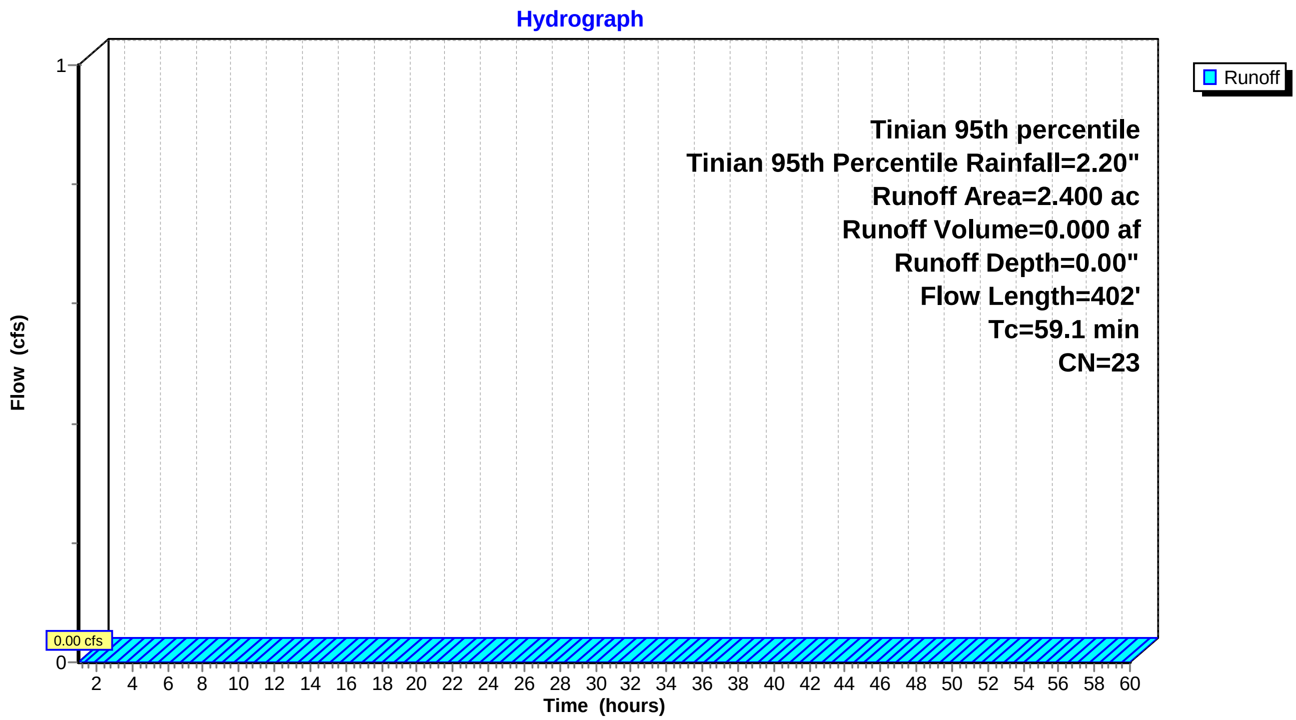
Runoff = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 95th percentile Tinian 95th Percentile Rainfall=2.20"

	Area (ac)	CN	Description
*	2.400	23	
	2.400		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.3	150	0.0140	0.06		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
18.8	252	0.0080	0.22		**Shallow Concentrated Flow, Shalloe Concentrated Flow Existing** Forest w/Heavy Litter Kv= 2.5 fps
59.1	402	Total			

Subcatchment 1S: ETR Analysis 2 Existing



Summary for Subcatchment 2S: ETR Analysis 2 Proposed

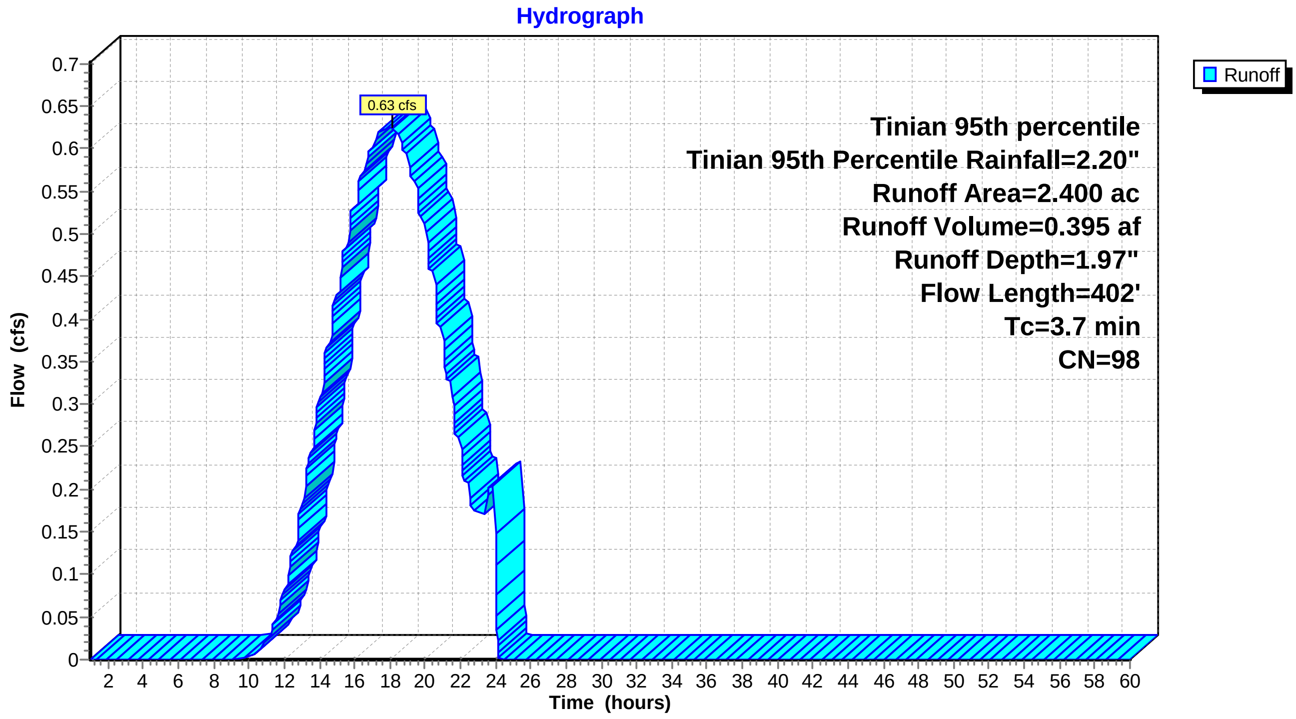
Runoff = 0.63 cfs @ 18.13 hrs, Volume= 0.395 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 95th percentile Tinian 95th Percentile Rainfall=2.20"

	Area (ac)	CN	Description
*	2.400	98	
	2.400		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.9	100	0.0170	1.91		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
2.8	302	0.0080	1.82		**Shallow Concentrated Flow, Shalloe Concentrated Flow Proposed** Paved Kv= 20.3 fps
3.7	402	Total			

Subcatchment 2S: ETR Analysis 2 Proposed



Summary for Subcatchment 3S: MPMR Analysis 2 Existing

[45] Hint: Runoff=Zero

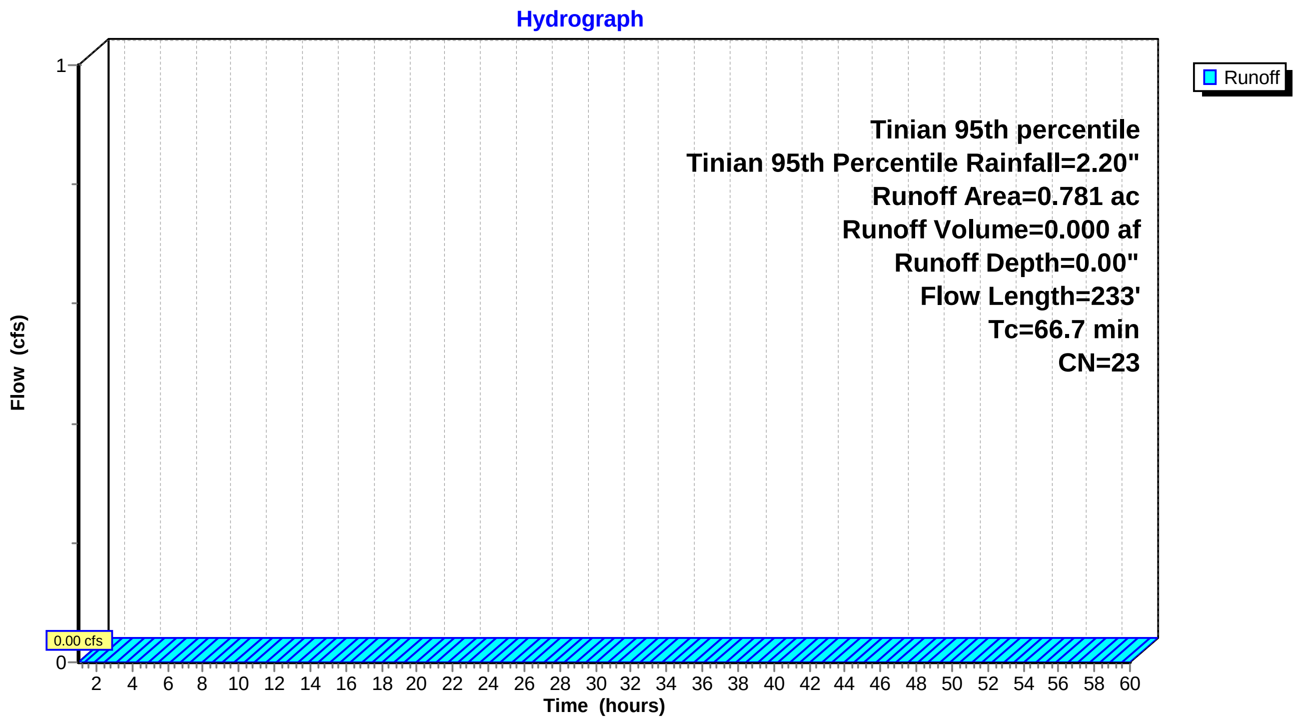
Runoff = 0.00 cfs @ 1.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 95th percentile Tinian 95th Percentile Rainfall=2.20"

	Area (ac)	CN	Description
*	0.781	23	
	0.781		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
56.6	150	0.0060	0.04		**Sheet Flow, Sheet Flow Existing** Woods: Dense underbrush n= 0.800 P2= 7.00"
10.1	83	0.0030	0.14		**Shallow Concentrated Flow, Shallow Concentrated Flow** Forest w/Heavy Litter Kv= 2.5 fps
66.7	233	Total			

Subcatchment 3S: MPMR Analysis 2 Existing



Summary for Subcatchment 4S: MPMR Analysis 2 Proposed

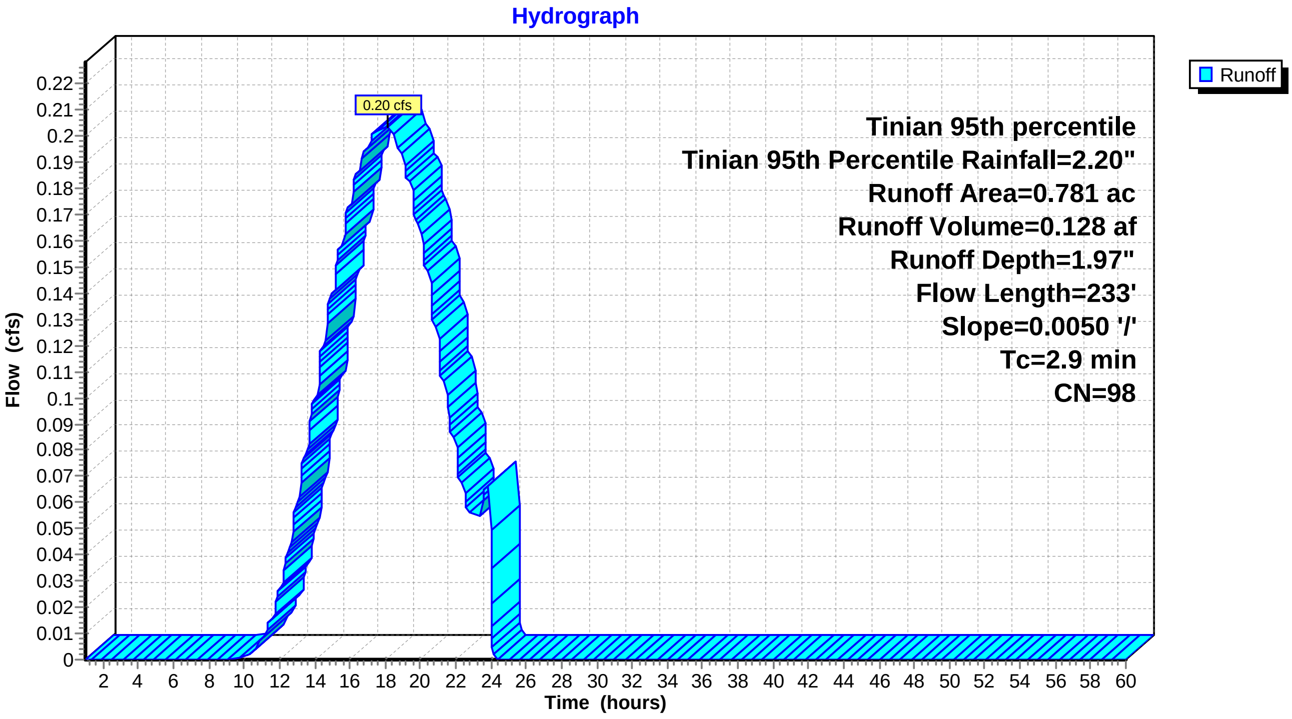
Runoff = 0.20 cfs @ 18.11 hrs, Volume= 0.128 af, Depth= 1.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-60.00 hrs, dt= 0.01 hrs
Tinian 95th percentile Tinian 95th Percentile Rainfall=2.20"

	Area (ac)	CN	Description
*	0.781	98	
	0.781		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.4	100	0.0050	1.17		**Sheet Flow, Sheet Flow Proposed** Smooth surfaces n= 0.011 P2= 7.00"
1.5	133	0.0050	1.44		**Shallow Concentrated Flow, Shalloe Concentrated Flow Proposed** Paved Kv= 20.3 fps
2.9	233	Total			

Subcatchment 4S: MPMR Analysis 2 Proposed



ATTACHMENT A.3
CALCULATIONS

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Final Results		Base Camp Analysis			MPMR Analysis		
		Existing	Proposed	Change	Existing	Proposed	Change
95th % Water Quality Storm		2.20			2.20		
1-yr 24-yr Rainfall Depth (in)		4.25			4.25		
25-yr 24-hr Rainfall Depth (in)		14.88			14.88		
Area (ac)		12.63			0.78		
Weighted Curve Number		22.50	98.00		22.50	98.00	
Flow length (ft)		842.00			233.00		
Time of Concentration (Tc) (min)		86.90	7.10		66.70	2.90	
95th % Water Quality Storm	Runoff Volume (acre-ft)	0.00	2.08	2.08	0.00	0.13	0.13
	Runoff Depth (in)	0.00	1.97	1.97	0.00	1.97	1.97
	Peak Flow (cfs)	0.00	3.29	3.29	0.00	0.20	0.20
1-yr 24-hr	Runoff Volume (acre-ft)	0.00	4.22	4.22	0.00	0.26	0.26
	Runoff Depth (in)	0.00	4.01	4.01	0.00	4.01	4.01
	Peak Flow (cfs)	0.00	6.46	6.46	0.00	0.40	0.40
25-yr 24-hr	Runoff Volume (acre-ft)	1.69	15.40	13.71	0.11	0.95	0.85
	Runoff Depth (in)	1.61	14.64	13.03	1.61	14.64	13.03
	Peak Flow (cfs)	4.13	22.73	18.60	0.26	1.41	1.15
Detention Pond Sizing	Infiltration Rate (in/hr)		1.00			1.00	
	Bottom Width (ft)		220.00			70.00	
	Bottom Length (ft)		440.00			140.00	
	Side Slope (run/rise) (ft/ft)		3.00			3.00	
	Depth (ft)		6.00			6.00	
	Footprint (ac)		2.79			0.43	
	Bottom Area (sf)		96,800.00			9,801.00	
	Bottom Area (ac)		2.22			0.23	
	Volume (cubic-ft)		654,663.24			84,070.80	
	Volume (ac-ft)		15.03			1.93	
	25-Year Peak Flow (cfs)		18.22			1.15	

Table 1.4 Summary of Data for use on Tinian and Pagan

Referenced Values for Use in CJMT Task 11m Study

Location	Mean Annual Rainfall (inches)	Water Quality Storm Events			(24 hr) Rainfall (inches) per Recurrence Interval (years)						
		80th %	90th %	95th %	1 yr	2 yr	10 yr	25 yr	50 yr	100 yr	500 yr
Tinian	83.4	0.8	1.5	2.2	4.25	7.00	10.32	14.88	19.20	26.40	50.70
Pagan	75	0.8	1.5	2.2	4.25	7.00	10.32	14.88	19.20	26.40	50.70

2.2.2.4 Overbank Flood Control Criteria ($Q_{p\text{-}25}$)

The post-development peak discharge rate shall not exceed the pre-development peak discharge rate for the 25-year, 24-hour storm event (see **Table 2.5** above). For site locations other than northern Guam, use **Figure 2.6** to determine the appropriate adjustment factors for rainfall in CNMI and Guam.

MPMR Analysis

	Existing	Proposed	Landuse
Length longest flow path for sheet flow (ft)	150.000	100.000	Forested
Elevation U/S of sheet flow (ft)	22.568	22.568	
Elevation D/S sheet flow (ft)	21.705	22.104	
Slope sheet flow (ft/ft)	-0.006	-0.005	
Length longest flow path for shallow concentrated flow (ft)	83.268	133.268	Forested
Elevation U/S shallow concentrated flow (ft)	21.705	22.104	
Elevation D/S shallow concentrated flow (ft)	21.420	21.420	
Slope shallow conentrated flow (ft/ft)	-0.003	-0.005	
CN Value	22.5	98	
Landuse	Forested	Developed	

	sq ft	**acre**
Proposed Total Impervious Area	34,000.00	0.780532599

Base Camp Analysis

	Existing	Proposed
Length longest flow path for sheet flow (ft)	150.000	100.000
Elevation U/S of sheet flow (ft)	74.031	74.031
Elevation D/S sheet flow (ft)	72.214	73.054
Slope sheet flow (ft/ft)	-0.012	-0.010
Length longest flow path for shallow concentr	691.831	741.831
Elevation U/S shallow concentrated flow (ft)	72.214	73.054
Elevation D/S shallow concentrated flow (ft)	64.440	64.440
Slope shallow conentrated flow (ft/ft)	-0.011	-0.012
CN Value	22.5	98
Landuse	Forested	Developed

	sq ft	acre
Proposed Total Impervious Area	549,980.00	12.62580349

Landuse_ID	A	B	C	D
Bare Ground	68.2	75.6	85.7	90.3
Grassland	30.1	51.1	64.9	71.6
Scrub	23.3	38.5	55.3	61.6
Mixed Forest	22.5	45.2	60.6	68.2
Native Forest	22.5	45.2	60.6	68.2
Wetland	72.8	81.6	85.7	88.8
Commercial	98.0	98.0	98.0	98.0

- The length of overland flow used in time of concentration calculations is limited to no more than 150 feet for predevelopment conditions and 100 feet for post development conditions.

Source: cnmi_guam_stormwater_management_criteria

Recharge Criteria, Re_v		
Precipitation (in), P	1.50	
	Base Camp E	MPMR
Area (acres), A	12.63	0.78
Impervious area (acres)	12.63	0.78
Impervious area (decimal percent), I	1.00	1.00
Recharge criteria, Re_v (acre-feet)	1.58	0.10

Volcanic-dominated areas and soil profiles extending at least 3 ft below the bottom of proposed stormwater facility

Based on annual rainfall and the percentages listed above, the recharge criteria for volcanic-dominated regions of CNMI and Guam are as follows:

$$Re_v = (F)(A)(I)/12$$

Where:
- Re_v = Recharge volume (acre-feet)
- F = Recharge factor (inches; see below)
- A = Site area in acres
- I = Site imperviousness (expressed as a decimal)

Hydrologic Soil Group	Recharge Factor (F)
A	0.80
B	0.50
C	0.20
D	0.10

Limestone-dominated areas

The criterion specific to the limestone-dominated regions of CNMI and Guam requires infiltration of 1.5 inches of precipitation from all impervious surfaces. The equation is as follows:

$$Re_v = (P)(A)(I)/12$$

Where:
- Re_v = Recharge volume (acre-feet)
- P = Precipitation (1.5 inches)
- A = Site area in acres
- I = Site imperviousness (expressed as a decimal)
- 12 = Conversion from inches to feet

Source: CNMIn SW Vol.1 Final

Water Quality Criteria, WQ_v

	90% of average annual	
Precipitation (in), P	1.5	
	BasenCamp E	**MPMR**
Area (acres), A	12.63	0.78
Impervious area (acres)	12.63	0.78
Impervious area (decimal percent), I	1.00	1.00
WQ_v (90%) (acre-ft)	1.58	0.10
min WQ_v	0.21	0.01
Sedimentation Volume acre-ft	0.40	0.03

The following equation can be used to determine the water quality storage volume WQ_v (in acre-feet of storage):

$$WQ_v = (P)(A)(I) / 12$$

where:

- WQ_v = water quality volume (in acre-feet)
- P = 90% Rainfall Event (1.5 inches) for high quality resource areas
  80% Rainfall Event (0.8 inches) for moderate quality resource areas
- A = site area in acres
- I = impervious area percentage of site area (decimal)

A minimum WQ_v value of 0.0167 ft * total area in acres (also referred to as 0.2 watershed inches) is required to fully treat the runoff from pervious surfaces on sites with low impervious cover.

Source: CNMIn SW Vol.1 Final

ELECTRICAL SYSTEM ANALYSIS
IN SUPPORT OF THE
COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS
JOINT MILITARY TRAINING ENVIRONMENTAL IMPACT STATEMENT

Department of the Navy
Naval Facilities Engineering Systems Command, Pacific
258 Makalapa Drive, Suite 100
JBPHH HI 96860-3134

June 2025

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1 PURPOSE

The purpose of this memorandum is to provide technical background and analysis of power distribution in support of the Commonwealth of the Northern Mariana Islands (CNMI) Joint Military Training Revised Draft Environmental Impact Statement (EIS).

1.1 BACKGROUND

The islands of the CNMI are strategically located in the United States (U.S.) Department of Defense (DoD) Indo-Pacific area of operations, as shown in Figure 1. Figure 2 shows the Military Lease Area on Tinian where the U.S. military has trained for several decades.

The Proposed Action would support the ongoing and evolving training requirements of U.S. Armed Forces forward deployed to the Western Pacific, and of U.S. allies and partners, specifically for distributed operations training within the Military Lease Area on Tinian. Proposed training events would include both ground and aviation training within the Military Lease Area.

Non-live-fire offensive and defensive training actions would continue to be conducted in the Military Lease Area with an increase in existing land-based training events, including both ground and aviation training, which are the same or similar to those currently being conducted on Tinian.

Live-fire training would be conducted at two ranges that would be developed within the Exclusive Military Use Area:

- **Multi-Purpose Maneuver Range.** A live-fire range occupying approximately 200 acres at the northern tip of Tinian to support platoon-size live-fire and maneuver, including three surface radar facilities.
- **Explosives Training Range.** A live-fire range on approximately 2.5 acres for the employment of demolitions and military explosives in support of offensive and defensive training events.

The following are also included in the Proposed Action to support training events:

- Establishment of 13 Landing Zones, areas cleared of vegetation to 6–8 inches, and associated access roads to conduct training events and to provide staging, bivouac, and gathering and rendezvous areas.
- Ground and aviation improvements at North Field, including establishment of a drop zone and the placement of a metal airfield surface.
- Construction and operation of a Base Camp.
- Clearance and improvements of roads within the Military Lease Area.

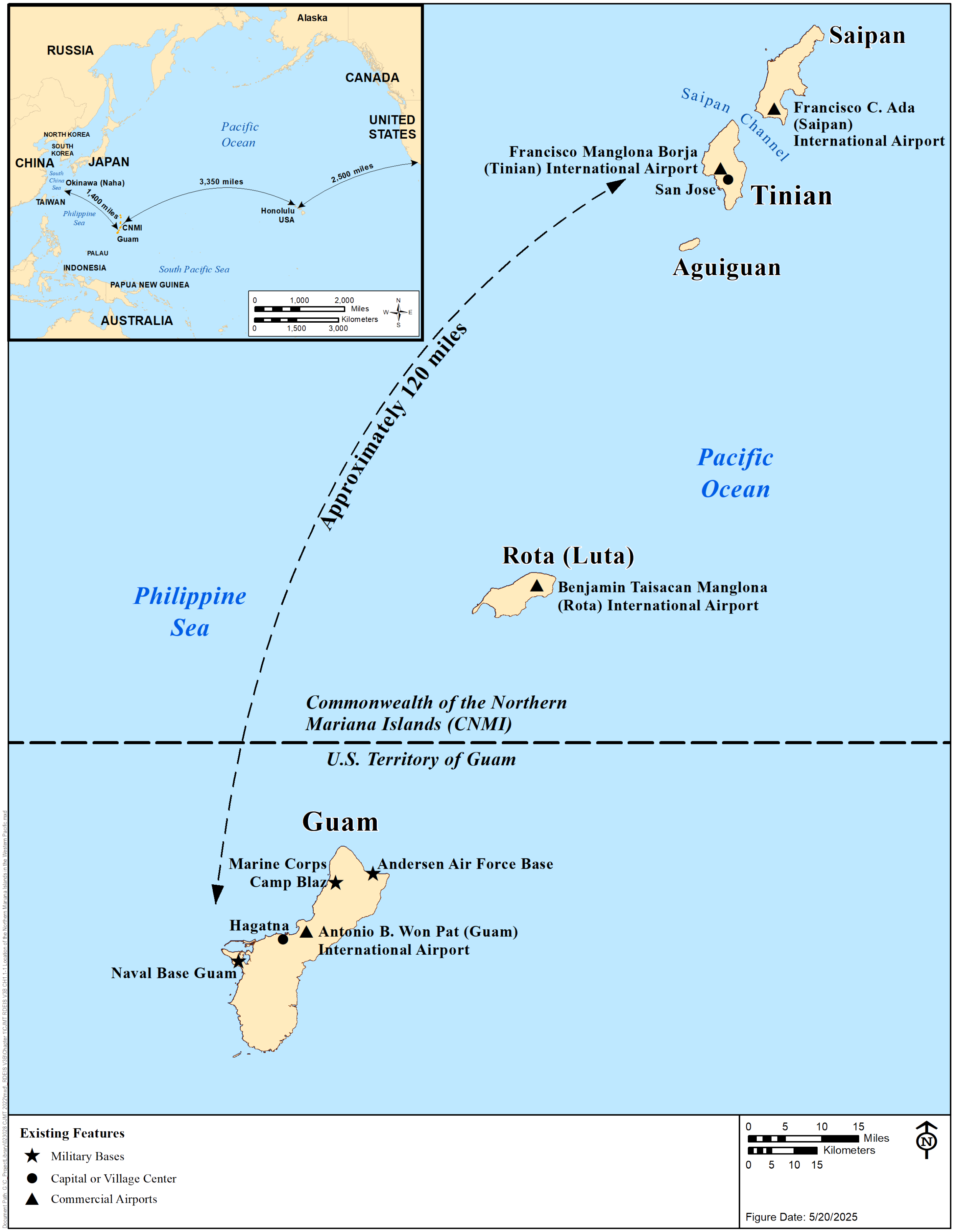

Figure 1. Island of Tinian – Location

Figure 2. Island of Tinian – Military Lease Area Boundaries

2 EXISTING ELECTRICAL SYSTEM ON TINIAN

2.1 COMMONWEALTH UTILITIES CORPORATION ISLAND-WIDE SYSTEM

The Commonwealth Utilities Corporation, a public corporation, owns the existing island-wide electrical distribution system on Tinian . Telesource CNMI, Inc., operates and maintains the system under an Independent Power Provider agreement with the Commonwealth Utilities Corporation. The status of the agreement and whether the Commonwealth Utilities Corporation would inherit the workforce and take over operations, has yet to be confirmed. This would still allow the Commonwealth Utilities Corporation to have flexibility to continue contracting certain items from Telesource CNMI, Inc., if needed. This existing system includes several electrical generation units and distribution infrastructure, which consists of overhead and underground distribution lines, power poles, utility holes, transformers, substations, and meters used to provide and measure power to island customers (Information cited in Cardno GS).

The existing electrical generation system at the powerplant consists of the following components:

- Four 4.16 kilovolt, 2.5 megawatt diesel generators
- Two 4.16 kilovolt, 5.5 megawatt diesel generators
- Two exhaust stacks:
- One 90-foot tall stack to service four 2.5 megawatt generators
- One 175-foot tall stack to service two 5.5 megawatt generators
- An aboveground fuel delivery pipeline from the existing diesel fuel storage tank at the Port of Tinian to a diesel storage tank, which is adjacent to the power plant facility
- Expansion capability for two additional 5.5 megawatt diesel generators (including space inside the existing generator building and tie-in points to the existing exhaust stack)

Data collected in the field indicated an installation date of 1999 for the generators.

The location, configuration, and electrical capacity are essential details for the evaluation of the Tinian Power Plant. The Tinian Power Plant is a single generation facility near the coast outside of San Jose at 25 feet above mean sea level. The powerplant has a total generator operating capacity of 18.2 megawatt with available capacity of 12.70 megawatt considering the maintenance scenario of the largest generator to accommodate additional loads. The powerplant's capacity could be expanded because it has space for two additional 5.5 megawatt generators that would provide an additional 11 megawatt to the system capacity, if installed; this would provide a total generator operating capacity of 29.2 megawatt and an available capacity of 24.7 megawatt. The 4,160-volt output from each of the six diesel generators feed the 1200A synchronizing switchgear that in turn feeds step-up transformers.

The step-up transformers increase the 4,160 volt up to 13.8 kilovolt for power distribution, except for Feeder 2, which distributes power at 4,160 volt. This feeder was anticipated to be upgraded from 4,160 volt to 13.8 kilovolt by 2024, and its current status is unknown. The island-wide electrical distribution consists of four medium voltage feeders that originate from the Commonwealth Utilities Corporation plant. Feeder 1 was identified as offline and loads transferred to Feeder 2. Feeders 2 and 3 support most of the island. Feeder 4 is a dedicated feeder that serves the former U.S. Agency for Global Media (USAGM) facility (Department of the Navy [DON] 2018).

See Figure 3 for existing feeder distribution and designations.

Much of the existing island-wide electrical distribution system is overhead except for lines within the vicinity of the airfield runways. The existing overhead power distribution on the island has been replaced with concrete poles after impacts from Typhoon Yutu in 2018. The extent of how much of the overhead line distribution has been replaced to date has yet to be determined.

A 2017 Tinian Unscheduled Power Outages report received during the site investigation, revealed the following outages:

- 2015 – 11 Emergency Outages
- 2016 – 6 Emergency Outages

No additional information as to the cause of the outage events is known.

3 ESTIMATED ELECTRICAL DEMAND AND PROPOSED ELECTRICAL INFRASTRUCTURE WITH CJMT ACTION

3.1 POWER DEMAND

The existing system capacity at the Tinian power shall not exceed 12.70 MW. Proposed operations would add an estimated 0.146 megawatt of peak electricity demand to operate facilities and supporting infrastructure and equipment. The additional electrical demand loads on the proposed operations include the three surface radar facilities, which may alternatively be powered by temporary or permanent generators. This increase in peak demand accounts for 1.15 percent of total island-wide/Commonwealth Utilities Corporation system capacity. Table 1 provides a summary of existing and proposed electrical demands relative to the existing electrical system capacity. With this added electrical demand, the system maintains a 9.55 megawatt capacity reserve, which is 75.2 percent of the total system capacity (see Attachment A for calculation details). The existing island-wide power generation facility is capable of meeting the increased power demand during the proposed operations; therefore, the impacts would be less than significant.

Table 1. Electrical Power System Peak Demand and Capacity

Item	*MW of Electricity*	*% of System Capacity*
Tinian Power Plant Effective Design Capacity	12.70	100
Peak Electrical Demand from Existing Customers	3.00	23.5
Additional Peak Electrical Demand from Proposed Facilities	0.146	1.15
Total Electrical Demand with Proposed Facilities	**3.146**	**24.8**
Remaining Electrical Generating Capacity with Proposed Action	**9.51**	**75.2**

Legend: % = percent; MW = megawatt.

Multiple interconnection points to the grid exist. However, a spare breaker is available that could be used for the U.S. Marine Corps (USMC) and, based on peak demand load information received for 2016 and 2017, it is recommended that the USMC be tied to the existing Feeder 4 with the former USAGM infrastructure. Further analysis and investigations and data gathering on peak demand readings are required to validate this recommendation.

Demand load information indicated a peak demand load of 1.4 megawatt on Feeder 4; the demand from the proposed facilities is approximately 0.146 megawatt. The addition of the 0.146 megawatt load on Feeder 4 is insignificant and would not require the installation of a dedicated feeder.

Figure 3. Existing Electrical Distribution System

3.2 MEDIUM VOLTAGE POWER DISTRIBUTION

Power and communications would be required at the proposed facilities, surface radars, and communications towers. Power would originate from the existing Commonwealth Utilities Corporation powerplant. Feeder taps on the existing 13.8-kilovolt USAGM overhead Feeder 4 would be required to support the facilities, surface radars, and communications towers.

Communications would originate from the Tinian commercial internet service provider hub, east of the Commonwealth Utilities Corporation power plant.

The electrical feeder and communications lines would be routed to the proposed facilities and surface radar towers via underground distribution. Surface radar towers supported via underground feeders would provide less maintenance, increased reliability and less cost in operating than if were supported by generators. However, initial cost of using generators would be substantially less. The underground distribution would include concrete-encased duct banks and medium-voltage utility holes. Utility holes would be installed at each change in direction and spaced not greater than 400 feet on straight runs as indicated per Unified Facilities Criteria 3-550-01 (DoD 2019). Where tapped from the existing overhead line, additional overhead power equipment and a riser would be required for the proposed distribution. Additional coordination with Commonwealth Utilities Corporation would be required for any outages during cutover of the 13.8-kilovolt feeder to the proposed operations.

Figure 4 reflects the proposed routing of the underground distribution for both power and communications. Further site investigation is required to verify the exact routing of the underground duct bank and utility hole locations to support the proposed operations. Duct bank configurations, utility hole sizes, and exact cable termination points would be deferred and determined during the detailed design effort.

3.2.1 Electrical Distribution System

The existing 13.8-kilovolt Commonwealth Utilities Corporation overhead line running north along 8th Street would be tapped at the power poles to provide underground lateral feeds to the proposed operations, except for the Base Camp and the communications towers.

The demobilization of the former USAGM facilities would allow reuse of the existing medium voltage distribution to support the Base Camp. An existing medium voltage switchgear would remain in place to be used from site electrical distribution. It was noted that the existing switchgear requires repair to the existing bus. The extent of the repair to the switchgear is currently unknown.

The feeder and communications lines would continue underground to the north approximately 2,000 feet east of Runway Baker to feed the two surface radar locations, the Multi-Purpose Maneuver Range, AHA1, and wells.

The feeder would also branch at 86th Street due west to support Base Camp Well Field – Option A or due east towards Base Camp Well Field – Option B, the preferred option.

A recently installed extension of Feeder 4 located north of the Francisco Manglona Borja/Tinian International Airport as part of the Tinian Divert Infrastructure Improvements would be tapped and routed underground to feed the proposed aircraft shelter.

Impacts to the existing electrical and communication systems on the neighboring Island of Saipan have been explored for training activities. No training activities would be conducted at the USAGM site on Saipan. Military traffic would be limited to occasional inspection and maintenance of the communication antenna. Replacement of the existing high-powered shortwave transmission station tower with lower-powered Radio Frequency antennas would either offset or result in a net increase of the existing electrical distribution capacity. Consequently, there would be no impact to the electrical distribution at this site on Saipan.

Figure 4. Proposed Electrical Distribution System

3.3 QUANTITIES – UNDERGROUND DISTRIBUTION

Below is a summary of the anticipated quantities of utility holes, trenching, and backfill for both the electrical and communications underground distribution systems.

This underground distribution includes approximately 85,665 linear feet of underground duct bank with 121 electrical utility holes and 221 communication utility holes. Table 2 provides the estimated quantity of duct bank (excavation, backfill, and concrete).

Table 2. Duct Bank Quantities

Type	*Total + 15% Contingency (Cubic Yards)*
Excavation	36,037
Concrete	14,299
Backfill	18,818

Legend: % = percent.

4 REFERENCES

DON. 2018. *Electrical Study Update V2a1 Final in Support of the Commonwealth of the Northern Mariana Islands Joint Military Training Environmental Impact Statement/Overseas Environmental Impact Statement.* JBPHH, HI. Prepared for NAVFAC Pacific.

DoD. 2019. *Unified Facilities Criteria (UFC), Exterior Electrical Power Distribution.* UFC 3-550-01. Including Change 3. November 1.

ATTACHMENT A
CALCULATIONS

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Base Camp Load Schedule

Tinian Base Camp Structures

Facility Name	*Unit of Measure*	*Quantity/ Size*	*Watt/ SF*	*Watt/ EA*	*Calculated (kW)*	*Calculated (kVA)*	*Total kVA inc. 25% spare*	*Xfmr size (kVA)*	*Total Demand (kVA)*	*Assumption & Notes*
Outdoor Services										
Ammunition Holding Area (AHA-1)	SF	100	2.19		0.22	0.27	0.34	7.5		
Bivouac Concrete Pad	SF	1	0		0.00	0.00	0.00	0		Electrical needs provided by generators
Biosecurity/Washrack	SF	5,400	0.15		0.81	1.01	1.27	7.5		
Facilities										
Administration/HQ Building	SF	2,115	24		50.76	63.45	79.31	112.5		
Range Control Building (Admin)	SF	4,155	7.5		31.16	38.95	48.69	75		
Base Camp	SF	1	0		0.00	0.00	0.00	0		Electrical needs provided by existing USAGM service
Warehouse	SF	18,000	2		36.00	45.00	56.25	75		
Exercise Control (Training Unit Operational Facility)	SF	1,000	6		6.00	7.50	9.38	15		
Restroom/Showers	SF	5,700	2		11.40	14.25	17.81	25		
Miscellaneous Facilities										
Surface Radar 1	EA	1		12500.00	12.50	15.63	19.53	25		
Surface Radar 2	EA	1		12500.00	12.50	15.63	19.53	25		
Communications Towers	EA	3	0		0.00	0.00	0.00	0		Electrical needs provided by existing USAGM service
Hardened Aircraft Shelter	SF	20,020	6		120.12	150.15	187.69	225		
Well Field Monitor	EA	2		750.00	1.50	1.88	2.34	7.5		(2) Sensor, (1) Data Logger, Aux. Equip., Lighting
Fueling/Fuel Tanks	SF	1,500	0.5		0.75	0.94	1.17	7.5		
								607.5	182.25	Demand kVA based on 30% of the sum of all transformer ratings
									145.8	Demand kW with 0.8 PF

Legend: % = percent; Admin = administration; USAGM = United States Agency for Global Media; Aux. = auxiliary; EA = each; HQ = headquarters; kVA = kilovolt ampere; kW = kilowatt; PF = power factor; SF = square foot; Xfmr = transformer.

Duct Bank - Quantities

		L (FT.)	W (FT.)	D (FT.)	Cross Section Area (FT.)	CU. FT.	CU. YD
Power/Comm	Excavation	53138.56	3.50	3.83	13.41	712322.34	26382.31
	Concrete	53138.56	3.50	1.83	5.30	281678.63	10432.54
	Backfill	53138.56	3.50	2.00	7.00	371969.89	13776.66
Comm	Excavation	45376.48	1.50	3.83	5.75	260687.89	9655.11
	Concrete	45376.48	1.50	1.83	2.30	104391.12	3866.34
	Backfill	45376.48	1.50	2.00	3.00	136129.44	5041.83

All Conduit Areas	
sqin.	Sqft.
95.00	0.66
64.00	0.44
159.00	1.10

Comm Conduit Areas	
sqin.	Sqft.
64.00	0.44
64.00	0.44

TOTALS		
		CUBIC YARDS
Total + 15% Contingency	Excavation	**36037.42**
	Concrete	**14298.88**
	Backfill	**18818.49**

Legend: % = percent; Comm = communications; CU. FT. = cubic foot; CU. YD = cubic yard; D = depth; FT. = foot or feet; L = length; squin. = square inch; Sqft. = square foot; W = width.

Electrical Distribution System – Quantities

Route Segments	*Connecting Segment Numbers*	*Route Description*	*Routing Type*	*Length (Feet)*	*Number of Poles @135' Spacing*	*Number of Manholes @400' Spacing*	*Length (Meters)*	*Notes*
Segment 1	A to B	Existing OH electrical to Tinian Powerplant	Existing Electrical (OH)	9,823			2,994	Tinian Powerplant to Airport, existing poles.
Segment 2	B to C	Existing UG electrical to Tinian Powerplant	Existing Electrical (UG)	2,810		8	856	West of Tinian International Airport clearance zone (west), required to be underground.
Segment 3	C to D	Existing OH electrical to USAGM	Existing Electrical (OH), Proposed Comm (OH)	17,392			5,301	Existing USAGM Feeder from Airport to Base Camp would connect wells in Well Option A Site. Comm installed on existing OH poles.
Segment 4	E to F	Proposed UG electrical and comm lines	Proposed Elec/Comm (UG)	11,205		29	3,415	Base Camp to Surface Radar Site 1.
Segment 5	G to H	Proposed UG electrical and comm lines	Proposed Elec/Comm (UG)	13,381		34	4,079	Unai Chulu Road to Ushi Point Road.
Segment 6	H to J	Proposed UG electrical and comm lines	Proposed Elec/Comm (UG)	5,260		14	1,603	Proposed UG from 8th Avenue To North Comm Tower.
Segment 7	H to K	Proposed UG electrical and comm lines	Proposed Elec/Comm (UG)	4,763		13	1,452	Ushi Point Road to AHA 1 (lighting, comms), also connects MPMR water tanks/wells.
Segment 8	L to M	Proposed UG electrical and comm lines	Proposed Elec/Comm (UG)	11,599		30	3,535	Proposed UG elec/comm from 8th Avenue to Well Field Option B (connects wells).
Segment 9	L to O	Proposed UG comm lines	Proposed Comm (UG)	26,236		67	7,997	Base Camp to Broadway (inside MLA Boundary).
Segment 10	N to P	Proposed UG comm lines	Proposed Comm (UG)	13,222		34	4,030	Broadway MLA to Commercial Internet Service Provider (San Jose).

Total Comm OH Poles	0
Total Elec OH Poles	0
Total # Poles	**0**
Total Comm Manholes	221
Total Elec Manholes	121
Total # of Manholes	**342**
MH Spacing	400
Pole Spacing	135

Legend: ADN = area distribution node; AHA = Ammunition Holding Area; Comm = communications; Elec = electrical; MLA = Military Lease Area; MPMR = Multi-Purpose Maneuver Range; OH = overhead; UG = underground; USAGM = United States Agency for Global Media.

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