



2010

STORM WATER DRAINAGE MASTER PLAN

BUREAU OF PLANNING
GOVERNMENT OF GUAM
P.O. BOX 2950
AGANA, GUAM 96910



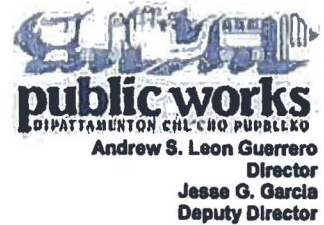
DEPARTMENT OF
PUBLIC WORKS
GUAM

2010



The Honorable
Felix P. Camacho
Governor

The Honorable
Michael W. Cruz, M.D.
Lieutenant Governor



December 17, 2010

Mr. Gene Niemasz
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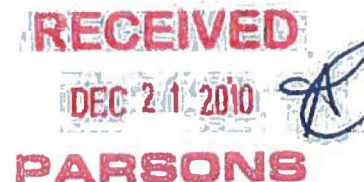
Subject: Storm Water Drainage Master Plan

Dear Gene,

The Guam Department of Public Works has reviewed and approves the Stormwater Drainage Master Plan dated December 2010.

Sincerely,

for
ANDREW S. LEON GUERRERO
Director



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**Guam Islandwide Program Management Services
PTG DPW FHWA - GU-NH-IPMS(002)**

Storm Water Drainage Master Plan

December 2010

**The Honorable Felix P. Camacho, Governor
The Honorable Michael W. Cruz, M.D., Lieutenant Governor**



Keith A. Hixson
I HEREBY CERTIFY THAT THIS REPORT WAS PREPARED
BY ME OR UNDER MY DIRECT SUPERVISION

Prepared by:
Parsons Transportation Group Inc.
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Final Report of the Study of the
The Federal Highway Administration

SPORTS WATER GARDENING MASTER PLAN

December 1971

The Honorable Earl Warren, U.S. Supreme Court
The Honorable William French Smith, U.S. House of Representatives



U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

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Executive Summary

The Government of Guam Department of Public Works (DPW) has prepared the Guam Storm Water Drainage Master Plan (SWDMP) to present a systematic approach for identifying existing storm water runoff patterns, existing storm water drainage systems, and assessing and prioritizing additional drainage improvements throughout the island of Guam. The SWDMP focuses on drainage improvements at the village level, as well as routed roads. This report documents:

- Methodology of defining drainage improvements;
- Criteria used to evaluate needed drainage improvements;
- Probable costs of improvements;
- Prioritization of projects for Capital Improvement Program (CIP) inclusion; and
- Available funding.

Some drainage improvement sites were initially identified in the Flood Control Master Plan (Earth Tech 1997) and the Village Streets Master Plan (Parsons 2009). Additional drainage improvement sites were obtained by letters and e-mails to the SWDMP team, which were usually sent to DPW and forwarded for inclusion in the SWDMP, as well as information received by the team during meetings with village mayors or mayor's delegated staff during the field effort. These drainage improvement sites were organized into a series of drainage improvement lists on a per village basis and guided the field effort.

The field effort began in mid January 2010 and was completed in early February 2010. During this timeframe, the SWDMP team conducted onsite inspections to evaluate the drainage improvement sites. Approximately 300 locations were evaluated. The field effort had two goals. The first goal was to document drainage deficiencies for later prioritization of potential CIP projects. The second goal was to recommend drainage improvements for generating project cost estimates. At each location, necessary drainage improvements were determined by evaluating and identifying the following:

- Deficiencies in drainage conveyance and storm drain systems;
- Issues regarding hillside, channel, and shoreline erosion;
- Potential undermining at bridges;
- Areas prone to severe sediment and/or debris deposition; and
- Maintenance issues.

Project Prioritization

Drainage improvements were organized into ten categories, including (1) Public Safety Risk; (2) Environmental Severity; (3) Maintainability; (4) Flooding Severity; (5) Floodplain; (6) Erosion Severity; (7) Number of Affected Properties; (8) Roadway Type; (9) Right-of-Way (ROW) Requirements; and (10) Estimated Cost. The evaluation categories and their associated scoring criteria displayed in Table ES-1 were used to develop a prioritized list of projects for each village. For each project, the sum of each criterion multiplied by its ranking factor yielded a prioritized score. Projects with the highest total scores are considered the highest priority projects and will likely be completed first when funding is available.

Table ES-1. Project Evaluation Criteria						
EVALUATION CATEGORIES	PRIORITY SCORE	CRITERIA	RANKING FACTORS			
			HIGHEST SCORE (X3)	MODERATE SCORE (X2)	LOW SCORE (X1)	NO SCORE (X0)
	10	Public Safety Risk	Inaction poses significant risk to public safety, potential loss of life.	Inaction poses moderate risk to public safety, potential injury.	Inaction poses low risk to public safety.	No risk to public safety.
	20	Environmental Severity	Directly impacts aquifer.	Directly impacts coastal area (within immediate area of shoreline).	Directly impacts surface water (e.g., river, stream, or lake).	No environmental risk.
	3	Maintainability	Low maintenance projects with easy accessibility.	Moderate maintenance requirement, moderately accessible.	Difficult to maintain and/or difficult to access.	Very difficult to maintain and/or very difficult to access.
	3	Flooding Severity	Unacceptable damage caused by flood events.	Moderate damage caused by flood events.	Flood events cause nuisance damage.	No flood hazard.
	3	Floodplain	Inside floodplain.	N/A	N/A	Outside floodplain.
	3	Erosion Severity	Unacceptable damage caused by erosion.	Moderate damage caused by erosion.	Erosion damage considered nuisance.	No erosion hazard.
	3	Number of Affected Properties	Greater than 4 properties affected.	3 to 4 properties affected.	1 to 2 properties affected.	No properties affected.
	3	Type of Roadway	Highway	Arterial	Collector	Private
	3	Right-of-Way Requirement	Requires no ROW.	N/A	N/A	Requires ROW.
	10	Estimated Cost	Cost < \$200,000	\$200,000 < Cost < \$1,000,000	\$1,000,000 < Cost < \$10,000,000	Cost > \$10,000,000

Project Work Type

For documentation and cost estimating purposes, drainage improvements were identified using eight separate categories. These categories were later characterized as the drainage work type. The eight work types are displayed in Table ES-2.

Table ES-2. Drainage Improvement Work Types

Improvement Type	
Erosion Control	Coastal Protection
Conveyance Improvements	Conveyance Maintenance
Storm Drain Improvements	Storm Drain Maintenance
Treatment BMP Improvements	Treatment BMP Maintenance

Project Cost Estimating

Costs were estimated based on planning-level cost estimates prepared for standardized improvements (e.g., gabion walls, culvert replacement, riprap revetment) and projecting those costs to the identified location using information obtained during the site visit.

Project Funding

The design, construction, operation, and maintenance of drainage control systems can involve a significant expense, especially when flood concerns, water quality issues, and population growth are factored in. Typically, government agencies can rely on stable sources of funding that are available from an already established storm water utility. For example, communities with an established storm water utility can utilize service fees, property taxes/general fund monies, system development charges, and special assessment districts to fund storm water programs. Given that a storm water utility is not established in Guam, the local government and the Federal Highway Administration (FHWA), as well as private land owners, will need to rely on grants and low-interest loans that are designated for flood control and water quality protection projects. Information on such grants and low-interest loans is provided at the end of the report.

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1.0 Introduction

The Government of Guam Department of Public Works (DPW) has prepared the Guam Storm Water Drainage Master Plan (SWDMP) to present a systematic approach for improving drainage throughout the island of Guam.

1.1 Report Objectives and Organization

The SWDMP is one of the key programs developed by DPW to develop criteria, a ranking system, and a prioritization methodology for identifying storm water improvement projects for drainage system upgrades, rehabilitation, and system extensions. Equally important to the prioritization methodology was a process for developing Capital Improvement Program (CIP) storm water projects that would effectively address roadway flooding and other drainage problems. An extensive process was used to analyze the storm water system and identify potential CIP projects.

This report documents the methodology of characterizing drainage system improvements, erosion control improvements, and water quality treatment improvements, along with criteria used to evaluate these improvements, the probable costs of improvements, and available funding. Lastly, it presents a verifiable and repeatable process for prioritizing projects and ensuring that the available funding is used effectively.

The report is divided into five sections, along with references provided in Appendix A and supplemental information provided in the remaining appendices. The report organization is indicated in Table 1-1.

Table 1-1. Report Organization

Section	Description
Introduction	Presents report objectives and project purpose and need.
Watershed Overview	Summarizes watershed characteristics for north and south Guam.
Methodology	Methodology for gathering data, prioritizing projects and estimating costs.
Ranking	Overall project ranking per village, summaries of project costs and results.
Appendices	Supporting information on proposed projects, including site visit data, watershed and site maps, project summaries, cost estimates, and prioritization spreadsheets.

1.2 Project Purpose and Need

The purpose of the SWDMP is to:

- Identify existing storm water runoff patterns;
- Identify existing storm water conveyance systems;
- Characterize drainage, erosion control, and treatment BMP improvements;
- Prioritize potential CIP projects; and
- Provide potential funding sources.

The SWDMP focuses on drainage and erosion control facilities at the village level and along routed roads and offers a generalized description of drainage or erosion control issues. The SWDMP team will work closely with DPW and the Federal Highway Administration (FHWA) to package and schedule these various drainage needs into viable projects as appropriate to the various identified funding sources.

2.0 Watershed Overview

This section summarizes Guam's watershed characteristics and provides information regarding existing surface drainage characteristics in the northern and southern portions of Guam. Guam is the largest and southernmost island in the Mariana Islands chain. It is approximately 30 miles long and 9 miles wide with a total of 116.5 miles of shoreline. The island is divided into two distinct geological formations by a central fault line. The northern half is mainly a broad sloping limestone plateau that is bordered by steep seaward cliffs and fringed by narrow coral reefs. The southern half is mountainous and composed of eroded volcanic formations with well-defined watersheds, as shown in Figure 2-1.

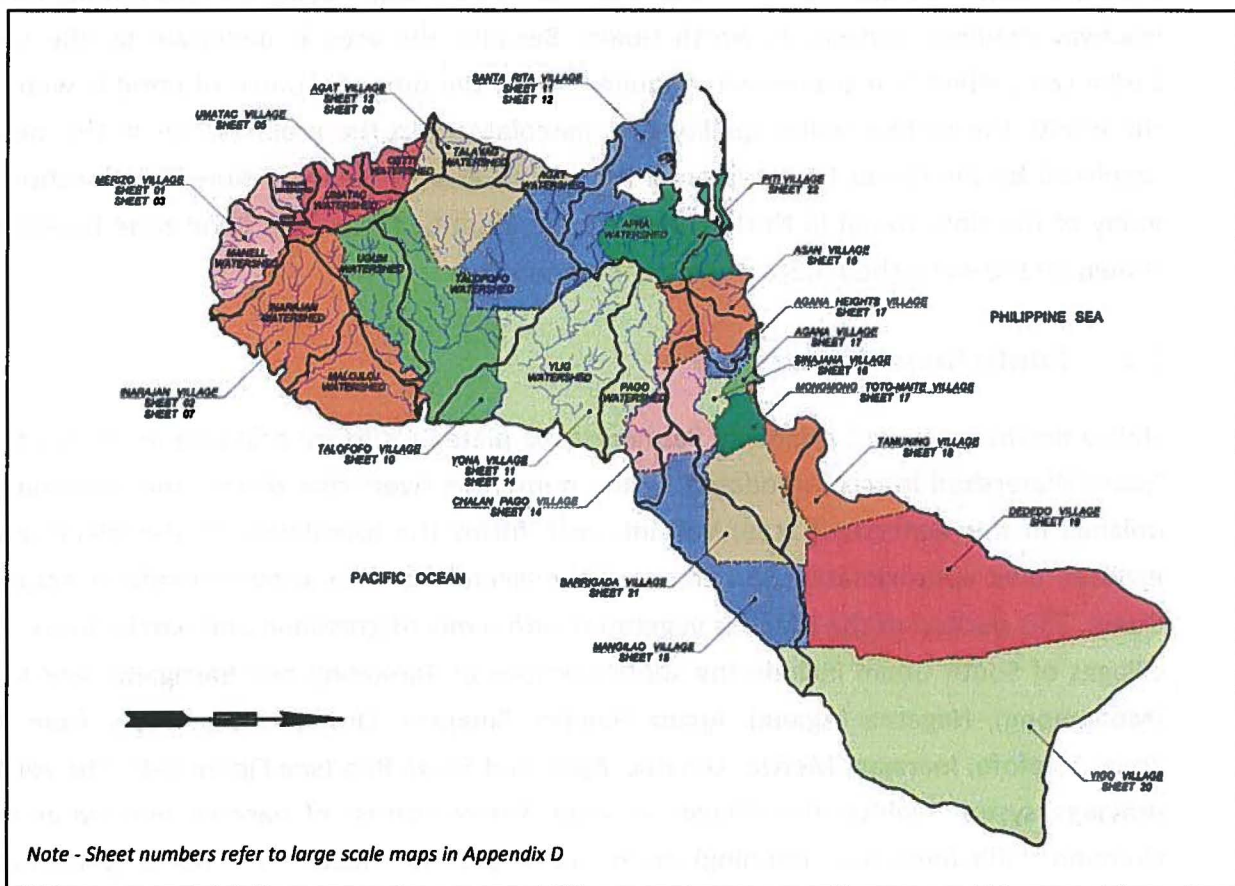


Figure 2-1 – Watershed and Village Map of Guam

2.1 North Guam Watershed

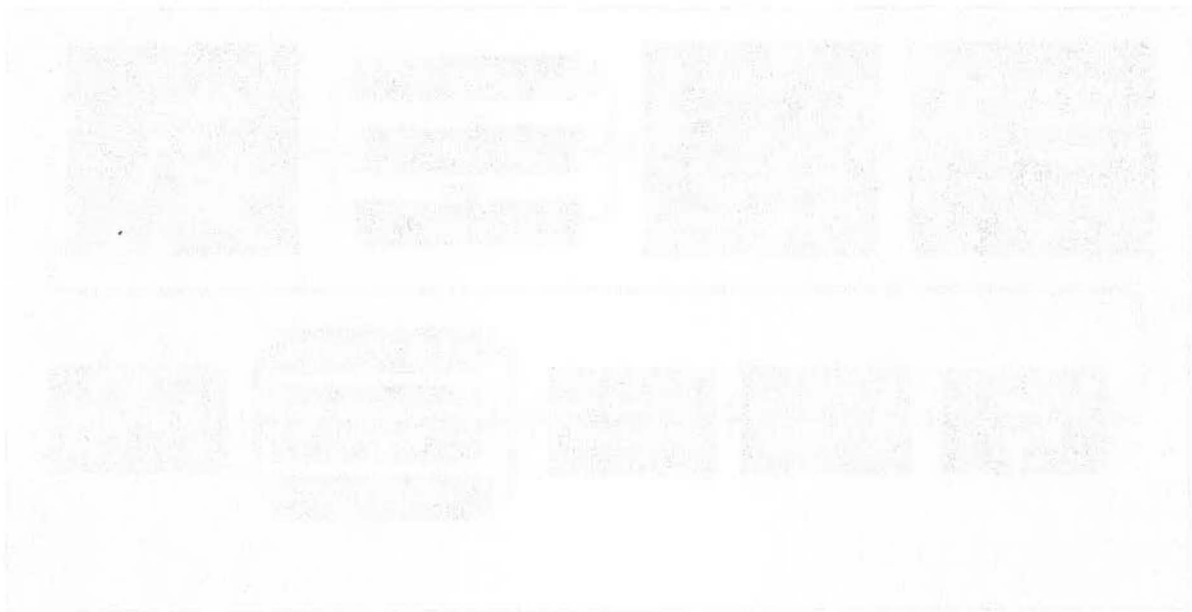
The surface in North Guam is relatively flat, and heavy precipitation generally flows by sheets into swales, then into depressions/retention basins (sinks), where it percolates into the ground. The subsoil is composed of highly porous limestone covered with a soil layer generally less than 2 feet thick. Percolation rates are high, generally from 8 to 24 feet per day. The villages of North Guam include the north portions of Tamuning and Barrigada, and Dededo, Yigo, and Mangilao (see Figure 2-1). Within the rural areas of the villages, roadway runoff either sheet flows through grass strips located along the edge of pavement or it ponds at low points. In the more urban locations, the road cross section is generally curbed with roadway runoff conveyed through a storm drain system that outlets into the sinks or existing infiltration basins. There are numerous infiltration basins owned and maintained by the Government of Guam DPW in this area that are currently being used as outlets for the roadway drainage systems in North Guam. Because the area is underlain by the North Guam Lens, which is a groundwater aquifer that is the primary source of potable water on the island, the surface water quality that percolates into the groundwater in this area is regulated by the Guam Environmental Protection Agency (GEPA). Note that locations of many of the sinks found in North Guam can be identified from the flood zone boundaries shown on the watershed maps provided in Appendix B.

2.2 South Guam Watershed

Unlike northern Guam's relatively flat limestone plateau, surface drainage in the Southern Guam Watershed is accommodated by the numerous rivers that dissect the mountainous uplands in this watershed area. Volcanic rock forms the foundation of the island and is exposed over approximately 35 percent of the island's surface, predominantly in southern Guam. This portion of the island is vegetated with a mix of grassland and patchy forest. The villages of South Guam include the south portions of Tamuning and Barrigada, and Maite (Mongmong), Hagatna (Agana), Agana Heights, Sinajana, Ordot, Chalan Pago, Asan, Piti, Yona, Talofofo, Inarajan, Merizo, Umatac, Agat, and Santa Rita (see Figure 2-1). The existing drainage systems within the villages in south Guam consist of earthen and riprap-lined channels, infiltration (i.e., ponding) basins, underground injection chambers, gabion-lined channels, grass-lined ditches, and storm drain networks in some of the more urban environments.

In general, the west side of southern Guam is traversed by rivers that are short with steep gradients and drainage areas of less than 3 square miles each. Route 1 is located very close to the mouths of several of these streams, which outlet into several bays connected to the

Philippine Sea or Apra Harbor. Several rivers are designated as floodways by the Federal Emergency Management Agency (FEMA), while others are designated as Flood Hazard Zone X (i.e., areas with minimal flooding potential). Several locations along the coast are designated within FEMA Flood Hazard Zone V or VE, which is defined as a coastal flood zone with velocity hazard due to wave action. Floodplain boundaries are shown on the watershed maps provided in Appendix B. The east side of southern Guam is traversed by rivers that are much longer with lesser gradients than the west side but with much larger watersheds. Route 4 is located very close to the mouths of these rivers, which outlet into several bays connected to the Pacific Ocean.



3.0 Methodology

Parsons Transportation Group Inc. (PTG) has assembled the SWDMP as part of the services provided to DPW under the Island-wide Program Management Services contract. A schematic that summarizes the overall approach for development of the SWDMP is indicated in Figure 3-1. Collectively, the project approach included the following:

- Identifying drainage needs;
- Conducting site visits;
- Classifying drainage work types;
- Prioritizing drainage improvements on a village-level basis;
- Performing cost estimates; and
- Ranking projects.

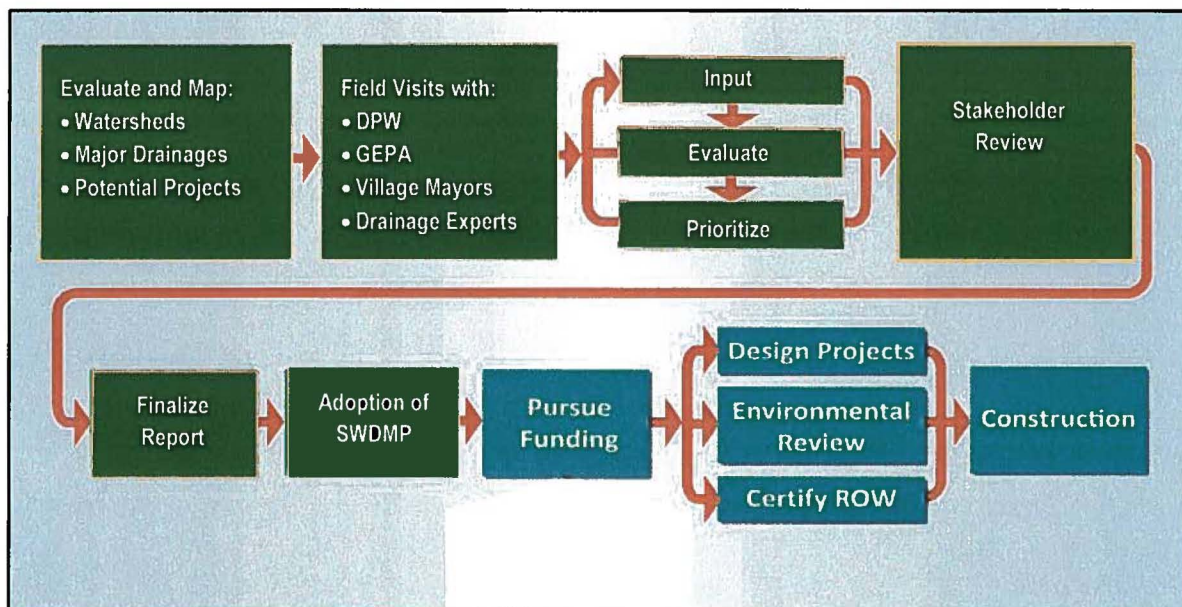


Figure 3-1. Methodology of the Storm Water Drainage Master Plan Effort

The drainage needs evaluated as part of the SWDMP were identified from the following sources:

- Flood Control Master Plan
- DPW direction on specific higher-priority drainage issues
- Projects identified by Village Mayors and/or their representatives
- Others, identified by DPW and their consultants

The methodology associated with the development of the SWDMP involved an understanding of the following:

- Overall watershed characteristics;
- Existing drainage facilities;
- Deficiencies in drainage facilities;
- Erosion potential;
- Input from others; and
- Prioritization of drainage improvements on a village-level basis.

3.1 Meetings with Agencies and Village Representatives

The SWDMP team initiated site visits on January 20, 2010. The initial drainage deficiency list used for the site visits was organized by village and was developed based on the Flood Control Master Plan (Earth Tech 1997), the Village Streets Master Plan (Parsons 2009), and existing geographic information system (GIS) mapping. Additional drainage deficiencies were obtained by letters and e-mails to the SWDMP team, which were usually sent to DPW and forwarded for inclusion in the SWDMP. Each day, prior to mobilizing, the SWDMP team contacted each village mayor to introduce the SWDMP team to the mayor and to:

- Make them aware of scheduled daily activities;
- Discuss initial list of deficiencies;
- Obtain additional information regarding drainage problems; and
- Invite the mayor and/or the mayor's representative to accompany the team.

Table 3-1 displays the field effort schedule and the level of participation by the mayors and the different agency representatives.

Table 3-1. Village Mobilization Schedule

DATE	VILLAGE	MAYOR STAFF MEETING	SWDMP TEAM			COMMENTS
			PTG	DPW	GEPA	
1/19/2010	Tamuning		X	X	X	Site added by DPW based on e-mail from owner
1/20/2010	Barrigada	X	X	X	X	Sites were added by the Mayor
1/21/2010	Piti		X	X	X	
1/21/2010	Agana Heights		X	X	X	Sites were added by DPW
	Agana		X	X	X	
1/22/2010	Asan		X	X	X	
	Piti		X	X	X	
1/25/2010	Dededo		X	X	X	Mayor provided list to DPW
	Yigo	X	X	X	X	Sites were added by Mayor's Representative
1/26/2010	Mangilao		X	X	X	Sites were added by DPW
1/27/2010	Talofofo	X	X	X		Sites were added by the Mayor
	Chalan Pago Ordot	X	X	X		Verified site list submitted by the Mayor
	Yona		X	X		Sites were added by DPW
1/28/2010	Inarajan		X	X		
1/29/2010	Agat	X	X			
1/31/2010	Merizo		X			
2/1/2010	Umatac	X	X	X		
2/2/2010	Mongmong-Toto-Malte		X			Site added by DPW based on e-mail from owner
2/3/2010	Barrigada		X	X		
	Santa Rita	X	X	X	X	Sites were added by DPW
2/4/2010	Barrigada		X			
	Chalan Pago Ordot		X			Site added by DPW
	Piti		X			
2/5/2010	Sinajana		X			
	Inarajan		X			Site added by DPW based on e-mail from owner

3.2 Site Visits

During site visits, it was noted that areas where improvements were required were generally related to maintenance, erosion control, conveyance capacity, or storm drain system issues. The SWDMP team, along with the mayor and/or his/her delegated staff, conducted onsite inspections at approximately 298 locations using a checklist and an evaluation guideline developed specifically for the SWDMP. Use of the checklist facilitated a systematic approach to define the priorities in each village. Later, prioritization was determined by assigning scores and ranking factors to the evaluation criteria.

Generally, the mayor or agency representative directed the SWDMP team to the drainage site and described in detail the deficiencies and problems they were experiencing. The PTG team inspected the site and recorded details of the existing drainage facilities and materials/activities required to resolve any recorded deficiencies. Information regarding the need for drainage easements and right-of-way (ROW) issues, as well as ponding or flooding incidents, was also documented. Projects were not scored in the field but were evaluated in

the office at a later time. A photo log was developed for all drainage sites visited, allowing further review to be performed. These photos are incorporated in the project summaries (see Appendix C).

Data collection was among the most critical aspect of this process. Field visits were conducted not only to gather information for prioritization and cost estimating purposes, but also to verify information provided on the initial drainage improvement list. Sump locations and overland flow paths were identified and documented. Approximate limits of ponding and potential for roadway flooding were noted. Open channels and cross sections were observed, and an estimate on their size was documented. In some instances, discussions with local property and land owners were held regarding past flooding events. Field checklists and digital photographs were used to collect and organize the field data. This extensive data collection process ensured that the analysis was accurate, which is vital for the planning-level cost analyses and project priority process.

3.3 Classification of Drainage Work Types

The SWDMP team began with a list of sites in need of drainage improvements and then added other sites based on visual reconnaissance during the site visits. Other sites were added to the list based on communication from property owners, village mayors or their delegated representatives, and DPW. Collectively, 298 sites were inspected for drainage improvements during the 3-week field effort. For items that were not on the initial list but were provided to PTG in writing after completion of the field effort, such as through personal communication to DPW, the PTG team interpreted the deficiency and added it to the list. The drainage improvements identified during the field effort considers the necessary maintenance, rehabilitation, and/or repair that are required to facilitate storm water runoff conveyance, minimize roadside ponding and adjacent property flooding issues, minimize erosion, and provide treatment for storm water runoff where needed. These drainage improvement categories translated into the project's drainage work types. Translating the drainage improvement categories into drainage work types allowed the PTG team to succinctly describe a drainage improvement at a particular location. This classification scheme also facilitated the project cost estimating process to be conducted in a manageable and efficient manner. The eight drainage work types are described in Table 3-2.

Table 3-2. Work Types

WORK TYPE	DESCRIPTION
Erosion Control	Locations where stream bank erosion, channel deformation, and down cutting were observed. Erosion control includes streambank protection, such as riprap revetment or installation of gabion retaining walls along steep cliff sides, control of hillside erosion with hydroseed, and mulch and/or bonded fiber matrix to control mass erosion.
Conveyance Improvements	Locations where the design and installation of offsite drainage conveyance structures, such as culverts, associated headwalls and wingwalls, channels, ditches, cross culverts, and bridges, are required. Examples include providing increased capacity, as well as replacing structures that are beyond repair.
Conveyance Maintenance	Locations where rehabilitation of conveyance structures or maintenance within conveyance structures is required. Examples include headwall and/or wingwall repair, removal of sediment and debris within and around culverts, and utility encasement or relocation within the conveyance facility.
Treatment BMP Improvements	Includes the design and installation of biofiltration strips/swales, detention devices, media filters, and infiltration trenches/basins for treatment of storm water runoff.
Treatment BMP Maintenance	Includes vegetation management, debris removal, sediment or vegetation removal, and/or side slope stabilization at locations where treatment best management practices (BMPs), such as infiltration basins, are present.
Coastal Protection¹	Locations where the coastline is within the limits of a routed road and the road has little to no protection. In areas that exhibit coastal erosion encroaching within the roadway ROW, coastal erosion protection in the form of riprap revetment or gabions has been recommended.
Storm Drain Maintenance	Includes locations where sediment/debris removal is required within the storm drain system.
Storm Drain Improvements	All locations where capacity improvements or storm drain replacement is required. Examples include design and installation of storm drain systems, including catch basins, roadway ditches, storm drain pipelines, and storm drain outlets to offsite conveyance systems. Also included are storm drain outlet structures that convey flow to the groundwater regime, such as infiltration basins, infiltration trenches, or underground injection chambers.

3.4 Prioritization

With approximately 298 sites requiring drainage improvements, priorities were established to develop a feasible improvement program. A systematic approach was developed to define the priorities in each village. Prioritization was determined by assigning scores and ranking factors to the evaluation categories. Projects that received the highest score ultimately received highest priority. Table 3-3 shows the developed evaluation criteria. The most important criteria are listed with the highest priority weight and the least important are listed with the lowest. These values range from 3 to 20. Each criterion has a ranking

¹ The sea level in Guam is expected to rise by 4.27 feet over the next 100 years.

multiplication factor ranging from 0 to 3. Multiplying the priority weights by the ranking factor provided the final score for the individual work type. After the priority weights were multiplied by the ranking factor for each work type, the final scores for the individual work type values were added together to provide a combined score. The combined score was used in the final prioritization of projects. The ten evaluation categories, along with the respective priority weighting factors, are described below.

Table 3-3. Project Evaluation Criteria						
EVALUATION CATEGORIES	PRIORITY SCORE	CRITERIA	RANKING FACTORS			
			HIGHEST SCORE (X3)	MODERATE SCORE (X2)	LOW SCORE (X1)	NO SCORE (X0)
	10	Public Safety Risk	Inaction poses significant risk to public safety, potential loss of life.	Inaction poses moderate risk to public safety, potential injury.	Inaction poses low risk to public safety.	No risk to public safety.
	20	Environmental Severity	Directly impacts aquifer.	Directly impacts coastal area (within immediate area of shoreline)..	Directly impacts surface water (e.g., river, stream, or lake)	No environmental risk.
	3	Maintainability	Low maintenance projects with easy accessibility.	Moderate maintenance requirement, moderately accessible.	Difficult to maintain and/or difficult to access.	Very difficult to maintain and/or very difficult to access.
	3	Flooding Severity	Unacceptable damage caused by flood events.	Moderate damage caused by flood events.	Flood events cause nuisance damage.	No flood hazard.
	3	Floodplain	Inside floodplain.	N/A	N/A	Outside floodplain.
	3	Erosion Severity	Unacceptable damage caused by erosion.	Moderate damage caused by erosion.	Erosion damage considered nuisance.	No erosion hazard.
	3	Number of Affected Properties	Greater than 4 properties affected.	3 to 4 properties affected.	1 to 2 properties affected.	No properties affected.
	3	Type of Roadway	Highway	Arterial	Collector	Private
	3	Right-of-Way Requirement	Requires no ROW.	N/A	N/A	Requires ROW.
	10	Estimated Cost	Cost < \$200,000	\$200,000 < Cost < \$1,000,000	\$1,000,000 < Cost < \$10,000,000	Cost > \$10,000,000

Public Safety Risk (Weight = 10)

The safety and protection of human life is of the utmost importance. The highest rated projects are those where inaction may result in the loss of human life. A medium rating may result in injuries. A low rating indicates there is a minor safety risk involved with inaction. Three example scenarios are described below.

High Severity: Undermining of roadway has progressed to near collapse. Without repair, a motorist could be on pavement section during collapse event.

Medium Severity: Low point in roadway experiences ponding after a storm event. Without routing runoff, a motorist could hydroplane and suffer an accident.

Low Severity: Standing water accumulates at the corner of an intersection after every storm event. Pavement begins to deteriorate creating a pothole, which may result in an unsafe road condition if resurfacing is not implemented in a timely manner.

Environmental Severity (Weight = 20)

Guam's quality of life is closely linked to the environmental integrity of its local water resources. As with flooding and erosion, water quality problems primarily stem from changing land use conditions (i.e., urbanization) that modify watershed hydrology and the level of pollutants in local waterways. The water quality assessments evaluated existing and future problem areas based on problem areas provided by DPW and GEPA. Water quality priorities are established based on the resource value of the receiving water and the severity of identified current and future water quality problems as described below.

Affected Water Body: Scoring is based on quality of water source, which is consistent with DPW/FHWA priorities.

Maintainability (Weight = 3)

Overall, DPW oversees and maintains the storm drainage network throughout the island. Maintainability plays an important role in the overall effectiveness of proposed improvements over time. Projects that are difficult to maintain or difficult to access will require greater operation and maintenance costs and may tend toward ineffectiveness in time if not appropriately maintained. The highest rated projects are those where maintenance is relatively easy, requiring maintenance activities that are not labor intensive, not very frequent, and easy to access by required maintenance vehicles. A low rating indicates significant maintenance issues related to the proposed improvements where accessibility may be difficult or where frequent/costly maintenance activities are required to keep the facilities working effectively.

Flooding Severity (Weight = 3)

This guideline is used to identify flooding and infrastructure-related problems and to quantify their causes. The term flooding is used for localized flooding that occurs due to failure of the secondary drainage system. The identification and prioritization of localized flooding problem areas will be based on DPW-provided data. Unlike the creek flooding studies, the prioritization of localized flooding areas will not be based on hydrologic and hydraulic models, but rather on the severity of the damage that occurs. Flooding simulation

models are not available for the extensive storm drain system due to incomplete information on the location, size, and condition of the system. This evaluation category is based on three performance factors, as described below.

Probable Cause of Flooding: Higher score where the cause of flooding can be easily remedied, such as maintenance-related projects that improve safety and protection of existing infrastructure with immediate relief and minimal cost.

Number of Properties Affected: Score is based on population served.

Flooding Frequency: Score is reflective of the severity of the problem. Flood Insurance Rate Maps (FIRMs), information provided, and engineering judgment will be used.

Floodplain (Weight = 3)

All other criteria being equal, projects within Flood Zone A take precedence over those outside the floodplain.

Erosion Severity (Weight = 3)

This evaluation category is used to identify current erosion problems along roads, bridges, and culverts on the road. Damage to roads is caused by water flowing over the top of the roadway and eroding road surfaces, shoulders, and embankments. Inadequate hydraulic capacity of a bridge may result in erosion of the streambed under piers and abutment footings and erosion of the embankments. Damage or failure of a culvert is caused by erosion of the embankment at its entrance and/or outlet, or around the outside of the culvert. Erosion problems primarily result from changing land use conditions (i.e., urbanization) that modify watershed hydrology, significantly increasing storm flows in creeks for even small rainfall events. The change in watershed hydrology, and sediment load, greatly increases the frequency, magnitude, and duration of "erosive" flows. These changes in stream flow have resulted in changes in local creek characteristics. The identification and prioritization of localized erosion problem areas will be based on DPW-provided data, drainage basin maps, and site visits. The prioritization of erosion areas will be based on three performance factors, which are described below.

Types of Erosion: Scoring is according to the severity of the problem and safety issues.

Probable Cause of Erosion: Higher score for maintenance-related issues that provide safety and protection of existing infrastructure with immediate relief and minimal cost.

Affected Area: Score is based on the overall area requiring erosion protection and the erosive nature of the area given soil and hydrologic/hydraulic conditions.

Number of Affected Properties (Weight = 3)

The number of affected properties helps assess the magnitude of drainage deficiencies. The score is based on population served. The ranges used to determine importance factors are as follows:

- **3** = greater than four properties affected
- **2** = three to four properties affected
- **1** = one to two properties affected
- **0** = no properties affected

Type of Roadway (Weight = 3)

The roadway classification helps assess the magnitude of drainage deficiencies. The score is based on level of service, access, and population served.

Right-of-Way Requirement (Weight = 3)

Adequate property owned by the Government of Guam needs to be available at each project location. Sufficient ROW is necessary to ensure that drainage systems are properly maintained and facilities can be upgraded as necessary. While many of the projects will likely require temporary construction easements, this level of detail is not known at this time; therefore, if ROW issues have not been identified, it is assumed that ROW is available. In this way, the projects requiring no ROW take precedence over those requiring ROW.

Estimated Cost (Weight = 10)

The cost of a project is the financial investment required to implement the particular drainage improvement. Cost will include all facets, including the engineering design, construction, and construction management, to complete the project. Lower-cost projects were ranked higher on the premise that more projects benefitting a wider cross section of properties/residents could be completed with limited funds. The cost ranges used to determine importance factors are as follows:

- **3** = project costing under \$200,000
- **2** = project cost ranging from \$200,000 to ≤\$1 million
- **1** = project cost ranging from \$1 million to ≤\$10 million
- **0** = project costing over \$10 million

3.5 Cost Estimates

By examining aerial mapping, site photos, and other available information, a conceptual-level plan was developed for each of the sample projects, including all of the various items

of work inherent in the work types. As an example, for each improvement project, utility relocation, erosion control, replacement of reinforced concrete pipes (RCPs) and reinforced concrete boxes (RCBs) were determined. Unit costs were based on recent estimates for other drainage improvement projects in Guam. The project cost estimates can be found in Appendix D.

3.5.1 Work Elements

The unit costs per site for the various work types were derived from standard elements used in storm water interception, treatment, conveyance, erosion control, and storage. These work elements include excavation, hydroseeding, rock slope protection, slope paving, landscape planting, fencing, removing culverts, installing pipe culverts, adjusting inlets, installing inlets, installing underground injection chambers, and installing minor concrete for channels, ditches, concrete aprons, concrete box culverts, headwalls, and wingwalls.

Additional minor items, such as surveying and construction-related activities, such as testing, erosion control, dust control, clearing and grubbing, and traffic control, were added to each of the work element costs when deemed appropriate for the project. Finally, percentage factors were applied for miscellaneous items, mobilization, contingencies, design, and construction engineering, which is a standard practice. These factors are as follows:

- | | |
|--------------------------------------|---------------------------------|
| • Miscellaneous items | 10 percent of base + minor |
| • Mobilization | 10 percent of base + minor |
| • Contingency | 20 percent of base + minor |
| • Design, Environmental, Permitting | 15 percent of construction cost |
| • Construction Management, Oversight | 15 percent of construction cost |

Each drainage improvement was broken down into work elements and unit types. The cost was calculated by multiplying the quantity by the cost per unit (see Table 3-4). The total drainage improvement cost was then calculated from the sum of the work elements. In general, unit costs were derived from contract bid item estimates in 2010 U.S. dollars for projects of similar magnitude on the island of Guam. Where unit costs were not available from the contract estimates, unit prices were computed using the Caltrans Contract Cost Data Book (CCDB) (California Department of Transportation 2009), escalated to 2010 at 7 percent per year and then multiplied by a uniform markup for the island of Guam of 2.23. The uniform markup factor was derived from the difference between the Guam unit bid item estimates for existing contracts and the CCDB estimates.

Because of the approximations made in this planning-level estimate, it must be recognized that some individual cost estimates may be higher than anticipated for a particular location, while others may be lower. In the aggregate, the costs offset each other for a reasonable program-level cost estimate.

Table 3-4. Drainage Improvement Unit Costs

Drainage Improvement Work Element	Unit	Unit Cost (\$/Unit)
- Concrete (for Channel Lining)	CY	815
- Concrete (for Culvert)	CY	1,105
- Concrete (for Ditch Lining, Aprons, Pipe Encasement)	CY	635
- Concrete (for Retaining Walls)	CY	1,005
- Concrete (for Slope Protection, Cross-Gutter)	CY	245
- ¾" Rock	CY	45
- Rock Slope Protection	CY	745
- Modify Inlet	EA	3,000
- Adjust Sewer Manhole	EA	1,800
- Catch Basin	EA	3,500
- AC Spillway	EA	1,000
- Headwall for Box Culvert	EA	5,000
- Headwall with Wingwalls	EA	10,000
- Erosion Control [Bonded Fiber Matrix]	SF	1.00
- Erosion Control [Hydroseed]	SF	5.00
- Erosion Control (Blanket)	SF	0.80
- Erosion Control (Netting)	SF	0.50
- Filter Fabric	SF	1.50
- Excavation (for ditches, channels, infiltration basins, trenches)	SF	28
- Clearing/ Debris Removal	AC	4,250
- Gabions	CY	710
- Chain Link Fence	LF	15
- Chain Link Gate	EA	715
- 24" RCP (Installed)	LF	555
- 30" RCP (Installed)	LF	680
- 36" RCP (Installed)	LF	715
- 48" RCP (Installed)	LF	745
- 54" RCP (Installed)	LF	1,160
- Injection Well (Installed)	LF	1,000
- Silt Fence	LF	2.80

CY = cubic yards; EA = each; LF = linear feet; SF = square feet

3.5.2 Cost Basis

Due to the large number of drainage improvements to be included in the cost estimate, and limited time to research as-built plans, the cost estimates used channel length and width, pipe diameters, approximate dimensions of culverts, and approximate areas needing erosion control based on estimates that were made during the site visits. Where size estimates were not directly available, average size estimates were used.

4.0 Summary of Projects

Approximately 298 sites were evaluated using the initial lists, along with information provided by village mayors or their delegated representatives, property owners, and DPW. Overall, there was no difference between the drainage deficiency documented on the initial list or communicated by the village mayors and others, and what was actually observed in the field. Based on the field observations, it was noted that drainage work types, in order of decreasing prevalence, were typically related to storm drain and conveyance structure improvements and maintenance, followed by erosion control, treatment best management practice (BMP) improvement and maintenance, and finally coastal protection.

Of the 298 sites assessed, 112 were characterized as having a direct impact on the aquifer. Of these, approximately twenty-two sites include infiltration trenches, fourteen include infiltration basins, six include routing additional storm water runoff to existing infiltration basins, three include infiltration galleys (i.e. infiltration wells within an infiltration basin), eight include bioswales, one includes an injection well and one includes abandonment of an existing injection well and constructing bioswales. Although another sixty projects were identified as having a direct impact on the aquifer, the use of infiltration BMPs as a drainage improvement strategy was not recommended. The reason for this is that infiltration BMPs were recommended in areas, typically in North Guam, characterized by soils with good infiltration characteristics and sufficiently low groundwater. Within the South Guam Region, where soils exhibit poor infiltration/permeability characteristics and/or groundwater levels are high, such as near the coastline, infiltration basins are not considered feasible.

With the exception of the regional projects, which are discussed later in this section, the frequency of observing drainage work types recommended for one village were similar to the prevalence of observing drainage work types in other villages (i.e., there were no significant differences between one village or another). The only thing that differed was the magnitude of the problem. For example, in Dededo a site was identified as needing erosion control and conveyance maintenance improvements. The project cost for this particular site was estimated at \$1,940, whereas in Merizo, a project requiring the same types of improvements was estimated at \$7.63 million.

A prioritized list of projects was developed for each village according to the evaluation and scoring criteria discussed in Section 3. For each project, the sum of each criterion times its importance factor yielded a prioritized score. Projects with the highest total scores are the highest priority projects and may be completed first when funding is available. The prioritization spreadsheets in Appendix E provide the ranking of projects within each village.

The location for each project is indicated on the cost estimation spreadsheets, which are provided in Appendix D, and detailed recommendations combined with a project photo are provided on the project summary data fact sheets in Appendix C.

It is important to note that the prioritized list of projects is not intended to serve as an implementation plan. Rather, the list is a result of an iterative and interactive process by the SWDMP team to identify locations where drainage deficiencies were observed and to rank and prioritize these projects using the evaluation and scoring criteria discussed in Section 3. Although development of the lists followed a logical and systematic process, the lists can be revised if it is found that it may be more cost effective to group or combine projects based on cost, size, location, or priority. A discussion regarding the organization of projects and contract execution is provided in Section 5.

4.1 Cost Estimates per Village

The final cost estimates by village in the SWDMP (derived from the cost estimating spreadsheets provided in Appendix D) are shown in Table 4-1. Total cost in 2010 U.S. dollars is estimated at \$150 million for the 298 projects.

Table 4-1. Funding Allocation

VILLAGE	PROJECTED COST (million \$)	% OF TOTAL
TOTAL ALL VILLAGES	150	100
Agana Heights	2.76	1.9
Agat	7.92	5.3
Asan	9.38	6.3
Barrigada	4.57	3.0
Chalan Pago-Ordot	5.50	3.7
Dededo	3.79	2.5
Hagatna	12.2	8.1
Inarajan	7.62	5.1
Mangilao	7.37	4.9
Merizo	13.2	8.8
Mongmong-Toto-Maite	1.08	0.7
Piti	36.6	24.4
Santa Rita	5.50	3.7
Sinajana	0.13	0.1
Talofofo	6.31	4.2
Tamuning	16.6	11.1
Umatac	7.58	5.1
Yigo	0.60	0.4
Yona	1.01	0.7

Some of these villages include regional-level projects that go beyond the individual village. Regional projects include: (1) TA-103 at the Tamuning Outlet Channel, which conveys runoff from the villages of Tamuning and Barrigada; (2) PI-119 along Route 1 at Apra Harbor located within the villages of Piti and Santa Rita; (3) ME-114 at the Manell Channel, which conveys runoff from the villages of Merizo and Inarajan; and (4) AS-102 along the coast between Fonte and Asan rivers located within the villages of Asan and Agana. Total cost in 2010 U.S. dollars is estimated at \$61 million for these regional projects.

4.2 Village Priority Projects

While Appendix E provides the spreadsheet results showing the prioritization of projects for each village, Table 4-2 provides a list of the high-priority projects for each village (up to 5 projects per village). Detailed descriptions for these projects are included in Appendix C.

Table 4-2. High Priority Projects

VILLAGE	Priority Projects
Agana Heights	AG-103,, AG-102 AG-101, AG-104
Agat	AV-128, AV-109, AV-125, AV-121, AV-111
Asan	AS-112, AS-111, AS-109, AS-104, AS-102
Barrigada	BV-116, BV-112, BV-131, BV-110, BV-130
Chalan Pago-Ordot	CP-111, CP-112, CP-102, CP-107, CP-104
Dededo	DE-101, DE-102, DE-103, DE-106, DE-105
Hagatna	HA-109, HA-105, HA-103, HA-110,HA-119
Inarajan	IV-116, I-102, IV-124, IV-104, IV-120
Mangilao	MO-111, MO-106, MO-107, MO-108, MO-102
Merizo	ME-102, ME-119, ME-128, ME-103, ME-129,
Mongmong-Toto-Maite	MM-101
Piti	PI-107, PI-103, PI-108, PI-111, PI-102
Santa Rita	SR-107, SR-109, SR-105, SR-108, SR-102
Sinajana	SV-102, SV-101
Talofofo	TA-102, TA-108, TA-113, TA-116, TA-112
Tamuning	TV-109, TV-110, TV-103, TV-108, TV-105
Umatac	UM-101, UM-108, UM-112, UM-109, UM-106
Yigo	YI-101, YI-102, YI-103, YI-107, YI-109
Yona	YO-103, YO-107, YO-105, YO-101, YO-108

5.0 Implementation

As demonstrated in previous sections, the need for improving storm water conveyance is great, and opportunities for funding are limited. Successful implementation of the SWDMP will require initiative and perseverance. This report presents a strategy for continuing with the highest-priority projects, as funding is available.

5.1 Existing and Potential Funding Sources

The design, construction, operation, and maintenance of drainage control systems can involve a significant expense, especially when flood concerns, water quality issues, and population growth are factored in. Typically, government agencies can rely on stable sources of funding that are available from an already established storm water utility. For example, communities with an established storm water utility can utilize service fees, property taxes/general fund monies, system development charges, and special assessment districts to fund storm water programs. Given that a storm water utility is not established in Guam, the local government and FHWA, as well as private landowners, can rely on grants and low-interest loans.

There are many resources that local and Federal government agencies, along with private land owners, can consider when seeking financial assistance for their storm water system improvement projects. For example, the United States Environmental Protection Agency (EPA) Catalog of Federal Funding Sources for Watershed Protection offers a searchable database of financial assistance sources (i.e., grants, loans, cost-sharing) available to fund a variety of watershed protection projects. Some of the funding sources identified within the database are displayed in Table 5-1. The agencies listed in this table administer or provide grant monies for government agencies and/or private land owners to pursue projects much like those identified in this SWDMP.

Table 5-1. Federal Funding Sources for Watershed Protection

Program Name	Overview
Aquatic Ecosystem Restoration (CAP 206)	Work under this authority may carry out aquatic ecosystem restoration projects that will improve the quality of the environment, are in the public interest, and are cost effective. There is no requirement that an existing United States Army Corps of Engineers (USACE) project be involved.
Clean Water State Revolving Fund	EPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source, and estuary protection projects. Point source projects typically include building wastewater treatment facilities; combined sewer overflow and sanitary sewer overflow correction; urban stormwater control; and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silviculture, rural, and some urban runoff control; onsite wastewater disposal systems (i.e., septic tanks); land conservation and riparian buffers; and leaking underground storage tank remediation. Estuary protection projects include all of the above point and nonpoint source projects, as well as habitat restoration and other unique estuary projects.
Coastal Program	The United States Fish and Wildlife Service (USFWS) Coastal Program works to conserve healthy coastal habitats on public or private land for the benefit of fish, wildlife, and people in 22 specific coastal areas. The program forms cooperative partnerships designed to (1) protect coastal habitats by providing technical assistance for conservation easements and acquisitions; (2) restore coastal wetlands, uplands, and riparian areas; and (3) remove barriers to fish passage in coastal watersheds and estuaries. Program biologists provide restoration expertise and financial assistance to federal and state agencies, local and tribal governments, businesses, private landowners, and conservation organizations, such as local land trusts and watershed councils.
Coastal Services Center Cooperative Agreements	The National Oceanic and Atmospheric Administration (NOAA) guides the conservation and management of coastal resources through a variety of mechanisms, including collaboration with the coastal resource management programs of the nation's states and territories. The mission of the NOAA Coastal Services Center (CSC) is to support the environmental, social, and economic well being of the coast by linking people, information, and technology. The vision of the NOAA CSC is to be the most useful government organization to those who manage and care for our nation's coasts.
Community Development Block & Entitlement Grants	The objective of this program is to develop viable urban communities by providing decent housing and a suitable living environment and by expanding economic opportunities, principally for persons of low and moderate income. Recipients may undertake a wide range of activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services.

Table 5-1. Federal Funding Sources for Watershed Protection

Program Name	Overview
Coral Reef Conservation Fund	The National Fish and Wildlife Foundation's Coral Reef Conservation Fund supports projects that build public-private partnerships to reduce and prevent degradation of coral reefs and associated reef habitats (e.g., seagrass beds, mangroves). Projects may address causes of coral reef degradation wherever they occur, from inland areas to coastal watersheds to the reefs and surrounding marine environment.
Emergency Watershed Protection	The United States Department of Agriculture (USDA) Natural Resources Conservation Service's Emergency Watershed Protection (EWP) program helps protect lives and property threatened by natural disasters such as floods, hurricanes, tornadoes, droughts, and wildfires. EWP provides funding for such work as clearing debris from clogged waterways, restoring vegetation, and stabilizing river banks. The measures that are taken must be environmentally and economically sound and generally benefit more than one property owner. EWP also provides funds to purchase floodplain easements as an emergency measure. Floodplain easements restore, protect, maintain, and enhance the functions of the floodplain; conserve natural values including fish and wildlife habitat, water quality, floodwater retention, groundwater recharge, and open space; reduce long-term federal disaster assistance; and safeguard lives and property from floods, drought, and the products of erosion. EWP can provide up to 90 percent cost share in limited resource areas as determined by the U.S. Census.
Flood Mitigation Assistance Program	The Flood Mitigation Assistance (FMA) program provides funding to states, federally recognized Indian tribal governments, and communities so that cost-effective measures are taken to reduce or eliminate the long-term risk of flood damage to buildings, manufactured homes, and other structures insured under the National Flood Insurance Program (NFIP). The long-term goal of FMA is to reduce or eliminate claims under the NFIP through mitigation activities. Three types of grants are available under FMA: Planning, Project, and Technical Assistance.
Hazard Mitigation Grant Program	FEMA's Hazard Mitigation Grant Program (HMGP) aims to provide states and communities with resources to invest in long-term actions that help reduce the toll from potential natural and manmade hazards. The program also supports implementation of mitigation measures during the immediate recovery from a disaster. The HMGP funds projects to protect either public or private property, as long as the project fits within the state's and local government's overall mitigation strategy and complies with program guidelines. In response to flood hazards, eligible projects include the elevation, relocation, or acquisition and demolition of flood-prone structures, stormwater management projects, and certain types of minor flood control projects. The state is responsible for setting priorities for funding and administering the HMGP. Eligible applicants must apply for the program through the state. Individuals, businesses, or other organizations should contact their State Hazard Mitigation Officer and local government official for specific details.

Table 5-1. Federal Funding Sources for Watershed Protection

Program Name	Overview
Nonpoint Source Implementation Grants (319 Program)	Through its 319 Program, EPA provides formula grants to states and tribes to implement nonpoint source projects and programs in accordance with Section 319 of the Clean Water Act (CWA). Nonpoint source pollution reduction projects can be used to protect source water areas and the general quality of water resources in a watershed. Examples of previously funded projects include installation of BMPs for animal waste; design and implementation of BMP systems for stream, lake, and estuary watersheds; basin-wide landowner education programs; and lake projects previously funded under the CWA Section 314 Clean Lakes Program.
Partners for Fish and Wildlife Program	The Partners for Fish and Wildlife Program provides technical and financial assistance to private landowners to restore fish and wildlife habitats on their lands. Since 1987, the program has partnered with more than 37,700 landowners to restore 765,400 acres of wetlands; more than 1.9 million acres of grasslands and other upland habitats; and 6,560 miles of in-stream and streamside habitat. In addition, the program has reopened stream habitat for fish and other aquatic species by removing barriers to passage.
Pre-Disaster Mitigation Program	The Pre-Disaster Mitigation Program will provide funds to states, territories, Indian tribes, communities, colleges, and universities for pre-disaster mitigation planning and implementation of cost-effective mitigation projects prior to a disaster event. Funding these plans and projects reduces overall risks to the population and structures, while also reducing reliance on funding from actual disaster declarations.
Project Modifications for Improvement of the Environment (CAP Section 1135)	Work under this authority provides modifications in the structures and operations of water resources projects constructed by USACE to improve the quality of the environment. Additionally, USACE may undertake restoration projects at locations where an existing USACE project has contributed to the degradation. The primary goal of these projects is ecosystem restoration with an emphasis on projects benefiting fish and wildlife. The project must be consistent with the authorized purposes of the project being modified, environmentally acceptable, and complete within itself.
Public Works and Development Facilities Program	This program provides assistance to help distressed communities attract new industry, encourage business expansion, diversify local economies, and generate long-term, private-sector jobs. Among the types of projects funded are water and sewer facilities, primarily serving industry and commerce; access roads to industrial parks or sites; port improvements; business incubator facilities; technology infrastructure; sustainable development activities; export programs; brownfields redevelopment; aquaculture facilities; and other infrastructure projects. Specific activities may include demolition, renovation, and construction of public facilities; provision of water or sewer infrastructure; or development of stormwater control mechanisms (e.g., a retention pond) as part of an industrial park or other eligible project.

5.2 Other Environmental Financing Sources

Access to many types of environmental financing information is available for local government programs and projects through the Environmental Financing Information Network (EFIN). EFIN maintains a Web site of environmental financial tools, including links to *A Guidebook of Financial Tools*, publications, and links to resources elsewhere on the Internet. Additional financing resources are provided in Table 5-2.

Table 5-2. Resources for Financing Storm Water/Water Quality Projects

Resource	Description	Internet Site
Sustainable Financing from the National Estuary Program	The National Estuary Program has employed multiple funding mechanisms to increase their capacity. Their Web site highlights examples of funding mechanisms such as real estate taxes, special appeals, and license plate programs.	http://www.epa.gov/owow/estuaries/fundexamples.html
Watershed Information	This Web site offers a roadmap to information services for protecting and restoring water resources, including resources on financial, technical, and hands-on assistance to support watershed efforts.	http://www.epa.gov/owow/watershed/
Environmental Finance Center (EFC) Network	The EFC Network is a university-based program that provides financial outreach services to regulated communities. The Network consists of ten EFCs that provide advisory services; education, publications, and training; technical assistance; and analyses on financing alternatives.	http://www.epa.gov/efinpage/efcn.htm
Internet Guide to Financing Storm Water Management	This Web site is designed to help communities find ways to pay for storm water management projects. The site includes an annotated bibliography of existing storm water finance materials; a manual that discusses the financing options available to communities for storm water management programs; a set of case studies that describe successful finance mechanisms that have been used in seven communities around the country; and links to other useful Web sites about storm water management.	http://stormwaterfinance.urbancenter.iupui.edu/
U.S. State and Local Gateway	The Gateway Web site is designed to give state and local government officials and employees easy access to federal funding information, including grant-writing tools, links to grants, and links to other funding directories.	http://www.usa.gov/Government/StateLocal.shtml

As part of the Islandwide Program Management Services contract (GU-NH-IPMS[002]), in 2009, PB Americas, Inc., in association with Hobbs, Ong and Associates, Inc., began a comprehensive study of funding mechanisms for Guam. The grant funding sources being evaluated by the PB Americas, Hobbs, Ong and Associates team include the United States

Department of Interior and the United States Department of Agriculture. The study was in process at the time this report was prepared, so detailed information was not yet available.

5.3 Project Application

Nineteen (19) villages from across the island were studied. The final Prioritization Ranking Worksheet was applied to each of the proposed projects that had been created to address drainage system problems. The drainage improvement projects identified and prioritized through the SWDMP project will allow DPW to prepare a proactive drainage improvement program, rather than a program that merely reacts as problems occur. The SWDMP ensures that funds will be spent on drainage infrastructure that is in the most need of replacement due to structural deficiencies, lack of capacity, or lack of an overland flow path, which may cause flooding. The prioritization methodology and criteria used to select the drainage improvement projects will be very helpful to DPW staff in explaining the short- and long-term need for the drainage improvement projects to the elected officials, as well as the general public. The DPW can now incorporate the remaining drainage improvement projects identified through this study into its future CIP for design and construction at a later date.

Once available funding amounts are defined, a detailed implementation plan can be developed to proceed with the highest priority projects in each village. Funding may be allocated to projects in proportion to the need in each village. This allocation would be based on the final cost estimates by village in the SWDMP, as shown in Table 4-1. Administrative adjustments to this approach would allow for moving money between villages and between projects.

As another option, combining projects in contracts by cost, size, prioritization, and/or location may be more efficient than implementing projects on a per village basis. For example, implementation of all projects along a routed road, which may even extend into other villages, could be more cost effective because it would minimize fragmenting large projects into smaller units just because they extend beyond the village boundary. In other instances, projects may be pursued on an individual basis based on available funding, such as grant funding for coastal protection projects that reduce and prevent coral reef and associated reef habitat degradation.

Prior to organizing projects into contracts, a study would be needed to determine the funding mechanism. Once funding is established, the next step would be to identify projects in each village that will receive funding and to set out an implementation plan for

Project Schedule																																																	
Storm Water Drainage Master Plan																																																	
PROJECT:	Manell Channel																																																
Project No.	MB-114																																																
DATE:																																																	
ACTIVITY	No. of Months	July	2011-2012				July	2012-2013				July	2013-2014				July	2014-2015				July	2015-2016																										
		J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Prelim Design/ Env	12																																																
Final Design	12																																																
Cost Estimating	1																																																
Permits	12																																																
Agency Review	3																																																
Bid/Award Contract	3																																																
Construction	18																																																
Cumulative Calendar Months	62																																																

Approved: _____ Title: _____

Project Name: Mannell Channel						
Project No.: ME -114						
Project Commencement: 1-Jul-11						
Description of Activity	Total Estimated Cost (\$)	1st Year	2nd Year	3rd Year	4th Year	5th Year
	\$7,630,000					
Prelim Design/ Environmental Docs		\$250,000				
Final Design			\$400,000			
Cost Estimating				\$50,000		
Permits				\$50,000		
Construction					\$3,080,000	\$3,800,000
Total	\$7,630,000	\$250,000	\$400,000	\$100,000	\$3,080,000	\$3,800,000
<u>Funding Summary</u>						
Federal Aid	\$7,000,000	\$150,000	\$150,000	\$35,000	\$2,980,000	\$3,685,000
Grant	\$600,000	\$100,000	\$250,000	\$50,000	\$100,000	\$100,000
Local Aid	\$30,000			\$15,000		\$15,000
Other (please specify)						
Total Funding	\$7,630,000	\$250,000	\$400,000	\$100,000	\$3,080,000	\$3,800,000

conducting the project. In a few cases, a project-specific impact analysis would need to be conducted. This could be followed by a mitigation plan to address the impacts. The impact analysis would also need to consider the cumulative impacts of the project and other projects in the area. The impact analysis would also need to consider the potential for impacts on the environment and the community. A sample impact analysis for implementation of a project is provided in Figure 2-1. Table 2-1 provides an example of a potential impact analysis for a project as well as a list of potential impacts.

Figure 2-1 - Sample Impact Implementation Analysis

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Table 2-1 - Sample Impact Implementation Analysis

Impact Category	Impact Description	Impact Severity	Impact Duration	Impact Frequency	Impact Mitigation	Impact Monitoring
Water Quality	Increased sedimentation in the river	High	Long-term	Annual	Install sediment traps and erosion control measures	Regular water quality monitoring
Water Quantity	Reduced water flow in the river	Medium	Short-term	Annual	Install water storage tanks and release water during dry periods	Regular water flow monitoring
Soil Quality	Increased soil erosion	High	Long-term	Annual	Install erosion control measures and revegetation	Regular soil erosion monitoring
Vegetation	Loss of native vegetation	High	Long-term	Annual	Replant native vegetation and install erosion control measures	Regular vegetation monitoring
Wildlife	Loss of habitat for native wildlife	High	Long-term	Annual	Recreate habitat and install wildlife corridors	Regular wildlife monitoring
Human Health	Increased risk of waterborne diseases	High	Long-term	Annual	Install water treatment facilities and educate the community	Regular water quality monitoring
Community	Increased risk of flooding	High	Long-term	Annual	Install flood control measures and educate the community	Regular flood monitoring
Environment	Increased risk of climate change	High	Long-term	Annual	Install renewable energy sources and reduce greenhouse gas emissions	Regular climate change monitoring

Appendices

- A References**
- B Watershed Maps**
- C Project Summary Data Sheets**
- D Cost Estimation Spreadsheets**
- E Prioritization Spreadsheets**

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Appendix A

References

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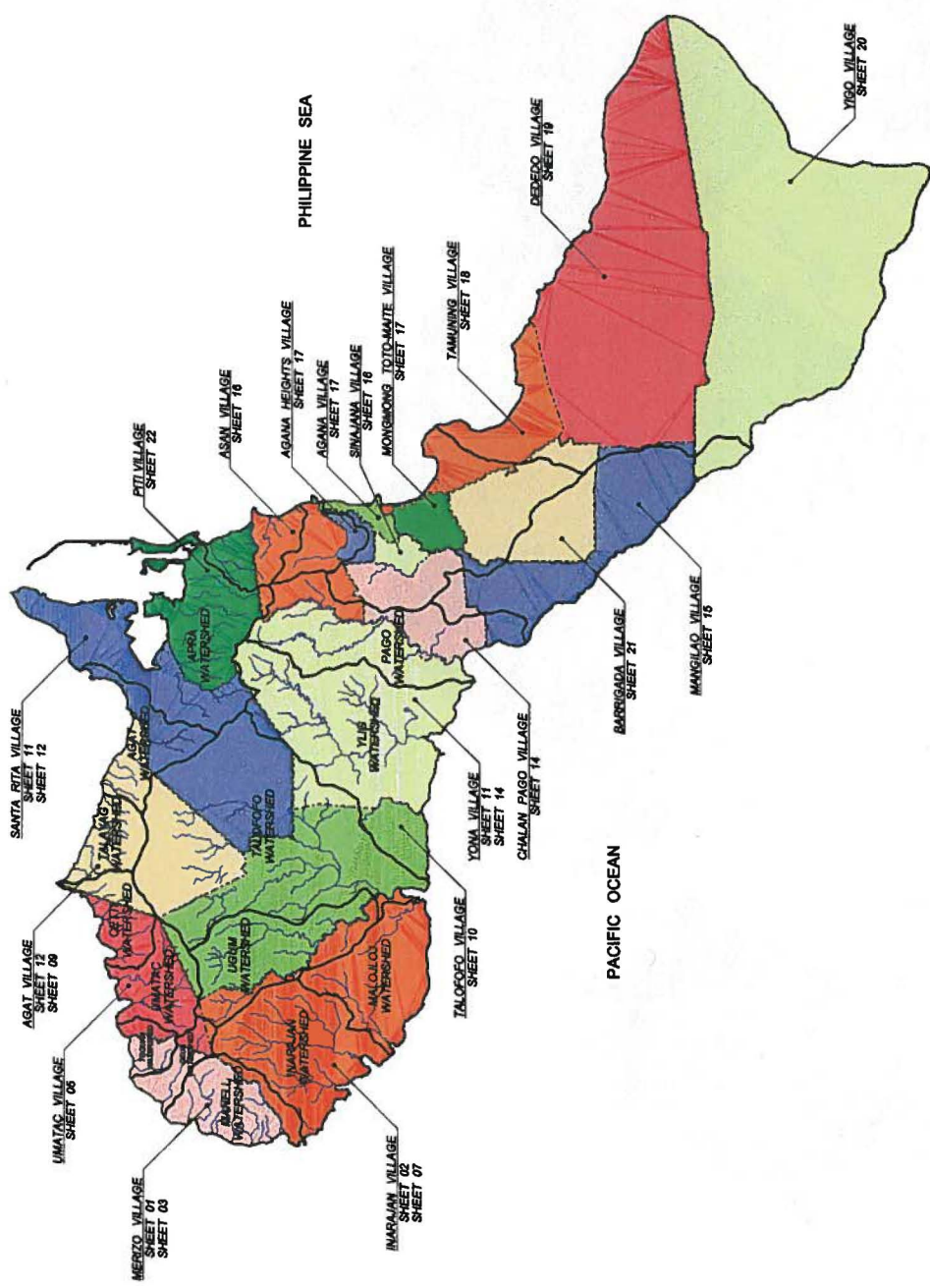
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Appendix B

Watershed Maps

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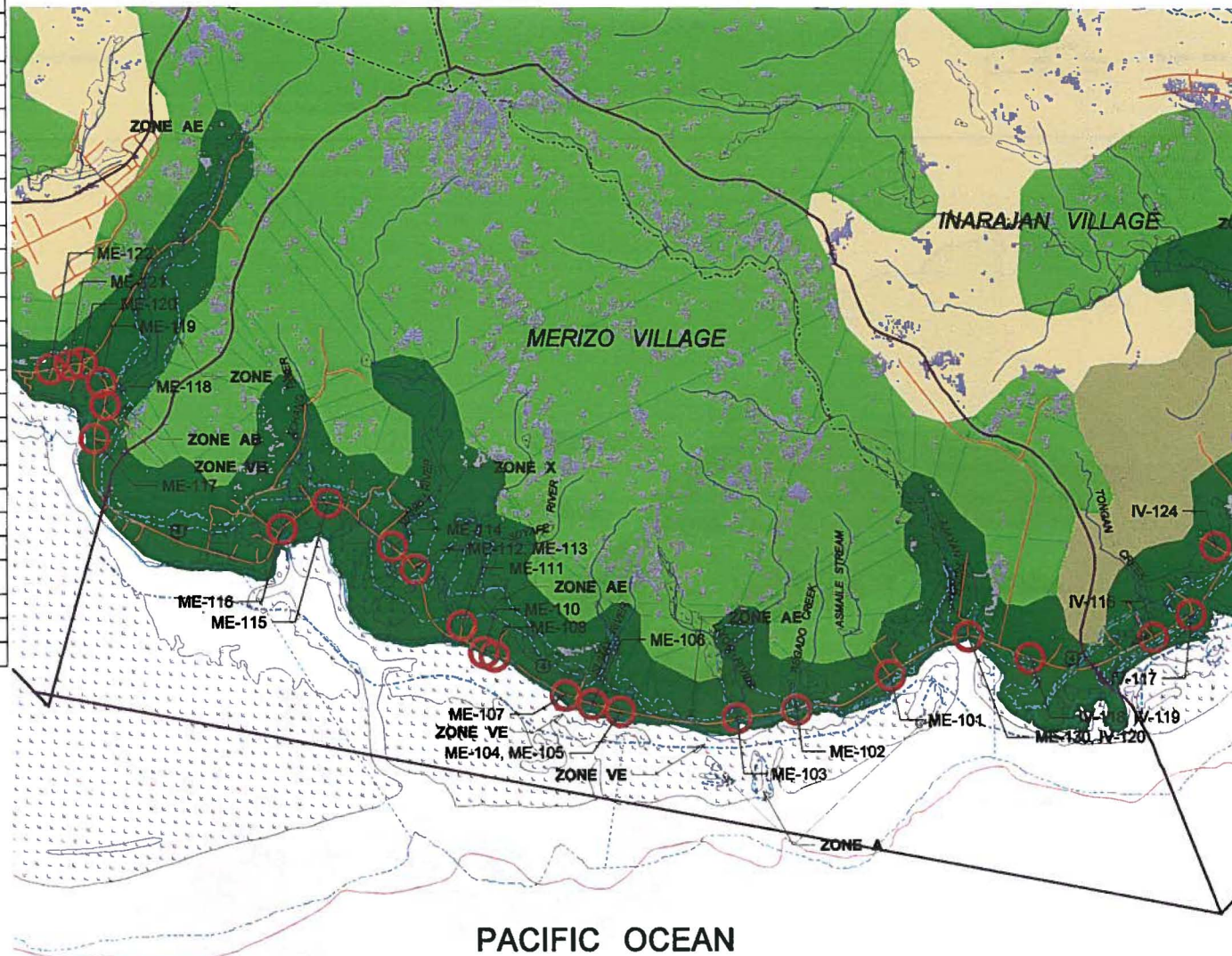


INDEX MAP



DRAINAGE NEED PER PROJECT

ME-101	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-102	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-103	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-104	COASTAL PROTECTION
ME-105	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-106	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-107	COASTAL PROTECTION
ME-108	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-110	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-111	CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
ME-112	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-113	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-114	EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
ME-115	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-116	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-117	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-118	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-119	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-120	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-121	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-122	EROSION CONTROL / CONVEYANCE MAINTENANCE
ME-124	EROSION CONTROL / CONVEYANCE IMPROVEMENT (SEE SHEET 03)
ME-125	STORM DRAIN IMPROVEMENT / CONVEYANCE MAINTENANCE (SEE SHEET 03)
ME-126	EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT (SEE SHEET 03)
ME-128	CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT (SEE SHEET 03)
ME-129	CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT (SEE SHEET 03)
ME-130	EROSION CONTROL / CONVEYANCE MAINTENANCE



- LEGEND**
- HIGH SOIL EROSION
 - WETLANDS
 - PULANTAT
 - AKINA-TOGCHA-YLIG
 - INARAJAN-INARAJAN
 - AKINA-AGFAYAN
 - CORAL REEFS
 - SEASHORE
 - VILLAGE BOUNDARY
 - RIVER/ STREAM/ CREEK
 - STREET CENTERLINE
 - WATERSHED BOUNDARY
 - FEMA FLOODPLAIN
 - LOCATION DRAINAGE PROJECT

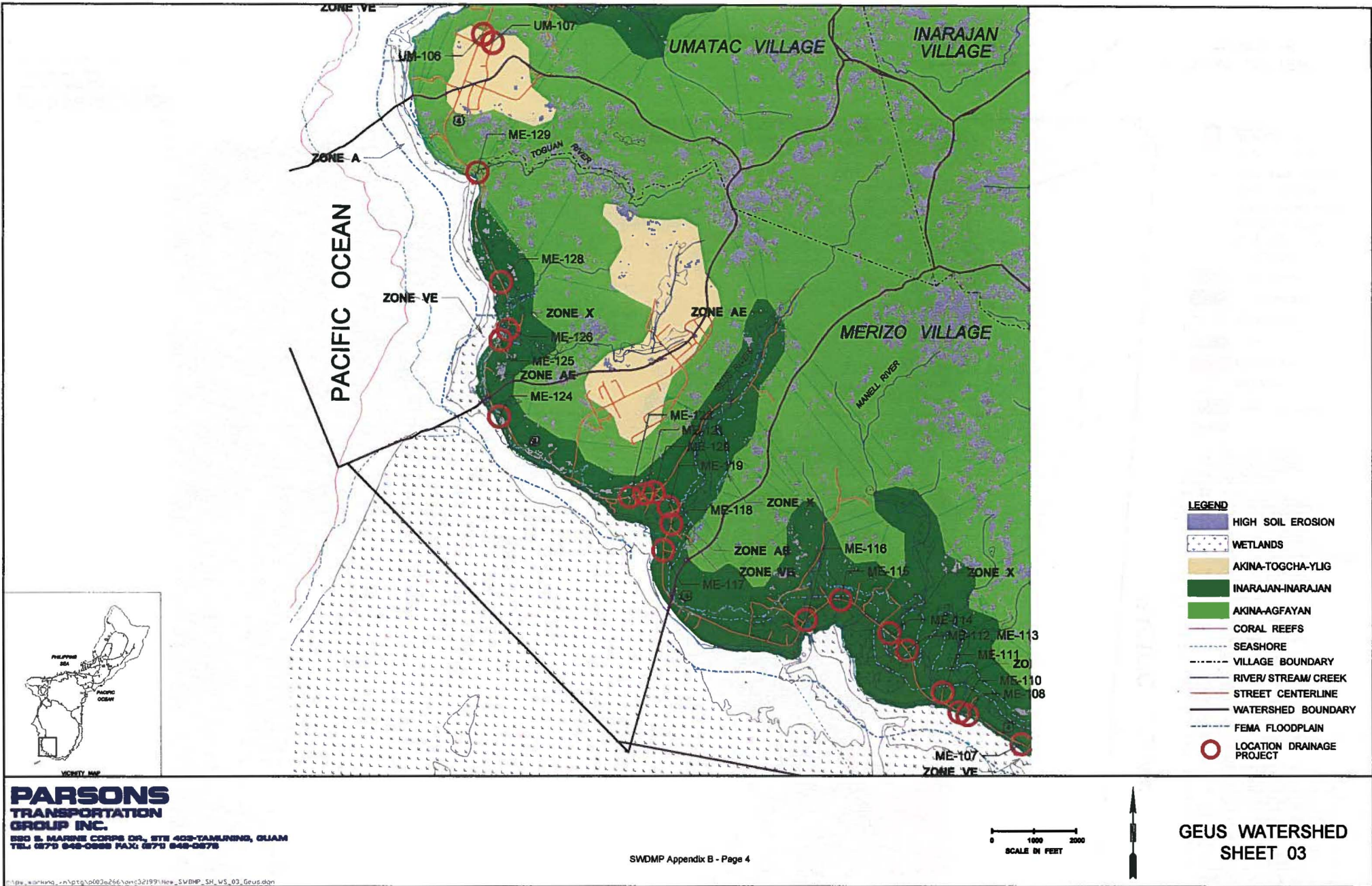


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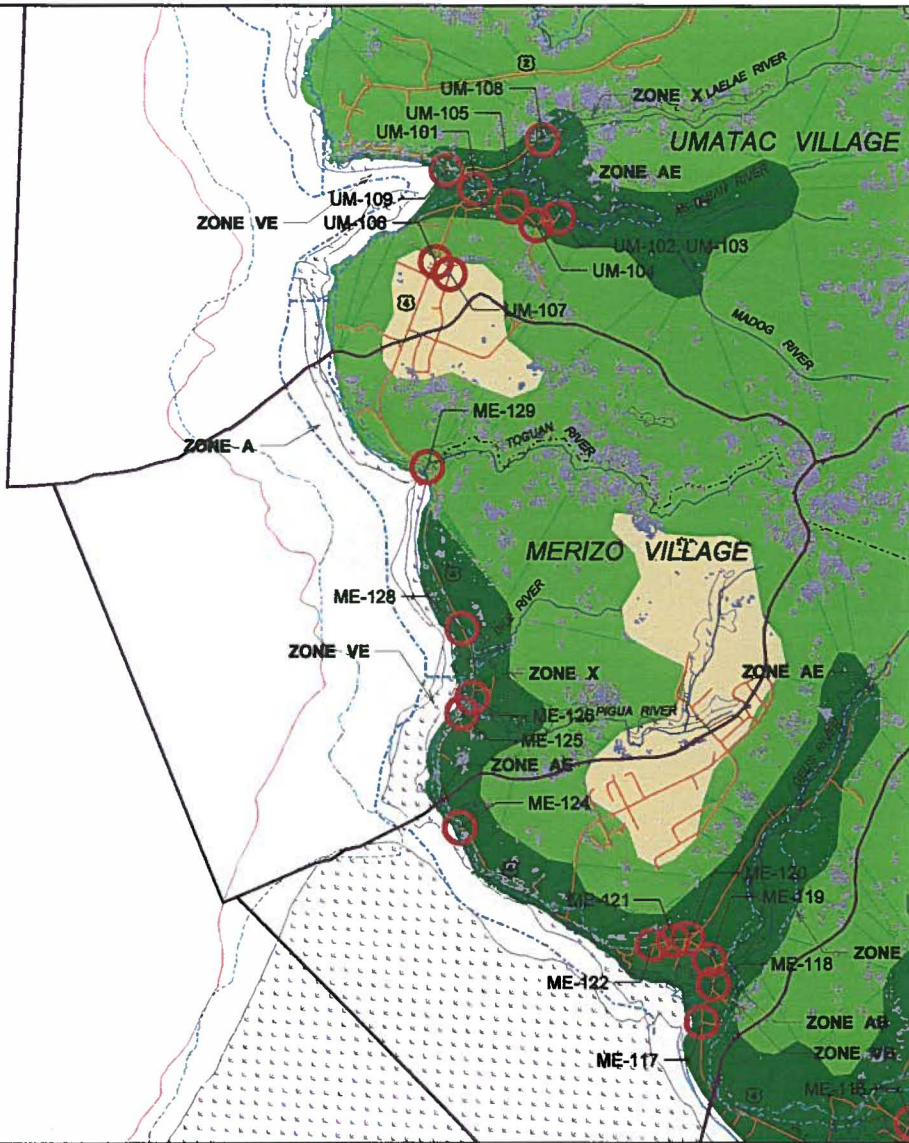
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SHEET 01

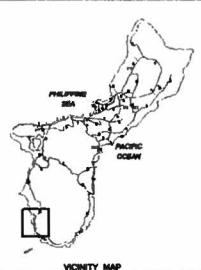


PACIFIC OCEAN

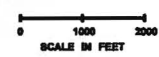


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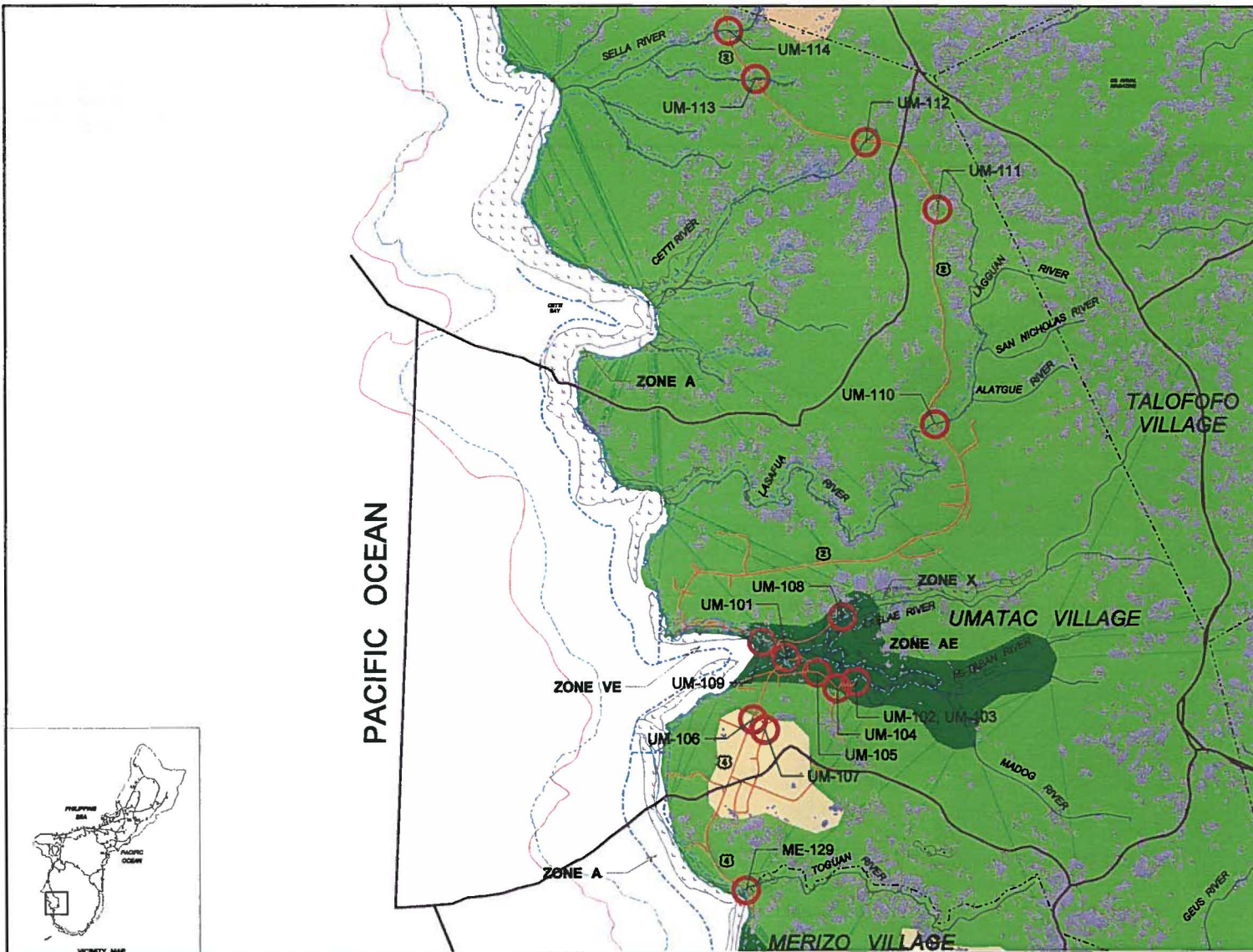
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- AKINA-AGFAYAN
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TOGUAN WATERSHED
SHEET 04



DRAINAGE NEED PER PROJECT

UM-101	EROSION CONTROL / CONVEYANCE MAINTENANCE
UM-102	EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
UM-103	CONVEYANCE IMPROVEMENT / CONVEYANCE MAINTENANCE
UM-104	STORM DRAIN IMPROVEMENT
UM-105	CONVEYANCE IMPROVEMENT / CONVEYANCE MAINTENANCE
UM-106	CONVEYANCE IMPROVEMENT / CONVEYANCE MAINTENANCE
UM-107	STORM DRAIN IMPROVEMENT
UM-108	EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
UM-109	EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
UM-110	EROSION CONTROL / STORM DRAIN IMPROVEMENT
UM-111	EROSION CONTROL
UM-112	EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
UM-113	CONVEYANCE MAINTENANCE
UM-114	CONVEYANCE MAINTENANCE

LEGEND

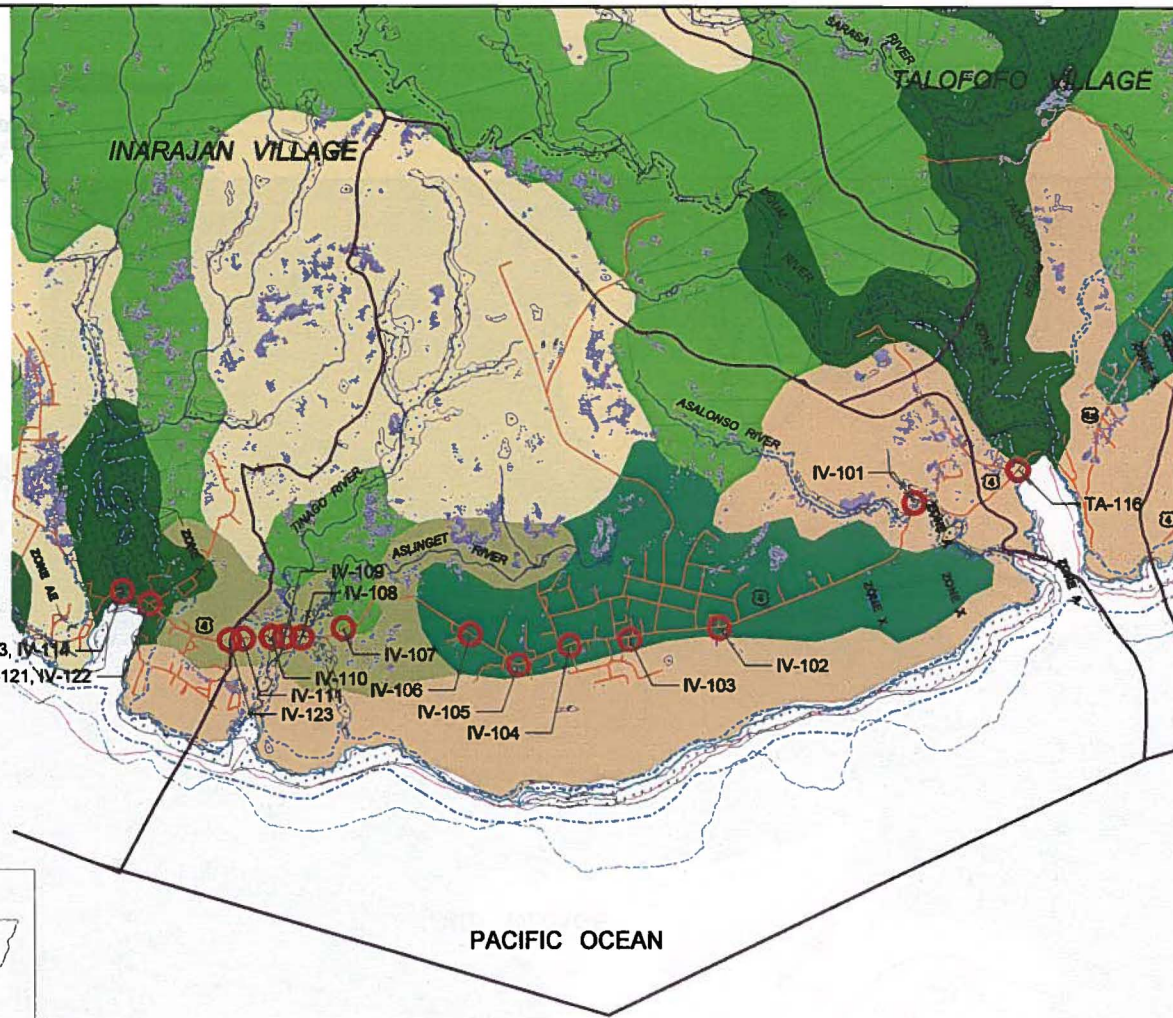
- HIGH SOIL EROSION
- RITIDIAN ROCK OUTCROP
- WETLANDS
- AKINA-TOGCHA-YLIG
- INARAJAN-INARAJAN
- AKINA-AGFAYAN
- CORAL REEFS
- SEASHORE
- VILLAGE BOUNDARY
- RIVER/STREAM/CREEK
- STREET CENTERLINE
- WATERSHED BOUNDARY
- FEMA FLOODPLAIN
- LOCATION DRAINAGE PROJECT

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SHEET 05



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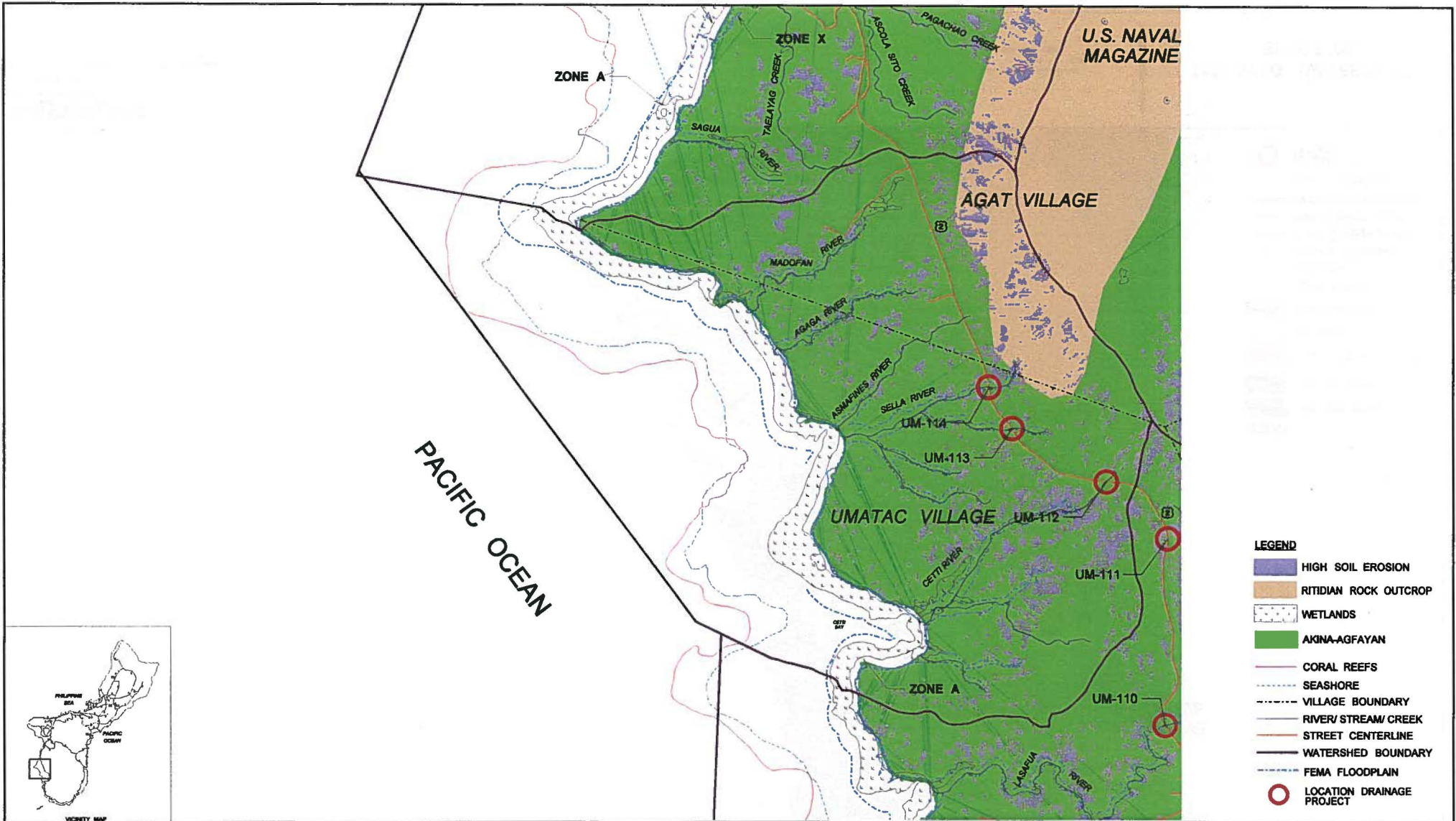
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- PULANTAT-KAGMAN-CHACHA
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- FEMA FLOODPLAIN
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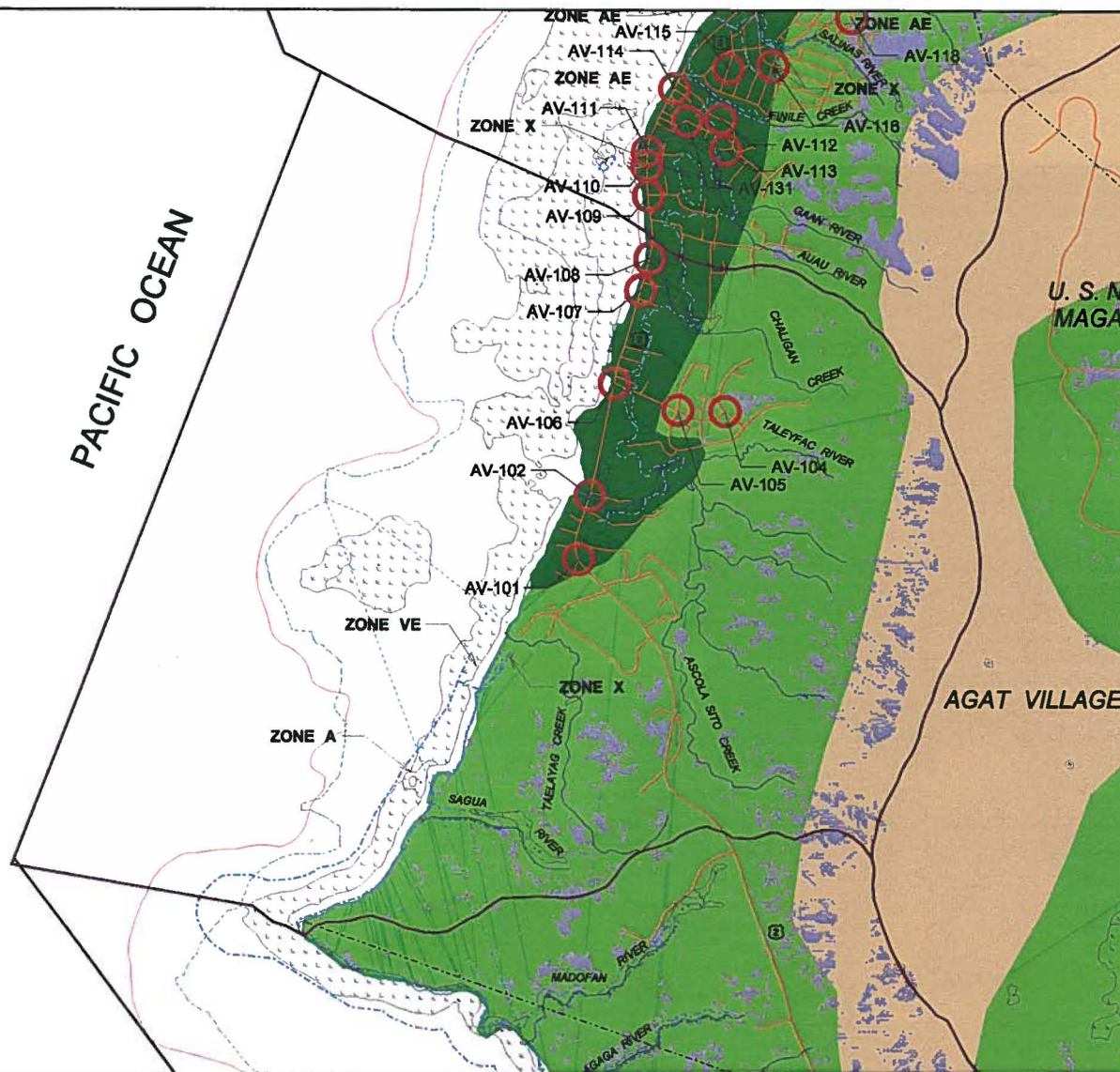




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PACIFIC OCEAN

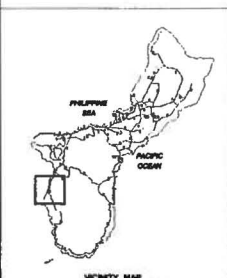


U. S. NAVAL MAGAZINE

AGAT VILLAGE

LEGEND

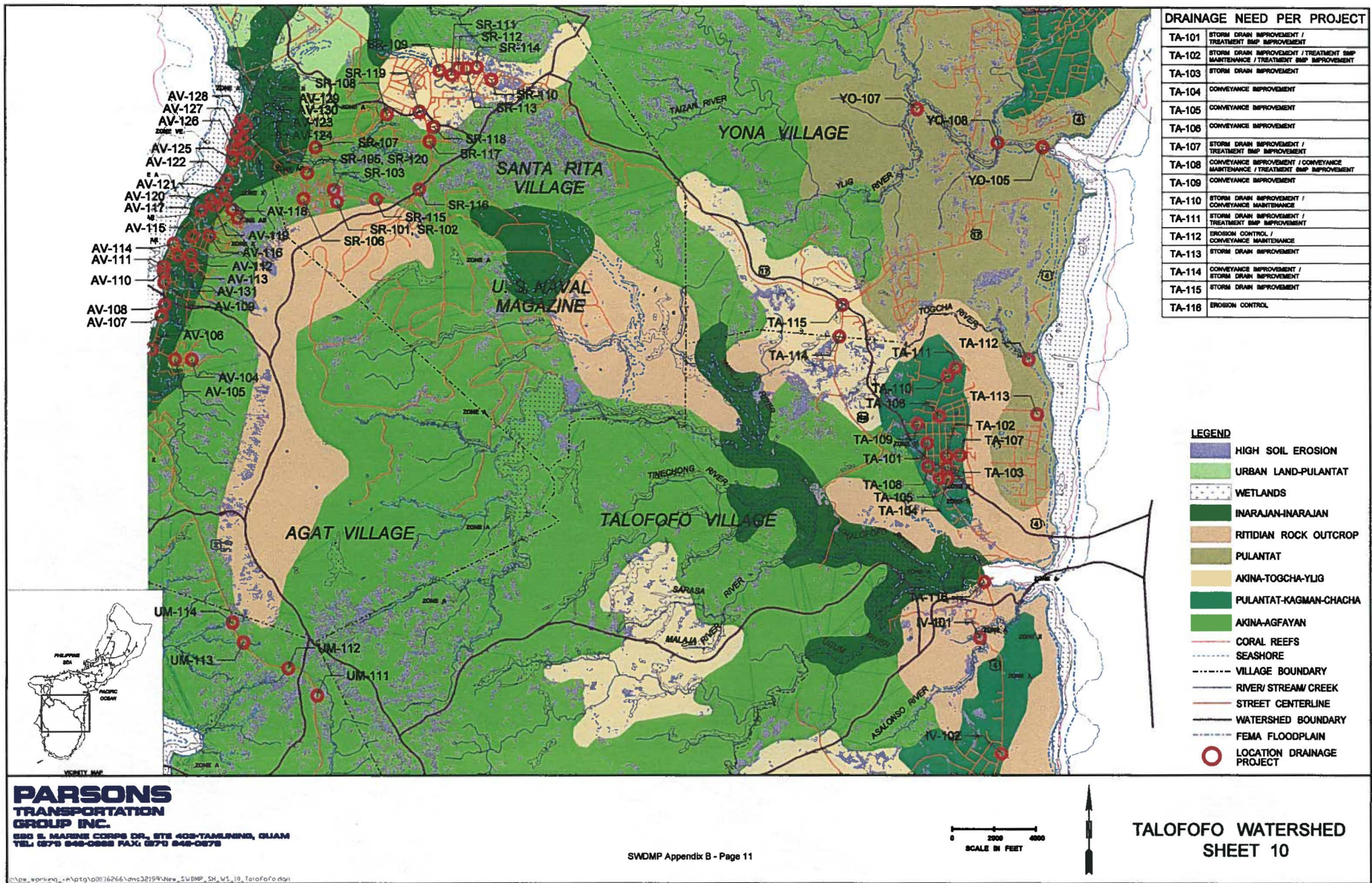
- HIGH SOIL EROSION
- INARAJAN-INARAJAN
- RITIDIAN ROCK OUTCROP
- WETLANDS
- AKINA-AGFAYAN
- CORAL REEFS
- SEASHORE
- VILLAGE BOUNDARY
- RIVER/ STREAM/ CREEK
- STREET CENTERLINE
- WATERSHED BOUNDARY
- FEMA FLOODPLAIN
- LOCATION DRAINAGE PROJECT

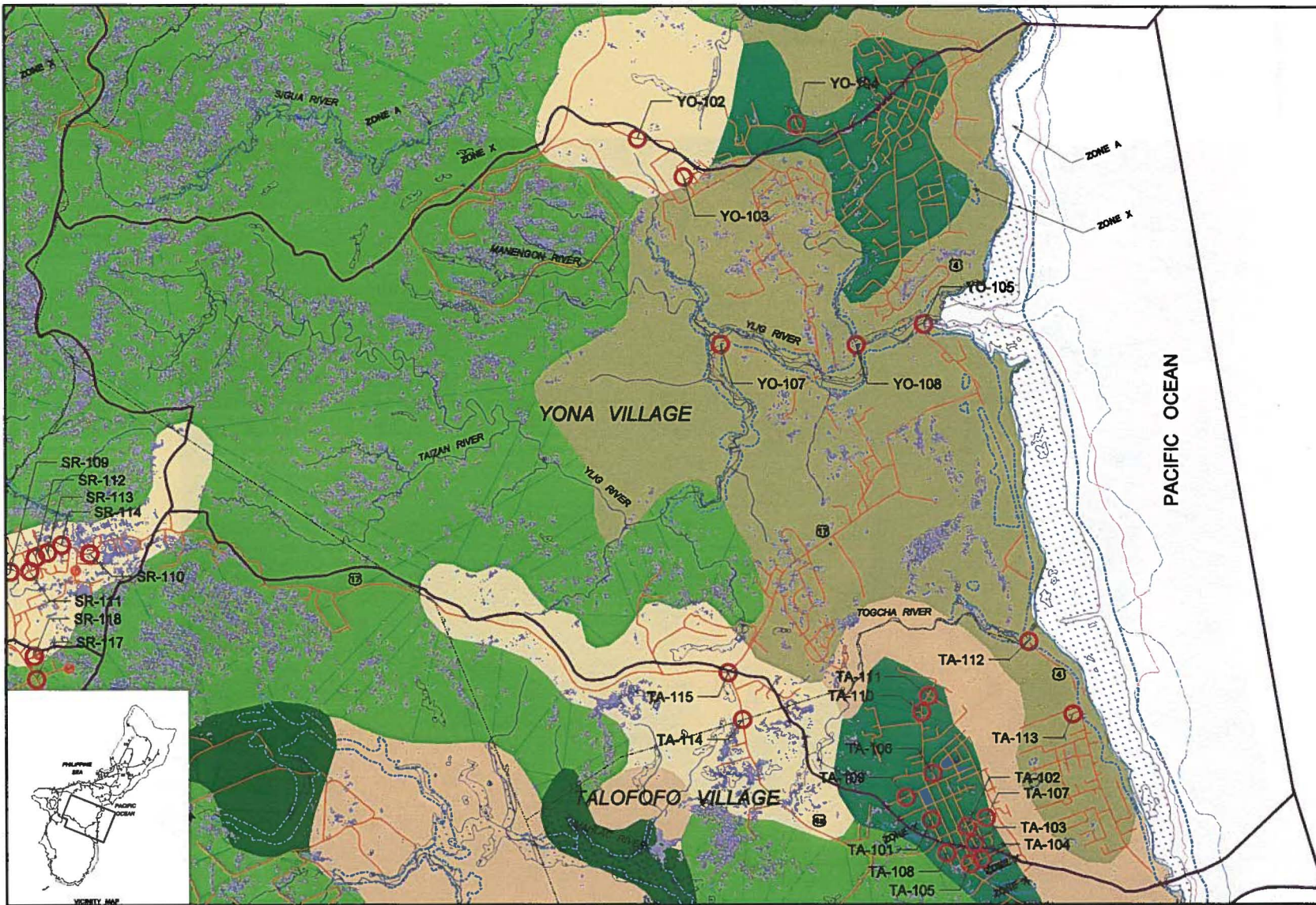


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SCALE IN FEET

TAE LAYAG WATERSHED
SHEET 09





DRAINAGE NEED PER PROJECT	
YO-101	EROSION CONTROL (SEE SHEET 10)
YO-102	STORM DRAIN IMPROVEMENT
YO-103	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
YO-104	STORM DRAIN IMPROVEMENT / CONVEYANCE MAINTENANCE / EROSION CONTROL
YO-105	EROSION CONTROL / CONVEYANCE MAINTENANCE
YO-107	STORM DRAIN IMPROVEMENT
YO-108	STORM DRAIN IMPROVEMENT / CONVEYANCE MAINTENANCE / EROSION CONTROL

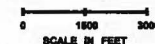
LEGEND

- HIGH SOIL EROSION
- WETLANDS
- INARAJAN-INARAJAN
- RITIDIAN ROCK OUTCROP
- PULANTAT
- AKINA-TOGCHA-YLIG
- PULANTAT-KAGMAN-CHACHA
- AKINA-AGFAYAN
- CORAL REEFS
- SEASHORE
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- LOCATION DRAINAGE PROJECT



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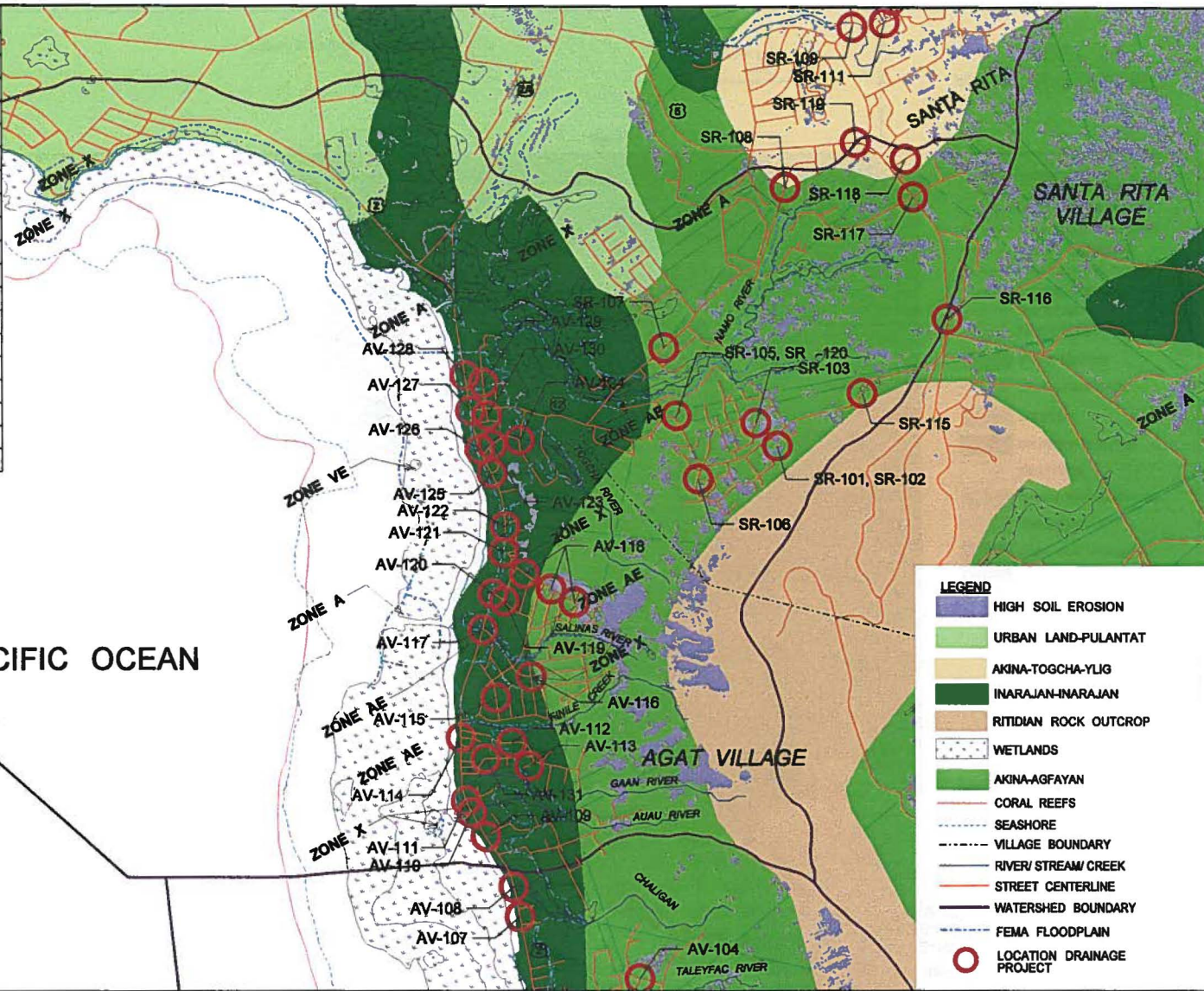


YLIG WATERSHED
SHEET 11

DRAINAGE NEED PER PROJECT	DRAINAGE NEED PER PROJECT
AV-101 STORM DRAIN IMPROVEMENTS / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE (SEE SHEET 09)	SR-101 EROSION CONTROL / CONVEYANCE IMPROVEMENT
AV-102 EROSION CONTROL (SEE SHEET 09)	SR-102 EROSION CONTROL / CONVEYANCE MAINTENANCE
AV-104 EROSION CONTROL (SEE SHEET 09)	SR-103 EROSION CONTROL / CONVEYANCE IMPROVEMENT
AV-105 STORM DRAIN MAINTENANCE (SEE SHEET 09)	SR-105 EROSION CONTROL / CONVEYANCE MAINTENANCE
AV-106 COASTAL PROTECTION / CONVEYANCE IMPROVEMENTS (SEE SHEET 09)	SR-106 EROSION CONTROL / CONVEYANCE IMPROVEMENT
AV-107 CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENTS	SR-107 CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
AV-108 EROSION CONTROL / CONVEYANCE MAINTENANCE	SR-108 EROSION CONTROL / CONVEYANCE IMPROVEMENT
AV-109 STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS	SR-109 STORM DRAIN IMPROVEMENT / EROSION CONTROL / CONVEYANCE MAINTENANCE
AV-110 EROSION CONTROL / CONVEYANCE MAINTENANCE	SR-110 CONVEYANCE IMPROVEMENT (SEE SHEET 11)
AV-111 EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENTS	SR-111 STORM DRAIN IMPROVEMENT / CONVEYANCE IMPROVEMENT
AV-112 EROSION CONTROL / CONVEYANCE MAINTENANCE	SR-112 CONVEYANCE IMPROVEMENT
AV-113 STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE	SR-113 STORM DRAIN IMPROVEMENT / CONVEYANCE IMPROVEMENT (SEE SHEET 11)
AV-114 EROSION CONTROL / CONVEYANCE IMPROVEMENTS	SR-114 CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT (SEE SHEET 11)
AV-115 STORM DRAIN IMPROVEMENTS	SR-115 EROSION CONTROL / STORM DRAIN IMPROVEMENT
AV-116 STORM DRAIN IMPROVEMENTS	SR-116 STORM DRAIN IMPROVEMENT / CONVEYANCE MAINTENANCE
AV-117 EROSION CONTROL / CONVEYANCE MAINTENANCE	SR-117 EROSION CONTROL / CONVEYANCE IMPROVEMENT
AV-118 STORM DRAIN IMPROVEMENTS / CONVEYANCE IMPROVEMENTS	SR-118 EROSION CONTROL / CONVEYANCE MAINTENANCE
AV-119 STORM DRAIN IMPROVEMENTS	SR-119 EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENT
AV-120 STORM DRAIN IMPROVEMENTS / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE	SR-120 EROSION CONTROL / STORM DRAIN IMPROVEMENT / STORM DRAIN MAINTENANCE
AV-121 CONVEYANCE IMPROVEMENTS	
AV-122 EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENTS	
AV-123 EROSION CONTROL / CONVEYANCE MAINTENANCE	
AV-124 EROSION CONTROL / CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENTS	
AV-125 STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE / TREATMENT BMP IMPROVEMENTS	
AV-126 CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENTS	
AV-127 STORM DRAIN IMPROVEMENTS / CONVEYANCE IMPROVEMENTS	
AV-128 CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE	
AV-129 STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE	
AV-130 STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE	
AV-131 CONVEYANCE MAINTENANCE / CONVEYANCE IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS	



PACIFIC OCEAN



- LEGEND**
- HIGH SOIL EROSION
 - URBAN LAND-PULANTAT
 - AKINA-TOGCHA-YLIG
 - INARAJAN-INARAJAN
 - RITIDIAN ROCK OUTCROP
 - WETLANDS
 - AKINA-AGFAYAN
 - CORAL REEFS
 - SEASHORE
 - VILLAGE BOUNDARY
 - RIVER/ STREAM/ CREEK
 - STREET CENTERLINE
 - WATERSHED BOUNDARY
 - FEMA FLOODPLAIN
 - LOCATION DRAINAGE PROJECT

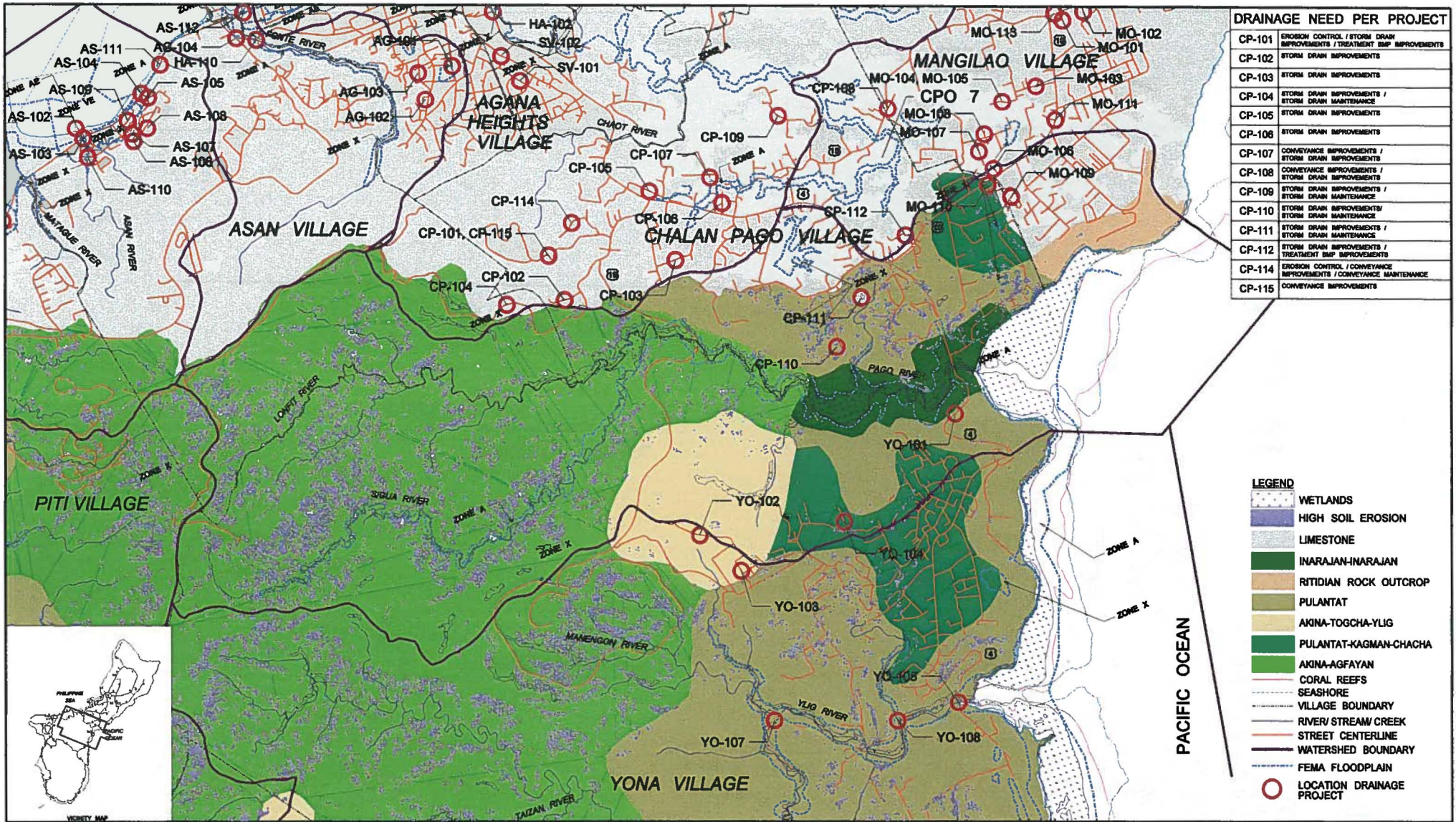
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SCALE IN FEET

AGAT WATERSHED
SHEET 12



DRAINAGE NEED PER PROJECT	
CP-101	EROSION CONTROL / STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
CP-102	STORM DRAIN IMPROVEMENTS
CP-103	STORM DRAIN IMPROVEMENTS
CP-104	STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE
CP-105	STORM DRAIN IMPROVEMENTS
CP-106	STORM DRAIN IMPROVEMENTS
CP-107	CONVEYANCE IMPROVEMENTS / STORM DRAIN IMPROVEMENTS
CP-108	CONVEYANCE IMPROVEMENTS / STORM DRAIN IMPROVEMENTS
CP-109	STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE
CP-110	STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE
CP-111	STORM DRAIN IMPROVEMENTS / STORM DRAIN MAINTENANCE
CP-112	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
CP-114	EROSION CONTROL / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
CP-115	CONVEYANCE IMPROVEMENTS

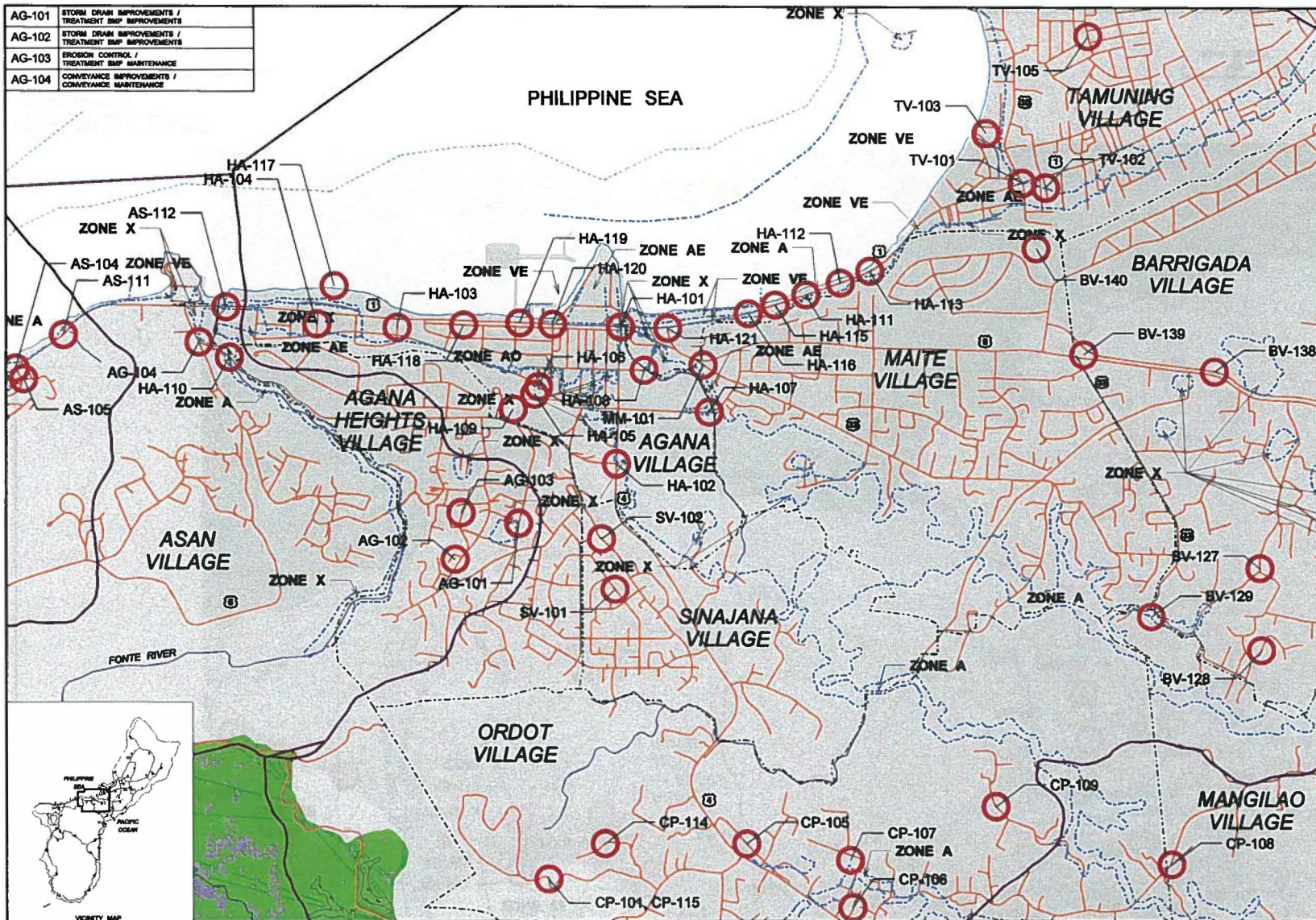
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LEGEND

-  HIGH SOIL EROSION
-  WETLANDS
-  RITIDIAN ROCK OUTCROP
-  PULANTAT
-  LIMESTONE
-  PULANTAT-KAGMAN-CHACHA
-  CORAL REEFS
-  SEASHORE
-  VILLAGE BOUNDARY
-  RIVER/ STREAM/ CREEK
-  STREET CENTERLINE
-  WATERSHED BOUNDARY
-  FEMA FLOODPLAIN
-  LOCATION DRAINAGE PROJECT

AG-101	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
AG-102	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
AG-103	EROSION CONTROL / TREATMENT BMP MAINTENANCE
AG-104	CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE



DRAINAGE NEED PER PROJECT

HA-101	EROSION CONTROL
HA-102	CONVEYANCE IMPROVEMENTS
HA-103	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
HA-104	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
HA-105	EROSION CONTROL
HA-106	STORM DRAIN IMPROVEMENTS
HA-107	EROSION CONTROL
HA-108	CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
HA-109	STORM DRAIN IMPROVEMENT / TREATMENT BMP IMPROVEMENTS
HA-110	EROSION CONTROL / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
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HA-112	EROSION CONTROL / CONVEYANCE IMPROVEMENTS
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HA-115	EROSION CONTROL / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
HA-116	EROSION CONTROL / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
HA-117	EROSION CONTROL
HA-118	EROSION CONTROL / CONVEYANCE IMPROVEMENTS
HA-119	EROSION CONTROL / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
HA-120	CONVEYANCE IMPROVEMENTS
HA-121	EROSION CONTROL / CONVEYANCE MAINTENANCE
MM-101	STORM DRAIN IMPROVEMENT / TREATMENT BMP IMPROVEMENTS

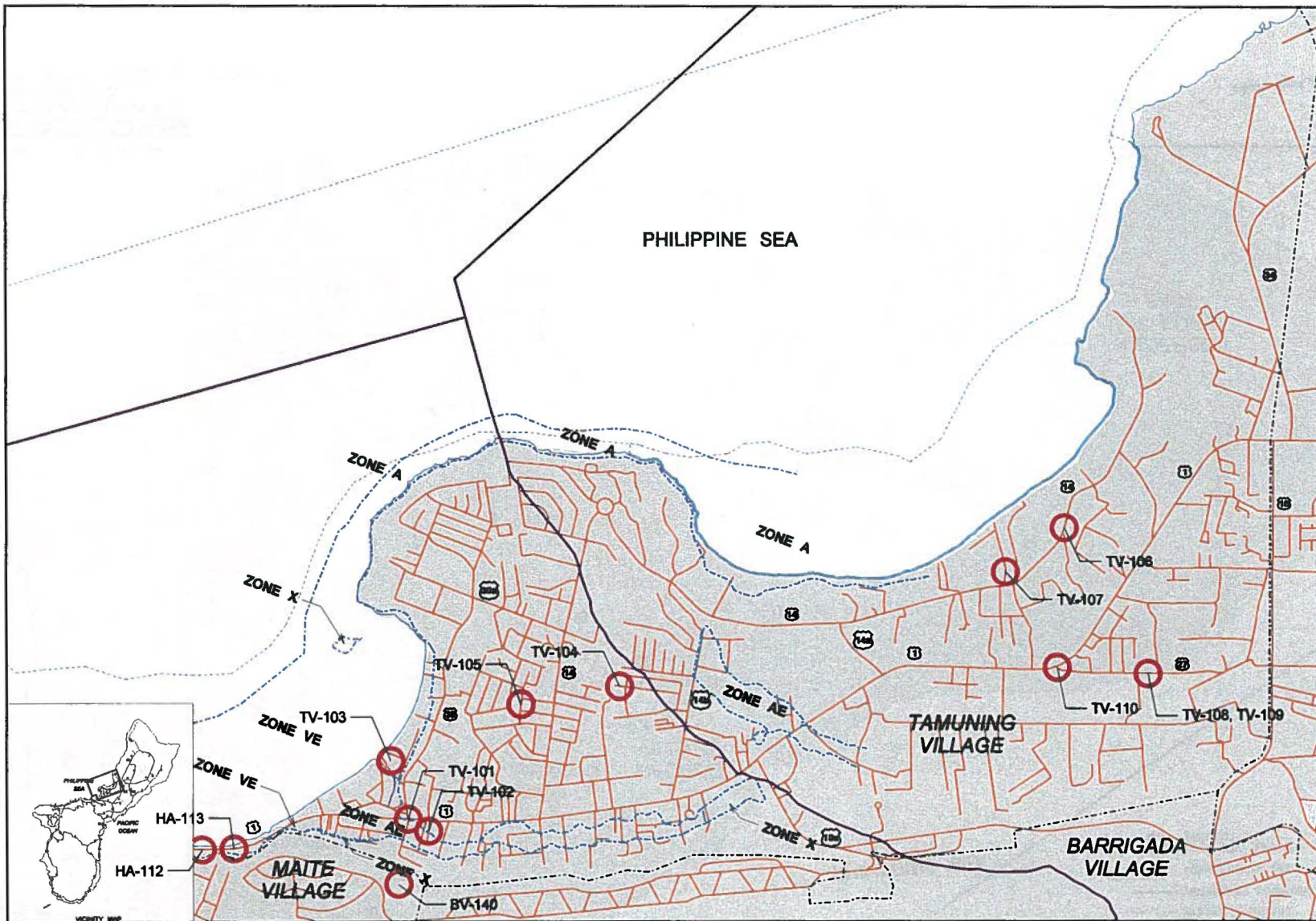
LEGEND

- HIGH SOIL EROSION
- LIMESTONE
- WETLANDS
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- CORAL REEFS
- SEASHORE
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AGANA HEIGHTS, AGANA,
MAITE, AND SINAJANA VILLAGES
SHEET 17



DRAINAGE NEED PER PROJECT

TV-101	CONVEYANCE IMPROVEMENT / CONVEYANCE MAINTENANCE
TV-102	STORM DRAIN IMPROVEMENT
TV-103	CONVEYANCE IMPROVEMENT / CONVEYANCE MAINTENANCE
TV-104	STORM DRAIN IMPROVEMENT
TV-105	STORM DRAIN IMPROVEMENTS / TREATMENT BASIN IMPROVEMENTS
TV-106	STORM DRAIN IMPROVEMENT
TV-107	STORM DRAIN IMPROVEMENT
TV-108	STORM DRAIN IMPROVEMENT
TV-109	STORM DRAIN IMPROVEMENTS / TREATMENT BASIN IMPROVEMENTS
TV-110	STORM DRAIN IMPROVEMENT

LEGEND

- LIMESTONE
- WETLANDS
- CORAL REEFS
- SEASHORE
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- RIVER/STREAM/CREEK
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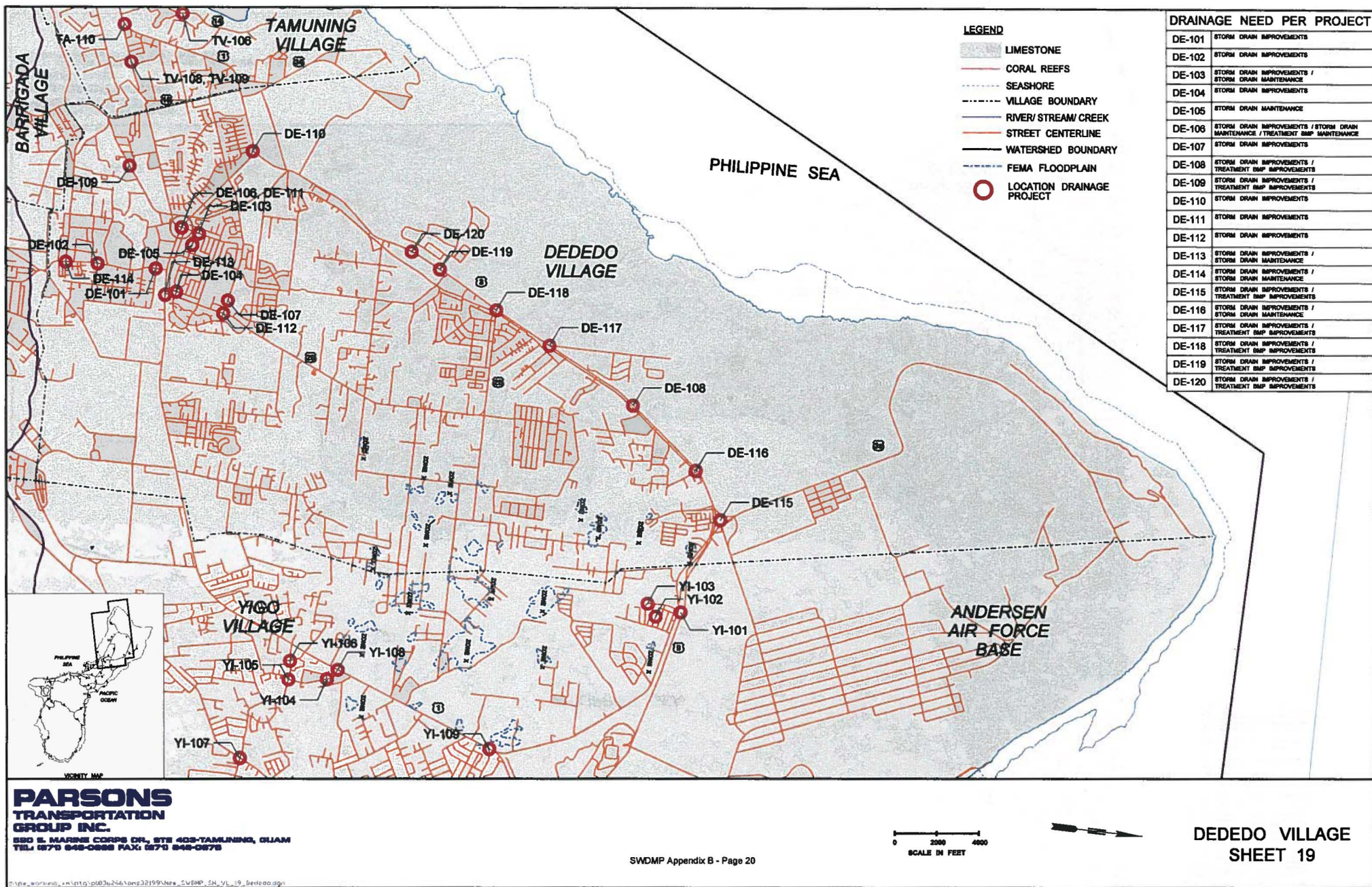
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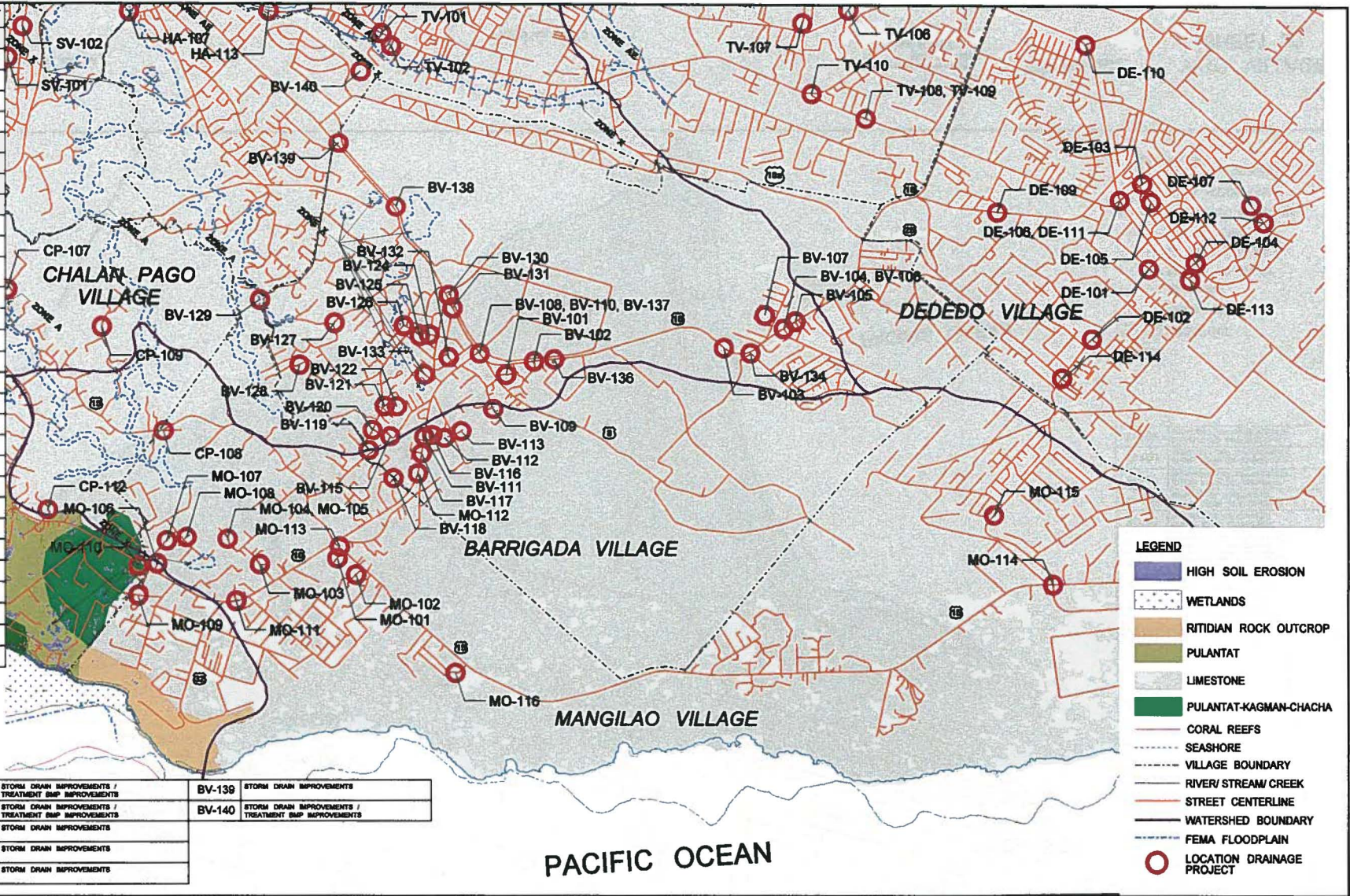
TAMUNING VILLAGE
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DRAINAGE NEED PER PROJECT

BV-101	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-102	STORM DRAIN IMPROVEMENTS
BV-103	STORM DRAIN IMPROVEMENTS
BV-104	STORM DRAIN IMPROVEMENTS
BV-105	CONVEYANCE IMPROVEMENTS
BV-106	STORM DRAIN IMPROVEMENTS
BV-107	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-108	EROSION CONTROL / CONVEYANCE MAINTENANCE
BV-109	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-110	CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
BV-111	CONVEYANCE IMPROVEMENTS
BV-112	EROSION CONTROL / STORM DRAIN MAINTENANCE / STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-113	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-115	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-116	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-117	STORM DRAIN MAINTENANCE
BV-118	STORM DRAIN IMPROVEMENTS
BV-119	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-120	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-121	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-122	EROSION CONTROL
BV-124	CONVEYANCE IMPROVEMENTS
BV-125	EROSION CONTROL / CONVEYANCE MAINTENANCE
BV-126	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-127	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-128	EROSION CONTROL / CONVEYANCE MAINTENANCE
BV-129	CONVEYANCE IMPROVEMENTS
BV-130	EROSION CONTROL / CONVEYANCE IMPROVEMENTS / CONVEYANCE MAINTENANCE
BV-131	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-132	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS



BV-133	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS	BV-139	STORM DRAIN IMPROVEMENTS
BV-134	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS	BV-140	STORM DRAIN IMPROVEMENTS / TREATMENT BMP IMPROVEMENTS
BV-136	STORM DRAIN IMPROVEMENTS		
BV-137	STORM DRAIN IMPROVEMENTS		
BV-138	STORM DRAIN IMPROVEMENTS		

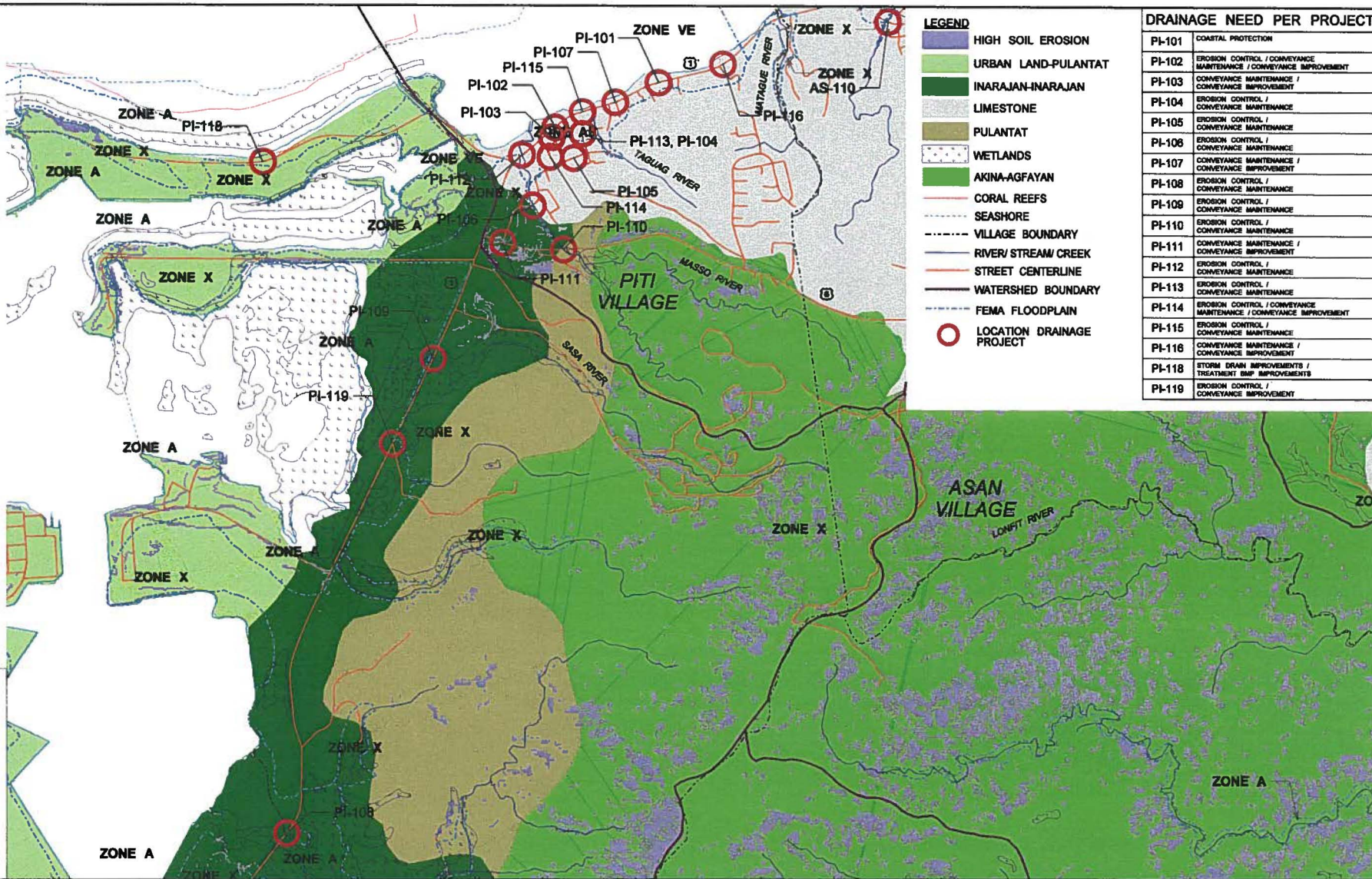


PARSONS
TRANSPORTATION
GROUP INC.
880 S. MARINE CORPS DR., STE 403-TAMUNING, GUAM
TEL: (671) 948-0588 FAX: (671) 948-0578

0 1500 3000
SCALE IN FEET



BARRIGADA VILLAGE
SHEET 21



PARSONS
TRANSPORTATION
GROUP INC.

550 S. MARINE CORPS DR., STE 403-TAMUNING, GUAM
TEL: (671) 848-0888 FAX: (671) 848-0878

0 1000 2000
SCALE IN FEET

PITI VILLAGE
SHEET 22

Appendix C

Project Summary Data Sheets

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AGANA HEIGHTS



AG-101

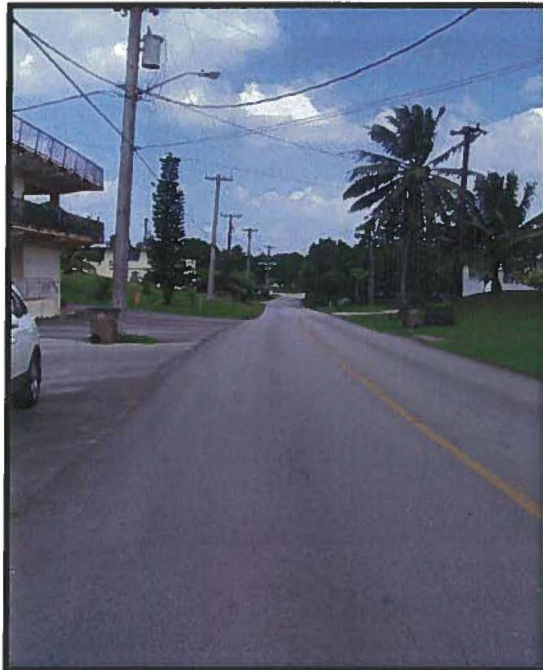
LOCATION: San Vicente Solomon Drive & Francisco Javier Ave

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: This is a ponding basin with dry wells. Ponding basin is undersized and more dry wells are needed. Surrounding home floods when basin overflows. High flows go to dry wells and low flows percolate. Much of Agana Heights runoff discharges to this basin.

RECOMMENDED IMPROVEMENTS Recommend placement of 6 new injection wells at this site along with an increase of the infiltration basin size by 5,000 square feet. This will accommodate the increase in capacity required to prevent flooding.

COST: \$2,360,000



AG-102

LOCATION: Joseph Cruz Ave & As Kotla Court

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Along this street, there is no drainage system and there is flooding of homes at the low point of the street. Also upstream from the low point at 439 Joseph Cruz Ave, the home's backyard gets flooded.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties, two 200 linear foot infiltration basins are recommended for construction along the crowned street at its low point.

COST: \$70,100



AG-103

LOCATION: Agana Heights Ponding Basin

MITIGATION TYPE: Erosion Control/ Treatment BMP Maintenance (Infiltration Basin)

SITE ASSESSMENT: There is significant erosion along basin fencing. On one side of the basin, an owner built a swimming pool very close to the limits of the basin, and this is causing more erosion. Need to stabilize with rip rap.

RECOMMENDED IMPROVEMENTS Recommend placement of 500 SF of rip rap along embankment of basin in close proximity to neighboring pool along with placement of approximately 500 SF of rip rap along top edge of basin at fence line where erosion is occurring. Also recommend removal of debris within basin (approximately 1/4 Ac). This will clean up existing basin and stabilize embankments to prevent further erosion.

COST: \$143,000



AG-104

LOCATION: RT 6 & RT 7

MITIGATION TYPE: Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: An RCB cross culvert under Route 6 and Route 7 is covered with debris and vegetation - more than half the depth is covered with sediment upstream and the embankment past the wingwalls is eroding. It needs debris and vegetation removal and embankment stabilization on the upstream side of the RCB. The downstream side has heavy vegetation that needs to be cleared and here it was impossible to check for erosion under the vegetation.

RECOMMENDED IMPROVEMENTS Erosion control and maintenance is needed at this site. Remove one acre of debris removal including some sediment removal to promote drainage and place 500 square feet of rip rap for channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the existing culvert. Place headwall/wingwall structures on upstream and downstream sides of culvert.

COST: \$182,000

AGAT VILLAGE



AV-101

LOCATION: RT 2 & Chalan Josen Milagro

MITIGATION TYPE: Storm Drain Improvements/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: The properties west from Rt2 between Chalan Josen Milagros and International Rd get flooded. Runoff from Rt2 is routed to a channel that runs parallel to Chalan Josen Milagro, then from this channel is routed through 2-24" PVC culverts that run under Chalan Josen Milagro and discharge to the private property at the northwest corner of Rt2 and Chalan Josen Milagro. To prevent flooding of all these properties, runoff from Rt2 should stay along Rt2 and runoff generated in the properties along Chalan Josen Milagros needs its own drainage conveyance system. A drainage conveyance system needs to be added along Rt2, west side starting south from Chalan Josen Milagros and discharging to Taleyfac River (about 1300' away). To take care of private properties within Chalan Josen Milagros, a drainage conveyance system needs to be added to capture runoff and route it the shoreline, a series of swales and cross culverts can be routed to an existing access easement at the end of a future cul-de-sac where prior to being discharged to the beach, runoff should outlet to a rip-rap lined channel to prevent erosion.

RECOMMENDED IMPROVEMENTS A storm drain system is needed to collect and convey street runoff from Rte 2 at Chalan Josen Milagros to the Taleyfac River. Propose installation of approximately 1250' of dual 3'x5' RCB along the west side of Rte 2, conveying flow the river. Propose a headwall/wingwall structure equipped with 100 SF rip rap energy dissipator at outlet to the river. Propose 1200 ft ditch along Rte 2 outleting to catch basins (2 total) connected to proposed RCB below. Recommend 1/4 Ac debris removal at Chalan Josen Milagros and Rte 2. Recommend placement of drainage ditch to route flow with Chalan Josen Milagros Development to shoreline (approximately 800 feet long).

COST: \$2,680,000



AV-102

LOCATION: RT 2 & Tun Ramon Chele Rd

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Double 36" RCP Cross culvert under Tun Ramon Chele Rd routes runoff to Taleyfac River. The upstream channel embankment needs stabilization.

RECOMMENDED IMPROVEMENTS Recommend placement of 1,000 square feet of rip rap channel stabilization along channel embankments for a distance of 50-ft upstream of double 36" cross culvert located at Tun Ramon Chele Rd to stabilize the channel upstream of culvert.

COST: \$141,000

**AV-104**

LOCATION: Pagachao Dr & Kalachucha St

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: At the intersection of Pagacho Dr and Kalachucha St. a concrete lined ditch discharges to the intersection. This ditch carries runoff and debris from the Pagachao subdivision - there is erosion all along the hillside above this subdivision. The runoff from this ditch continues along Kalachucha St. down to Manha St. where a curb inlet is located at the end of the cul-de-sac. Even where there is evident hillside erosion, along the ditch and street there are no signs of sediment issues or flooding.

RECOMMENDED IMPROVEMENTS Recommend placement of hydroseed and bonded fiber matrix over 1 acre of hillside where soil is exposed to prevent further erosion.

COST: \$74,100



AV-105

LOCATION: Pagachao Dr & Mike Cruz St

MITIGATION TYPE: Storm Drain Maintenance

SITE ASSESSMENT: There is a sinkhole along Pagacho Dr just west of Mike Cruz St. The sinkhole location is in line with a sewer line. The broken sewer line needs to be fixed to stop undermining of the street.

RECOMMENDED IMPROVEMENTS There is a broken sewer line on this site that needs to be fixed to stop the undermining of the roadway. One new sewer manhole and the placement of a 24" RCP for 20 linear feet will be needed to stop the undermining.

COST: \$24,800



AV-106

LOCATION:

RT 2 & Pagachao Dr

MITIGATION TYPE:

Coastal Protection/ Conveyance Improvements

SITE ASSESSMENT:

42" RCP cross culvert under Rt2 routes runoff from Pagachao Dr to Nimitz Beach. The upstream cross culvert needs a headwall/wingwall structure, and clearing of the channel; the cross culverts are not visible. Downstream, a sediment structure needs to be added to prevent sand from clogging the outlet, and coastal erosion control (riprap) is needed to prevent undermining of Route 2.

RECOMMENDED IMPROVEMENTS

Coastal protection is needed at this site along with improvements to the drainage conveyance system. A quarter acre of debris removal is needed both upstream and downstream of the culvert. A 1000 ft concrete ditch should be placed along the shoreline side of Rte 2, outletting to the channel located at the downstream side of the cross-culvert. This will protect Route 2 from being undermined during high tides and will promote drainage along the freeway. For further erosion protection, it is recommended that a half acre of hydromulch w/ bonded fiber matrix be used as needed over the land adjacent to the ditch.

COST:

\$80,800



AV-107

LOCATION: RT 2 & north of Chalan Lada

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvements

SITE ASSESSMENT: North of Chalan Lada, a 42" RCP cross culvert runs under Route 2 and discharges to Nimitz beach. Need to add headwall/wingwall structures to both upstream and downstream, erosion stabilization (riprap), and vegetation/debris upstream.

RECOMMENDED IMPROVEMENTS Maintenance and improvements are needed for the drainage conveyance system at this site. A quarter acre of debris removal is needed (both upstream and downstream) along with placement of headwall/ wingwall structures and a 100 SF rip rap energy dissipator placed upstream and downstream of the culvert.

COST: \$64,100



AV-108

LOCATION:

RT 2 & Chaligan Creek

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

A 11'x3.5' RCB routes Chaligan Creek across Route 2. There is erosion around the wingwalls; need to add erosion stabilization (riprap). Downstream, the existing concrete channel slab is being undermined, and needs to be repaired, and a cutoff wall needs to be added along with riprap.

RECOMMENDED IMPROVEMENTS

Erosion control and maintenance to the drainage conveyance system are needed at this site. A quarter acre of debris removal is needed both upstream and downstream of the culvert. Approximately 50 sq feet of rip rap should be placed along the upstream wingwalls to prevent further undermining. Approximately 50 sq feet of grouted rip rap should be placed along the bottom and toe of slope of the downstream side of the culvert to prevent further undermining of the bottom slab.

COST:

\$143,000



AV-109

LOCATION: RT 2 & Babauta Rd

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements (Infiltration Trench)

SITE ASSESSMENT: At the intersection of Route 2 and Babauta Rd, three homes get flooded, there is no existing drainage conveyance system and therefore the formation of ponding occurs. A swale needs to be added along Route 2 and a cross culvert to route runoff to the beach.

RECOMMENDED IMPROVEMENTS A storm drain system is needed to collect and convey street runoff from Rte 2 at Babauta under Rte 2. Propose 100' bioswale placed adjacent to Rte 2, conveying flow to a low point along Rte 2 where a grated catch basin will intercept the treated runoff and outlet it through approximately 100 feet of 24" RCP placed across Rte 2, outletting to a headwall/wingwall structure equipped with a 100 sq ft rip rap energy dissipator located along the shoreline.

COST: \$134,000



AV-110

LOCATION: RT 2 & Auau Creek

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 6'x3' RCB cross culvert routes Agau Creek under Route 2 to Bangi Point. Removal of debris/vegetation and of accumulated sediment is needed both upstream and downstream. There is a RCB that is clogged with sediment. Dredging and riprap along the embankment downstream for approximately 50' towards the beach is needed.

RECOMMENDED IMPROVEMENTS Recommend a quarter acre of debris removal, 1000 square feet of rip rap channel stabilization placed a distance of 50 feet downstream of the culvert and 400 cubic yards of dredging for a distance of 50 ft downstream of the culvert.

COST: \$159,000



AV-111

LOCATION: RT 2 & Gaan River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvements

SITE ASSESSMENT: A double 6'x4' RCB routes Gaan River under Route 2. Erosion control (riprap) is needed adjacent to the wingwall structures to prevent further undermining of Route 2. Trash and sediment needs to be removed from channels both upstream and downstream, and embankment stabilization (rip rap) is needed.

RECOMMENDED IMPROVEMENTS Recommend placement of new headwall/wingwall structures upstream and downstream of double 6'x4' RCB and placement of rip rap stabilization along the embankments of the river for a distance of 25 feet upstream and 25 feet downstream of the culvert (totaling 1000 sq ft of rip rap). A quarter acre of debris removal (upstream and downstream of the culvert) is also recommended.

COST: \$177,000



AV-112

LOCATION: Finile Dr

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Need bank stabilization and cleanup at inlet. 10' x 8' RCB at Inlet. Bank revetment at outlet side. Encase/protect utility line (possibly sewer).

RECOMMENDED IMPROVEMENTS Erosion control and maintenance to the drainage conveyance system are needed at this site (Finile Drive and Rte 2). A quarter acre of debris removal is needed along with placement of 1000 square foot rip rap embankment stabilization for a distance of 50-ft upstream of culvert and placement of a 100-ftx12-inch concrete encasement of an existing sewer line located at the upstream side of the culvert

COST: \$201,000



AV-113

LOCATION: Orong Circle & Finile Dr

MITIGATION TYPE: Storm Drain Improvements/ Storm Drain Maintenance

SITE ASSESSMENT: At the end of Orong Circle a low points exists and a 12" RCP cross culvert routes runoff from this low point to a natural flow path. This 12" cross culvert is not sufficient to route all the runoff generated in this area. Along Orong Circle a drainage conveyance system needs to be added and route it to the natural flow path.

RECOMMENDED IMPROVEMENTS Recommend improvements to the existing storm drain system along Orong Circle to stop flooding in street. The drainage system should include approximately 200 LF of ditch located adjacent to the road, routing flow to 2 grated catch basins located at the low points in the road, connecting to 100'x18" RCP that will route flow adjacent to a private residence to the natural flow path located behind the residence (an easement will most likely be required for the 18" RCP). Also recommend one quarter acre debris removal downstream of the 18" RCP outlet and placement of headwall/wingwall structure with 100 SF rip rap energy dissipator placed at the outlet of the storm drain.

COST: \$159,000



AV-114

LOCATION: RT 2 & Finile Creek

MITIGATION TYPE: Erosion Control/ Conveyance Improvements

SITE ASSESSMENT: A 10'x8' RCB routes Finile Creek under Rt2. The upstream and downstream headwall and wingwalls need to be replaced. Sediment and debris need to be removed upstream. Stabilization (riprap) of the embankment and roadway along Route 2 both in the upstream channels and the downstream channels are needed. A lateral 24" RCP culverts runs under Finile Dr and discharges to Finile Creek, this culvert needs the removal of debris and sediment and the addition of headwalls.

RECOMMENDED IMPROVEMENTS Recommend placement of 2,000 square feet of rip rap channel stabilization along Finile Creek channel embankment for a distance of 50-ft upstream and downstream of cross culvert located at Rte 2 to stabilize the channel embankment. Also recommend placement of new headwall/ wingwall structures at both ends of Finile Creek Culvert under Rte 2 and for adjacent 24" RCP lateral running along Finile Drive.

COST: \$349,000



AV-115

LOCATION: Tomas Mesa St

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: A drainage conveyance system along the street is not working properly and street floods. Need to depress existing grated inlets and replace existing gutters with wider gutters.

RECOMMENDED IMPROVEMENTS Recommend improvements to the existing storm drain system along Tomas Mesa Street to stop flooding in street. The drainage system should include concrete ditches adjacent to the road (4 ditches at 100-ft length) routing flow to new grated catch basins at the low point of the 2 sides of the crowned road. The grated catch basins should connect to a 100-ft x 24" RCP storm drain that will route the flow to the Finile Creek. Place a headwall structure equipped with 100 SF rip rap energy dissipator at outlet to river. May require easement to route flow to Finile Creek.

COST: \$258,000



AV-116

LOCATION: San Vicente Ave & San Roque St

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At the interchange of San Vicente Ave and San Roque St, four grated inlets exist - one at each corner. There are signs of runoff flooding the intersection - possible solution is to have double grated inlets instead of single grated.

RECOMMENDED IMPROVEMENTS Recommend improvements to the existing storm drain system at this intersection to stop flooding in street. Recommend adding 4-100-ft ditches routing flow to 2 and 2 existing catch basins. Connect the new catch basins with the existing catch basins via 100-ft of 24" RCP.

COST: \$109,000



AV-117

LOCATION: RT 2 & Salinas River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 4'x4' RCB cross culvert routes the flow from Salinas River under Route 2. Upstream, there is a trapezoidal concrete lined channel discharges to the RCB, there are no issues present with this channel. Downstream needs about 50' of embankment stabilization and debris/sediment removal.

RECOMMENDED IMPROVEMENTS The downstream channel at this site needs stabilization for the embankment and removal of debris/sediment. Recommend a quarter acre of debris removal and the placement of 1,000 square feet of rip rap channel stabilization for a distance of 50-ft downstream of the culvert routing Salinas River under Rte 2.

COST: \$143,000

**AV-118**

LOCATION: Erskin Dr

MITIGATION TYPE: Storm Drain Improvements/ Conveyance Improvements

SITE ASSESSMENT: Runoff from Erskin Dr and from teacher's housing along Commissioner Charfauros Ct flows down to all the streets perpendicular to Erskin Dr (Perry St, Cook St, Eugenlo St, Marteres , Osbone St, Bruce St). All the runoff needs to be captured and routed along Erskin Dr. Add a v-ditch along south side of Erskin Dr and at each intersection route the runoff via cross culverts across to an existing channel that runs along the north side of Erskin Dr. This channel begins at Commissioner Charfauros Ct and continues along Erskin Dr until it discharges to a 6'x3' RCB cross culvert that runs under Rt2.

RECOMMENDED IMPROVEMENTS Recommend storm drain improvements along Erskin Drive from Commissioner Charfauros Ct to Bruce St including: 1) placement of a concrete ditch along south side of Erskin for a distance of 2500 feet, 2) placement of 50'x24" RCP cross culverts at each intersection (6 total equipped with headwalls) to route flow from conc ditch to channel located on opposite side of Erskin, 3) addition of 2 catch basins connecting to 100'x24" RCP storm drain at Commissioner Charfauros Ct routed to conc channel located on north side of Erskin.

COST: \$363,000



AV-119

LOCATION: Father Follard St & Bruce St

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Runoff floods and ponds the north corner at the intersection of Father Follard St and Bruce St. Add a grated catch basin and tie into an existing catch basin at the south corner of Father Follard St and Route 2.

RECOMMENDED IMPROVEMENTS Recommend improvements to the existing storm drain system at this intersection to stop flooding in street. Recommend placing new catch basin on north and south corners of Father Follard and Bruce St connecting to 100'x24" RCP to exist catch basin on south corner of Father Follard and Rte 2. Place 400-ft ditch adjacent to street to convey flow to new catch basins. Also recommend one quarter acre debris removal and placement of 1000 SF rip rap at outlet of system, downstream of Rte 2.

COST: \$252,000

**AV-120**

LOCATION: RT 2 & Father Follard St

MITIGATION TYPE: Storm Drain Improvements/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: At the intersection of Rt2 and Father Follard St, two grated catch basins collect runoff from Route 2 and Father Follard St, discharging to a cross culvert under Rt2. The catch basin on the northeast corner is undersized and flooding/ponding is created - need to add another grated catch basin. At the downstream end of the cross culvert, the receiving channel needs embankment stabilization (riprap) and debris/vegetation removal.

RECOMMENDED IMPROVEMENTS Recommend improving the drainage system along Father Follard Drive by replacing the undersized catch basin with 2 new catch basins connected by approximately 100 feet of 24" RCP and adding approximately 100' of ditch adjacent to road on both sides of the 2 new catch basins. The new system will connect to the existing cross-culvert under Rte 2. A quarter acre of debris removal downstream of this culvert is needed (in the downstream channel). Also recommend placement of 1000 SF of rip rap along the embankments of the downstream channel for a distance of approximately 50 feet.

COST: \$252,000



AV-121

LOCATION: RT 2 & Erskin Dr

MITIGATION TYPE: Conveyance Improvements

SITE ASSESSMENT: A 6'x3' RCB cross culvert routes runoff collected upstream from Erskin Dr. Upstream, a concrete lined channel discharges to a RCB. Downstream, the RCB outlets to a channel, the addition of wingwalls, and stabilization (rip rap) of the embankment and roadway are needed. The Elite Bakery building adjacent to the downstream channel is being undermined by runoff from the channel - it needs to be protected with riprap to stop the undermining.

RECOMMENDED IMPROVEMENTS Recommend improvements to the existing drainage conveyance system located mainly on the west side of Rte 2 (downstream side of 6'x3' culvert at this site). Recommendations include: 1) placement of a new headwall/wingwall structure with 100 SF rip rap energy dissipator at the downstream side of the 6'x3' culvert, 2) placement of 1000' concrete ditch along west side of Route 2 (north of channel) outletting to a grated catch basin located upstream of Elite Bakery - catch basin to connect to 50' of 24" RCP routing flow southward to new headwall/wingwall structure at channel, and 3) placement of 400 ft long ditch located along west side of Route 2, south of channel, outletting to a grated catch basin that connects to 50' of 24" RCP storm drain conveying flow northward to headwall/wingwall structure proposed in channel.

COST: \$182,000



AV-122

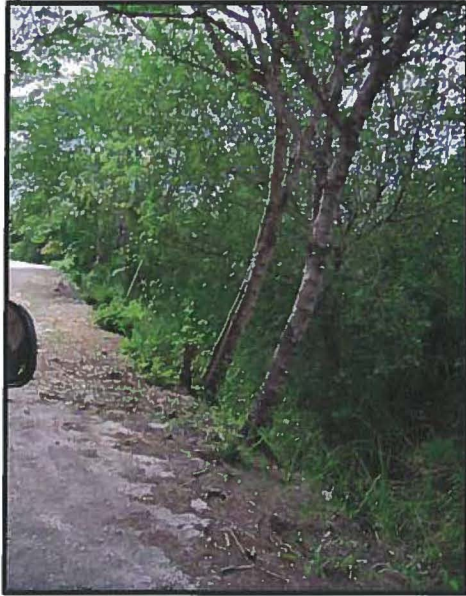
LOCATION: RT 2 & South of Atao Rd

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvements

SITE ASSESSMENT: A 36" RCP cross culvert runs under Route 2. The upstream and downstream headwalls and wingwalls need to be replace. Vegetation and debris need to be removed in the upstream channel. Add embankment stabilization(riprap) along downstream channel. A lateral 24" RCP culvert discharges to the upstream channel to the 36" cross culvert, the upstream channel to the 24" RCP needs embankment stabilization(riprap).

RECOMMENDED IMPROVEMENTS The upstream and downstream headwall/wingwall structures on this site need to be replaced and erosion control is needed. Recommend placement of 2,000 square feet of rip rap channel stabilization along channel embankments for a distance of 50-ft upstream and downstream of 36" cross culvert located at Rte 2 to stabilize the channel embankment. Also recommend placement of new headwall/ wingwall structures at both ends of culvert along with a quarter acre of debris removal within channel.

COST: \$317,000



AV-123

LOCATION:

V T Babauta Lane

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

V T Babauta Lane runs parallel to Togcha River. The river needs embankment stabilization to prevent undermining of road, and also needs removal of debris and vegetation.

RECOMMENDED IMPROVEMENTS

Recommend a quarter acre of debris removal and placement of 1,000 square feet of rip rap channel stabilization along the embankment of Togcha River adjacent to Babauta Rd (approximately 100 ft in length).

COST:

\$143,000



AV-124

LOCATION: R R Cruz St

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvements

SITE ASSESSMENT: The Togcha River crosses the R R Cruz St at two locations where two 10'x10' RCB culverts route the river flow. At the upstream RCB, the downstream headwall has cracks and pieces of the structure are falling apart - the headwall and wingwalls need to be repaired or replaced. At the same location, a 60" HDPE lateral culvert needs a headwall. At both RCB locations, the river needs debris/sediment/vegetation removal and embankment stabilization.

RECOMMENDED IMPROVEMENTS Recommend placement of new headwall/wingwall structures on the upstream and downstream sides of the 2 culverts located at the 2 crossings of the Togcha River. Recommend placing the 60" HDPE lateral through the wingwall of the upstream culvert. Also recommend removal of one quarter acre of debris throughout and placement of 1,000 square feet of rip rap channel stabilization (for a distance of 10 feet upstream and downstream of each culvert).

COST: \$226,000



AV-125

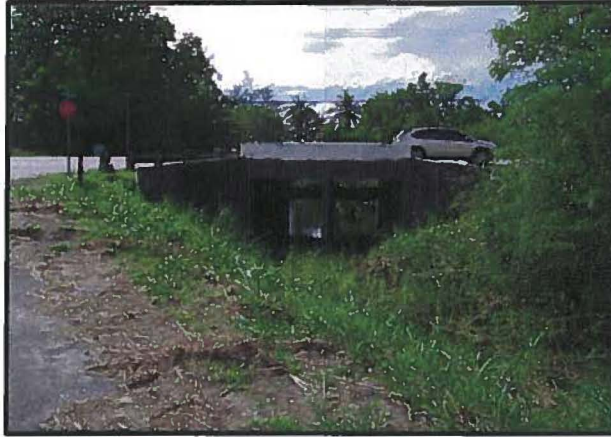
LOCATION: Salinas Rd

MITIGATION TYPE: Storm Drain Improvements/ Storm Drain Maintenance/ Treatment BMP Improvements

SITE ASSESSMENT: Along Salinas Rd there are about four homes that flood due to debris accumulation and overgrown vegetation next to the road. Remove debris and vegetation, add swales and culverts along the road, and route the runoff to the Togcha river.

RECOMMENDED IMPROVEMENTS Recommend addition of a storm drain system along Salinas Road to stop flooding of homes. The drainage system should include swales adjacent to the road (2 bioswales at 50-ft length) routing flow to a catch basin at the low point in the road. The grated catch basin should connect to a 100-ft x 24" RCP storm drain that will route the flow to the Togcha River (at Salinas and Baubata intersection). Place a headwall/wingwall structure equipped with 100 SF rip rap energy dissipator at outlet to river.

COST: \$134,000



AV-126

LOCATION: RT 2 & Togcha River

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvements

SITE ASSESSMENT: A double cell RCB routes the Togcha River under Rt2. Overgrown vegetation upstream and downstream need to be removed. Upstream there is erosion around the RCB wingwalls, to prevent further undermining of the roadway embankment stabilization needs to be added. Downstream, the north embankment needs to be stabilized (riprap). A sewer line runs through the RCB, pipe should be concrete encased to prevent any spills.

RECOMMENDED IMPROVEMENTS Maintenance and improvements to the drainage conveyance system is needed at this site. A quarter acre of debris removal will be needed, 1,000 square feet of rip rap channel stabilization 30 linear feet of concrete encasement, and two new headwall/wingwall structures will be needed.

COST: \$235,000

**AV-127**

LOCATION: RT 2 & RT 12

MITIGATION TYPE: Storm Drain Improvements/ Conveyance Improvements

SITE ASSESSMENT: At the intersection of Route 2 and Route 12 there is ponding on the two east corners. Add a drainage conveyance system and route the runoff to the north along Route 2 to an existing RCB or south to the Togcha River.

RECOMMENDED IMPROVEMENTS Recommend addition of a drainage conveyance system at Rte 2 and Rte 12 to eliminate roadside ponding. The drainage system should include ditches adjacent to the road (totaling 400-ft length) routing flow to 2 catch basins connecting to 200 LF of 24" RCP storm drain equipped with a headwall/wingwall structure with 100 SF rip rap energy dissipator at the outlet. The flow will be routed to the Togcha River.

COST: \$252,000



AV-128

LOCATION:

RT 2 & north of RT 12

MITIGATION TYPE:

Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT:

North of the Route 2 and Route 12 interchange, there are 3-36' RCP cross culverts that run under Route 2. Upstream there is a channel with a rock/concrete embankment that runs adjacent to Bay Dollar Mart and adjacent to private properties. Around this area six properties including the store become flooded, berms should be added next to the channel to stop the flooding. Both the upstream and downstream channels need removal of overgrown vegetation. The downstream channel also has rock/concrete embankments and sediment/debris that need to be removed.

RECOMMENDED IMPROVEMENTS

To minimize flooding of adjacent properties, a 2-ft high berm (5 ft wide) is recommended along both embankments of the channel on the upstream side of the culvert for a distance of approximately 100 feet. Remove one quarter acre of debris (on upstream and downstream sides of culvert). Place 500 square feet of rip rap for berm at the top of embankment on both sides of channel. Replace existing headwall on upstream culvert with taller headwall/ wingwall structure.

COST:

\$158,000



AV-129

LOCATION: north Perino St

MITIGATION TYPE: Storm Drain Improvements/ Storm Drain Maintenance / Conveyance Maintenance

SITE ASSESSMENT: At the north end of Perino St there are 3-24" RCP cross culverts that run under the street. Both the upstream and downstream channels are covered with trash/debris/vegetation that need to be removed.. Add swales along Perino and route them to the cross culvert to prevent flooding of the street

RECOMMENDED IMPROVEMENTS Recommend improvements to the existing storm drain system along Perino to stop flooding in street. The drainage system should include concrete ditches or swales adjacent to each side of the crowned road (2 ditches at 1000-ft length) routing flow to the triple 24" RCP culvert crossing Perino Street. Also recommend debris removal upstream and downstream of the culvert and placement of a 100 SF rip rap energy dissipator at culvert inlet and outlet.

COST: \$56,700



AV-130

LOCATION: south Perino st

MITIGATION TYPE: Storm Drain Improvements/ Conveyance Maintenance

SITE ASSESSMENT: At the south side of Perino St there is no drainage conveyance system to route roadway runoff. Add a drainage conveyance system and discharge it to the proposed drainage conveyance system at the intersection of Route 12 and Route 2.

RECOMMENDED IMPROVEMENTS A drainage conveyance system is needed along Perino Street that will route the street runoff to the proposed drainage conveyance system at the intersection of Route 12 and Route 2. Recommend placement of two catch basins placed at this street's low point connecting to a 24" RCP for 200 linear feet that routes the flow to the system at Rte 2 and Rte 12. Also a quarter acre of debris removal is needed at this site.

COST: \$202,000



AV-131

LOCATION: Tun Leon Rd

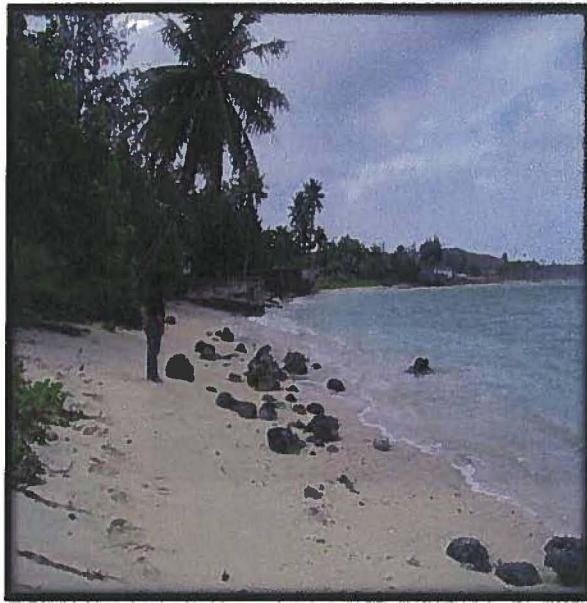
MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Along Tun Leon Rd, there is one property that becomes flooded - there is no drainage conveyance system along this street. Provide a drainage conveyance system along this road, and route it south to the Gaan River. An easement will be needed to route the drainage system to the Gaan River. Debris and overgrown vegetation needs to be cleaned along the street - this is also causing runoff to create flooding.

RECOMMENDED IMPROVEMENTS Recommend addition of a drainage conveyance system along Tun Leon Road to stop flooding of homes. The drainage system should include swales adjacent to the road (2 bioswales at 100-ft length) routing flow to the south to a culvert conveyance system consisting of 300' x 24" RCP equipped with 2 headwall/wingwall structures outleting to a 100-ft rip rap energy dissipator at the Gaan River embankment. One quarter AC of debris removal will also be required.

COST: \$337,000

ASAN VILLAGE



AS-102

LOCATION: RT 1 & Fonte to Masso River

MITIGATION TYPE: Coastal Protection

VILLAGE RANKING

SITE ASSESSMENT: There is significant costal erosion from Masso River(south) to Fonte River (north). There still some home foundations left along the coastline.

RECOMMENDED IMPROVEMENTS To prevent further shoreline erosion, placement of 50,000 square feet of rip rap coastal stabilization (approximately 10-ft in width along the shoreline) from the Fonte River outlet to the Asan River outlet (approximately 5000 feet) is recommended.

COST: \$7,030,000



AS-103

LOCATION:

RT 1 & Asan River Bridge

MITIGATION TYPE:

Conveyance Improvements

SITE ASSESSMENT:

Bridge is in good condition, there is no erosion nor debris or overgrown vegetation. On the upstream side of the bridge a water main crosses the river, this water line is too low and may cause debris to accumulate on this side of the bridge. Water line should be raised.

RECOMMENDED IMPROVEMENTS

Recommend replacing the existing 8" DIP Water Main obstructing flow upstream of the existing bridge with a new 8" DIP Water Main (equipped with air release valve) connected to the bridge deck in order to move the water line out of the flow path and prevent excessive sediment and debris deposition upstream of the bridge.

COST:

\$10,700



AS-104

LOCATION: RT 1 & Msgnr Jose A Leon Guerrero St

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: At the intersection of Rt1 and Msgnr Jose A Leon Guerrero St three grated inlets are located. Its not clear where these inlets outlet to, but they capture runoff from Rt1 and from Msgnr Jose A Leon Guerrero St. Two of these grated inlets are covered with sediment and debris. Per the FCD Document, a box culvert located here must be upsized.

RECOMMENDED IMPROVEMENTS Improvements to the drainage conveyance system at this site are needed. There are three grated inlets located on this site, two of which are covered in debris. Recommend clearing debris and upsizing conveyance line (as per the Flood Control Document) to a 6'x4' RCB for 100 linear feet.

COST: \$167,000



AS-105

LOCATION: Consolation St & Msgr Jose A Leon Guerrero St

MITIGATION TYPE: Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Existing 4'x3' RCB under consolidation St needs to be upsized. Upstream channel is heavily vegetated. Channel needs to be cleared of vegetation and debris to prevent flooding of street.

RECOMMENDED IMPROVEMENTS The cross culvert at this site needs to be replaced with 100 linear feet of 4'x4' RCB equipped with upstream and downstream headwall structures along with 100 sq ft rip rap stabilization placed upstream and downstream of the culvert. Approximately one quarter acre of debris should be removed along the channel.

COST: \$158,000



AS-106

LOCATION: Niño Perdido St & Santa Ana St

MITIGATION TYPE: Erosion Control/ Storm Drain Maintenance/ Storm Drain Improvements

SITE ASSESSMENT: A concrete lined channel discharges to an inlet located behind the sidewalk and this inlet discharges to a double grated inlet on the street. There is significant debris and sediment from hillside, the receiving inlet is clogged. Erosion control is needed upstream. As per the Flood Control Document, the connecting storm drain needs to be replaced with a 100"x24" RCP.

RECOMMENDED IMPROVEMENTS Erosion control, maintenance and improvements to the storm drain system are needed at this site. A quarter acre of debris removal and placement of one acre of hydromulch with bonded fiber matrix is recommended along the hillside to eliminate further sedimentation and clogging of the downstream inlet. As per the Flood Control Document, the connecting storm drain needs to be replaced with a 100"x24" RCP.

COST: \$170,000



AS-107

LOCATION: West San Carlos Ct & Msgnr Jose A Leon Guerrero St

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Existing drainage conveyance system along West San Carlos Ct needs to be upsized, there are signs of street flooding.

RECOMMENDED IMPROVEMENTS Improvements to the storm drain at this site are needed. The existing drainage system needs to be upsized to a 30" RCP conveyance system (per FCD) for 1,000 linear feet and two catch basins are proposed to eliminate existing street flooding issues.

COST: \$1,170,000



AS-108

LOCATION: Santa Ana St & Santa Ana Lane

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: An existing 18" Cross culvert crossing Santa Ana St is capturing runoff from hillside. The upstream culvert has a headwall that is submerged in water and debris. Hillside is heavily vegetated, and there are signs of erosion. Hillside needs to be stabilized for erosion and a debris basin should be added to the upstream side of the cross culvert to prevent clogging of pipe, possible the cross culvert should be upsized.

RECOMMENDED IMPROVEMENTS The cross culvert at this site needs to be replaced with 100 linear feet of 3'x3' RCB equipped with headwalls upstream and downstream and 100 sq ft rip rap stabilization downstream of the culvert. Approximately one quarter acre of debris should be removed along the channel. Recommend placement of hydromulch w/ a bonded fiber matrix over approximately 1 acre of the adjacent hillside.

COST: \$170,000



AS-109

LOCATION: Sen Juan Tim Tovas St & Msgnr Jose A Leon Guerrero St

MITIGATION TYPE: Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: An existing 18" RCP culvert discharges to a channel located between Sen Juan Tim Tovas St and Msgnr Jose A Leon Guerrero St. Possible this culvert outlets runoff from Msgnr Jose A Leon Guerrero st. This culvert should be replaced with a 3'x3' RCB. The culvert is in good shape and its not causing any erosion along the channel embankment, but possibly is undersized and should be replaced at least with a 3'x3' RCB. There are signs of flooding of the channel, there is debris along the sides of the channel embankments.

RECOMMENDED IMPROVEMENTS The cross culvert at this site needs to be replaced with 100 linear feet of 3'x3' RCB equipped with downstream headwall and 100 sq ft rip rap stabilization downstream of the culvert. Approximately one quarter acre of debris should be removed along the channel.

COST: \$87,000



AS-110

LOCATION: Msgnr Jose A Leon Guerrero St & Asan River

MITIGATION TYPE: Conveyance Improvements

SITE ASSESSMENT: There is 30" RCP culvert outleting to the Asan river, just north of the Asan River bridge over Msgnr Jose A Leon Guerrero st. This culvert and headwall are in good shape, and there are no signs of erosion around outlet, needs to be replaced with a 3'x3' RCB. The existing 30" RCP is undersized.

RECOMMENDED IMPROVEMENTS The culvert at this site needs to be replaced with a 3'x3' RCB for 200 linear feet equipped with upstream and downstream headwall structures outleting flow to a 100 square foot rip rap energy dissipator.

COST: \$156,000



AS-111

LOCATION: RT 1 & Church of Christ

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 24" to 36" cross culvert with headwall crosses Route 1. The upstream side lies next to the Church of Christ. Also the upstream side is covered with debris and overgrown vegetation, there is erosion along the toe of the hillside behind the church which runoff flows towards this cross culvert. Possibly this area also floods due to the clogged cross culvert. Debris and overgrown vegetation need to be cleared, and sediment control implemented on hillside and possibly a sediment basin added upstream of the cross culvert entrance.

RECOMMENDED IMPROVEMENTS Recommend placement of hydromulch w/ a bonded fiber matrix over approximately 1 acre of the hillside behind the church in an effort to control mass erosion that contributes to sedimentation in the downstream culvert. Also recommend maintenance in the channel upstream of the culvert in the form of 1/4 acre of debris removal (and sediment removal in the existing culvert). Recommend adding headwall and wingwall structure to upstream side of culvert to alleviate potential erosion at culvert inlet.

COST: \$101,000



AS-112

LOCATION: RT 1 & Fonte River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance / Conveyance Improvements

SITE ASSESSMENT: Fonte River bridge along Rt1 with significant erosion on the upstream side of the bridge, with accumulated debris and sediments. The upstream river embankment needs to be stabilized with riprap and debris removed. At this location next to the river on the east side lies Pigo Catholic cemetery, the river is eroding the cemetery and either the channel needs to be channelized or riprap or gabions placed to prevent any further erosion.

RECOMMENDED IMPROVEMENTS To prevent further erosion, 1 acre of debris removal followed by rip rap channel stabilization 250 feet upstream and 50 feet downstream of Fonte River Bridge is required (totaling approximately 10,000 SF Rip Rap Stabilization).

COST: \$142,000

BARRIGADA VILLAGE



BV-101

LOCATION: Manibusan Rd

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Runoff flood s one property, existing infiltration trench can't handle volume of runoff. Need to maintain existing infiltration trench.

RECOMMENDED IMPROVEMENTS Recommend placement of a 200 linear foot infiltration trench adjacent to the existing infiltration trench along with maintenance of the existing infiltration trench to enable proper infiltration.

COST: \$19,600



BV-102

LOCATION: RT 16 & Cepeda Way

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Along Rt16, adjacent to Cepeda way, there is an existing concrete ditch that runs parallel to Rt16, a portion of this ditch was covered with a concrete slab and a few openings left on top. Need to remove concrete top and replaced it with a metal grate (or replace system with a storm drain system with 3 catch basins and pipeline to outlet offsite). The existing concrete slabs prevents maintenance of the ditch and also does not allow runoff to enter ditch properly.

RECOMMENDED IMPROVEMENTS Recommend replacement of the existing concrete drainage structure located along Route 16 adjacent to Cepeda Way with three catch basins connecting to a 24" RCP (approximately 100 linear feet in length) connecting to the existing Rte 16 storm drain via a manhole structure.

COST: \$45,200



BV-103

LOCATION: RT 16 & 261C

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Cross Culvert under Rt16 should carry flow from west to east, but most of the flow does not cross the street and continues flowing south along Rt16. Modify/add catch basins on upstream side of culvert to route flow to the east more efficient.

RECOMMENDED IMPROVEMENTS Recommend improvements to the storm drain conveyance system along Rte 16, connecting to the existing cross-culvert. Improvements include placement of 2 catch basins north of the cross-culvert, connecting to approximately 100' of 24" RCP routing flow southerly to the upstream side of the culvert, outleting through a headwall/wingwall structure and 100 SF rip rap energy dissipator.

COST: \$137,000



BV-104

LOCATION: RT 16 & North Sabana

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At the intersection of Rt16 and North Sabana ponding is created. There are two existing catch basins along North Sabana, but this is not sufficient and looks to be undersized. Add an additional grated catch basin along North Sabana on the north side of road, add an overside drain to the existing catch basin on the south side of North Sabana, and add two catch basins along RT16 east side to prevent flooding of area.

RECOMMENDED IMPROVEMENTS To prevent further roadway flooding, recommend placement of an additional grated catch basin along North Sabana on the north side of road adjacent to the intersection with Rte 16, add an overside drain leading to the existing catch basin on the south side of North Sabana, and add two catch basins along the east side of Rte16 (along with approximately 100 LF of roadside ditch routing surface runoff to catch basins). Connect proposed catch basins to existing storm drain system using 100'x24" RCP.

COST: \$117,000



BV-105

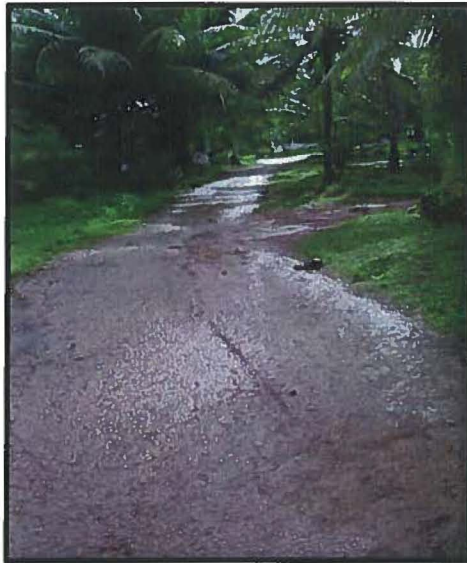
LOCATION: RT 16 & Mobil Gas Station

MITIGATION TYPE: Conveyance improvements

SITE ASSESSMENT: A cross culvert under Rt16 carries flow from the east to the west where a property is being developed. Upstream, a headwall and wingwalls should be added to existing cross culvert. Downstream, the new development will build a structure to route flow to the north.

RECOMMENDED IMPROVEMENTS: Two new headwall/wingwall structures should be added to the existing cross culvert on this site, outleting flow through a 100 square foot rip rap energy dissipator. This will route the flow to the north.

COST: \$48,100



BV-106

LOCATION: RT 16 & North Sabana

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Private property off route 16. Property gets flooded by upstream runoff, a new development upstream has increased runoff discharging to private property. Need to add a drainage conveyance system.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Rte 16 to prevent flow from entering North Sabana. Two catch basins should be placed along Rte 16 (upstream and downstream of the entrance to N Sabana), connecting to a 24" RCP for 100 linear feet equipped with a headwall/wingwall structure, outletting the flow through a 100 square foot rip rap energy dissipator placed adjacent to Rte 16.

COST: \$137,000



BV-107

LOCATION: Rosario Loop Rd & Pangelinan Way

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvement

SITE ASSESSMENT: Rosario Loop is off Pangelinan Way and adjacent to the airport. This is a new development and street is not paved yet -it has a gravel surface. Three homes get flooded. A future cul-de-sac within the loop will be an ideal location to build an infiltration basin or an infiltration trench.

RECOMMENDED IMPROVEMENTS Recommend placement of a 200'x200' infiltration basin at this site along with a drainage system along Rosario Loop. Two catch basins should be placed along the street to intercept and convey flow to a 24" RCP for 100 linear feet, outleting to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator placed at the infiltration basin. Recommend placement of 100 LF of ditch along each side of the crowned roadway to convey flow to proposed catch basins.

COST: \$479,000



BV-108

LOCATION:

RT 8 & RT 16

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

Homes in the area along Rt8 and east of Rt16 get flooded. On the south side of Rt8 a berm keeps water from flowing south and floods all this area, under the berm there is a 8" pipe but this is not sufficient to drain all this area. There is also a cross culvert under the road but is not sufficient. Need to add a drainage conveyance system to prevent flooding of private properties and roadway.

RECOMMENDED IMPROVEMENTS

Recommend improvements to the storm drain conveyance system along Rte 8, at the existing cross-culvert located east of Rte 16. Improvements include replacement of existing culvert with 50"x36" RCP equipped with upstream trash rack and downstream wingwall with 200 SF rip rap energy dissipator outleting to a new 200'x200' infiltration basin (located along the south side of Rte 8 approximately 50 feet east of culvert). A quarter acre of debris removal is also needed.

COST:

\$514,000



BV-109

LOCATION: Lizama St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Maintenance

SITE ASSESSMENT: At the end of Lizama St there is a Cul-de-Sac where a temporary basin was created to take care of the flooding generated by the new development. Since this basin is at the low point, this temporary should be made into a permanent infiltration basin, need to acquire right of way for basin and for an access road to basin.

RECOMMENDED IMPROVEMENTS Recommend making temporary infiltration basin into permanent infiltration basin to be owned and maintained by DPW (requires ROW acquisition and fencing for 800 linear feel around perimeter of the existing infiltration basin).

COST: \$21,500



BV-110

LOCATION: RT 10 & RT 8

MITIGATION TYPE: Conveyance improvements/ Conveyance Maintenance / Treatment BMP Maintenance

SITE ASSESSMENT: Along Rt10 east side and south from Rt8 an infiltration basin has become a permanent wet basin. The infiltration basin is not draining the runoff anymore and has become a permanent lake and habitat for endangered species.

RECOMMENDED IMPROVEMENTS The infiltration basin along Route 10 and south of Route 8 no longer drains the runoff and has turned into a permanent lake/habitat for endangered species. This area needs a quarter acre of debris removal and approximately 1,000 cubic yards of dredging (cut). In order for the maintenance to occur, an agreement between DPW and DFW will most likely be required.

COST: \$48,700



BV-111

LOCATION: Vietnam, Veterans Highway (RT 10)

MITIGATION TYPE: Conveyance Improvements / Conveyance Maintenance

SITE ASSESSMENT: Along the west side of Rt10 an inlet to a cross culvert has been plugged, and another inlet to a cross culvert at an adjacent property is not sufficient to route all the runoff to the east side of Rt10 thus flooding these properties. Need to unplug existing cross culvert.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Rte 10 connecting to the existing cross culvert including placement of 2 new catch basins along the west side of Rte 10 connecting to 100 LF of 24" RCP outleting to existing cross-culvert. Also recommend placement of a headwall/wingwall structure to the inlet of the existing cross-culvert along with 100 sq ft of rip rap to prevent further sedimentation of the culvert.

COST: \$137,000



BV-112

LOCATION: San Antonio St & Rte 10

MITIGATION TYPE: Erosion Control/ Storm Drain Maintenance/ Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Runoff from Route 10 discharges to this street and floods homes.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Rte 10 to prevent flow from entering San Antonio Street. Two catch basins should be placed along Rte 10 (upstream and downstream of the intersection with San Antonio Street), connecting to a 24" RCP for 100 linear feet equipped with a headwall/wingwall structure, outleting the flow through a 100 square foot rip rap energy dissipator and to a 200' long infiltration trench placed adjacent to Rte 10.

COST: \$157,000



BV-113

LOCATION: Ungkulu St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Possible location for an infiltration basin or trench, this at a low point.

RECOMMENDED IMPROVEMENTS Recommend placement of storm drain system in Ungkulu Street to assist in flood prevention along the street, outleting to an infiltration trench (200' long) adjacent to the low point in the street. Propose intercepting roadway flow via catch basins (1 located on each side of the street) connected by 24" RCP (estimated length of 100-ft) outleting to headwall/wingwall structure and 100 SF rip rap energy dissipator located immediately upstream of proposed infiltration trench.

COST: \$45,800



BV-115

LOCATION: Westbrooks St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: 7 homes get flooded need to add a infiltration basin to take care of the runoff.

RECOMMENDED IMPROVEMENTS Recommend placement of a 200'x200' infiltration basin at this site along with a drainage system along Westbrooks Street. Two catch basins should be placed at the street's low points to intercept and convey flow to a 24" RCP for 100 linear feet, outleting to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator placed at the infiltration basin.

COST: \$479,000



BV-116

LOCATION: Limitiaco St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: An existing infiltration basin overtops and floods homes. Also concentrated flow entering the basin is eroding embankment next to a home. Erosion control needs to be provided to embankment next to private property, and basin needs to be resized to take care of all the runoff without flooding properties.

RECOMMENDED IMPROVEMENTS Homes at this site become flooded due to an existing infiltration basin that overtops. Recommend placement of two 200-ft long infiltration trenches (or widening of the infiltration basin by 10-ft if right of way permits) along with rip rap added to the sides of the existing basin where erosion is occurring.

COST: \$39,100



BV-117

LOCATION: RT 10

MITIGATION TYPE: Storm Drain Maintenance

SITE ASSESSMENT: There is a natural basin on side of Rt10, on the opposite side there is a cross culvert that needs to be maintained to prevent roadway flooding.

RECOMMENDED IMPROVEMENTS In order to promote proper drainage and conveyance of flow through culvert, recommend placement of a new headwall/wingwall structure equipped with trash rack to inlet of cross-culvert at this site.

COST: \$20,400



BV-118

LOCATION: Anderson St

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Existing grated channel needs to be dredged and cleared of overgrown vegetation to prevent flooding of street, also existing cross culvert upstream from this channel needs to be cleaned of any debris and headwall and wingwalls added.

RECOMMENDED IMPROVEMENTS Recommend placement of storm drain system in Anderson Street to assist in flood prevention along the street, outleting to existing channel that needs sediment removal (approximately 100 CY). Place 2 catch basins at the street's low point connecting to a 24" RCP (approximately 100 linear feet), routing flow to adjacent channel. Storm drain system should outlet into channel via a 100 square foot rip rap energy dissipator. Place headwall/wingwall structure at outlet of existing culvert located at upstream end of channel.

COST: \$137,000



BV-119

LOCATION: Leyang Rd & Manibusan Ln

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: A house on the north side of Leyang Rd, east from Manibusan Lane gets flooded due to a cross culvert that is plugged downstream. The street pavements has collapsed and there are ponding, two signs that the cross culvert has collapsed. Need to replace the cross culvert and need to replace the catch basin upstream with a grated catch basin, downstream right-of-way needs to be acquired to route the outlet through a private property.

RECOMMENDED IMPROVEMENTS A drainage conveyance system is needed along Leyang Rd to prevent future flooding of the street and surrounding private properties. Recommendations include placement of grated catch basins connected by 50 LF of 24" RCP, with runoff conveyed through an additional 50 LF of 24" RCP equipped with headwall/wingwall structure at outlet and 100 SF rip rap energy dissipator to natural flow path (easement may be required for this last segment of conveyance line).

COST: \$137,000



BV-120

LOCATION:

#415 Layang Rd

MITIGATION TYPE:

Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT:

A catch basin discharges to a swale which outlets to a private property(#415 Layang Rd) which gets flooded.

RECOMMENDED
IMPROVEMENTS

To prevent further ponding at this site, a 200 linear foot infiltration trench should be placed at the outlet of the swale located adjacent to 415 Layang Rd.

COST:

\$19,600



BV-121

LOCATION: Leon Guerrero & Layang Rd

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: A house gets flooded and as a temporary solution a berm was built to prevent flooding. Across the street, a wetland is located. To prevent flooding of the house, an Infiltration trench should be built parallel to the berm.

RECOMMENDED IMPROVEMENTS To prevent further flooding, two 200' long infiltration trenches (one on each side of the crowned street) are recommended.

COST: \$39,100



BV-122

LOCATION:

Leon Guerrero

MITIGATION TYPE:

Erosion Control / Treatment BMP Improvements

SITE ASSESSMENT:

At the end of Leon Guerrero St, an infiltration basin exists. A side of the basin has been eroded and the basin fence has collapsed - need to stabilize erosion with rip-rap.

RECOMMENDED IMPROVEMENTS

To prevent further erosion and damage to the existing infiltration basin, rip rap stabilization of approximately 1000 SF is recommended along the embankment where erosion is occurring.

COST:

\$141,000



BV-124

LOCATION:

Ungaguan Place

MITIGATION TYPE:

Conveyance Improvements

SITE ASSESSMENT:

Existing concrete lined channel needs to be re-built to keep area from flooding - the existing channel was damaged and, since sections have collapsed, is not functioning properly.

RECOMMENDED IMPROVEMENTS

To prevent further flooding of the roadway, the existing rectangular concrete lined channel at this site needs to be re-built. Recommend replacement of entire channel estimated at 10' width and 5' height for a distance of 200 linear feet.

COST:

\$79,800



BV-125

LOCATION: Captain Reyes & Ungaguan Place

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: At the intersection of Captain Reyes Way and Ungaguan Place runoff from the street is collected by a catch basin located on the private property. Runoff from this catch basin is routed to a low area behind the property, need to work on doing a land exchange in order to use that low area as a infiltration basin. Area needs significant erosion control and debris removal.

RECOMMENDED IMPROVEMENTS Recommend making existing low area into permanent infiltration basin (will require ROW through possibly a land exchange) and improve site through 1/4 acre debris removal and applying site with hydroseed and bonded fiber matrix where erosion is occurring (approximately 10,000 sq ft).

COST: \$112,000



BV-126

LOCATION:

Captain Reyes

MITIGATION TYPE:

Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT:

Along the middle of Captain Reyes Way on both sides of the street, flooding exists. On the east side of the road there are existing infiltration trenches that are not working properly. Need to build new infiltration trenches along both sides of the street.

RECOMMENDED IMPROVEMENTS

To prevent further flooding, two new 200' long infiltration trenches (one on each side of the crowned street) are recommended.

COST:

\$19,600



BV-127

LOCATION: Canada Toto Loop Rd & Dodo St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: An infiltration gallery is located where a baseball field used to be, but is not working properly and is causing flooding. New infiltration gallery needs to be built, and needs to be maintained in order to function properly.

RECOMMENDED IMPROVEMENTS To prevent further flooding, two new 200' long infiltration trenches (one on each side of the crowned street) are recommended to replace existing infiltration trench located at baseball field.

COST: \$39,100



BV-128

LOCATION: Lujan Way

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Two Concrete channels along Lujan Way need debris and vegetation removal. There is erosion around headwalls and side of channel embankment, they need erosion control(riprap).

RECOMMENDED IMPROVEMENTS To prevent further erosion and possible damage to the existing headwalls and channel embankment, 1/4 acre of debris removal followed by rip rap channel stabilization around headwalls and at top of concrete channel (estimated at approximately 1000 SF of rip rap) is recommended.

COST: \$143,000



BV-129

LOCATION:

Canada Toto Loop Rd

MITIGATION TYPE:

Conveyance Improvements

SITE ASSESSMENT:

A cross culvert located at the low point of Canada Toto Loop Rd is undersized for the amount of runoff that is routing. Cross culvert needs to be upsized.

RECOMMENDED IMPROVEMENTS

The culvert located at the low point of Canada Toto Loop Rd needs to be upsized to a 36" RCP for 100 linear feet.

COST:

\$122,000



BV-130

LOCATION: RT 8 & San Vicente Dr

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Two catch basins on Route 8, just west of San Vicente Dr get clogged often and Route 8 gets flooded. One of the catch basins is in the center of one lane, and probably not capturing runoff. Need to cap the catch basin located in the middle of the lane, and need to add an additional catch basins along the shoulder of the roadway to capture more runoff and prevent flooding of the roadway.

RECOMMENDED IMPROVEMENTS There are two catch basins on Route 8 that often become clogged causing Route 8 to become flooded. Two new catch basins to capture runoff need to be placed along the shoulder of the roadway and the existing catch basin located in the middle of the roadway needs to be capped. A quarter acre of debris removal is also needed. 100'x 24" RCP connecting to the newly placed catch basins is also required. The outlet should be equipped with a headwall/wingwall structure outleting flow to a 100 square foot rip rap energy dissipator.

COST: \$142,000



BV-131

LOCATION: RT 8 & 1000' West of RT 16

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: This area of Route 8 floods, there are no drainage system visible along this stretch of the roadway. Need to add a drainage conveyance system and route runoff to the airport.

RECOMMENDED IMPROVEMENTS Route 8 at this site floods. Two new catch basins need to be placed along Rte 8 (approximately 1000 feet west of Rte 16) at the road's low point to intercept and route runoff through a new 24" RCP for 100 linear feet, conveying flow to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator outleting toward the airport.

COST: \$137,000



BV-132

LOCATION: San Roque Drive

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: There is flooding of the street, created by the raised driveway at 196 San Roque DR. Because of this the Santos family property gets flooded. Need to add a drainage conveyance system to prevent water from ponding and flooding private property.

RECOMMENDED IMPROVEMENTS To prevent further flooding, two 200' long infiltration trenches (one on each side of the crowned street) are recommended at this site along San Roque Drive.

COST: \$39,100



BV-133

LOCATION:

As Chena Place

MITIGATION TYPE:

Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT:

An existing infiltration trench is not working properly and also may not be enough to take care of the street runoff. A property gets flooded. Should extend length of infiltration trench and also maintain trench.

RECOMMENDED IMPROVEMENTS

Recommend placement of a 200 linear foot infiltration trench adjacent to the existing infiltration trench along with maintenance of the existing infiltration trench to enable proper infiltration.

COST:

\$19,600



BV-134

LOCATION: RT 16 & South Sabana

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Northeast corner of interchange shows signs of ponding. There may be enough right of way to place an infiltration trench to take care of runoff.

RECOMMENDED IMPROVEMENTS To prevent further ponding at this site, a 200 linear foot infiltration trench should be placed along the edge of pavement at the NE corner of the intersection of Rte 16 and S Sabana.

COST: \$19,600



BV-136

LOCATION: RT 16 & Pedang St

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Along the east side of Rt16 a series of graded ditches and 24" RCP culverts collect and route runoff generated along Rt16. There are signs of flooding along the road shoulder, ditches and culverts need to be upsized.

RECOMMENDED IMPROVEMENTS Recommend improvements to the storm drain system located along the east side of Rte 16 at Pedang Street including replacement of 24" culverts with 36" RCP culverts equipped with upstream and downstream wingwall/headwall structures (estimated culvert length = 100 LF and number of wingwall/headwall structures=4), and improvement of existing ditches located between culvert structures (approximately 200 LF of ditch along the Rte 16 edge of pavement).

COST: \$192,000



BV-137

LOCATION: RT 10 & RT 8

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At the southeast corner of Rt10 and Rt8 intersection there are signs of ponding(76 Gas Station) and the ponding continues south along Rt10 east side. Need to add a drainage conveyance system added along Rt10 and route it to the existing infiltration basin located next to Rt10.

RECOMMENDED IMPROVEMENTS To prevent roadway flooding, two catch basins need to be placed along the east side of Rte 10, south of Rte 8, routing flow to the existing infiltration basin located south of the 76 gas station. The catch basins will connect to a 24" RCP for 100 linear feet, routing the runoff to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator located at the infiltration basin.

COST: \$137,000



BV-138

LOCATION: RT 8 & Church of Jesus Christ of Latter Day Saints

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: A storm drain Manhole cover in the middle of Rt8 pops out open when it rains.

RECOMMENDED IMPROVEMENTS Recommend upsizing Rte 8 storm drain system in vicinity of manhole (assume 100 LF of 36" RCP to replace existing storm drain in area).

COST: \$122,000



BV-139

LOCATION: RT 8 & RT 33

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At the interchange of Rt8 and Rt33 some of the runoff flows towards the southeast corner where this area functions as an infiltration basin. Need to add spillways along the edge of pavement to prevent ponding or re-grade area to prevent ponding.

RECOMMENDED IMPROVEMENTS To prevent further ponding at this site, one AC spillway, a 100 linear foot ditch that outlets flow through a 100 square foot rip rap energy dissipator is needed.

COST: \$20,700



BV-140

LOCATION: Punzalan St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Along Punzalan St above Rt1 needs to add percolation basins to minimize the amount of runoff that flows down to Rt1 near Pizza Hut.

RECOMMENDED IMPROVEMENTS Recommend placement of a 200'x200' infiltration basin along Punzalan Street to minimize runoff that flows downstream to Tamuning Drainageway.

COST: \$342,000

CHALAN PAGO VILLAGE



CP-101

LOCATION: Chalan Famha & Leo Palace

MITIGATION TYPE: Erosion Control/ Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Bridge leading to Cruz residence needs guardrail. Debris from channel along road causes flooding, this channel is tributary to Chaot river. Road is eroded is not paved, need right-of-way to add drainage conveyance systems along road.

RECOMMENDED IMPROVEMENTS Recommend storm drain system along Leo Place at Ch Famha, routing flow to channel adjacent to Ch Famha. Recommend swale along Leo Palace (400 LF total) routing flow to double 24" RCP. The double 24" RCP should be equipped with headwall/ wingwall structures (upstream and downstream) and convey the flow for approximately 500 LF to channel adjacent to Ch Famha. Channel will require 1/4 acre debris removal and 200 sq feet of rip rap placed at the pipeline outlet for erosion control.

COST: \$555,000



CP-102

LOCATION: Victoriano Road & Dero Road

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At the end of Victoriano Road, three homes probably get flooded. Need to add swale to carry the flow along the road to the end of the road.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Victoriano Road with a ditch on both sides (200' on each side) of the street routing flow to grated catch basins placed on both sides of street at the street's low point. The two catch basins will connect to a 24" RCP for 100 linear feet conveying flow to the end of the road, outleting through a headwall/wingwall structure to a 100 square foot rip rap energy dissipator.

COST: \$140,000



CP-103

LOCATION: Ramirez Drive & Judge Sablan St

MITIGATION TYPE: Storm Drain Improvements / Conveyance Improvements

SITE ASSESSMENT: A culvert from the school was discharging to a private property, the property has been raised and the culvert outlet clogged. Add a junction structure at the end of the culvert and route the flow with culvert along the north of Ramirez Dr to the intersection with Judge Sablan St where an existing cross culvert is located.

RECOMMENDED IMPROVEMENTS Recommend storm drain improvements at Ramirez Drive including placement of 400 LF of ditch placed along the north of Ramirez Drive with placement of two catch basins (one at Judge Sablan Street cross-culvert and one connecting to culvert located along the school (where the culvert has been plugged), connected by 500' of 24" RCP. Also, place 1 headwall/wingwall structure and 100 SF rip rap at the existing school culvert inlet to control erosion that was observed at the upstream side of the culvert.

COST: \$517,000



CP-104

LOCATION: Dero Rd & RT 4

MITIGATION TYPE: Storm Drain Improvements Storm Drain Maintenance

SITE ASSESSMENT: This intersection gets flooded, need to add drainage conveyance systems.

RECOMMENDED IMPROVEMENTS The intersection of Dero Road and Route 4 gets flooded. This site needs a drainage conveyance system. A quarter acre of debris needs to be removed, 2 catch basins should be place at the street's low points to capture flow that will travel through a 24" RCP for 100 linear feet, leading to one headwall/wingwall structure, outleting through a 100 square foot rip rap to a 400 linear foot ditch.

COST: \$142,000



CP-105

LOCATION: Gogue Drive

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: This street is located in the flooding zone, and homes get flooded. There is no drainage conveyance systems. Need to build drainage conveyance systems to route flow to Chaot river.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system in Gogue Drive to intercept and convey flow to Chaot river. Place ditches along both sides of the crowned road (200 LF each side) conveying flow to two grated catch basins located at the low point in the road, connecting 600 linear feet of 24"/ 36" pipeline. The new pipeline should route flow to a headwall/wingwall structure outleting to a 100 square foot rip rap energy dissipator at the Chaot River.

COST: \$765,000



CP-106

LOCATION: Chalan Totot & RT 4

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At low point of Chalan Totot Street, the private owner built a berm to keep flow on the street. Runoff from Rt4 flows to this street. Water continues to flood this property and the property behind along Nakie St. Need to add a drainage conveyance system to collect runoff at low point and route it through these two private properties toward Nakie Street where an existing drainage conveyance system exists. Need to acquire an easement for the conveyance drainage system.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Chalon Totot St with a ditch on both sides (200' on each side) of the street routing flow to grated catch basins placed on both sides of street at the street's low point. The two catch basins will connect to a 24" RCP for 100 linear feet and a 36" RCP for 500 linear feet, placed along the right of way between 2 properties (may require easement if one does not exist already) conveying flow to Nakie Street. Along Nakie, the pipe will connect to an existing ditch via an outlet equipped with a headwall/wingwall structure and a 100 square foot rip rap energy dissipator.

COST: \$765,000



CP-107

LOCATION: Nakie St & RT 4

MITIGATION TYPE: Conveyance Improvements/ Storm Drain Improvements

SITE ASSESSMENT: At the low point of this street a private property floods, flow from Rt4 also flows to this area. The property has a 36" Cross culvert at the north side of the property. This cross culvert carries flow to an earthen channel along Nakie St which eventually discharges to Apusento Garden development.

RECOMMENDED IMPROVEMENTS Recommend improvement of the storm drain system along Nakie Street including placement of ditches (approximately 50-ft each) on both sides of the street to intercept and convey roadway runoff to 2 grated catch basins located at the street's low point (on both sides of the street). The catch basins should connect to a new, 100'x 36" RCP storm drain placed in the street that outlets to a concrete channel located at the downstream side of the existing 36" RCP culvert. The channel will route the flow along Nakie to an existing channel located immediately upstream of the Apusento Garden Development. 100 SF of rip rap should be placed at the outlet to the existing channel (which runs perpendicular to Nakie Street).

COST: \$154,000



CP-108

LOCATION: Chalan Apusento & Maimai St

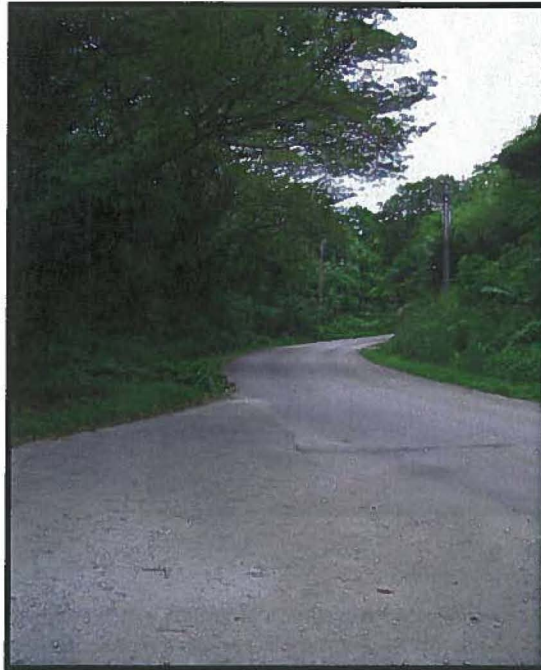
MITIGATION TYPE: Conveyance Improvements/ Storm Drain Improvements

SITE ASSESSMENT: Apusento Garden development is blocking the natural flow from the Nakie St drainage system. Within the complex, a drainage system needs to be built to carry the runoff from Nakie to discharge to Rt 15.

RECOMMENDED IMPROVEMENTS

The natural flow from the Nakie Street drainage system is being blocked by the Apusento Garden development slightly downstream of the existing channel outlet for the Nakie Street drainage system (see CP-107). A drainage system needs to be built to carry the runoff from Nakie to a discharge point at Route 15. Recommend the following improvements to the drainage conveyance system at Apusento Garden Development: 1) placement of a 100 linear foot concrete channel routing runoff from Nakie Street to a 48" RCP (equipped with headwall/ wingwall structure) located at the upper limits of the Apusento Garden Development, 2) placement of 500'x 48" RCP storm drain system along edge of right of way for Apusento Garden Development (may require easement) routing flow to Rte 15 and across Rte 15 to natural flow path, 3) placement of 2 catch basins connecting to proposed 48" pipeline crossing Rte 15 approximately at the entrance to the Apusento Garden Development, 4) placement of 50' ditch routing flow along Rte 15 to proposed grated catch basins, and 5) placement of 100-SF rip rap energy dissipator at outlet of 48-inch pipeline.

COST: \$682,000



CP-109

LOCATION: Kongga Rd

MITIGATION TYPE: Storm Drain Improvements Storm Drain Maintenance

SITE ASSESSMENT: Along this road there is no drainage conveyance system, the natural flow is from west to east and the road gets flooded. Debris issues. No homes in the proximity of the road.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system in Kongga Rd to stop roadway flooding. Place ditches along both sides of the crowned road (200 LF each side) conveying flow to two grated catch basins located at the low point in the road, connecting to 100 linear feet of 24" pipeline. The new pipeline should route flow to a headwall/wingwall structure outleting to a 100 square foot rip rap energy dissipator. One quarter ac debris removal is also necessary.

COST: \$142,000



CP-110

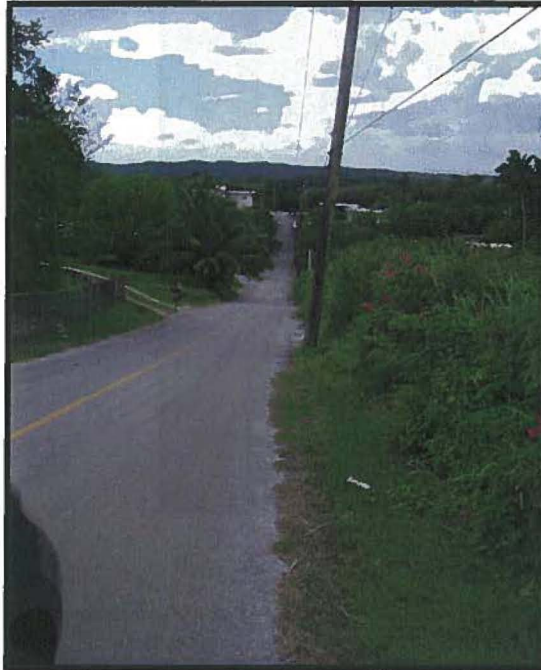
LOCATION: Chalan Okso & Santa Cruz Dr

MITIGATION TYPE: Storm Drain Improvements/ Storm Drain Maintenance

SITE ASSESSMENT: Along this road there is no drainage conveyance system, at the intersection with Juan M. Bernardo Ct a cross culvert is needed to prevent flooding of a property along Chalan Okso. Runoff needs to be routed to a tributary to Pago river to the east of Chalan Okso. Debris Removal Required.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Ch Okso with a ditch on both sides (200' on each side) of the street routing flow to grated catch basins located at Juan Bernardo Court. The two catch basins will connect to a 24" RCP for 100 linear feet, equipped with headwall/wingwall structure at the outlet to a new 100' conc channel conveying flow to a tributary of Pago River, outleting through a 100 square foot rip rap energy dissipator. A quarter acre of debris removal is also needed.

COST: \$196,000



CP-111

LOCATION: Manibusan Lane & Santa Cruz Dr

MITIGATION TYPE: Storm Drain Improvements Storm Drain Maintenance

SITE ASSESSMENT: Runoff from road cascades into private properties. Need to add curb road and add catch basins. Sections of the road pavement is failing, probably from runoff undermining.

RECOMMENDED IMPROVEMENTS Recommend improvements to the storm drain system in Manibusan Lane including placement of ditches along both sides of the crowned road (200 LF each side) conveying flow to two grated catch basins located at the low point in the road, connecting to a 24" RCP for 100 linear feet. The new pipeline should route flow to a headwall/wingwall structure outleting to a 100 square foot rip rap energy dissipator.

COST: \$142,000



CP-112

LOCATION: Chalan Chirik & RT 10

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Runoff from Rt10 floods three properties along Chalan Chirik. Need to add conveyance systems along Rt10 to prevent runoff from entering Chalan Chirik. Place Infiltration trenches along Rt10.

RECOMMENDED IMPROVEMENTS Three properties flood along Chalan Chirik due to the runoff from Route 10. A drainage conveyance system along route 10 to prevent runoff from entering Chalan Chirik is needed. Recommend 400 ft ditch placed upgradient of Chalan Chirik (to capture roadway runoff), placement of two grated catch basins (one at end of ditch and one immediately downgradient of Chalan Chirik along Rte 10). Connect via a 24" RCP for 100 linear feet and outlet to a headwall/wingwall structure and 100 square foot rip rap energy dissipator. A quarter acre of debris removal will be needed.

COST: \$140,000



CP-114

LOCATION: Chalan Nganga & Leo Palace

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Existing Cross culvert under road, unknown size. Need Gabions on both sides of cross culvert to stabilize embankment, need to removal debris/vegetation, and also upsize existing cross culvert.

RECOMMENDED IMPROVEMENTS Recommend replacement of existing culvert with 100'x 5'x5' RCB, a quarter acre of debris removal (upstream and downstream), placement of 1,000 square feet of gabions along embankments upstream and downstream of culvert for a distance of 50-ft (approximately 5' high), placement of rip rap at base of gabions (400 square feet total), and placement of headwall/wingwall structures at both ends of culvert.

COST: \$602,000



CP-115

LOCATION: Chalan Famha

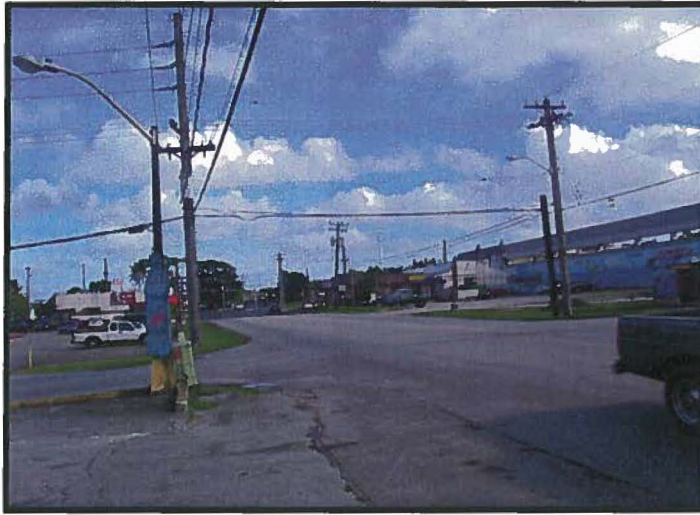
MITIGATION TYPE: Conveyance Improvements

SITE ASSESSMENT: On a street off Chalan Famha, existing 2-18" PVC cross culverts that were outleting to a low area were plugged. The property has been developed and the ground raised, now an adjacent property floods. The 2-18" PVC culverts should be replaced with 2-24" RCP or an RCB. Need to get an easement through private property to route these pipes to the existing earthen channel behind the property where all the runoff used to naturally flow.

RECOMMENDED IMPROVEMENTS Recommend replacement of existing culvert with 100'x 2-24" RCP equipped with upstream and downstream headwall/wingwall structures, outleting to a new concrete channel, 100-feet long, routing flow along the right-of way of 2 properties (may require easement) to the natural flow path located at the back of the property. A 100 SF rip rap energy dissipator should be placed at the outlet of the channel.

COST: \$555,000

DEDEDO VILLAGE



DE-101

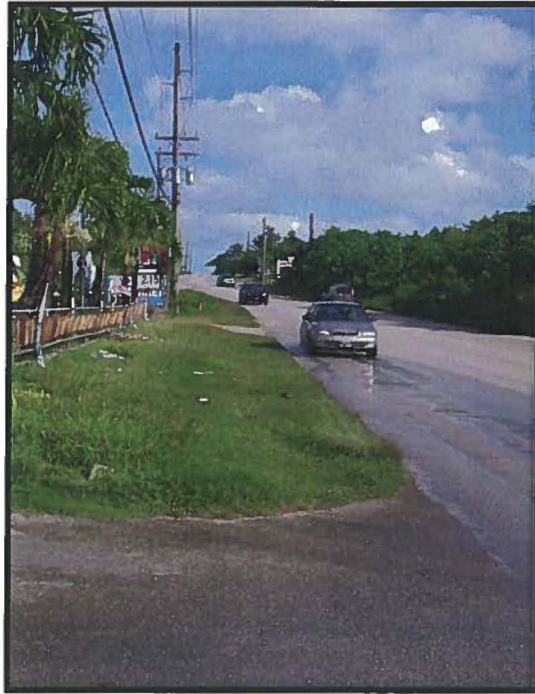
LOCATION: RT 26 & RT 1

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Runoff from Route 1 creates flooding along Route 26. There is a low point along Route 26 and cross W. Ligan street where two inlets are located. The flooding extends to Winchells donuts, possible 5-9 properties get flooded. Possible solution is to capture the flow generated on Route 1 before it flows into Route 26.

RECOMMENDED IMPROVEMENTS To prevent further flooding along Route 26 at the low point, two catch basins are proposed along Rte 1 and 2 additional catch basins are proposed at the low point in Rte 26. The catch basins along Rte 26 should be routed to the system at Rte 1, connecting to the system with approximately 200 LF of 24" RCP and two manholes. Ditches are also proposed along Rte 26 to route the pavement flow to the catch basins at the low point (approximately 400 LF total).

COST: \$225,000



DE-102

LOCATION: RT 26 & Magof Rd

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: This is a low point along Route 26, where ponding is created and possibly flooding one commercial property. There are no existing drainage systems at this location. Possible solution will be to add a drainage system that can route the flow to an existing infiltration basin near by.

RECOMMENDED IMPROVEMENTS To prevent further ponding and possible flooding of one commercial property at the low point of this site, two catch basins connecting to a 24" RCP for 100 linear feet leading to one headwall/wingwall structure outleting flow to a 100 square foot rip rap energy dissipator is needed at this site to improve the storm drain system.

COST: \$137,000



DE-103

LOCATION: Salisbury St

MITIGATION TYPE: Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: An existing concrete lined ditch discharges to a pipe with a trash rack. This pipe connects to a drainage system along Salisbury St. The channel is covered with trash and debris, which clogs the pipe and creating flooding for two adjacent homes. Trash and debris is a constant problem, as long as the pipe is clogged the homes will continue to get flooded.

RECOMMENDED IMPROVEMENTS Recommend the following improvements to the existing storm drain system at the site: 1) remove a quarter acre of debris, 2) remove box culvert at site and extend existing channel to edge of Salisbury Street (this will improve maintainability) which will require approximately 100-feet of open concrete trapezoidal channel, and 3) connect to 2 new catch basin structures at Salisbury that connect to existing culvert in street.

COST: \$23,500



DE-104

LOCATION: Loreta St & E. Sta Barbara Ave

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At the intersection of these two streets, three infiltration trenches exist. These trenches are not sufficient to take care of all runoff and ponding is created, thus flooding one commercial property and three residential. An existing infiltration basin exists along E. Sta Barbara Ave, about 100 feet away from intersection. A possible solution is to add a drainage system and discharge to the existing infiltration basin.

RECOMMENDED IMPROVEMENTS Recommend the addition of a storm drain system along Loreta Street including 2 catch basins connecting to a 24" RCP for 200 linear feet outletting to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator located at the existing infiltration basin at E Santa Barbara Ave.

COST: \$232,000



DE-105

LOCATION: Redondo Luchan & W. Sta Barbara Ave

MITIGATION TYPE: Storm Drain Maintenance

SITE ASSESSMENT: An existing grated inlet gets clogged with debris, and this causes flooding of about three to four private properties in the area. A possible solution is to add a debris/trash rack that will take care of debris/trash and thus solve the flooding issue.

RECOMMENDED IMPROVEMENTS Maintenance to the storm drain system at this site is needed to prevent further flooding of private properties in the area. 1,000 square feet of debris removal is needed to unclog the existing grated inlet, a 100 square foot apron and 1-ft high trash rack should be placed around the inlet to prevent further clogging.

COST: \$5,670



DE-106

LOCATION: RT 1 & RT 27

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Maintenance

SITE ASSESSMENT: An existing infiltration basin exist south from Route 1 and east of Route 27. Water is not infiltrating anymore, the basin needs to be dredged and all vegetation cleared. This situation creates major flooding around the perimeter of this basin, which in this area is mainly commercial properties.

RECOMMENDED IMPROVEMENTS To prevent the continuation of major flooding around the perimeter of this basin, recommend roadway storm drain improvements along with improvements to the existing infiltration basin. Storm drain improvements include placement of two catch basins connecting to approximately 100 linear feet of 24" RCP that will convey the street runoff along Rte 27 and along the roadway south of the infiltration basin to the infiltration basin. Recommend the outlet to the infiltration basin be equipped with one headwall/wingwall structure and a 100 square foot rip rap energy dissipator. Improvements to the existing basin (which has been silted up and has limited infiltration capacity because of it) include dredging the bottom of the basin (approximately 4000 CY of sediment removal) along with approximately one acre of debris removal.

COST: \$326,000



DE-107

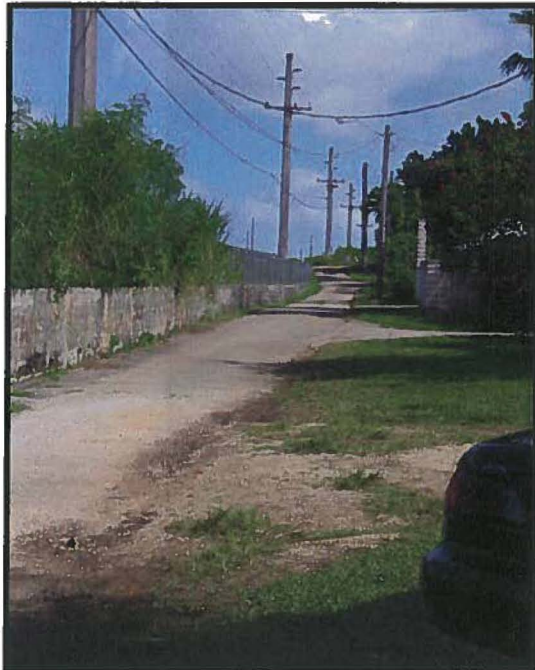
LOCATION: RT 27A

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: At this location there is a low point on Route 27A , where the roadway runoff is discharged to the south to a private property. No apparent flooding or ponding occurs. There is an existing infiltration basin on the north side of this location. In order to route the runoff to the infiltration basin, a drainage system needs to be built.

RECOMMENDED IMPROVEMENTS There is a low point on Route 27A where the runoff is discharged to the south of a private property. There are no signs of flooding or ponding, however improvements to the current storm drain system are needed. The runoff needs to be re-routed to the infiltration basin located on the north side of this property. Two catch basins need to be placed at the low points on the street, connecting to a 24" RCP, outleting to a headwall/wingwall structure with a downstream 100 square foot rip rap energy dissipator located at the infiltration basin.

COST: \$137,000



DE-108

LOCATION:

RT 3

MITIGATION TYPE:

Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT:

Runoff from Route 3 roadway flows offsite to the adjacent properties on the east side. Where the low point is located and ponding occurs thus flooding two properties. One of these properties home is already abandon due to flooding. A solution will be to have an infiltration basin where this house is located.

RECOMMENDED IMPROVEMENTS

To prevent further ponding and property flooding, a new infiltration basin is needed at the location of the abandoned house or adjacent to the house within public right of way (though some right of way will most likely be required). A 200'x200' infiltration basin is proposed at this location as an outlet for a storm drain system along Rte 3 including two catch basins connecting to a 24" RCP for 100 linear feet, outleting to a 100 square foot rip rap energy dissipator at the infiltration basin.

COST:

\$462,000



DE-109

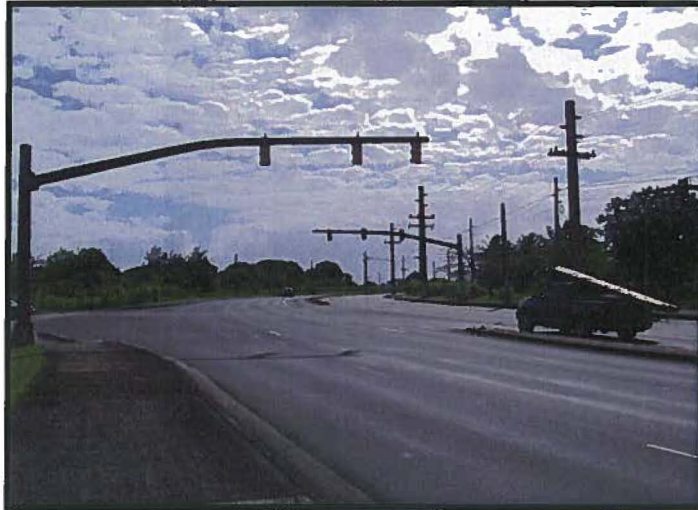
LOCATION: Ukudo St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Here, a low point is located along this street where ponding is created - flooding two properties. Within this low area, the lowest point is located at the corner of one of the properties where possibly two injection wells could be built to take care of the flooding. There is an existing fuel line easement within the street.

RECOMMENDED IMPROVEMENTS Recommend placement of a 100' x 100' infiltration basin with 3 injection wells for outleting flow generated along Ukudo Street. The infiltration basin can be placed within public right of way. Recommend placement of bioswales adjacent to the road to pre-treat runoff prior to outleting to injection wells/ infiltration basin (200 linear ft total). Bioswale will outlet to proposed infiltration basin through small 24" culvert (approximately 10-ft in length equipped with headwall upstream and downstream) and outleting to infiltration basin through a 100 square foot rip rap energy dissipator.

COST: \$666,000



DE-110

LOCATION: RT 3 & RT 1

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Low points along Rt3 on both sides of the road. Need to add catch basins and connect to Rt1 existing drainage system. There is an existing catch basin at RT1 where Rt3 connects to Rt1.

RECOMMENDED IMPROVEMENTS Low points are located on both sides of the road along Route 3. Recommend placement of a storm drain system along Rte 3 that will connect to existing storm drain system along Rte 1. Storm drain system will include two catch basins connecting to 100 linear ft of 24" RCP conveying flow to a new manhole connecting to the Rte 1 drainage system. Roadside ditches should be placed upstream of each catch basin (approximately 100 LF in length each).

COST: \$112,000



DE-111

LOCATION: RT 27A & RT 1

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: There are signs of ponding at the south corner of Rt1 and Rt27A intersection, there is a Mobil Gas station at that location. At the west corner of the intersection there is an curb catch basin, and two more west along Rt27A. Solution for the ponding is to add a catch basin and pipe and routed across to the catch basin in the corner.

RECOMMENDED IMPROVEMENTS To avoid further ponding at the intersection of Route 1 and Route 27A, recommend placing one catch basin at the southeast corner of the intersection, connecting to a 24" RCP for 100 linear feet, connecting to the existing storm drain system located across the street via a manhole structure.

COST: \$105,000



DE-112

LOCATION: RT 27A & RT 28

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: Intersection of Route 27A and Route 28 floods on all four corners. There is only one catch basin in the west corner. Need to re-grade corners and add catch basins to other three corners and connect to existing inlet. Or place cross gutter and route the flow to the existing catch basin.

RECOMMENDED IMPROVEMENTS Recommend improvements to the storm drain system at this intersection including placement of 4 catch basins connecting to a 24" RCP for 100 linear feet, routing flow to an outlet equipped with a headwall/wingwall structure and a 100 square foot rip rap energy dissipator.

COST: \$222,000



DE-113

LOCATION: Buena Vista Ave & Y-Seng Song Rd(RT 28)

MITIGATION TYPE: Storm Drain Improvements/ Storm Drain Maintenance

SITE ASSESSMENT: There is an existing Infiltration Basin at the north West Intersection of Route 28 and Route 1, it needs maintenance(vegetation clearance), runoff from both route discharge directly to the basin but due to overgrown vegetation runoff is ponding on street. West from Route 28 along Buena Vista Ave an existing catch basin at the low point of the street is on the sidewalk, should be on street and an additional catch basin added.

RECOMMENDED IMPROVEMENTS Recommend 1/4 acre debris removal at the infiltration basin located at the north west corner at Route 28 and Route 1. Also recommend improvements to the storm drain system along Buena Vista Ave which will require two new catch basins connecting to a 24" RCP for 100 linear feet, outleting to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator located at the infiltration basin. Roadside ditches will be required to convey flow to the new catch basins (estimated at approximately 400 LF in total length).

COST: \$142,000



DE-114

LOCATION: RT 26 & Lily St(RT 25)

MITIGATION TYPE: Storm Drain Improvements/ Storm Drain Maintenance

SITE ASSESSMENT: This intersection possibly floods. Along Rt26 on the southwest of the intersection a concrete lined channel routes runoff from Rt26 from the south and ends at the intersection where possibly an inlet exists but is not visible under a pile of debris. The property across the street at the northwest corner of the intersection could be possible an existing infiltration basin, overgrown vegetation in that property makes it hard to verify. A double 18" RCP cross culverts discharge to the possible infiltration basin location, these cross culverts run under Rt26 and carry flow from the northeast corner of the intersection. A solution will be to clear vegetation in the possible infiltration basin, add catch basins along the north west corner along Route 26 and clear debris from existing concrete lined channel.

RECOMMENDED IMPROVEMENTS To prevent further flooding at this site, debris first needs to be removed from the existing concrete lined channel and infiltration basin. A quarter acre of debris will need to be removed. A new storm drain system including two catch basins will need to be added at the northwest corner of Rte 26 and Rte 25, connecting to a 24" RCP (for approximately 100 linear feet). This system should route flow to the infiltration basin through a headwall/wingwall structure and a 100 square foot rip rap energy dissipator.

COST: \$139,000



DE-115

LOCATION: RT 9 & RT 3a

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At the intersection of Route 9 and Route 3a, there is a low point along Rt3a. There is no existing drainage conveyance systems, need to add a conveyance to prevent flooding of area.

RECOMMENDED IMPROVEMENTS Recommend a drainage conveyance system along Rte 3a at the intersection with Rte 9. Recommend placement of 2 catch basins located at the low point along Route 3a, connecting to a 24" RCP for 100 linear feet outleting into a 100 square foot rip rap energy dissipator equipped with an upstream headwall/wingwall structure and finally to a 200 LF bioswale (or infiltration trench) located adjacent to the road.

COST: \$169,000



DE-116

LOCATION:

Chalan Kareta & RT 3

MITIGATION TYPE:

Storm Drain Improvements/ Conveyance Maintenance

SITE ASSESSMENT:

At the northwest intersection of Chalan Kareta and Rt3 there are signs of flooding. A 10'x5' RCB runs under Kareta, and is clogged about 50% and does not seem to have zero longitudinal slope. RCB needs to be cleared of debris and entrance and exit of cross RCRB needs to be grated to prevent clogging of RCB.

RECOMMENDED IMPROVEMENTS

Recommend the following improvements to the existing conveyance structure: 1) remove a quarter acre of debris and sediment from culvert and upstream and downstream channels, 2) Add two headwall/wingwall structures on the upstream and downstream side of the culvert, 3) add a 100 sq ft rip rap pad upstream and downstream of the culvert headwall/wingwall structures, and 4) add a trash rack at the inlet and outlet side of the culvert.

COST:

\$70,900



DE-117

LOCATION: RT 3 & Bullard Ave

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: The intersection of Rt3 and Bullard Ave is a low point area. There is no drainage conveyance system. Need to add a drainage conveyance system to prevent flooding. Need to add three catch basins, two at Boullard low points and one along Rt3 south side where another low point is located(Shell entrance).

RECOMMENDED IMPROVEMENTS

Recommend placement of a new storm drain system along Bullard Ave and Rte 3 consisting of two new grated catch basins along Bullard at the low point (both sides of the crowned road) and one located at Rte 3 (south side adjacent to the Shell entrance where another low point exists). The three catch basins should connect to a 24" storm drain (approximately 150 ft in length) routing flow to a 200-ft bioswale (or infiltration trench) located along Rte 3. The 24" storm drain outlet to the bioswale should consist of a headwall/wingwall structure and a 100 SF rip rap energy dissipator.

COST: \$222,000



DE-118

LOCATION: RT 3 & RT 28

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Ponding at the northeast corner of Rt3 and Rt28. Need to re-grade corner and add an infiltration trench along Rt3 where the runoff can be routed.

RECOMMENDED IMPROVEMENTS Recommend improvements to the storm drain system at the corner of Rte 3 and Rte 28 including two catch basins along Rte 3 connecting to a 24" RCP for 100 linear feet conveying the flow to an outlet structure consisting of a 100 square foot rip rap energy dissipator equipped with an upstream headwall/wingwall structure and a downstream bioswale (100 ft length) or a downstream infiltration trench.

COST: \$174,000



DE-119

LOCATION: RT 3 & Royal Palm Drive

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At the intersection of Rt3 and Royal Palm, ponding occurs. A solution is to build a cross gutter at Royal Palm Drive to continue runoff down Rt3. Another solution is to add a catch basin on Royal Palm Drive and route the flow via a cross culvert under Rt3 to the east where there may be room to build an infiltration trench.

RECOMMENDED IMPROVEMENTS To prevent further ponding at this site, recommend placement of a catch basin on Royal Palm Drive (at the intersection with Rte 3), connecting to 100'x 24" RCP storm drain routing flow under Rte 3 to a 200 LF bioswale (or infiltration trench). The outlet of the storm drain system should consist of a headwall/wingwall structure with a downstream energy dissipator (100 sq ft rip rap pad).

COST: \$68,800



DE-120

LOCATION: RT 3 & Control Tree Drive

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Runoff from Rt3 is entering Royal Palms. Need to add a drainage conveyance system to capture flow from Rt3. Add a cross gutter to force the flow from Rt3 to continue along Rt3.

RECOMMENDED IMPROVEMENTS A drainage conveyance system needs to be added to this site to capture the flow from Route 3 prior to entering the Royal Palms site. Two catch basins should be placed along Rte 3 on both sides of the entrance to Royal Palms with a concrete cross gutter placed at the entrance to route flow along Rte 3 to the downstream catch basin. The catch basins should connect to a 50"x24" RCP conveying flow along Rte 3 from the upstream catch basin to the downstream catch basin then to another segment of 50"x24" RCP routing flow to a bioswale (or infiltration trench) located along the edge of Rte 3.

COST: \$147,000

HAGATNA VILLAGE



HA-101

LOCATION:

RT 4 & RT 1

MITIGATION TYPE:

Erosion Control

SITE ASSESSMENT:

A RCB outleting into the Hagatna river just south from the Bank of Guam building needs erosion control at the channel embankment(riprap).

**RECOMMENDED
IMPROVEMENTS**

Recommend placement of a 10'x10' rip rap energy dissipator at the outlet of the culvert at Hagatna River for erosion control.

COST:

\$14,100

**HA-102**

LOCATION: RT 4 & RT 7B

MITIGATION TYPE: Conveyance Improvements

SITE ASSESSMENT: A graded channel on the north side of Rt7B, west of Route 4 a channel is covered in silt and has become a percolation pond. The outlet RCB that runs under Rt4 is plugged with sediment, and the property adjacent to channel gets flooded. This cross RCB needs to be resized to accommodate runoff and to prevent sediment accumulation.

RECOMMENDED IMPROVEMENTS To prevent further silt buildup and ponding at this site, recommend replacement of existing cross-culvert under Rte 4 with a 200'x4'x4' RCB equipped with upstream headwall and 100 SF rip rap for channel stabilization.

COST: \$245,000

**HA-103**

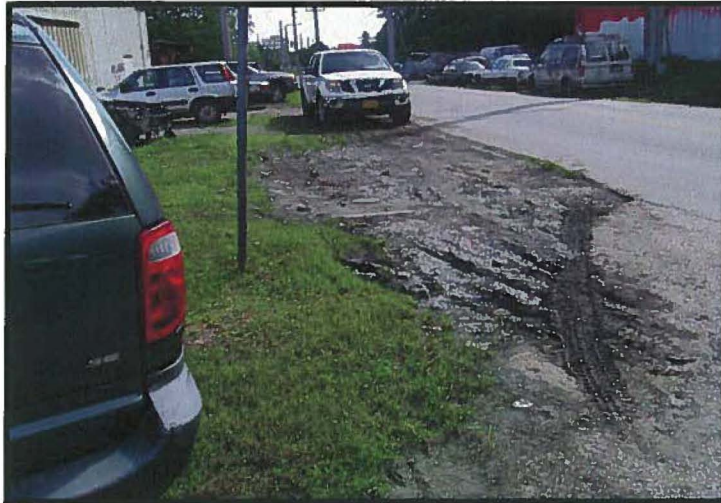
LOCATION: RT 7A & 6th St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At the intersection of Rt7A and 6th Street four catch basins are located that probably discharge to Rt1 drainage systems or to Hagatna river. Dry wells are located on the northeast corner and are not functioning properly during high tide and heavy storms. These dry wells only work with low flows, they are about 150' deep. These drywells are collecting runoff that is contaminating the ground water. Runoff needs to be treated before entering these existing drainage systems.

RECOMMENDED IMPROVEMENTS Recommend storm drain improvements at the intersection of Route 7A and 6th St consisting of 2-100' long bioswales placed adjacent to the roadways, routing surface flow to 2 new catch basins located at the intersection. Note that the 2 bioswales are being proposed since this area is considered a "hotspot". Connect the 2 new catch basins to a new storm drain pipeline in Route 7A routing flow to the Hagatna River via 1000-ft of 30" RCP. There are a total of 6 dry wells which, according to DPW, need to be abandoned and the site.

COST: \$1,240,000



HA-104

LOCATION: RT 7A & Aniceto St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Grated catch basins at the intersection of Rt7A and Aniceto St are silted up with soils that are contaminated and ponding is created. In the proximity there are car maintenance shops that probably discharge contaminants to street. These inlets probably discharge to drainage systems along Rt1. Need remove debris from inlets, and provide a runoff treatment.

RECOMMENDED IMPROVEMENTS Recommend storm drain improvements at the intersection of Route 7A and Aniceto Street consisting of 4-100' long bioswales placed adjacent to the roadways, routing surface flow to 2 existing catch basins located at the intersection (note that both these existing catch basins will need to be unclogged) and to 2 new catch basins located across the street from the existing catch basins. Note that the 4 bioswales are being proposed since this area is considered a "hotspot". Route the 2 new catch basins to the existing storm drain system in Route 7A via 200' of 24" RCP.

COST: \$254,000



HA-105

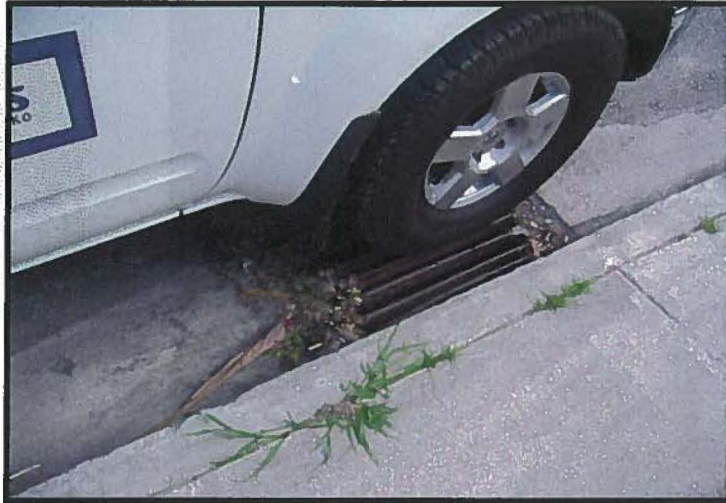
LOCATION: RT 7A & Detention Facility

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Hillside above Rt7A and across from detention facility is being eroded by runoff from an percolation basin above hillside, also this runoff is causing to flood Rt7a and carries debris to the street.

RECOMMENDED IMPROVEMENTS To prevent further hillside erosion above Route 7A across from the detention facility, 1/4 acres of debris removal and rip rap channel stabilization 50 feet upstream and 50 feet downstream of existing culvert is required.

COST: \$143,000



HA-106

LOCATION: RT 7A & O'Brien Drive

MITIGATION TYPE: Storm Drain Improvements

SITE ASSESSMENT: The existing drainage system along Rt7A and across from the detention facility needs to be upsized in order to handle the street and hillside runoff.

RECOMMENDED IMPROVEMENTS The drainage system that currently runs along Route 7A needs to be upsized. Recommend placement of 4,000 linear feet of a 48" RCP outleting to a new headwall/wingwall structure and a 100 square foot energy dissipator.

COST: \$5,100,000



HA-107

LOCATION: RT 7A & Minondo Bridge

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Minondo bridge along Rt7A is being undermined at the approach slabs.

RECOMMENDED IMPROVEMENTS To prevent further undermining at the approach slabs, four new wingwall structures at the abutment are needed and a 400 square foot rip rap energy dissipator is needed.

COST: \$90,300



HA-108

LOCATION: Chalan Santo Papa Juan Pablo Dos & Agana River Bridge

MITIGATION TYPE: Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Bridge over Hagatna river along Chalan Santo Papa Juan Pablo Dos. The bridge embankment needs maintenance and vegetation clearing. Runoff from the street goes through private properties, need to add drainage conveyance system to capture runoff before enters the private properties.

RECOMMENDED IMPROVEMENTS Recommend placement of a drainage conveyance system along Ch Santo Papa Juan Pablo Dos to capture the runoff (prior to it going through the private properties) and route to Hagatna River including 100'x24" RCP with headwall/wingwall structure. Also recommend one acre of debris removal upstream and downstream of bridge.

COST: \$119,000



HA-109

LOCATION: RT 7 & RT 33

MITIGATION TYPE: Storm Drain Improvement/ Conveyance improvement /Treatment BMP Improvements

SITE ASSESSMENT: An infiltration gallery above Rt7A does not have enough capacity to handle all the runoff that is being routed to the gallery and the excess runoff flows downstream to Rt7A and is eroding hillside and floods Rt7A. Need to upsize the infiltration gallery.

RECOMMENDED IMPROVEMENTS The present infiltration gallery above Route 7A does not have enough capacity to handle all the runoff it receives. Need to expand infiltration basin by 5,000 square feet (50'x100') and add 6 injection wells within the basin.

COST: \$2,360,000

**HA-110**

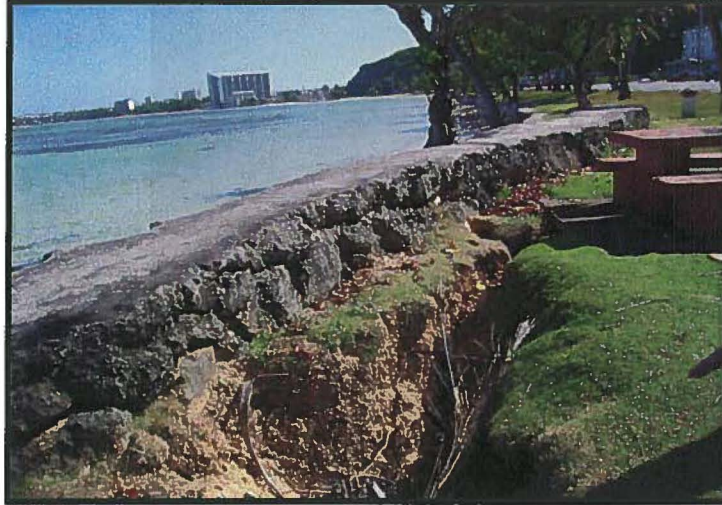
LOCATION: RT 7 & Fonte River

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: A three cell RCB cross culvert under Rt7 routes Fonte River, this cross culvert is undersized and as a result debris and sediment accumulates upstream and the river has eroded the south embankment next to a private property. Need to upsize cross culvert and need to provide erosion stabilization upstream and downstream (riprap) and need to clear debris and overgrown vegetation.

RECOMMENDED IMPROVEMENTS Recommend a quarter acre of debris removal at the site, replacement of the existing culvert with two 200'x9'x4' RCB's under Rte 7, placement of wingwall/headwall structures on upstream and downstream sides of structure and placement of 500 SF of rip rap placed along channel embankments for a distance of 25 ft both upstream and downstream of the culvert.

COST: \$1,180,000



HA-111

LOCATION: RT 1 & East Hagatna Beach

MITIGATION TYPE: Erosion Control/ Coastal Protection

SITE ASSESSMENT: Cross culvert under Rt1 discharging north of East Hagatna Beach. Need erosion control along coastline, and need to modify outlet headwall to a sediment basin structure to prevent sand from clogging outlet.

RECOMMENDED IMPROVEMENTS To prevent further erosion of the shoreline and clogging of the outlet, a new headwall/wingwall structure with 100 square feet of rip rap outlet pad is recommended at downstream side of culvert.

COST: \$31,100



HA-112

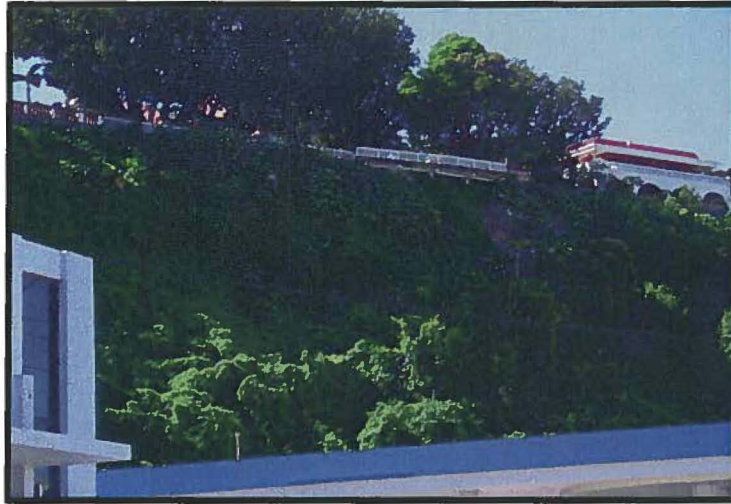
LOCATION: RT 1 & Chen's Furniture

MITIGATION TYPE: Erosion Control/ Conveyance Improvements

SITE ASSESSMENT: Cross culvert RCB under Rt1 discharging to Trinchera Beach. This RCB carries runoff from Rt1 and from Chen's Furniture store proximity and from above cliffs. Need to modify outlet headwall to a sediment basin structure to prevent sand from clogging outlet. Also need to control erosion along coastline with riprap. Behind the furniture store at the toe of the cliffs, a concrete ditch should be built to route all the runoff from the cliffs, and a rock fence or wire mesh added to control debris from cliffs.

RECOMMENDED IMPROVEMENTS Recommend placement of 10,000 square feet of rock blanket placed behind Chen's Furniture Store on east side of Rte 1 for erosion control along the bluffs. Place conc ditch (200 LF) at toe of bluffs to route flow to cross culverts. Place new headwall/wingwall structure at culvert outlet with 100 SF rip rap for stabilization at the RCB outlet.

COST: \$178,000

**HA-113**

LOCATION: RT 1 & Mobil Gas Station

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Cross culvert RCB under Rt1 discharging to Trinchera Beach. This RCB carries runoff from Rt1 and from the Mobil gas station proximity and from above cliffs. Need to modify outlet headwall to a sediment basin structure to prevent sand from clogging outlet. Also need to control erosion along coastline with riprap. At the toe of the cliffs, a concrete ditch should be built to route all the runoff from the cliffs, and a rock fence or wire mesh blanket need to be added to toe of cliffs to control rocks falling.

RECOMMENDED IMPROVEMENTS Recommend placement of 10,000 square feet of rock blanket placed behind Mobil Gas Station on east side of Rte 1 for erosion control along the bluffs. Place conc ditch (200 LF) at toe of bluffs to route flow to cross culverts. Place new headwall/wingwall structure at culvert outlet with 100 SF rip rap for stabilization at the RCB outlet.

COST: \$178,000



HA-115

LOCATION: RT 1 & Citibank

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Cross culvert RCB under Rt1 discharging to East Hagatna Beach. This RCB carries runoff from Rt1 and from the Citibank proximity and from above cliffs. Need to modify outlet headwall to a sediment basin structure to prevent sand from clogging outlet. Also need to control erosion along coastline with riprap. At the toe of the cliffs a concrete ditch should be built to route all the runoff from the cliffs, and a rock fence or wire mesh blanket need to be added to toe of cliffs to control rocks falling.

RECOMMENDED IMPROVEMENTS Recommend placement of 10,000 square feet of rock blanket placed behind Citibank on east side of Rte 1 for erosion control along the bluffs. Place conc ditch (200 LF) at toe of bluffs to route flow to cross culverts. Place new headwall/wingwall structure at culvert outlet with 100 SF rip rap for stabilization at the RCB outlet.

COST: \$178,000



HA-116

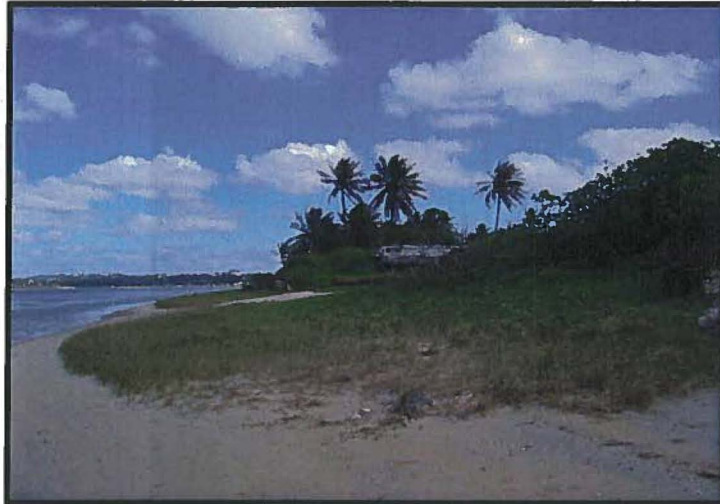
LOCATION: RT 1 & Shell Gas Station

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Runoff from the cliffs above the Shell station and from the station proximity flows towards a lot just south of the gas station. From the property, a grated catch basin collects the runoff and discharges it to the city drainage systems which outlets to the East Hagatna Beach to the north. The area upstream where the grated catch basin is located needs significant trash and debris removal, and it needs to be improved to properly collect and route runoff - add two additional grated inlets. At the toe of the cliffs, a concrete ditch should be built to route all the runoff from the cliffs, and a rock fence or wire mesh blanket needs to be added to toe of cliffs to control rocks falling.

RECOMMENDED IMPROVEMENTS Recommend placement of hydromulch and bonded fiber matrix (or rock blanket) along approximately 10,000 SF of embankment behind the Shell Station to control erosion on the east side of Rte 1. Place conc ditch (200 LF) at toe of bluffs behind retaining wall to route flow to catch basin connecting to cross culvert. Place new 10'x10' concrete apron around catch basin grate. Remove approximately 1 AC of debris.

COST: \$45,900



HA-117

LOCATION: West Hagatna Beach & Dulce Nombre de Maria Dr

MITIGATION TYPE: Coastal Protection

SITE ASSESSMENT: Need shoreline erosion stabilization(riprap), and need to provide drainage outlets where concentrated runoff from Dulce Nombre de Maria Dr discharge to coast.

RECOMMENDED IMPROVEMENTS To prevent further shoreline erosion, rip rap channel stabilization for a distance of 50 feet downstream of existing culvert (1000 SF rip rap total) is recommended.

COST: \$141,000



HA-118

LOCATION: RT 1 & District Court House

MITIGATION TYPE: Erosion Control/ Conveyance Improvements

SITE ASSESSMENT: Cross culvert under Rt1 outlets to West Hagatna Beach. Outlet structure is covered with sand, need to modify outlet structure to a sediment basin structure to prevent sand from clogging outlet. Also need shoreline erosion control(riprap).

RECOMMENDED IMPROVEMENTS To prevent further erosion of the shoreline and clogging of the outlet, a new headwall/wingwall structure with 100 square feet of rip rap outlet pad is recommended at downstream side of culvert.

COST: \$31,100



HA-119

LOCATION: RT 1 & Sewage Treatment Plant

MITIGATION TYPE: Erosion Control/ Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Double 24" RCP cross culverts under Rt1 discharge just north of Sewage Treatment Plant driveway. Need embankment stabilization(riprap) for about 20' on the downstream end, also debris removal and dredging of channel. Also need to stabilize coastline with riprap at this location.

RECOMMENDED IMPROVEMENTS A quarter acre of debris removal is needed at this site along with placement of 1,000 square feet of rip rap channel stabilization placed along the downstream embankments for a distance of 20 feet.

COST: \$143,000



HA-120

LOCATION: RT 1 & Gregorio Perez Marina

MITIGATION TYPE: Conveyance Improvements

SITE ASSESSMENT: Two 36" RCP cross culverts discharge to the Marina docking area, these culverts probably carry flow from Rt1. Headwall for the cross culverts need to be replaced, and a trash rack also added. Per the Flood Control Document, this RCB is to be increased in size to a 4'x4' RCB.

RECOMMENDED IMPROVEMENTS The RCB at this site needs to be increased in size to a 4'x4' RCB for 200 linear feet (as per the Flood Control Document) routing flow from Rte 1 to the Marina. A new headwall located at the Marina is also required

COST: \$231,000



HA-121

LOCATION: RT 1 & Padre Palomo Memorial Park

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance / Conveyance Improvement

SITE ASSESSMENT: A 5'x4' RCB cross culvert under Rt1 discharges to the north of Padre Palomo Memorial Park. The outlet channel embankment needs erosion stabilization(riprap) and debris removal for about 200'. Also the bottom of the channel needs to be cleaned of sediment.

RECOMMENDED IMPROVEMENTS Recommend erosion stabilization (rip rap) and one half acre of debris removal along with sediment removal from the channel's bottom. Place 2,000 square feet of rip rap channel stabilization for a distance of 100' along channel embankments.

COST: \$285,000

INARANJAN VILLAGE



IV-101

LOCATION: RT 4 & Asalonso River

MITIGATION TYPE: Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT: Existing cross culvert under Rt4 does not handle all the runoff that receives. This cross culvert needs to be upsized to a RCB cross culvert. Road alignment is within a private property R/W, the road needs to be realigned to be taken out of private property. River needs embankment stabilization(riprap) to stop erosion.

RECOMMENDED IMPROVEMENTS Recommend replacement of cross-culvert routing flow from Asalonso Rive under Rte 4 to a 100'x6'x6' RCB with upstream and downstream headwall/wingwall structures. Placement of 1,000 square feet of rip rap is recommended for a distance of 25 feet upstream and downstream of the crossing. A quarter acre of debris removal is also required.

COST: \$427,000



IV-102

LOCATION: RT 4 & Ates Ln

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Inarajan Mayor placed infiltration trenches along Rt4 at low point close to Ates St, but they are not working properly. Infiltration trenches were not built per standards - need to be rebuilt.

RECOMMENDED IMPROVEMENTS Infiltration trenches at this site were not constructed properly and need to be re-built. Recommend replacement with 2 standard infiltration trenches (200 LF each).

COST: \$45,300

**IV-103**

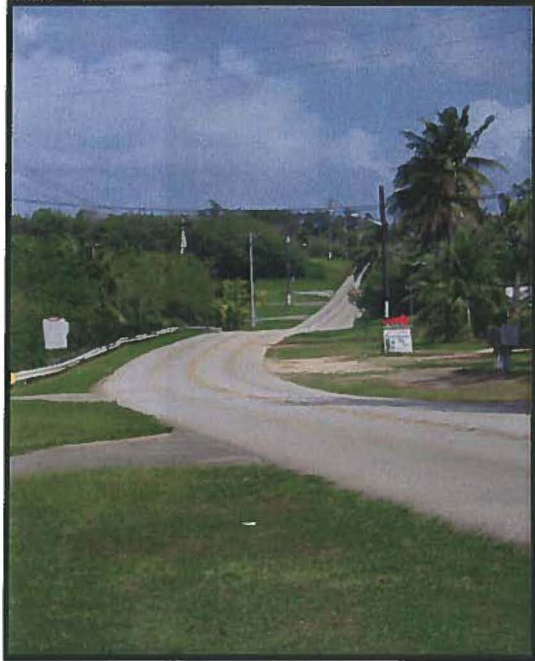
LOCATION: RT 4 & Dan Dan Store

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At this location, infiltration trenches can be built on both sides of Rt4 to take care of runoff and prevent flooding and ponding.

RECOMMENDED IMPROVEMENTS To prevent future flooding at this site, placement of two 200 ft infiltration trenches are recommend along Rte 4 (both sides of road) at this site.

COST: \$45,300



IV-104

LOCATION: RT 4 & North of Malojloj wall

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At low point add an infiltration trench on both sides of road.

RECOMMENDED IMPROVEMENTS To prevent future flooding at this site, placement of two 200 ft infiltration trenches are recommend along Rte 4 (both sides of road) at this site.

COST: \$45,300



IV-105

LOCATION: RT 4 & Chalan Tun Pedro Rivera Dr.

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Opposite side of Mayor's office - need to build an infiltration trench to prevent runoff from flooding private property.

RECOMMENDED IMPROVEMENTS To prevent further flooding, recommend placement of a 200 linear foot infiltration trench along road.

COST: \$22,600



IV-106

LOCATION: RT 4 & Chargala

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Add infiltration trenches along Rt4 to capture runoff.

RECOMMENDED IMPROVEMENTS To prevent future flooding at this site, placement of two 200 ft infiltration trenches are recommend along Rte 4 (both sides of road) at this site.

COST: \$45,300

**IV-107**

LOCATION: RT 4 & North Aslinger River

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Along Rt4 just north of the Aslinger River hillside are eroding and probably the sediment from these hillside runs down to the river. Need to take care of the erosion adjacent to Rt4.

RECOMMENDED IMPROVEMENTS To prevent further erosion of the hillside upstream of Aslinger River, recommend placement of hydroseed and bonded fiber matrix in areas devoid of vegetation (estimated at one acre).

COST: \$111,000



IV-108

LOCATION: RT 4 & Aslinger River

MITIGATION TYPE: Erosion Control/ Conveyance Improvements

SITE ASSESSMENT: This is a three cell RCB under Rt4 that routes the Aslinger River. Upstream channel needs debris and vegetation removal to prevent clogging of RCB. Downstream wingwalls need to be extended to improve the conveyance of flow and to control the embankment erosion. Roadway is being undermined, need to add riprap on the downstream embankment.

RECOMMENDED IMPROVEMENTS Erosion control is needed for the embankment at this site. Recommend replacement of downstream headwall/wingwall with new headwall/wingwall structure with wingwalls extended to avoid further embankment erosion. Also recommend placement of 2,000 square feet of rip rap along downstream embankment for a distance of 100 feet. Also recommend one half acre of debris removal upstream of the culvert.

COST: \$302,000

**IV-109**

LOCATION: RT 4 & Tinago River

MITIGATION TYPE: Erosion Control, Conveyance Maintenance

SITE ASSESSMENT: At this location along Rt4 a bridge runs over the Tinago River. Both upstream and downstream need debris and vegetation removal. Upstream a 36" RCP is discharging on the southwest corner of bridge where the embankment is slope pave on the northwest corner the slope paving is falling apart and it needs to be redone to prevent erosion. Downstream both the north and south wingwalls need to be extended to stop erosion and prevent roadway undermining.

RECOMMENDED IMPROVEMENTS Erosion control and maintenance is needed at this site. Remove one half acre of debris. Place 2,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream and 50 feet downstream of bridge. Replace existing slope paving at bridge corners.

COST: \$305,000



IV-110

LOCATION: RT 4 & Jamieann's Grill

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: An existing 2' base trapezoidal channel runs along the west side of Route 4 then discharges into a 36" RCP which outlet to the Tinago River on the southwest corner. The channel is in good shape but it should be upsized to a 4' base for easier maintenance. Multiple water lines cross the channel, these water lines should be routed under box or protected since they will break easily with any debris entering the channel when flowing at full capacity.

RECOMMENDED IMPROVEMENTS Recommend replacing 2' wide rectangular channel at this site with a 4' wide channel (1000' in length). Also recommend routing existing water lines under new channel.

COST: \$287,000



IV-111

LOCATION: RT 4 & South Tinago River

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Along Rt4 between Tinago River and Apman Dr, a low point is located where ponding is created. Need to build an infiltration trench to prevent ponding.

RECOMMENDED IMPROVEMENTS To avoid ponding at the low point at this site, recommend installation of a 200 linear foot infiltration trench adjacent to Rte 4.

COST: \$22,600



IV-112

LOCATION: RT 4 & Agfayan River

MITIGATION TYPE: Erosion Control, Conveyance Maintenance

SITE ASSESSMENT: At this location along Rt4 a bridge crosses the Agfayan River. There are Nipa trees on both the upstream and downstream of the river, these are protected trees. These trees grow in the water and cause debris to accumulate, a permit is needed to remove these trees. There is erosion on both the upstream of the river, need embankment stabilization (riprap). There is undermining of the Rt4 at the approach slabs of the bridge, need to stabilized the road embankment with riprap.

RECOMMENDED IMPROVEMENTS Erosion control and maintenance is needed at this site. Remove one quarter acre of debris. Place 1,000 square feet of rip rap for embankment stabilization adjacent to the roadside approach slabs for a distance of 25 feet upstream and 25 feet downstream of bridge.

COST: \$143,000

**IV-113**

LOCATION: RT 4 & Inarajan River (north)

MITIGATION TYPE: Erosion Control, Conveyance Maintenance

SITE ASSESSMENT: Rt4 crosses two branches of the Inarajan River. On the north branch there are Nipa trees on both the upstream and downstream of the river, these are protected trees. These trees grow in the water and cause debris to accumulate, a permit is needed to remove these trees. There is erosion on both the upstream of the river, need embankment stabilization (riprap) also to stop the undermining of Rt4.

RECOMMENDED IMPROVEMENTS Erosion control and maintenance is needed at this site. Remove one half acre of debris. Place 2,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream and 50 feet downstream of bridge

COST: \$285,000



IV-114

LOCATION: RT 4 & Inarajan River (South)

MITIGATION TYPE: Erosion Control, Conveyance Maintenance

SITE ASSESSMENT: Rt4 crosses two branches of the Inarajan River. On the south branch there are Nipa trees on both the upstream and downstream of the river, these are protected trees. These trees grow in the water and cause debris to accumulate, a permit is needed to remove these trees. There is erosion on both the upstream of the river, need embankment stabilization (riprap) also to stop the undermining of Rt4.

RECOMMENDED IMPROVEMENTS Erosion control and maintenance is needed at this site. Remove one half acre of debris. Place 2,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream and 50 feet downstream of bridge

COST: \$285,000



IV-116

LOCATION: RT 4 & Tun Mariano D. Leon Guerrero Rd

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: Along Rt4 and on the proximity of Tun Marino D. Leon Guerreo Rd three homes get flooded. Need to add a drainage conveyance system to route runoff to the north where it can be discharged to the Tongan Creek.

RECOMMENDED IMPROVEMENTS To prevent homes from being flooded, improvements to the storm drain system are needed. Recommend placing two catch basins along Rte 4, connecting to 100 linear feet of 24" RCP conveying flow northerly to Tongan Creek. Equip outlet with one headwall/wingwall structure and a 100 square foot rip rap energy dissipator. Recommend 200 LF of roadside ditch to convey flow to catch basins along Rte 4.

COST: \$139,000



IV-117

LOCATION: RT 4 & Tongan Creek

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: At this location a cross culvert carries the Tongan Creek under Rt4. This cross culvert consists of 3-36" RCP and a 4'x3' RCB, the structure is in good shape. Need sediment removal upstream and downstream, and embankment stabilization (riprap). Need to modify outlet headwall to a sediment basin structure to prevent sand from clogging outlet, currently portion of downstream culverts are clogged.

RECOMMENDED IMPROVEMENTS Sediment removal upstream and downstream is needed at this site along with embankment stabilization. A quarter acre of debris/sediment removal is needed along with the placement of 1,000 square feet of rip rap channel stabilization for a distance of 25' upstream and downstream of the culvert. Also recommend placement of wingwalls adjacent to headwalls on the upstream and downstream sides of the culvert.

COST: \$177,000

**IV-118**

LOCATION: RT 4 & Bibesbes

MITIGATION TYPE: Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT: At this location 2-24" RCP cross culverts run under Rt4. These culverts are partially clogged with sediment and trash. There is embankment erosion on both sides of the culverts and ponding along the sides of the road. Downstream bottom needs to be dredged, embankments need to be stabilized with riprap, cross culverts replaced with a 6'x3' RCB with wingwalls on both ends.

RECOMMENDED IMPROVEMENTS To prevent further erosion of the embankment and to unclog the culverts at this site, improvements and maintenance will need to be made to the drainage conveyance system. Recommend replacing existing culvert with 100'x3'x6' RCB equipped with upstream and downstream headwall/wingwall structures, and 100 SF rip rap energy dissipators placed upstream and downstream of the culvert. A quarter acre of debris removal along with some sediment removal to promote proper drainage will be required.

COST: \$189,000



IV-119

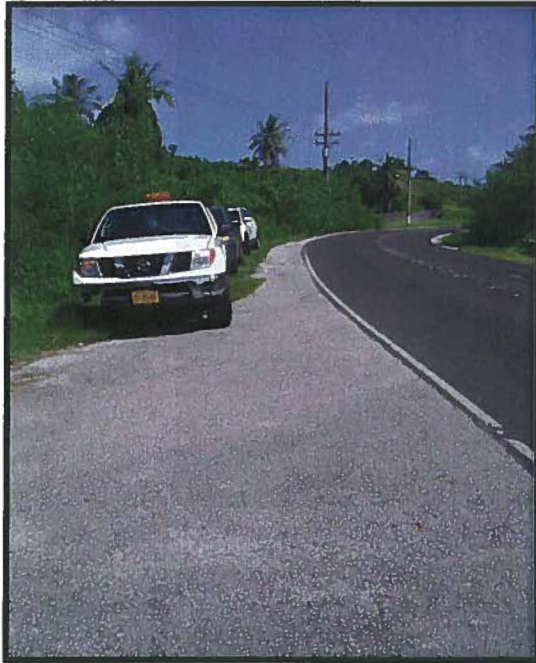
LOCATION: RT 4 & South of Bibesbes

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Improvement/ Conveyance Maintenance/ Treatment BMP Improvements

SITE ASSESSMENT: Existing 3-24" RCP cross culverts with headwall and wingwalls cross Rt4. There is ponding along roadway adjacent to cross culverts, also significant debris/trash/sediment accumulated both upstream and downstream, culverts are clogged and erosion around headwalls. Need to replace cross culverts with a 6'x3' RCB cross culvert with wingwalls, need to dredge upstream and downstream channel, clear vegetation, add rip rap on channel embankments for erosion control, and add an infiltration trench along Rt4 to prevent ponding.

RECOMMENDED IMPROVEMENTS Erosion control is needed at this site and measures need to be taken to prevent future ponding along roadway. Recommend replacement of existing culvert with 100'x6'x3' RCB equipped with upstream and downstream headwall/wingwall structures and 100 sq ft rip rap energy dissipators at the culvert inlet and outlet. Also recommend placement of a 200 linear foot infiltration trench along Rte 4 and a quarter acre of debris removal throughout area.

COST: \$209,000



IV-120

LOCATION: RT 4 & Ahayan way

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: Property south of Ahayan way on Rt4 westside floods. Need to add a drainage conveyance system to route runoff to the creek north of Ahayan way.

RECOMMENDED IMPROVEMENTS To avoid further flooding of a property on this site, it is recommended that a drainage conveyance system be added to this site, routing all runoff to the creek north of Ahayan Way. Recommend placement of 2 catch basins along Rte 4 connecting to 100 linear feet of 24" RCP storm drain routing flow northerly along Rte 4, outleting to the creek located north of Ahayan Way. Outlet at the creek should consist of one headwall/wingwall structure and a 100 square ft rip rap energy dissipator. Recommend 200 LF of roadside ditch to convey flow to catch basins along Rte 4.

COST: \$139,000



IV-121

LOCATION: RT 4 & Belen Ave

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Intersection of Rt4 and Belen Ave gets flooded, as a result two properties get flooded. At the intersection of Rt4 and Belen Ave three corners have grated inlets, there is another grated inlet along Belen Ave west side; these catch basins outlet to the Inarajan Bay via an outlet structure that needs debris removal. The northeast corner is a wetland. Need to add swales along Rt4 and Belen to route runoff to existing catch basins, also need to add another grated catch basin along Rt4 adjacent to the existing catch basin on the northwest corner.

RECOMMENDED IMPROVEMENTS To prevent further ponding at this site, recommend placement of 2-200 linear foot infiltration trenches along Rte 4 (both sides of Belen) or place 2 additional catch basins connecting to existing catch basins at site.

COST: \$45,300



IV-122

LOCATION: Chagamn Lago Ave

MITIGATION TYPE: Coastal Protection

SITE ASSESSMENT: Along Chagamn Lago Ave the roadway is being undermined by the Inarajan Bay. Need shoreline protection (about 2000' of riprap) and debris removal along coastline.

RECOMMENDED IMPROVEMENTS To prevent further shoreline erosion as a result of high tides along Chagamn Lago Ave, maintenance including 1 acre of debris removal followed by installation of 20,000 square feet of rip rap coastal stabilization (approximately 10-ft in width along the shoreline at Inarajan Bay, adjacent to the road for a distance of 2000 feet) is recommended.

COST: \$2,820,000



IV-123

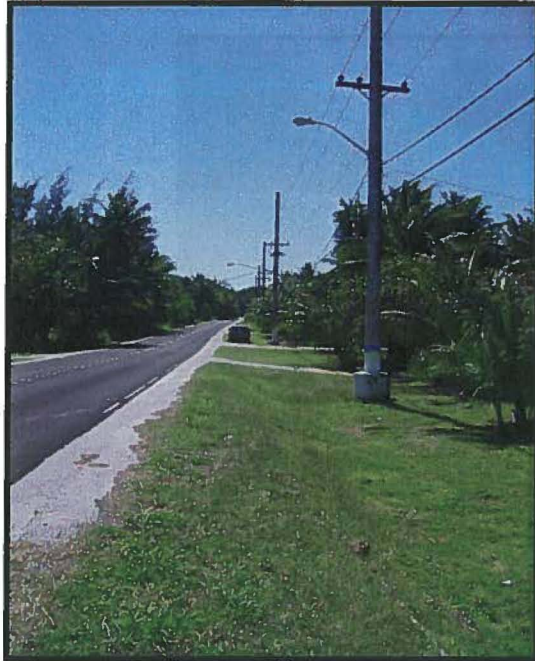
LOCATION: Apman Dr

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 36" RCP cross culvert with upstream and downstream headwall and wingwalls is located at the low point of Apman Dr. Cross culvert is 1/3 clogged with debris/trash/vegetation, and there is erosion around headwalls. One property gets flooded on the proximity of the cross culvert. Need to remove excessive debris/vegetation/trash from both upstream and downstream and provide embankment stabilization(riprap).

RECOMMENDED IMPROVEMENTS To prevent further erosion and flooding, recommend 1/4 acre of debris removal and placement of 1000 SF of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of existing culvert along the channel embankments.

COST: \$143,000



IV-124

LOCATION: Tun Enemecio & Regina Diego Dr & RT 4

MITIGATION TYPE: Conveyance Improvements/ Conveyance Maintenance

SITE ASSESSMENT: Properties along Tun Enemecio & Regina Diego Dr get flooded, creek north of the street also floods these homes. Homeowners placed a 36" cross culvert to route runoff to the south towards Tongan Creek but flooding still prevails. During the last year this area has been flooded three times. There used to be a CMP cross culvert that carried the runoff under Rt4 towards the ocean, but that cross culvert was taken out and now there is no outlet. A solution will be to build a concrete trapezoidal channel (6' base and 6' depth) parallel to Rt4 along the west side of Rt4 and discharge it to the Tongan Creek.

RECOMMENDED IMPROVEMENTS Recommend maintenance and improvements to the drainage conveyance system throughout this area. Place a concrete trapezoidal channel (6' base, 6' depth, 24' top width) adjacent to the west side of Rte 4 to route flow from a channel located north of the property southward to Tongan Creek (approximately 1500 feet long). Two culverts will be required for conveyance under a driveway and under Regina Drive (50'x 48" RCP each, equipped with headwall/wingwall structures on both sides). An existing 36" CMP currently routes flow under Regina Drive, in another channel that flows southerly to Tongan Creek behind the properties. Recommend replacement of this culvert with new double 36" culvert (50 linear feet with headwall/wingwall structure both sides). Entire area will require 1 AC debris removal and dredging (approximately 100 CY) of the channel located north of the property to promote drainage to the proposed concrete channel along with placement of 1000 SF rip rap at the upstream and downstream sides of the proposed conc channel.

COST: \$1,390,000

MANGILAO VILLAGE



MO-101

LOCATION: Spanish Lane & RT 15

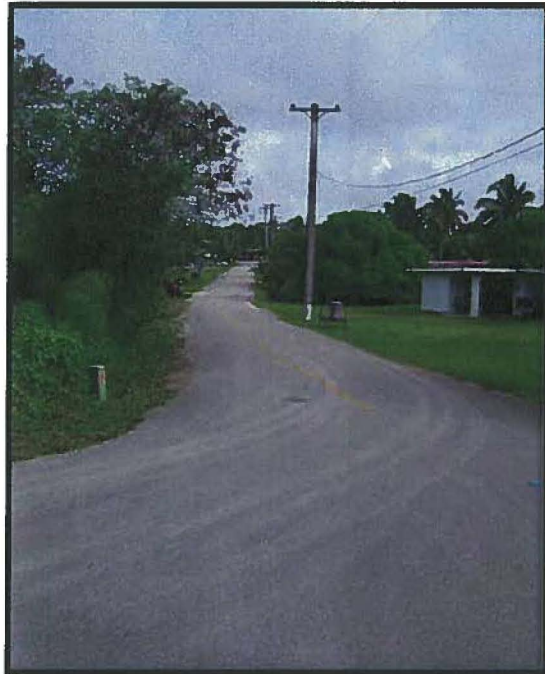
MITIGATION TYPE: Storm Drain Improvement

VILLAGE RANKING 15

SITE ASSESSMENT: Concentrated flow from Route 8 on and off ramps discharge to Rt33 at a location where the apartment complex at 105 Roy T. Damian is located. Building gets flooded from runoff. Need to add catch basins with a pipe outletting to the Hagatna river, which is located behind this apartment complex. Need to add underground infiltration chamber or media filter to system (assume underground infiltration chamber @ \$500,000)

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along Route 15 to prevent flow from entering Spanish Lane. Place 2 catch basins along Rte 15 connecting to 100 linear feet of 24" RCP storm drain routing flow to the Rte 10 drainage system. Also recommend a quarter acre of debris remove and placement of 200 LF of roadside ditches to route surface flow to catch basins.

COST: \$139,000



MO-102

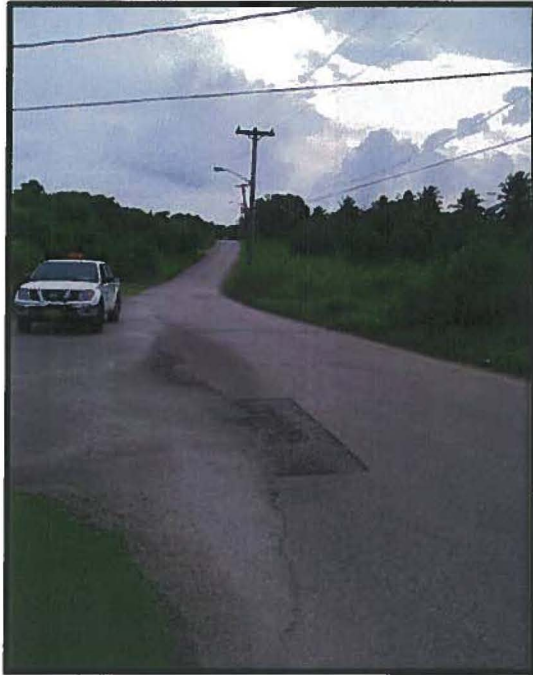
LOCATION: Farfan Street & RT 15

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: This is a low point along Farfan street, where runoff from Route 15 creates ponding and thus flooding of properties until starts to flow towards Spanish Lane. The possible solution is to add a curb to Route 15 and add drainage conveyance system that can tie in to the existing sytem along Route 10. This will take care of all the runoff generated from Route 15.

RECOMMENDED IMPROVEMENTS To avoid future flooding of area properties a drainage conveyance system needs to be added along Rte 15 to prevent flow from entering Farfan Street. Recommend placement of 2 catch basins (one on both sides of Farfan, along Rte 15), connected by 100 linear feet of 24" RCP storm drain, outleting to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator. Also recommend placement of roadside ditches to convey flow to catch basins (200 linear foot total).

COST: \$139,000



MO-103

LOCATION: Cotpus Street & Pelowky

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Maintenance/ Treatment BMP Improvements

SITE ASSESSMENT: At this location a low point along the street exists, this creates ponding thus flooding four properties. A possible

RECOMMENDED IMPROVEMENTS Reroute the flow at this site to an infiltration basin at the end of Chargualat Street (within an existing City easement) to avoid future flooding of adjacent properties at this site. Recommend placement of two catch

COST: \$450,000



MO-104

LOCATION: Chargualaf Street & Chalan Kareta

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Maintenance/ Treatment BMP Improvements

SITE ASSESSMENT: At this location, a low point along the street exists. This creates ponding, thus flooding of about three properties. Also, this is known to be a location for mosquito breeding due to the stagnant water. A possible solution is to add a drainage conveyance system that can route flow downstream at the end of this street where an infiltration basin can be built at the lowest location.

RECOMMENDED IMPROVEMENTS Recommend placement of a 50'x400' infiltration basin with 900' of fencing at the end of the street along with grading the edge of pavement along Chargualaf Street to drain toward the basin Also recommend 1 AC of debris removal throughout area.

COST: \$463,000



MO-105

LOCATION: Chargualaf Street

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: This is the end of the street and is also the lowest point along the street. At this location, there is ponding and flooding of one property. Here, an infiltration basin can be built within an existing city easement - all runoff from this street and from Kotpus Street can be routed to this infiltration basin.

RECOMMENDED IMPROVEMENTS Recommend placement of a 200'x200' infiltration basin (with 800 LF of fencing) at the end of Chargualaf Street. Also recommend placement of a storm drain system in Chargualaf consisting of two catch basins connecting to 100 linear feet of 24" RCP storm drain and a quarter acre of debris removal. The pipeline should route the runoff to the proposed infiltration basin.

COST: \$779,000



MO-106

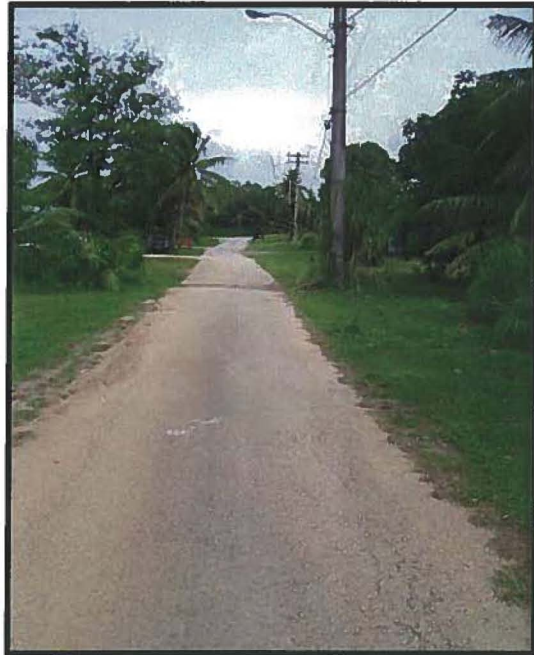
LOCATION: Tangerine Lane & RT 10

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: This is a low point along Tangerine Lane where significant runoff has created in the past significant ponding and thus flooding approximately six properties at this location, including properties along Manderine Lane (parallel street to tangerine). There is no existing drainage conveyance system at this location. A possible solution is to build an infiltration basin with about eight injection wells at the end of the street in an empty lot. This basin will take care also of runoff from Manderine Lane, and it is possible that the basin can also be accessible from Manderine Lane.

RECOMMENDED IMPROVEMENTS Recommend placement of a 200'x200' infiltration basin with 800 linear feet of fencing 8 injection wells toll improve the current drainage problems in the area. Recommend grading along the edge of pavement along Tangerine Lane to drain to infiltration basin.

COST: \$1,190,000



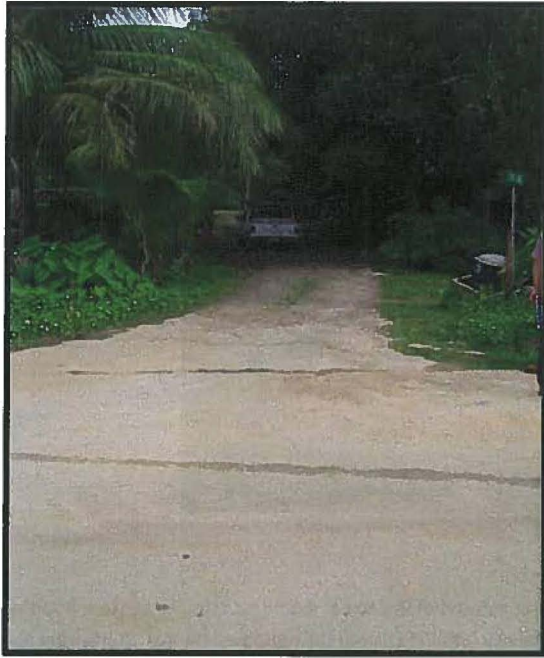
MO-107

LOCATION: Mandarin Lane & Chero Lane

MITIGATION TYPE: Conveyance Improvement

RECOMMENDED IMPROVEMENTS Recommend placement of a 1000 LF ditch along the edge of roadway for Mandarin Lane, routing roadway runoff to the infiltration basin along Tangerine Lane (MO-106).

COST: \$86,400



MO-108

LOCATION: Lemon Lane & Chero Lane

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: There is a low point at this interchange. There is no existing drainage conveyance system and therefore ponding occurs and thus flooding of four properties. A possible solution will be to add a drainage conveyance system which can outlet to the proposed infiltration basin at Tangerine Lane.

RECOMMENDED IMPROVEMENTS To avoid future flooding of the properties in the area a drainage conveyance system along Lemon Lane needs to be constructed. Recommend placement of two catch basins connecting to 100 linear feet of 24" RCP storm drain outletting to the proposed infiltration basin along Tangerine (MO-106). The outlet should be equipped with a headwall/wingwall structure and a 100 square foot rip rap energy dissipator. Also recommend placement of roadside ditches (200 LF total) to route runoff to catch basins.

COST: \$139,000



MO-109

LOCATION: Aga Lane & Mangga Lane

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: At the location, a low point is located at the end of the street where ponding is created, flooding three properties. Within this low area, the lowest point is located between two homes. A possible solution is to build a drainage conveyance system to outlet to the back of one of the properties where a natural depressed area exists. An easement will need to be created to build this system.

RECOMMENDED IMPROVEMENTS To avoid future flooding recommend placing two catch basins along Aga Lane connecting to 100 linear feet of 24" RCP storm drain, routing flow between 2 properties to a natural sink located behind the properties (most likely requiring an easement). The outlet should be equipped with one headwall/wingwall structure and a 100 square foot rip rap energy dissipator. Recommend placement of 200 linear ft of roadside ditch adjacent to Aga Lane to route flow to catch basins.

COST: \$139,000



MO-110

LOCATION:

Kita L G Court & Mangga Lane

MITIGATION TYPE:

Storm Drain Improvement/ Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT:

At this end of this street a natural local depression exists within private properties where all runoff from the street drains to. There is no flooding of properties, since the lowest point is not developed and water infiltrates without causing permanent ponding or flooding of adjacent properties. There is significant erosion within the perimeter of this depression, which happens within private properties. A possible solution to stop erosion is to build a retaining wall and a concrete lined channel.

RECOMMENDED IMPROVEMENTS

To prevent further erosion from occurring it is recommended that an 8000 SF retaining wall (approximately 20 feet tall by 400 feet long) be placed along the eroding hillside with a 1,000 linear foot concrete channel placed at the road edge, immediately adjacent to the wall. The conc channel will route flow to the existing sink located at the downstream side of the property. A quarter acre of debris removal throughout the area will also be needed along with placement of hydromulch and bonded fiber matrix placed along the embankments devoid of vegetation (estimated at approximately 1000 square feet).

COST:

\$1,590,000



MO-111

LOCATION: Manha Lane & RT 10

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Significant runoff from Route 10 flows to this street and creates flooding of possibly three homes. There is no existing drainage conveyance system along this street. A solution is to add drainage conveyance system along Route 10 to prevent runoff from Route 10 from entering Manha Lane, and adding infiltration trenches at the lowest point of the street to capture just street runoff.

RECOMMENDED IMPROVEMENTS To prevent further flooding at this site, recommend interception of Rte 10 flows upstream of Manha Lane and placement of an infiltration trench at the low point in Manha Lane. Along Rte 10, recommend placement of one catch basin placed immediately upgradient of Manha Lane, connecting to 100 linear feet of 24" RCP conveying flow past Manha Lane and outleting flow to a headwall/wingwall structure and a 100 square foot rip rap energy dissipator along Rte 10. Also recommend placement of a 200 linear foot infiltration trench along Manha Lane with roadway ditches (200 LF total) routing flow to infiltration trench.

COST: \$151,000



MO-112

LOCATION: Lalo Street & RT 10

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: At this interchange ponding occurs due to a high point along the entrance to Lalo Street from Route 10. A solution is to re-grade this area and to add a cross gutter to maintain the runoff along route 10.

RECOMMENDED IMPROVEMENTS To avoid future ponding, recommend placement of a 100 linear foot concrete cross gutter along Rte 10 at the intersection with Lalo Street in order to maintain drainage along Rte 10.

COST: \$19,900



MO-113

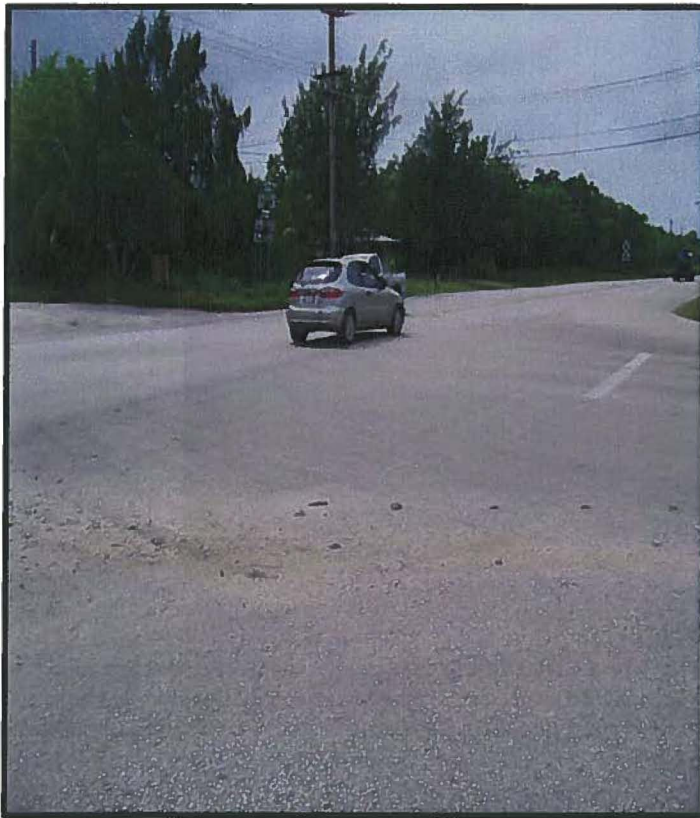
LOCATION: RT 10 & RT 15

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: Signs of ponding/flooding exists on the north east corner of this interchange. A drainage conveyance system already exists at interchange, one grated inlet on north west corner and another one on the north east corner, and possibly another grated inlet has been covered with asphalt on the north east corner along Route 10. The solution to this situation is to add more grated catch basins on the interchange to prevent ponding and flooding.

RECOMMENDED IMPROVEMENTS To prevent further ponding/flooding, recommend improvements to the existing storm drain system located at the Rte 10/ Rte 15 intersection. Place 3 catch basins (one on northeast corner and 2 on northwest corner) connecting to 200 linear feet of 24" RCP.

COST: \$206,000



MO-114

LOCATION: RT 15 & RT 26

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At this interchange there are signs of ponding on all four corners, and possibly flooding of one property on the north west corner. A possible solution is to re-grade corners to prevent ponding and add swales.

RECOMMENDED IMPROVEMENTS To prevent flooding, recommend along edge of shoulders at all 4 corners and placement of 100-ft bioswales routing flow from Rte 15 to Rte 26 on all four corners.

COST: \$63,500



MO-115

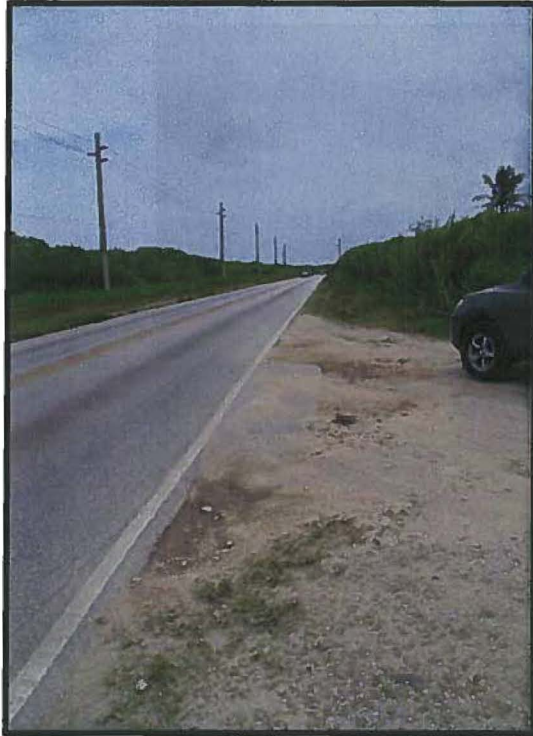
LOCATION: RT 15 & Old RT 26

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: At this location ponding is created along west side of Route 15, and there is significant trash and debris along the old Route 26. Possible solution for ponding is to create a drainage conveyance system to outlet runoff to the south along west side of Route 15 where a grated area exists. The debris and trash along the old Route 26 is probably from illegal dumping.

RECOMMENDED IMPROVEMENTS To avoid future ponding along west side of Route 15 at this site, a storm drain system is recommended. Place 2 catch basins along the west side of Rte 15 at Old Rte 26, connecting to 100 linear feet of 24" RCP storm drain routing flow southerly to an outlet structure along the west side of Rt 15. The structure should include a headwall/wingwall structure with a 100 square foot rip rap energy dissipator. Recommend placement of 200 linear feet of roadside ditch to convey flow to catch basins. Also recommend removal of debris along Old Rte 26.

COST: \$139,000



MO-116

LOCATION:

RT 15 & Southern Cross Lane

MITIGATION TYPE:

Storm Drain Improvement/ Conveyance Maintenance/ Treatment BMP Improvements

RECOMMENDED IMPROVEMENTS

To prevent flooding of this area, recommend placement of a storm drain system including construction of 2 catch basins connected to a 24" RCP storm drain for 100 linear feet, conveying flow to an infiltration basin (200'x200') requiring 800 LF of fencing or to an infiltration trench. A quarter acre of AC debris removal is also needed.

COST:

\$779,000

MERIZO VILLAGE



ME-101

LOCATION: RT 4 & Asmaile Creek

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Three cross culverts under Rt4 route Asmale Creek to Ajayan Bay. 2-36" RCP and 1-24" cross culverts with straight headwalls. Both upstream and downstream need debris/vegetation removal, dredging of channel base and embankment stabilization with riprap for about 100' upstream and downstream.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one half acre of debris. Place 2,000 square feet of rip rap for channel stabilization for a distance of 100 feet upstream and 100 feet downstream of culvert.

COST: \$285,000



ME-102

LOCATION: RT 4 & Asgado Creek

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Two 36" RCP cross culverts with headwalls under Rt4 route Asgado Creek to Asgado Bay. Upstream culverts are clogged with sediment and debris, downstream they are about 2/3 covered with sediment. Road is been undermined in the proximity of the cross culverts. Need to remove debris/sediment/vegetation and add enbankment stabilization for about 50' both upstream and downstream.

SITE IMPROVEMENTS: To prevent further clogging of culverts and further undermining of the road near the cross culverts, maintenance including 1/4 acre of debris removal followed by placement of a 10'x10' rip rap energy dissipator (both upstream and downstream) along with installation of a headwall/ wingwall structure at the culvert outlet is recommended.

COST: \$47,100



ME-103

LOCATION:

RT 4 & Lyog River

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

Bridge along Rt4 over Lyog river. All four approach slabs corners are undermined, and both upstream and downstream of the river there is significant accumulation of sediment and debris. Both upstream and downstream need debris and sediment removal, and need to provide enbankment stabilization upstream and downstream for about 50' .

SITE IMPROVEMENTS:

To prevent further undermining of all four approach slabs at the bridge along Route 4 over Lyog River, maintenance consisting of a quarter acre of debris removal along with 100 cubic yards of excavation and installation of 1,000 square feet rip rap channel stabilization for a distance of 50' upstream and 50' downstream of the bridge is recommended.

COST:

\$147,000



ME-104

LOCATION: RT 4 & south of Sumay river

MITIGATION TYPE: Coastal Protection

SITE ASSESSMENT: South from Sumay river the roadway has eroded next to the shoreline, it needs shoreline protection for about 200' from Sumay river.

SITE IMPROVEMENTS: To prevent further shoreline erosion as a result of high tides, maintenance including 1/2 acre of debris removal followed by installation of 5,000 square feet of rip rap coastal stabilization (approximately 10-ft in width along the shoreline) from Sumay River to 500 feet south of the river is recommended.

COST: \$711,000



ME-105

LOCATION: RT 4 & south of Sumay river

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: South from Sumay river a 4'x4' RCB cross culvert runs under Rt4 and discharges to Sumay Bay. Needs erosion stabilization upstream and downstream for about 50', and also along RT4 next to the headwalls. Also needs debris and vegetation removal upstream and downstream.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one quarter acre of debris. Place 1,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream and 50 feet downstream of culvert.

COST: \$143,000



ME-106

LOCATION: RT 4 & Sumay River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Bridge over Sumay river. Need erosion stabilization along approach slabs and also upstream and downstream along the river enbankment. Also needs upstream and downstream debris/sediment/vegetation removal.

SITE IMPROVEMENTS: To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 50 feet upstream and 50 feet downstream of the bridge is required.

COST: \$143,000



ME-107

LOCATION: RT 4 & north of Sumay river

MITIGATION TYPE: Coastal Protection

SITE ASSESSMENT: North of Sumay river along the shoreline Rt4 needs erosion stabilization to prevent erosion during high tides for sand to cross roadway.

SITE IMPROVEMENTS: To prevent further shoreline erosion as a result of high tides, maintenance including 1/2 acre of debris removal followed by installation of 5,000 square feet of rip rap coastal stabilization (approximately 10-ft in width along the shoreline) from Sumay River to 500 feet north of the river is recommended.

COST: \$711,000



ME-108

LOCATION: RT 4 & South of Suyafe River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Un-named tributary at this location. Standing water observed on the upstream side. Downstream side needs bank stabilization along the culvert and roadway. Along Route 4 there are 4 cross culverts with un-named tributaries that need bank stabilization on the upstream and downstream sides.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one half acre of debris and place 250 square feet rip rap for channel stabilization for a distance of 25 feet upstream and 25 feet downstream of 4 culverts (2,000 square feet total).

COST: \$285,000



ME-110

LOCATION: RT 4 & Suyaje river

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A double 6'x3' RCB cross culvert routes Suyaje river to Sumay Bay. It needs about 100' of enbankments stabilization upstream, and about 50' downstream. Also needs roadway stabilization along the two headwalls, about 50' on both sides of headwalls to stop the undermining of Rt4. Need dredging of river bottom both upstream and downstream.

SITE IMPROVEMENTS: To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 100 feet upstream and 50 feet downstream of the culvert is required.

COST: \$143,000



ME-111

LOCATION: Emma Reyes St

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: Home 100' away from Rt4 floods. The Suyaje river floods property, need to add a berm to raise the Suyaje river embankment and prevent flooding of property.

SITE IMPROVEMENTS: To minimize flooding of the adjacent home, a 1.5-ft high berm (5 ft wide) is recommended along both embankments of the river on the upstream side of the culvert for a distance of approximately 200 feet. Remove one quarter acre of debris. Place 1,000 square feet of rip rap along inner side of berm and 3,000 cubic feet of fill.

COST: \$144,000



ME-112

LOCATION: RT 4 & South of Juan Babauta St

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 6'x4' RCB cross culvert under Rt4, just south of Juan Babauta St. The RCB is in good condition, there is erosion around the upstream headwall. Need to extend headwall (or add rip rap) upstream to include a 36" RCP that is discharging to the side of the headwall, and also need to add riprap for erosion control.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one quarter acre of debris and place 1,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream of existing culvert and around 36" RCP culvert outlet located immediately upstream of cross culvert.

COST: \$143,000



ME-113

LOCATION: RT 4 & Juan Babauta St

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Double 6'x3' RCB cross culvert. Upstream three grated inlets discharge to RCB, these inlets are adjacent to a home. There is also a lateral cross culvert discharging to RCB from the north. Downstream channel needs debris/trash/vegetation removal and enbankment stabilization(riprap).

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one quarter acre of debris and place 1,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream of existing culvert and around 36" RCP culvert outlet located immediately upstream of cross culvert.

COST: \$143,000



ME-114

LOCATION:

RT 4 & Manell Channel

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT:

A 20'x8' (estimated dimensions) rectangular concrete channel runs parallel to Rt4 along the east side, it carries the manell river flow. The channel is covered with sediment. Need to clean channel of sediment and stabilize upstream Manell river to prevent sediment to continue covering the channel. Probably upstream from the concrete lined channel a sediment basin needs to be built to capture all the sediment. Downstream from this channel there are two outlets that are completely covered with sediment that needs to be cleared of debris. Segments of the channel's east wall are collapsing, they need to be replaced with new walls.

SITE IMPROVEMENTS:

To prevent the continuation of sediment falling and covering the channel and to stabilize the Manell River, maintenance in the form of a quarter acre of debris removal, removal of 4,000 cubic yards of rock, placement of 5,000 square feet of rip rap channel stabilization (upstream of the concrete channel for an estimated 250 feet), 20 cubic yard of soil excavation, and replacement of portions of the existing concrete rectangular channel (approximately 2000 feet approximated by 10,000 sq ft of retaining wall) is recommended.

COST:

\$7,630,000



ME-115

LOCATION: RT 4 & North of Manell Channel

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: North of Manell Channel along Rt4 three existing 5'x3' RCB cross culverts need improvements on the upstream and downstream channels. Need debris removal and embankment stabilization for about 20' upstream and downstream.

SITE IMPROVEMENTS: Embankment stabilization and maintenance are needed at this site. Remove one quarter acre of debris and place 330 square feet of rip rap for a distance of approximately 20' both upstream and downstream of each culvert

COST: \$143,000



ME-116

LOCATION: RT 4 & Achang River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: 6'x3' RCB cross culvert under Rt4 carries Achang river flow to Achang Bay. Upstream and downstream need sediment and debris removal.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one quarter acre of debris. Place 1,000 square feet of rip rap for channel stabilization for a distance of 25 feet upstream and 25 feet downstream of culvert.

COST: \$143,000



ME-117

LOCATION: RT 4 & South of Geus river

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A double 24" RCP cross culvert under Rt4 just south of Geus river. Upstream channel is in good condition except for vegetation clearing, downstream channel needs debris/sediment removal and enbankment stabilization.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one quarter acre of debris and place 1,000 square feet of rip rap for channel stabilization for a distance of 50 feet downstream of existing culvert.

COST: \$143,000



ME-118

LOCATION: RT 4 & Geus river

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 4 cell 12'x8' RCB under Rt4 carries Geus river flow. Needs debris/sediment/vegetation removal and enbankment stabilization both upstream and downstream.

SITE IMPROVEMENTS: Erosion control and maintenance is needed at this site. Remove one half acre of debris. Place 2,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream and 50 feet downstream of culvert.

COST: \$285,000



ME-119

LOCATION: RT 4 & south of Benny Espinoza Ave

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A 3-36" RCP cross culvert under Rt4 south of Benny Espinoza Ave. At the upstream of these culverts a house has been built on top of the headwall. It needs debris/sediment removal, and enbankment stabilization(riprap) both upstream and downstream channels.

SITE IMPROVEMENTS: Maintenance and channel stabilization for the area adjacent to and upstream of the house is required. Remove one quarter acre of debris. Place 1,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream and 50 feet downstream of culvert.

COST: \$143,000



ME-120

LOCATION: RT 4 & Benny Espinoza Ave

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: A concrete lined channel parallel to Rt4 needs sediment removal. It discharges to the 3-36" RCP cross culverts.

SITE IMPROVEMENTS: Maintenance is needed at this site. Remove one quarter acre of debris and sediment from channel.

COST: \$1,940



ME-121

LOCATION:

RT 4 & north of Benny Espinoza Ave

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

A 10'x5' RCB cross culvert under Rt4. This RCB needs sediment/debris/vegetation removal and enbankment stabilization(riprap) both upstream and downstream. Along the downstream base also riprap need to be placed to stop the undermining of the RCB wingwalls.

SITE IMPROVEMENTS:

To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 50 feet upstream and 50 feet downstream of the

COST:

\$143,000



ME-122

LOCATION:

RT 4 & Chalan Joseph A Cruz

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

10'x5' RCB cross culvert under Rt4, just south of Chalan Joseph A. Cruz. This RCB routes runoff from a channel along the south side of Chalan Joseph A. Cruz. The RCB is in good condition, upstream channel needs debris/sediment removal and enbankment stabilization.

SITE IMPROVEMENTS:

Erosion control and maintenance is needed at this site. Remove one quarter acre of debris and place 1,000 square feet of rip rap for channel stabilization for a distance of 50 feet upstream of existing culvert.

COST:

\$143,000



ME-124

LOCATION: RT 4 & south Merizo Catholic Cemetary

MITIGATION TYPE: Erosion Control/ Conveyance Improvement

SITE ASSESSMENT: A mixed of cross culverts cross Rt4 south of Merizo Catholic Cementary. The upstream side consits of 4-36" RCP and 4-24" RCP cross culverts, the 4-24" cross culverts sit on top of the 4-36" cross culverts. The upstream side is a RCB cross culvert. This system should be replaced with a 12'x6' RCB cross culvert with wingwalls on both ends. The upstream and downstream channels need debris/sediment/vegetation removal, and enbankment stabilization(riprap) to stop the undermining of Rt4.

SITE IMPROVEMENTS: To stop the undermining of Route 4, the placement of approximately 100 linear feet of 12'x6' RCB, with two headwall/wingwall structures (one upstream and one downstream), and 1,000 square feet of channel stabilization are required.

COST: \$677,000



ME-125

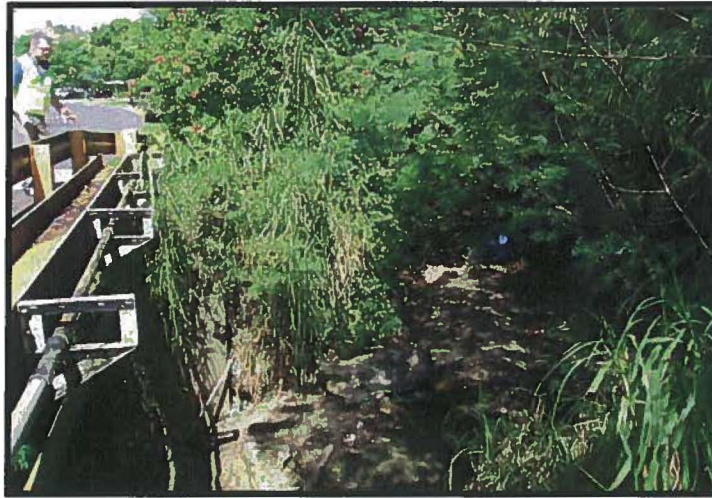
LOCATION: RT 4 & north of Merizo Catholic Cemetary

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Maintenance

SITE ASSESSMENT: North of Merizo Catholic cemetary, there is a 36" RCP cross culvert runs under Rt4. The upstream end of the cross culvert has a catch basin that needs an apron and trash rack, the downstream end couldn't be located (it is possibly covered with sediment).

SITE IMPROVEMENTS: To prevent further erosion, maintenance including 1/4 acre of debris and sediment removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 50 feet downstream of the culvert is required. Add apron and trash rack to existing catch basin at the site.

COST: \$16,200



ME-126

LOCATION:

RT 4 & Pigua river

MITIGATION TYPE:

Conveyance Maintenance/ Conveyance Improvement/ Erosion Control

SITE ASSESSMENT:

A 6'x12' RCB under Rt4 routes Pigua River. This cross culvert RCB needs to be widened and debris/vegetation removal and embankment stabilization(riprap or gabions) is needed on both upstream and downstream channels.

SITE IMPROVEMENTS: The cross culvert at this site needs to be widened, and embankment stabilization is needed upstream and downstream. Recommended improvements include 100 cubic yard of excavation, placement of 100 square feet of rip rap stabilization along the base (10 feet upstream and 10 feet downstream of the culvert), 800 square feet of gabions placed along the embankments (400 sq ft upstream and 400 sq ft downstream of culvert), and placement of a 100'x6'x12' RCB.

COST:

\$543,000



ME-128

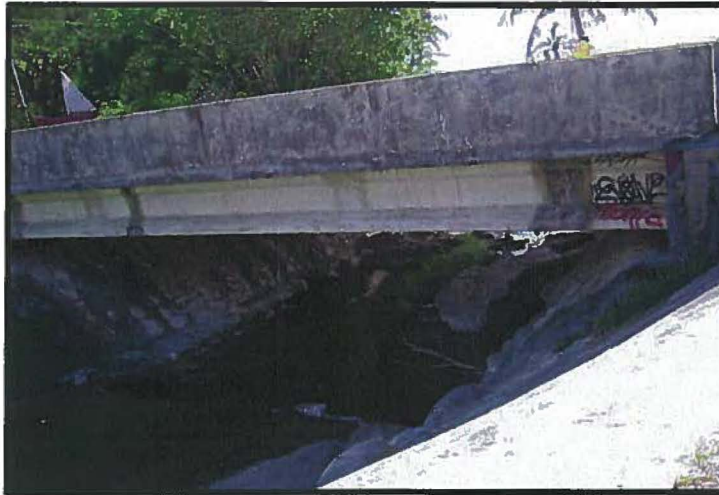
LOCATION: RT 4 & north of Bile river

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: A single 36" RCP cross culvert runs under Rt4 north of Bile river. This cross culvert should be replaced with a 5'x3' RCB with wingwalls, and the upstream and downstream channels need debris/vegetation removal and enbankment stabilization(riprap).

SITE IMPROVEMENTS: The cross culvert at this site needs to be replaced with 100 linear feet of 5'x3' RCB , a headwall/wingwall structure with 100 sq ft rip rap stabilization upstream and downstream of the culvert, excavation of approximately 20 cubic yards and maintenance including a quarter acre of debris removal.

COST: \$167,000



ME-129

LOCATION: RT 4 & Toguan river

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: Bridge along Rt4 over Toguan river. The upstream river is routed along a trapezoidal concrete lined channel, this channel ends with the bridge. Portions of the upstream concrete embankment are broken and need to be fixed. Bottom of the concrete channel needs to extend under bridge and downstream to stop the undermining of the bridge abutments. Need to add embankment stabilization(riprap) along the approach slabs, and also need to add riprap downstream base of river to stop erosion.

SITE IMPROVEMENTS:

COST: \$196,000



ME-130

LOCATION: RT 4 & Ajayan river

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Bridge along Rt4 over Ajayan river. Approach slabs are been undermined, need to stabilize roadway enbankment with riprap.

SITE IMPROVEMENTS: To prevent further undermining of the approach slabs, maintenance consisting of a quarter acre of debris removal along with installation of 1,000 square feet rip rap channel stabilization is recommended.

COST: \$143,000

MONGMONG VILLAGE



MM-101

LOCATION: Sergeant Roy T. Damian (RT 33) & RT 8

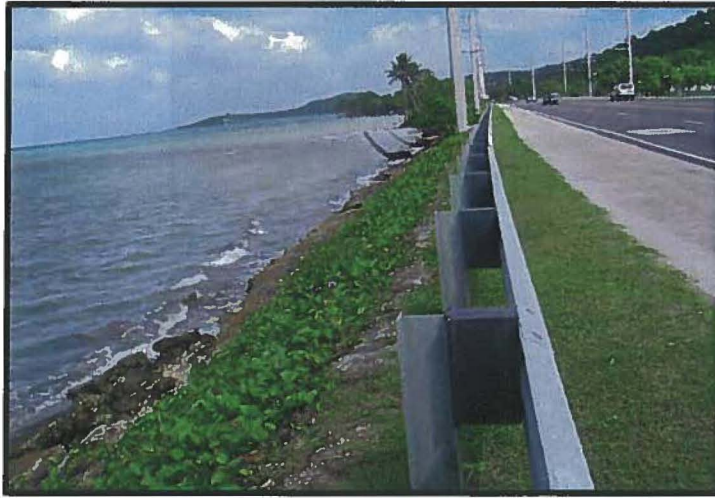
MITIGATION TYPE: Storm Drain Improvement/ Treatment BMP Improvements

SITE ASSESSMENT: Concentrated flow from Route 8 on and off ramps discharge to Rt33 at a location where the apartment complex at 105 Roy T. Damian is located. Building gets flooded from runoff. Need to add catch basins with a pipe outletting to the Hagatna river, which is located behind this apartment complex. Need to add underground infiltration chamber or media filter to system (assume underground infiltration chamber @ \$500,000)

RECOMMENDED IMPROVEMENTS To prevent the continuation of flooding at 105 Roy T. Damian, improvements to the storm drain system need to be made to the Rte 8/ Rte 33 intersection. The proposed improvements are to add 2 catch basins connected by 200"x24" RCP, conveying flow from Rte-8 to the east side of Rte 33, across Rte 33 to the west side where it can outlet to an existing drainage flow path along the Agana River. In order to treat the runoff, it is recommended that an underground infiltration vault be constructed under Rte 33 to accommodate the water quality volume of the roadway runoff. It is apparent that sufficient right of way is unavailable for placement of a bioswale downstream of the proposed drainage network. The outlet of the drainage system will consist of a headwall/wingwall structure, leading flow to a 100 square foot rip rap energy dissipator.

COST: \$1,008,000

PITI VILLAGE



PI-101

LOCATION: RT 1 & Masso River to 1000' North

MITIGATION TYPE: Coastal Protection

SITE ASSESSMENT: There is significant coastline erosion, if not taken care of will undermine Route 1. Need to add riprap all along the coastline.

RECOMMENDED IMPROVEMENTS To prevent further shoreline erosion, maintenance including 1 acre of debris removal and placement of 10,000 square feet of rip rap coastal stabilization (approximately 10-ft in width along the shoreline) from Masso River to 1000 feet north of the river is recommended.

COST: \$1,430,000



PI-102

LOCATION: RT 1 & Santos Memorial Park

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: A double 36" cross culverts runs under Route 1 and outlets on the north side of Pedro Santos Park. These culverts are under sized and there is significant sediment blocking the downstream end, they carry runoff from the south side of Route 1 from Mary Pling St. This double cross culvert should be replaced with a RCB with wingwalls, downstream debris and sediment should be removed also.

RECOMMENDED IMPROVEMENTS In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 200 linear feet of a 3'x5' RCB equipped with headwall/wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.

COST: \$394,000



PI-103

LOCATION:

Mary Pelen & J.M. Tuncap St

MITIGATION TYPE:

Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT:

This area flows to the 2-36" cross culverts at Rt1. A 24" RCP cross culverts carries from from the area to the 2-36" RCP cross culverts. Homes have encroached into the earthen swales. Need to improve the drainage system in order to prevent the flooding of homes, also this area is in the flooding zone. Need to clear earthen channel of debris and vegetation and replace the 24" RCP cross culvert with a double 36" cross culverts with headwalls on both ends.

RECOMMENDED IMPROVEMENTS

In order to provide sufficient conveyance capacity, the existing 24" culvert should be replaced with 100 linear feet of double 36" RCP culvert with headwall/wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including a 200 sq ft energy dissipator located at the downstream side of the culvert is recommended.

COST:

\$186,000



PI-104

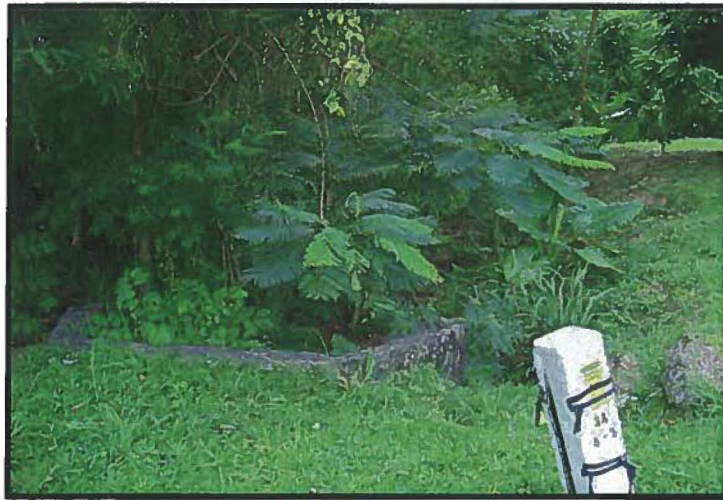
LOCATION: A Quenga St & Assumption Drive

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: This area flows to the 2-36" cross culverts at Rt1. There is a double 36" RCP cross culvert that crosses under A Quenga St, upstream there is an earthen channel and downstream an concrete lined channel, both need debris and vegetation removal with slope stabilization at earthen channel.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is recommended.

COST: \$143,000



PI-105

LOCATION: Assumption Drive

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Cross culvert under Assumption Drive discharges to a tributary to Masso River. Need to clear overgrown vegetation at the downstream end and provide outlet energy dissipation to prevent flooding.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is recommended.

COST: \$143,000



PI-106

LOCATION: Assumption Drive & Masso River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Masso river bridge along Assumption drive. The river overtops and it has been undermining the approach slabs - need to clear all the overgrown vegetation upstream and downstream of the bridge to prevent flooding of bridge. The street pavement at the approach slabs needs to be fixed.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.

COST: \$143,000



PI-107

LOCATION: Chalan Soling & RT 1

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: A concrete/rock channel along Chalan Soling discharges into a triple cross culverts 18"-24" which runs under Rt1 and discharges to the Tepungan Beach. The outlet at the beach is covered with sediment. These cross-culverts should be replaced with a RCB with headwall and wingwalls at both upstream and downstream, and riprap at the downstream end to prevent erosion. Neighboring homes get flooded especially during high tides.

RECOMMENDED IMPROVEMENTS In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 100 linear feet of 3'x3' RCB equipped with headwall/wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including a 200 sq ft energy dissipator located at the downstream side of the culvert is recommended.

COST: \$129,000



PI-108

LOCATION: RT 1 & Atantano River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Bridge along Rt1 over Atantano river. Approach slabs are sinking, there is erosion at approach slabs, and parts of wingwalls missing. Upstream of channel there is significant erosion along embankment. Need to add erosion control(riprap) along upstream embankment and wingwalls.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 50 feet upstream of the bridge is required.

COST: \$143,000



PI-109

LOCATION:

RT 1 & Sasa River

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

Bridge along Rt1 over Sasa river. There is undermining of approach slabs and under a water line that runs parallel to the bridge on the downstream side. Need to incorporate wingwalls to bridge on the downstream side to stop the undermining of road and erosion.

RECOMMENDED IMPROVEMENTS

To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.

COST:

\$143,000



PI-110

LOCATION: RT 6 & Masso River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenan

SITE ASSESSMENT: Where Masso river crosses Rt6 there are signs of flooding of Rt6. River was not visible.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.

COST: \$143,000



PI-111

LOCATION: RT 6 & Assumption Drive

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: At the intersection of Rt6 and Assumption Drive there is a 18" cross culvert that runs parrallel to Rt6 under Assumption Drive. This cross culvert carries flows from Assumption Drive and from Rt6. This culvert should be replaced with a 2'x3' minimum RCB to handle the flow. The runoff from the culvert and a swale from Assumption Drive are collected by a double 18" cross culverts at the interchange of Rt6 and Rt1(northeast corner), the entrance has a straight headwall it needs wingwalls added and debris removal.

RECOMMENDED IMPROVEMENTS In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 100 linear feet of 24" RCP equipped with headwall/wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.

COST: \$158,000



PI-112

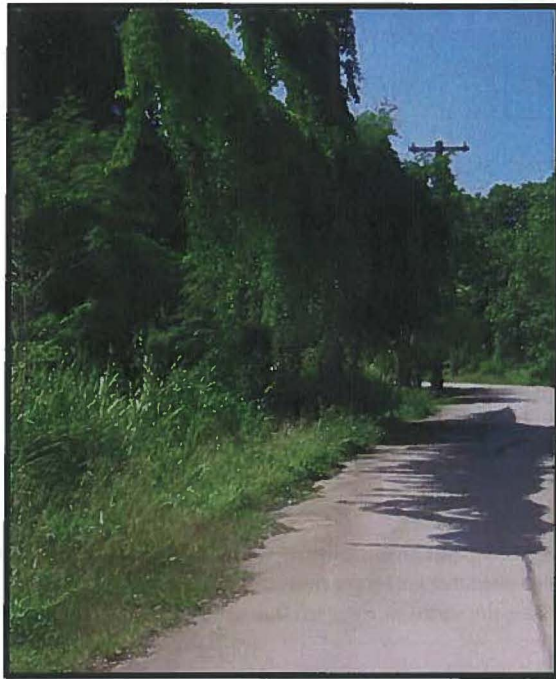
LOCATION: RT 1 & Masso River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Bridge along Rt1 over Masso River. Significant erosion on upstream river embankment, need to add riprap to stabilize area. There is a earthen graded ditch that enters the river on the north east side of the bridge, there is a lot of debris and also erosion undermining the wingwall. Need to clean the debris and line the channel with riprap to stop the undermining of wingwalls.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.

COST: \$143,000



PI-113

LOCATION: A Quanga St

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: There is a cross culvert under this street that couldn't be located, both sides of the road are heavily vegetated with some erosion evident.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is recommended.

COST: \$143,000



PI-114

LOCATION: J.C. Santos & J.M. Tuncap St

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: A graded swale runs along J.C. Santos and discharges to a 24" metal cross culvert that runs under J.M. Tuncap St and discharges at peling St. A house exteded its patio into the graded swale, and the cross culvert has about 1/3 of sediment and debris. Cross culvert should be increased to a 36" RCP and headwall added, and the house patio taken out of the graded swale.

RECOMMENDED IMPROVEMENTS In order to provide sufficient conveyance capacity, the existing 24" culvert should be replaced with 100 linear feet of 36" RCP culvert with headwall/wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris/ sediment removal (and removal of the patio in the flow path) along with erosion control including 1000 sq ft of rip rap channel stabilization placed 50 feet upstream and 50 feet downstream of the culvert is recommended.

COST: \$507,000



PI-115

LOCATION: RT 1 & Taguag River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Cross culvert RCB under Rt1, this is possibly the Taguag river. RCB in good shape, downstream channel needs to remove a palm tree that is growing on the side of the concrete/rock embankment and repair the embankment.

RECOMMENDED IMPROVEMENTS To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is recommended.

COST: \$143,000



PI-116

LOCATION: RT 1 & Tepungan Beach Park

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvemen

SITE ASSESSMENT: A double 36" Cross culvert runs under Rt1 and discharge to the Tepungan Beach Park, just south from the Tepungan Beach Parking lot. The two pipes are covered with sand, one is about 2/3 covered and the other close to 100%. The sand needs to be removed and the area graded so flow can continue to the beach.

RECOMMENDED IMPROVEMENTS Maintenance and improvements need to be made to the existing drainage conveyance system to allow for the flow to be adequately conveyed to the shore. Maintenance including one quarter acre of debris and sediment removal is required. Replacement of the double 36-inch pipes under the parking lot may be required (approximately 100 linear feet of 2 - 36" RCP) and upstream and downstream headwall/wingwall structures with a 200 square foot rip rap outlet energy dissipator is recommended.

COST: \$186,000



PI-118

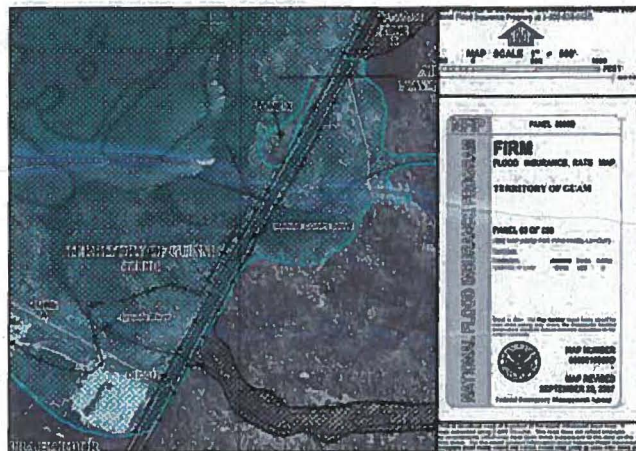
LOCATION: RT 11 & Commercial Port

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: Existing catch basin next to Rt11, it discharges directly to the beach. There is a concern of oil spills from trucks entering and leaving the commercial port. Add a grassed swale to hold any spills.

RECOMMENDED IMPROVEMENTS In order to mitigate water quality concerns along the road, 2-100 linear foot bioswales are proposed for conveyance of runoff along the west side of the road to a grated inlet with a 100 square foot apron located at the low point of the road. The bioswales will be located on both sides of the inlet.

COST: \$37,900



PI-119

LOCATION: RT 1 & Polaris Point

MITIGATION TYPE: Erosion Control/ Storm Drain Improvements/ Conveyance Improvements/ Treatment Improvements

SITE ASSESSMENT: Raise Rt1 over Sasa, Laguas, Agueda and Atantano River flood plains by 1' for Zone X areas and by 2' for Zone A areas. Place grass strips along edges of pavement with gabion walls along raised portions of roadway. Add rip rap stabilization 50' upstream and downstream of each crossing. Place media filters at each side of 4 bridges for on-site drainage system. Add storm drain network (22 catch basins, 6500' of 24" storm drain to media filters).

RECOMMENDED IMPROVEMENTS Raise Rt1 over Sasa, Laguas, Agueda and Atantano River flood plains for a total distance of 13,000 feet (raise 1 ft for a distance of 4000' at Sasa River, raise 2' for a distance of 4000' at Atantano River and raise 2' for a distance of 5000' at Aguada and Laguas Rivers). Place gabions along the edge of right-of-way where necessary to raise roadway elevation (estimated 13,000 CY). Replace an estimated 30,000 SY of pavement along entire length. Add rip rap stabilization of channels for a distance of 50' upstream and downstream of each crossing (estimated 1200 CY of rip rap). Construct storm drain network along raised portion of roadway (estimated 22 catch basins and 6500' of 24" RCP). Where roadway flow is not concentrated, place biostrips along edges of pavement for treatment. Where flow enters storm drain system, add media filters at outlets to treat runoff prior to outleting into offsite waterways (estimated 8 media filters). Bioswales may be an option instead of media filters if right of way is available. Cost estimate assumes media filters.

COST: \$32,300,000

SANTA RITA VILLAGE



SR-101

LOCATION: #746 Obispo Olano(RT 12) & Pale Medina St

MITIGATION TYPE: Erosion Control/ Conveyance Improvement

SITE ASSESSMENT: Private property at 746 Obispo Olano has water seeping through the back hillside. This continuous runoff has been eroding property. Needs a concrete lined channel or a riprap channel to channeliz runoff and stop the erosion. This is probably a water of the U.S. and will need EPA and DPW involvement. Uphill from this property is Santa Rita Spring, which is probably where this water is coming from.

RECOMMENDED IMPROVEMENTS This property will require approximately 200 linear feet of concrete trapezoidal channel to convey flow from what appears to be overflow from a spring located at the back of the property to the front of the property along the edge of right of way. Approximately 1000 SF of rip rap stabilization is also needed at this site for erosion control.

COST: \$142,000

**SR-102****LOCATION:**

Obispo Olano(RT 12) & Pale Medina St

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

Adjacent to 746 Obispo Olano, a new drainage structure and a lined concrete ditch is under construction to route runoff from Pale Medina St. to an existing RCB cross culvert under Obispo Olano. This is a 6'x3' RCB which outlets on the north side of Obispo Olano. Runoff on the downstream end has eroded the natural ground and now there is a 20' drop from the street down to the bottom of the channel. This area needs to be stabilized with riprap or gabions and on top of the box, a fence should be built to protect people from falling into the channel.

RECOMMENDED IMPROVEMENTS

Recommend placement of 20' high gabion walls on each side of the culvert outlet for a distance of 50 feet downstream along with 1000 cubic feet of rip rap placed at the channel bottom for the same distance for erosion control at the site. One quarter acre of debris removal is also needed at this site.

COST:

\$166,000



SR-103

LOCATION: Pale Ramon St

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: A 2-36" cross culvert under Pale Ramon St carry the flow from Obispo Olane. These culverts should be replaced with a 8'x5' RCB, and upstream and downstream needs embankment stabilization (riprap or gabions for about 200') and debris/vegetation removal.

RECOMMENDED IMPROVEMENTS The double 36" RCP cross culvert at this site needs to be replaced with 100 linear feet of 8'x5' RCB and a headwall/wingwall structure with 2000 sq ft rip rap stabilization along the channel bottom and 1000 sq ft gabion placement along the channel sides for a distance of 200 feet upstream and downstream of the culvert. One quarter acre of debris removal is also needed at this site for maintenance and approximately 1000 sq ft of hydromulch with bonded fiber matrix is recommended at the top of the channel.

COST: \$1,010,000

**SR-105****LOCATION:**

Namo Falls Park & Obispo Olano(RT 12)

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

A 36" RCP cross culvert under Namu Falls Rd carries flow from a rock/concrete lined channel upstream which probably carries flow from Rt12 upstream. At this location four homes get flooded. This 36" RCP cross culvert is not sufficient for all the runoff that is routed through the rock/concrete channel - it needs to be upsized to a double 36" RCP cross culvert with headwall upstream and downstream. Also the rock concrete channel sides should be raised, channel embankments upstream and downstream need to be stabilized with riprap, and the road should have curb or dike and overside drains added. There is also another low point along Namu Falls that needs a catch basin and cross culvert added.

RECOMMENDED IMPROVEMENTS

Recommend placement of 100 linear feet of 36" RCP adjacent to existing cross-culvert in order to improve conveyance capacity across roadway at this location. The new cross-culvert should be equipped with new headwall/wingwall structures upstream and downstream of the culvert. Namu Falls Road should also have a storm drain conveyance system consisting of 3 grated catch basins connecting to 100 linear feet of 24" RCP that will connect to the cross-culvert in Namu Falls Road. Channel stabilization of approximately 500 sq ft of rip rap is recommended upstream and downstream of the culvert crossing.

COST:

\$407,000



SR-106

LOCATION: Chalan Pale Duenas Haya & Sgt. Quenga St

MITIGATION TYPE: Erosion Control/ Conveyance Improvement

SITE ASSESSMENT: Existing 36" RCP cross culvert under Chalan Pale Duenas, street gets flooded and downstream embankment has been eroding road. Need to add another 36" RCP cross culvert and stabilize downstream embankment.

RECOMMENDED IMPROVEMENTS The cross culvert at this site needs to be replaced with 100 linear feet of 5'x3' RCB and a headwall/wingwall structure with 100 sq ft rip rap stabilization upstream and downstream of the culvert.

COST: \$284,000

**SR-107**

LOCATION: Pale Ferdinand Way(RT 12A) & High School

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: An onsite drainage system within the school discharges to a dry well that is not handling all the runoff and excess runoff flows to football field. The drainage system consists of a 24" RCP cross culvert that runs under a driveway, then outlets to a concrete lined channel which discharges to the dry well at the southwest corner of the highschool. The solution is to replace the concrete channel to a grass swale and outlet it to a grated catch basin which can connect via a 36" RCP culvert to a City system along Pale Ferdinand Way.

RECOMMENDED IMPROVEMENTS Recommend maintenance at the site including one quarter acre of debris removal, placement of a headwall/wingwall structure with a 100 sq ft rip rap energy dissipator located at the existing 24" RCP outlet, replacement of the existing concrete channel with a swale, placement of a 100-sq ft energy dissipater at the downstream end of the swale connecting to a new double 5'x3.5' RCB approximately 100' in length (sized per the Flood Control Document) and equipped with a headwall/wingwall structure. The new culvert will connect to the City system in Pale Ferdinand Way.

COST: \$191,000



SR-108

LOCATION:

Sumay Memorial St (RT 12A)

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT:

An existing 24" RCP cross culvert runs at an angle under Sumay Memorial St. This cross culvert is broken and is causing the roadway to collapse, also due to the alignment of the culvert the upstream headwall does not seem to be capturing all the runoff and the downstream end is covered with excessive debris and trash. Cross culvert should be replaced with a double 36" RCP cross culvert and aligned perpendicular to road and add a new headwalls upstream and downstream also with embankment stabilization both upstream and downstream.

RECOMMENDED IMPROVEMENTS

The cross culvert at this site needs to be replaced with 100 linear feet of 36" RCP, a headwall/wingwall structure with 500 sq ft rip rap stabilization (approximately 25 feet in length) upstream and downstream of the culvert and maintenance including a quarter acre of debris removal.

COST:

\$298,000



SR-109

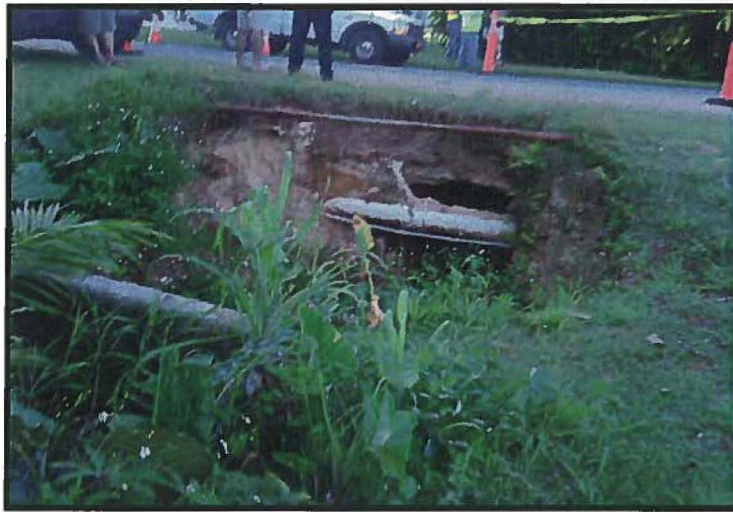
LOCATION: RT 17 & Aplacho River

MITIGATION TYPE: Storm Drain Improvement/ Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Bridge along Rt17 over Aplacho river. There is undermining of approach slabs and ponding, also embankment erosion. Need to add overside drains at all four corners of bridge to prevent ponding and embankment stabilization both upstream and downstream(riprap), along with debris and vegetation removal.

RECOMMENDED IMPROVEMENTS To prevent further undermining of approach slabs and ponding, placement of 2 overside drains is recommended along with one quarter acre of debris removal upstream and downstream of the bridge and 1,000 square feet of rip rap channel stabilization placed a distance of 50 feet upstream and downstream of the bridge.

COST: \$146,000



SR-110

LOCATION: RT 17

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: All existing CMP cross culverts under Rt17 need to be replaced with RCP cross culverts.

RECOMMENDED IMPROVEMENTS An estimated 5 CMP cross-culverts along Rte 17 (North of Aplacho River) from Iseke Street to Bishop FC Flores Street within the Village of Santa Rita must be replaced with RCP. Each crossing will require the addition of headwalls upstream and downstream of the culverts and an estimated 100-ft of culvert. For cost estimating purposes, all cross-culverts are assumed to be 36-inch RCP (totaling 500 linear feet of 36" RCP).

COST: \$693,000



SR-111

LOCATION:

Vicente S Borja Dr & RT 17

MITIGATION TYPE:

Storm Drain Improvement/ Conveyance Improvement

SITE ASSESSMENT:

An existing double 12" cross culvert routes flow under Vicente S. Borja Dr and discharges to an RCB that runs under a house, which outlets to Aplacho river. Upstream, a concrete ditch was enclosed and now is functioning as an RCB. The double 12" cross culverts should be replaced with a 4'x4' RCB and existing swales along the street need to be improved in order to function properly.

RECOMMENDED IMPROVEMENTS

The dual 12" RCP cross culvert at this site needs to be replaced with 100 linear feet of 4'x4' RCB equipped with a headwall and 100 sq ft rip rap channel stabilization at the upstream and downstream ends.

COST:

\$165,000



SR-112

LOCATION: Felix T Pangelinan Dr & RT 17

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: A 12" RCP cross culvert runs under Felix T Pangelinan Drive. The downstream used to be a 15' wide easement where the runoff will continue down to Vicente S. Borja Dr via a 36" RCP behind two properties. Two properties have encroached into the 15' easement - they have built two concrete block walls and now only about 1.5' is left to route runoff. Between the two retaining walls, a well defined concrete channel that can handle the runoff should be built.

RECOMMENDED IMPROVEMENTS The 36" RCP cross culvert at this site needs to be replaced with 100 linear feet of 6'x4' RCB (sized in accordance with the Flood Control Document) equipped with a headwall/wingwall structure at the upstream and downstream ends. Recommend an 18" rectangular concrete ditch (estimated at 500 feet in length) be placed between the existing retaining wall structures that will convey the flow to the upstream side of the 6'x4' RCB.

COST: \$219,000



SR-113

LOCATION: Felix T Dydasco Dr & RT 17

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Improvement

SITE ASSESSMENT: Felix Dydasco Dr does not have any drainage conveyance system to outlet runoff properly and it ponds the street. Runoff from this street flows to Felix T. Pangelinan Dr. Need to add a cross gutter across street to prevent ponding, and to allow runoff flow downstream.

RECOMMENDED IMPROVEMENTS Place a storm drain system along Felix Dydasco Dr consisting of 100' of concrete ditch, 100 linear feet of a 6'x4' RCB (per Flood Control Document) with a headwall/wingwall structure upstream and downstream of the culvert.

COST: \$259,000



SR-114

LOCATION: RT 17 & Felix T Dydasco Dr

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: Runoff from Rt17 flows towards Felix T. Dydasco Dr. Need to add swales along Rt17 to keep runoff from entering Felix T. Dydasco Dr, and outlet the swales towards Felix T. Pangelinan Dr where the runoff can be routed.

RECOMMENDED IMPROVEMENTS Recommend grading a 1,000 linear foot ditch along Rte 17 to convey flow downstream of Felix T. Dydasco Drive toward Felix T. Pangelinan Dr. Recommend placing a 36" culvert under Felix T. Dydasco Drive to convey flow upstream of the road to the ditch downstream of the road. The culvert should include approximately 100'x36" RCP and headwalls with 100 sq ft rip rap stabilization placed upstream and downstream of the culvert.

COST: \$174,000



SR-115

LOCATION: RT 12 & Navy

MITIGATION TYPE: Erosion Control/ Storm Drain Improvement

SITE ASSESSMENT: Runoff from the Navy is being routed via cross culverts under Rt12. Need to add headwalls to these existing cross culverts, a connecting storm drain system and embankment stabilization upstream and downstream of these cross culverts.

RECOMMENDED IMPROVEMENTS Recommend adding headwall/wingwall structures with 100 sq ft rip rap energy dissipators to the upstream and downstream ends of the existing cross culverts at Rte 12. A storm drain system connecting to these cross culverts is needed along Rte 12 consisting of a 200 linear foot ditch adjacent to both sides of the crowned road conveying flow to a catch basin located at the low point on both sides of the road. The catch basins will be connected to a new 24" RCP in the road that will route flow to the cross culvert.

COST: \$168,000



SR-116

LOCATION:

RT 12 & Navy Base Entrance

MITIGATION TYPE:

Storm Drain Improvement/ Conveyance Maintenance

SITE ASSESSMENT:

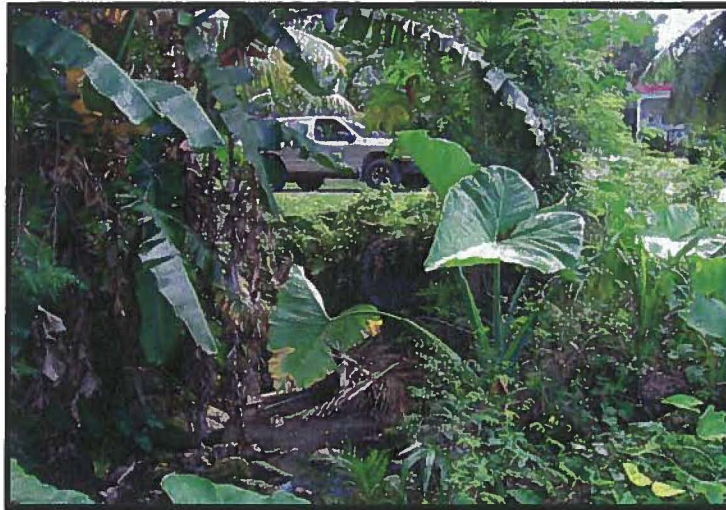
A trapezoidal concrete channel at the entrance of the navy base needs debris removal, couldn't locate outlet.

**RECOMMENDED
IMPROVEMENTS**

A quarter acre of debris removal and the replacement of one catch basin is recommended at the end of the concrete trapezoidal ditch at this site. The system is assumed to connect to an existing storm drain system in the road.

COST:

\$7,890



SR-117

LOCATION: Juan P Sarmiento Dr & Pedro Roberto Dr (Rt12)

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: Two 48" RCP cross culverts run under Juan P. Sarmiento Dr. These two culverts are on top of each other there is significant embankment erosion both upstream and downstream. Replace cross culverts with a 8'x5' RCB cross culvert with headwall and wingwalls both upstream and downstream. Need also to clear debris and vegetation upstream and downstream.

RECOMMENDED IMPROVEMENTS The double 48" RCP cross culvert at this site needs to be replaced with 100 linear feet of 8'x5' RCB and a headwall/wingwall structure with 500 sq ft rip rap stabilization upstream and downstream of the culvert. One quarter acre of debris removal is also needed at this site.

COST: \$465,000



SR-118

LOCATION: Vicente D. Lizama Dr & Pedro Roberto Dr (RT 12)

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: Along the north side of Vicente D. Lizama Dr a series of 24" RCP cross culverts and swales route runoff towards a junction structure at Rt12. The upstream channel need debris removal and embankment stabilization, the receiving junction structure outlets to a channel that needs debris and vegetation removal and embankment stabilization.

RECOMMENDED IMPROVEMENTS In order to provide sufficient erosion control, the channel located upstream of Route 12 (along the north side of Vicente D. Lizama Drive) should be stabilized with 500 sq ft of rip rap for a distance of approximately 25 feet and the channel located downstream of the structure should be stabilized for a distance of 25 feet with 500 sq ft of rip rap A quarter acre of debris removal, and placement of two headwalls with wingwalls (one upstream of Rte 12 and one downstream of Rte 12) are also recommended.

COST: \$177,000



SR-119

LOCATION:

Pedro Roberto Dr (Rt12) & RT 17 & RT 5

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT:

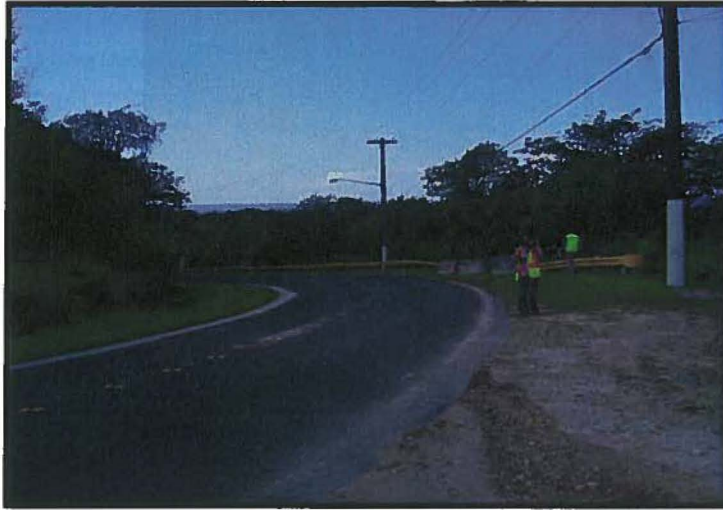
A 36" CMP under Rt17 routes flow from an upstream channel along Pedro Roberto Dr and discharges to another channel downstream. This 36" CMP cross culvert needs to be replaced with a 33'x3' RCB along with the upstream headwall. Both upstream and downstream channels need debris and vegetation removal and embankment stabilization.

RECOMMENDED IMPROVEMENTS

The 36" CMP cross culvert at this site needs to be replaced with 100 linear feet of 3'x3' RCB equipped with a headwall/wingwall structure and 500 sq ft rip rap channel stabilization at the upstream and downstream ends.

COST:

\$242,000



SR-120

LOCATION: Obispo Olano(RT 12) & Namo Falls Park

MITIGATION TYPE: Erosion Control/ Storm Drain Improvement/ Storm Drain Maintenance

SITE ASSESSMENT: Along Rt12 at a curve just north of Namo Falls Park the roadway is being undermined. Need to stabilize roadway embankment with riprap and need to add ac overside drains.

RECOMMENDED IMPROVEMENTS Recommend placement of an AC Spillway along Rte 12 at this location and 2,000 square feet of rip rap stabilization for erosion control. Maintenance in the form of one quarter acre debris removal is also needed.

COST \$285,000

SINAJANA VILLAGE



SV-101

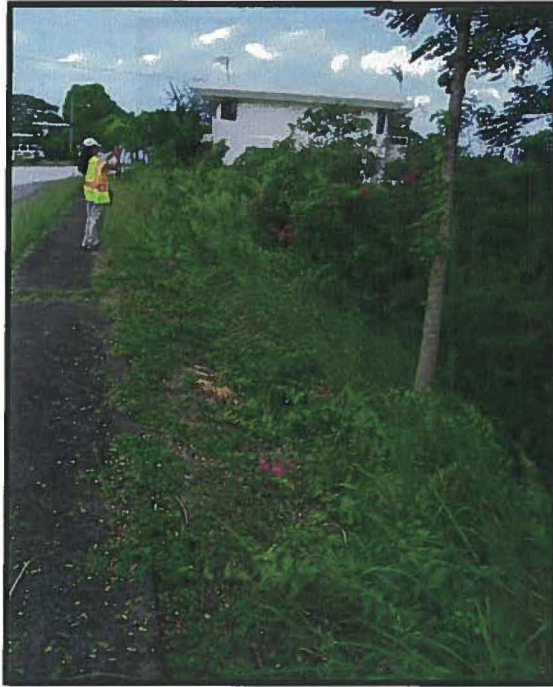
LOCATION: Chalan Gumayuus & Pipino Ct

MITIGATION TYPE: Erosion Control/ Treatment BMP Improvement

SITE ASSESSMENT: Infiltration basin where runoff entering the basin from the street has been eroding adjacent property. Need to stabilize basin embankment next to the private property with gabions.

RECOMMENDED IMPROVEMENTS To prevent further erosion of infiltration basin embankment and to the adjacent property at this site, a quarter acre of debris removal followed by placement of 400 SF of gabions along the infiltration basin embankment and placement of approximately 100 square feet of rip rap at the bottom of the gabions is recommended.

COST: \$72,300



SV-102

LOCATION: RT 24A

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Street embankment on the east side needs stabilization, the slope is very steep and embankment has been eroding and may begin undermining roadway.

RECOMMENDED IMPROVEMENTS To prevent further erosion, a quarter acre of debris removal followed by placement along the road embankment of approximately 500 square feet of rip rap stabilization is needed.

COST: \$52,400

TALOFOFO VILLAGE



TA-101

LOCATION: E Johnny S Taitague St & San Miguel St

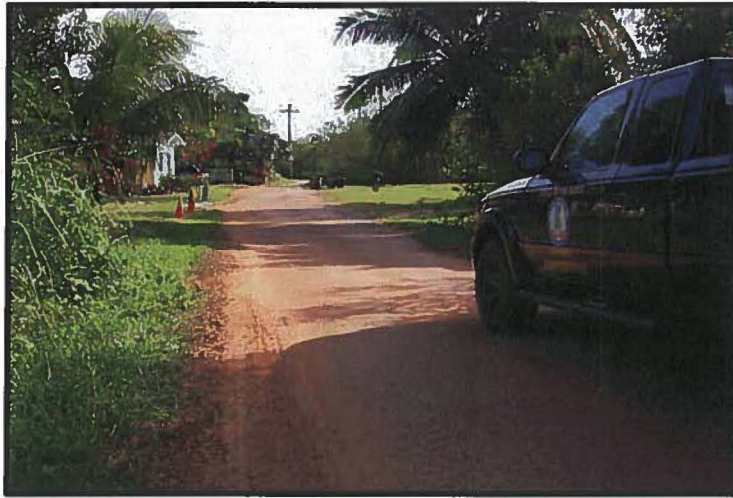
MITIGATION TYPE: Storm Drain Improvement/ Treatment BMP Improvement

VILLAGE RANKING 14

SITE ASSESSMENT: 24" RCP cross culvert under E Johnny S Taitague St needs headwalls upstream and downstream. Possible floods one property and also street. Add drainage system to street.

RECOMMENDED IMPROVEMENTS To prevent flooding, construct a storm drainage system along E Johnny S Taitague Street consisting of 500' of channel located on both sides of low point. At low point, add 1 catch basin equipped with apron connecting to existing 24" RCP cross-culvert outletting flow into a 100 square foot rip rap energy dissipator to a bioswale.

COST: \$134,000



TA-102

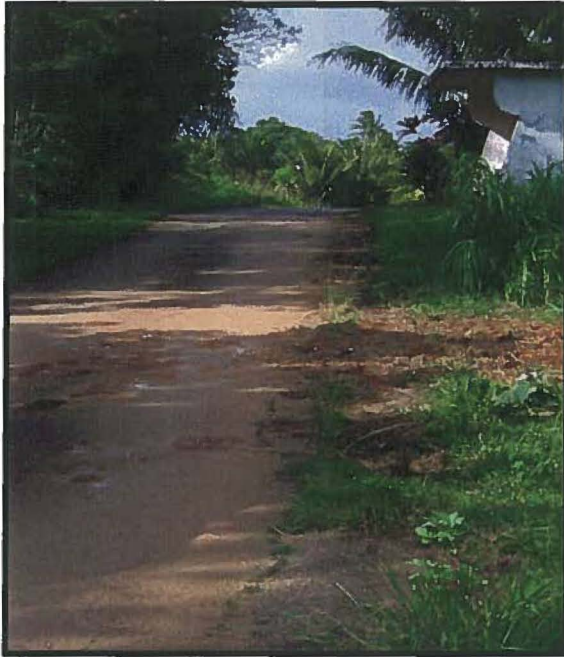
LOCATION: Ignacio P Quitugua & Jose P Cruz St

MITIGATION TYPE: Storm Drain Improvement/ Treatment BMP Maintenance/ Treatment BMP Improvement

SITE ASSESSMENT: At low point of Ignacio P Quitugua St south of Jose P Cruz St the existing infiltration basin does not work. Need to clear infiltration basin of debris and overgrown vegetation in order to make it work. Also increase depth of basin to add more capacity.

RECOMMENDED IMPROVEMENTS Existing infiltration basin is under capacity. Propose a new, deeper infiltration basin at the same site with a depth of 6 feet, width of 50 feet, and length of 200 feet with 500 linear feet of fencing. Also add an AC spillway to route street runoff into new infiltration basin at this site.

COST: \$120,000



TA-103

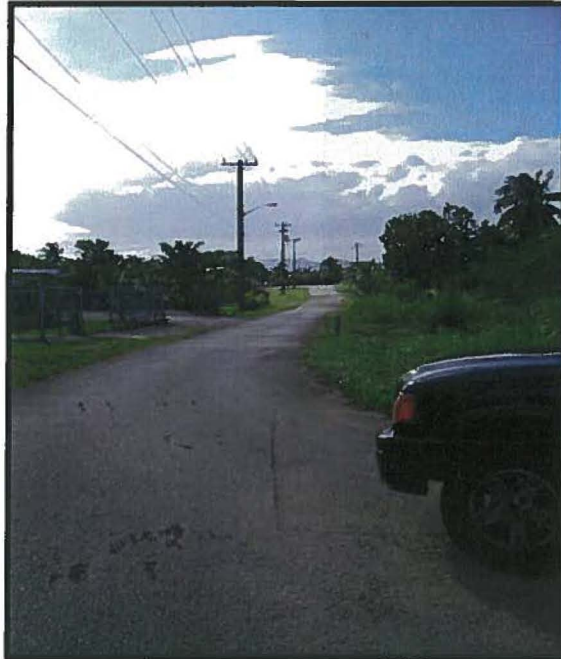
LOCATION: Ignacio P Quitugua

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: Add a drainage conveyance system to collect street runoff, and route to the infiltration basin.

RECOMMENDED IMPROVEMENTS A storm drain system is needed to collect and convey street runoff along Ignacio P Quitugua Street. Propose one catch basin placed at the street's low point, and convey flow to the proposed infiltration basin via 300 linear feet of 24" RCP. Pipeline outlet shall consist of a headwall/wingwall structure with a 100 square foot rip rap energy dissipator located at the infiltration basin.

COST: \$320,000



TA-104

LOCATION: Francisco A Reyes Ave & Ignacio P Quitugua

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: Add swales and cross gutters along north side of Francisco A Reyes Ave. East of Ignacio P. Quitugua will be routed to the infiltration basin at Ignacio P. Quitagua. West of Ignacio P. Quitugua runoff will be routed to the 36" RCP cross culvert at David Gorton St.

RECOMMENDED IMPROVEMENTS A conveyance system is needed to collect and convey street runoff along the north side of Francisco A. Reyes Ave. The system will consist of approximately 1,000 linear ft of concrete ditch with interim culverts located at driveways (consisting of approximately 100 linear foot of 12" RCP and 6 headwall/wingwall structures). The ditch will route flow to the infiltration basin at Ignacio P. Quitugua.

COST: \$173,000



TA-105

LOCATION: Francisco A Reyes Ave & Leonardo C Tenorio St

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: Add a drainage conveyance system along Francisco A Reyes Ave and route to will be routed to the 36" RCP cross culvert at David Gorton St.

RECOMMENDED IMPROVEMENTS A conveyance system is needed to collect and convey street runoff along Francisco A. Reyes Ave. (West of Ignacio P. Quitugua). The system will consist of approximately 2,000 linear ft of concrete ditch with interim culverts located at driveways (consisting of approximately 200 linear foot of 12" RCP and 12 headwall/wingwall structures). The ditch will route flow to the 36" RCP cross culvert at David Gorton Street.

COST: \$390,000



TA-106

LOCATION: Leonardo C Tenorio & Jose P Cruz St

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: Add a drainage conveyance system (swales and cross culverts) along Leonardo C Tenorio St towards Jose P. Cruz St. From Jose P. Cruz add another drainage conveyance system and bring it west to the fire station where runoff can outlet towards the Togcha river.

RECOMMENDED IMPROVEMENTS A conveyance system is needed to collect and convey street runoff along Leonardo C Tenorio Street. The system will consist of approximately 2,000 linear ft of concrete ditch with interim culverts located at driveways (consisting of approximately 200 linear foot of 12" RCP and 12 headwall/wingwall structures). The ditch will route flow toward Jose P Cruz, then westerly to the fire station, outleting to an existing flow path toward the Togcha River.

COST: \$390,000



TA-107

LOCATION: Jose P Cruz St & N. San Miguel St

MITIGATION TYPE: Storm Drain Improvement/ Treatment BMP Improvement

SITE ASSESSMENT: Along Jose P. Cruz St just east of N. San Miguel St a street low point is located and one house gets flooded. Need to add a drainage conveyance system (swales and cross culverts) to route runoff to the west along Jose P Cruz St (towards the fire station).

RECOMMENDED IMPROVEMENTS To prevent future flooding, construct a storm drain system along Jose P. Cruz Street. Place two catch basins at the street's low point connecting to 100 linear feet of 24" RCP (routing flow westerly) equipped with a headwall/wingwall structure and a 100 square foot rip rap energy dissipator at its outlet. Add a 100 linear foot bioswale to the end of the energy dissipator.

COST: \$153,000



TA-108

LOCATION: David Gorton St & Jose P Cruz St

MITIGATION TYPE: Conveyance Improvement/ Conveyance Maintenance/ Treatment BMP Improvement

SITE ASSESSMENT: A 36" RCP cross culvert runs under David Gorton St where a low point is located(south of Jose P. Cruz St). This is the lowest point of Talofofo village and most of the village runoff is routed to this low point. The cross culvert is clogged with debris and sediment. It floods about four properties. Need to upsize system to accomodate all runoff and clear upstream and downstream of debris and overgrown vegetation.

RECOMMENDED IMPROVEMENTS To prevent further flooding of area properties it is necessary to upsize the current conveyance system. The 36" RCP clvert should be replaced with 100 linear foot of 48" RCP equipped with headwall/wingwall structures on the upstream and downstream side. Downstream, a 100 sq ft rip rap energy dissipator and 200-ft bioswale is recommended.

COST: \$188,000



TA-109

LOCATION: Juan P Mantanona St & David Gorton St

MITIGATION TYPE: Conveyance Improvement

SITE ASSESSMENT: Add swales on both sides of Juan P Mantanona St to route runoff from David Gordon St and also from Juan P Mantanona to an existing wetland at the end of the street.

RECOMMENDED IMPROVEMENTS Construct a conveyance system to route runoff from David Gordon Street and Juan Mantanona Street to an existing wetland at the end of Juan Mantanona Street. Construct ditches along both streets (totaling approximately 2,000 linear ft of concrete ditch), with interim culverts located at driveways (consisting of approximately 200 linear foot of 12" RCP and 12 headwall/wingwall structures).

COST: \$390,000



TA-110

LOCATION:

Ernest P Santos St & Siguansa

MITIGATION TYPE:

Conveyance Maintenance/ Storm Drain Improvement

SITE ASSESSMENT:

An existing catch basin at the intersection of Ernest P Santos St and Siguansa has been plugged. The 36" RCP outlet pipe needs to be unplugged and extended along Siguansa for about 200' to an existing wetland (federal easement).

RECOMMENDED IMPROVEMENTS

Replace existing catch basin and connect 300 linear feet of 24" RCP to existing RCP. Equip outlet with a headwall/wingwall structure and a 100 square foot rip rap energy dissipator.

COST:

\$320,000



TA-111

LOCATION: Pasaderun Francisco Diego & Ernest P Santos St

MITIGATION TYPE: Storm Drain Improvement/ Treatment BMP Improvement

SITE ASSESSMENT: Runoff from Ernest P Santo St floods five homes along Pasaderun Francisco Diego. Add a drainage conveyance system (Catch basin and 24" culverts) along Ernest P Santos St from its street high point (north of Pasaderun Francisco Diego) and route it to Siguenza to the existing wetland, this will capture all runoff from Ernest P. Santo St and should prevent flooding of Pasaderun Francisco Diego.

RECOMMENDED IMPROVEMENTS Runoff floods several homes at this site. A drainage conveyance system needs to be added along Ernest P Santos street conveying runoff from its high point to the wetlands at Siguenza. The flow will be captured with two catch basins (one on each side of the street) at the low point in the road. The catch basins will connect to approximately 200 linear feet of 24" RCP with a headwall/wingwall structure and 100 square foot rip rap energy dissipator at its outlet. Construct a 100 linear foot bioswale downstream prior to conveyance to the wetland.

COST: \$247,000



TA-112

LOCATION:

RT 4 & Togcha River

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

Bridge along Rt4 over Togcha river. There is erosion on bridge embankment both upstream and downstream, need to add embankment stabilization (riprap), and need to clear debris and overgrown vegetation.

RECOMMENDED IMPROVEMENTS

To prevent further erosion on the bridge embankment at this site, remove approximately 1,000 square feet of debris at bridge embankments and add approximately 1000 sq ft of rip rap (500 sq feet along each embankment) for embankment stabilization.

COST:

\$143,000



TA-113

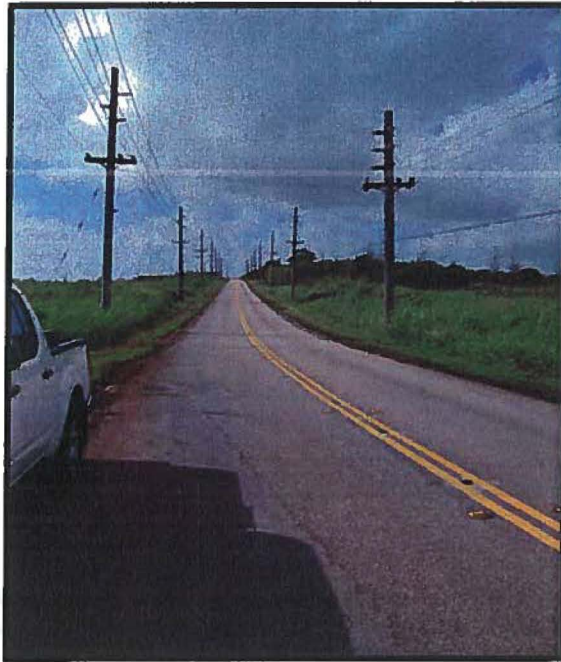
LOCATION: RT 4 & Pacifico Drive

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: At the intersection of Rt4 and Pacifico Drive two properties gets flooded(Pacifico Drive #108 and #113). Need to add a catch basin at each corner of Pacifico Drive and connect them via a 24" RCP then route it via another 24" RCP to the low point along Rt4 where another cross culvert with headwall will route runoff to the east where it will outlet to the Pacific ocean.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties at this site, construct a storm drain system consisting of 4 catch basins (one at each corner of Pacifico Drive) connected by approximately 400 linear feet of 24" RCP routing flow easterly to an outlet equipped with a headwall/wingwall structure outletting to a 100 square foot rip rap energy dissipator prior to outletting to the Pacific Ocean.

COST: \$432,000



TA-114

LOCATION:

RT 4A

MITIGATION TYPE:

Conveyance Improvement/ Storm Drain Improvement

SITE ASSESSMENT:

Low area along Rt4A and water ponds. Need to add a drainage conveyance system to the south side of the road.

**RECOMMENDED
IMPROVEMENTS**

To prevent future ponding at the Rte 4A low point, construct a drainage conveyance system along both sides of the road consisting of approximately 3000 LF of ditch on both sides of the low point. Capture flow with two catch basins and convey flow to the south using approximately 50' of 24" RCP.

COST:

\$86,800



TA-115

LOCATION: RT 4 & Golf Course

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: At a low point along Rt4 next to the golf course, two grated catch basins need to be improved to be more effective. Depress grate and add a concrete apron.

RECOMMENDED IMPROVEMENTS There are currently 2 catch basins at this site that need to be replaced with 2 new grated catch basins with aprons to improve interception capacity.

COST: \$11,900



TA-116

LOCATION: RT 4 & Talofoto Beach Park

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Need to extend and raise existing jetty and extend riprap to talofoto beach to stop erosion of beach.

RECOMMENDED IMPROVEMENTS To prevent further shoreline erosion as a result of high tides, install 20,000 square feet of rip rap coastal stabilization (approximately 10-ft wide along the shoreline) for a distance of approximately 2000 feet along Talofoto Beach at Rte 4.

COST: \$2,810,000

TAMUNING VILLAGE



TV-101

LOCATION:

RT 1 & Jalaguac wy

MITIGATION TYPE:

Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT:

Runoff from the airport floods the area around the Pizza Hut along Rt1 and Jalagua way. Need to capture runoff at airport to prevent this flooding. Also clear debris and add channel to route flow to Tamuning Drainageway. Add erosion control downstream of bluffs.

RECOMMENDED IMPROVEMENTS

To prevent future flooding in this area, construction of a 200 linear foot concrete trapezoidal channel routing flow from Jalagua Way to the Tamuning Drainageway is proposed. A quarter acre of debris removal will be needed along with erosion control at the channel outlet in the form of 1,000 square feet of rip rap.

COST:

\$314,000



TV-102

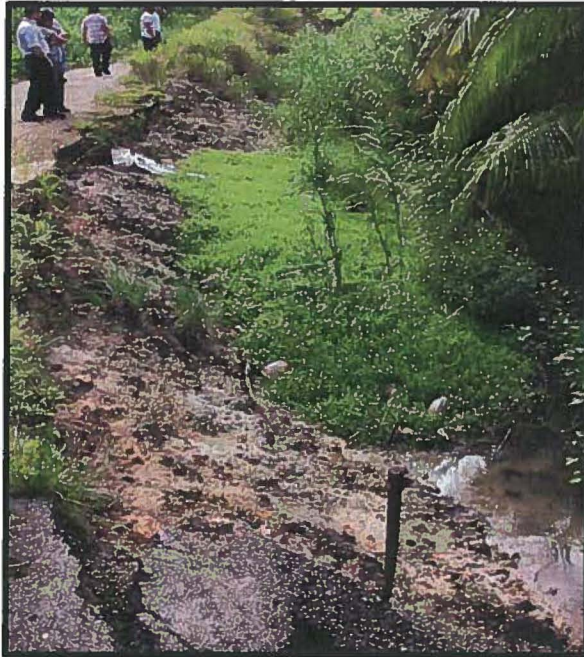
LOCATION: Tun Josen Tovas Way

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: Runoff from the airport floods this area along Tun Josen tovas Way. Need to capture runoff at airport to prevent this flooding. Add drainage system to prevent flooding in road.

RECOMMENDED IMPROVEMENTS To prevent future flooding in this area, construction of a storm drainage system in this area is required. Construction of 2 catch basins along Tun Josen Tovas Way, connected to 100' of 24" RCP which routes flow to a double 3'x5' RCB is recommended. Approximately 200 linear feet of the RCB will be required to convey flow southerly toward the proposed concrete trap channel at Jalagua Way. An easement will be required for this RCB.

COST: \$315,000



TV-103

LOCATION: Tamuning Outlet Channel

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: Tamuning Drainage Way Channel is highly eroded and needs stabilization for entire length to coast along with debris removal.

RECOMMENDED IMPROVEMENTS Conveyance maintenance and improvement is needed along the entirety of the Tamuning Drainage Way Channel from Rte 1 to the coast (approximately 2500 feet). Maintenance including approximately five acres of debris removal is needed along with embankment stabilization for both embankments along the 2500 ft length (estimated at 50,000 sq ft of rip rap along each embankment).

COST: \$14,100,000



TV-104

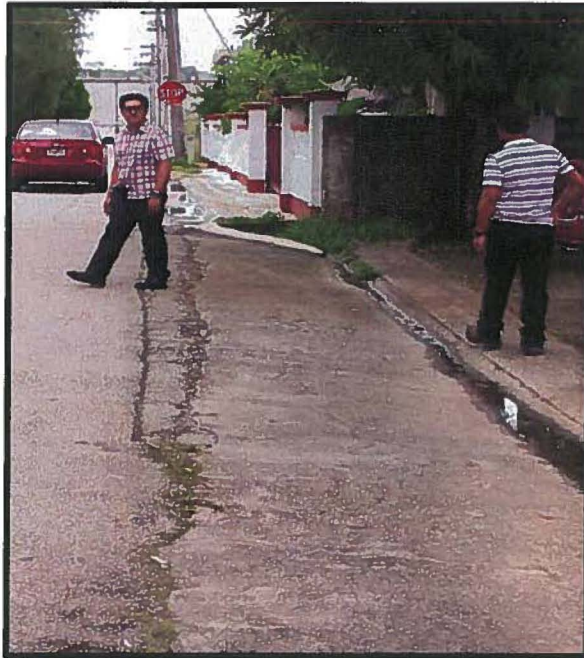
LOCATION: Estrellita Court

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: A storm drain discharges to a private property. Need to route storm drain to a drainage conveyance system along Rt1.

RECOMMENDED IMPROVEMENTS At this site, a storm drain at the end of Estrillita Court discharges to a private property. It is recommended that a storm drain pipeline be installed at the outlet of the pipe to convey flow westerly (requiring an easement on the existing parcel) to a utility/ street easement located on the west side of the parcel. Along this existing easement, the pipeline should be routed southerly to outlet to the natural flow path of the terrain that eventually drains to the corner of Rte 14 and Pale Leon Murphy Street. The proposed improvements include 400 linear feet of pipeline (24 to 36 inch), 2 junction structures, and an outlet consisting of a headwall/wingwall with a 100 square foot rip rap energy dissipator.

COST: \$420,000



TV-105

LOCATION: N. Sgt David Camacho St

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: There is no drainage conveyance system along this street. Need to add a drainage conveyance system (and possibly infiltration trenches to outlet flow) in order to prevent flooding of street and private properties.

RECOMMENDED IMPROVEMENTS A drainage conveyance system is needed along N. Sgt David Camacho Street to prevent future flooding of the street and surrounding private properties. Recommendations include placement of approximately 200 linear feet of ditch adjacent to the street routing flow to a 200 linear ft infiltration trench.

COST: \$21,000



TV-106

LOCATION:

Sand Castle & Pale San Vitores Rd

MITIGATION TYPE:

Storm Drain Improvement

SITE ASSESSMENT:

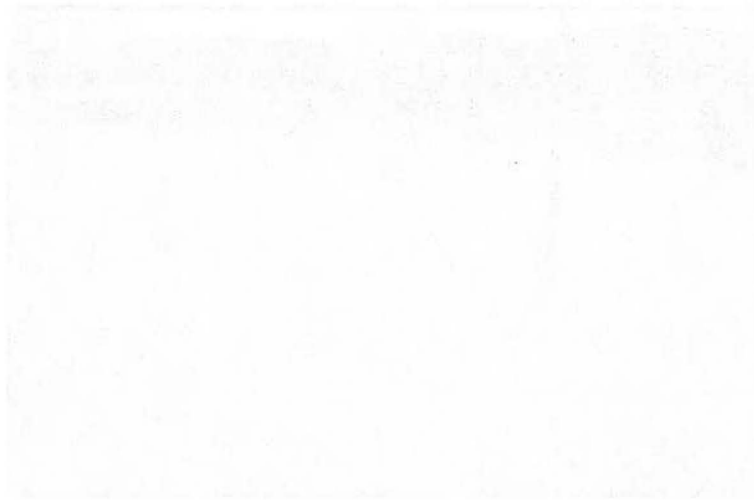
The back of San Castle property gets flooded since a new development is under construction in the back and has created a low point where water ponds. Owners of Sand Castle have installed a pump to pump the water out to Pale San Vitores(Rt14) via a pvc pipe. The pump is a temporary solution.

RECOMMENDED IMPROVEMENTS

A new development that is being constructed behind the Sand Castle property has created a low point in the back of the property causing flooding. It is recommended that the runoff at the back of the property be intercepted and conveyed to the front of the property and connected to the existing storm drain system in Pale San Vitores Rd. The system would consist of 2 catch basins connecting to 100 feet of 24" RCP that would route the runoff to the existing storm drain system.

COST:

\$106,000



TV-107

LOCATION: Fujita Rd

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: This road does not have a drainage conveyance system and runoff flows to Tumon Bay without treatment. Need to add a drainage conveyance system along road to capture and treat runoff before being discharged to bay.

RECOMMENDED IMPROVEMENTS Fujita Rd has no drainage system in this area. A drainage conveyance system is needed along the road to capture and convey the runoff to the Fujita Ponding Basin. The system consists of 2 grated catch basins placed at the low point of the crowned roadway (on both sides of the road), connecting to 100 linear feet of 24" RCP outleting to the adjacent ponding basin with a headwall/ wingwall structure and a 100 square foot rip rap energy dissipator placed at the outlet.

COST: \$137,000



TV-108

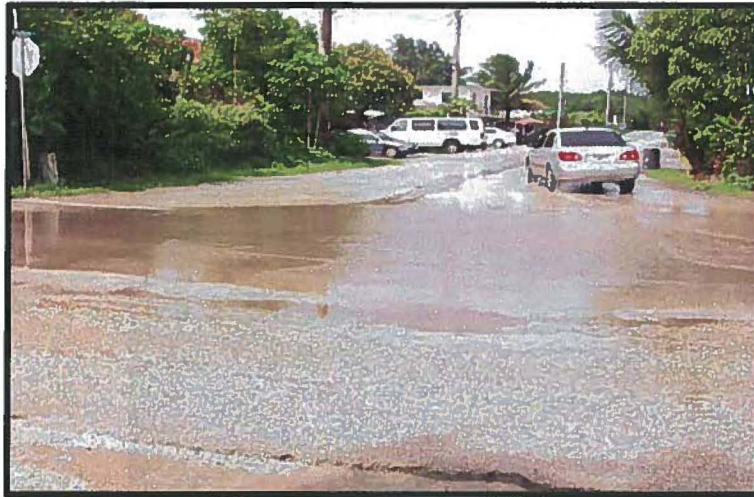
LOCATION: RT 27 & McDonalds

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: There is no drainage conveyance system along this route. Need to build a drainage conveyance system. Possible solution will be to build infiltration trenches along the route.

RECOMMENDED IMPROVEMENTS A storm drain system along this section of Rte 27 is required to alleviate flooding at this site. In order to capture and convey flow at this site, a system including two catch basins connecting to approximately 400 linear feet of 36" RCP routing flow to the storm drain system in Rte 16 is recommended.

COST: \$597,000



TV-109

LOCATION: RT 27 & Anthurium Ln

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At the intersection of Rt27 and Anthurum Ln no drainage conveyance system exists and this interchange constantly floods. Need to build a drainage conveyance system, possible solution will be to build infiltration trenches along Rt27 and along Anthurium Ln.

RECOMMENDED IMPROVEMENTS The lack of a drainage conveyance system along Rte 27 in this area causes constant flooding. A storm drainage system is recommended in Rte 27, capturing runoff at the low point in the crowned roadway with two catch basins connecting to 400 linear feet of 24" RCP outletting to a 100 square foot rip rap energy dissipator. At the outlet, installation of a 200 foot infiltration trench is proposed to resolve the flooding problems that currently take place at this site.

COST: \$423,000



TV-110

LOCATION:

RT 27 & RT 1

MITIGATION TYPE:

Storm Drain Improvement

SITE ASSESSMENT:

There is a local depression at the interchange of Rt27 and Rt1. Need to add a drainage conveyance system to capture runoff at the low point(catch basin) and connect this system to existing system along Rt1. The low point is creating ponding of retail/commercial properties.

RECOMMENDED IMPROVEMENTS

To avoid further ponding of retail/commercial properties at this intersection, a storm drainage system is needed to intercept and convey flow from Rte 27 to Rte 1. The system will consist of 2 grated catch basins located at the low point along Rte 27 (on both sides of the street), connecting into the existing Rte 1 drainage system via 200 linear feet of 24" RCP.

COST:

\$140,000

UMATAC VILLAGE



UM-101

LOCATION: RT 2 & Umatac River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT: River bed and bay need to be dredged. Need embankment stabilization upstream of bridge(riprap, gabions), need to clear all overgrown vegetation and debris. Due to the accumulation of sediment on the river bed the river capacity has diminished and is causing homes within the river proximity to get flooded, on the last flooding two homes were flooded on the south side of the river.

RECOMMENDED IMPROVEMENTS To prevent further loss of the river bed and flooding of surrounding homes, approximately two acres of debris removal to clear out all overgrown vegetation and accumulated debris and approximately 2,000 cubic yards of sediment removal is required at the site. Embankment stabilization (both sides) is required from the shoreline upstream for approximately 1000 feet (totaling 20,000 square feet of rip rap placement) as a means of implementing erosion control and to maintain the conveyance system.

COST: \$2,820,000



UM-102

LOCATION:

Finona St & Madog River

MITIGATION TYPE:

Erosion Control/ Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT:

A home has been flooded by the river at the end of Finona St. Soils and rocks were brought to the property to keep the river from flooding the home. This is a temporary solution to the problem. The river alignment needs to be re-aligned to prevent continued flooding of this property, and the river bottom should also be dredged at this location to remove the accumulated sediment. Other two homes have been flooded in this area but not as bad as the home at the end of the street.

RECOMMENDED IMPROVEMENTS

To prevent further flooding of area properties/homes, recommend one acre of debris removal along with 1000 cubic yards of sediment removal within the channel to minimize meandering and improve capacity. Also recommend stabilization of the river embankment through the placement of 10,000 square feet of rip rap channel stabilization for a distance of approximately 400 feet downstream of the site and 100 feet upstream of the site.

COST:

\$1,420,000



UM-103

LOCATION:

Finona St & Jose A Quintana St

MITIGATION TYPE:

Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT:

2-24" RCP cross culverts run under Finona St. These two culverts route runoff to the Umatac river, and the downstream side of the culverts have significant erosion. Need to remove debris both upstream and downstream, and also clear any overgrown vegetation and the downstream side of the culverts need embankment stabilization(riprap).

RECOMMENDED IMPROVEMENTS

A quarter acre of debris removal is needed to clear accumulated debris and any overgrown vegetation uprstream and downstream of the existing culverts crossing Finona Street. It is also recommended that an additional 100 linear feet of 24" RCP be placed adjacent to the existing dual 24" RCP culverts to improve capacity and the upstream and downstream headwalls be replaced with new headwall/wingwall structures accomodating all 3 culverts with 100 SF rip rap placed on the upstream and downstream sides. Downstream, approximately 1000-ft of concrete channel outleting to the Umatic River through a 100 sq ft rip rap energy dissipator is recommended.

COST:

\$158,000



UM-104

LOCATION: Finona St & Jose A Quintana St

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: There is an existing cross-gutter routing runoff upstream from Finona St and crosses Jose A Quintana St, and discharges to the west of Fiona St which outlets into the Umatac river. This cross-gutter has a non defined configuration, it needs to be replace with a cross gutter that has a defined alignment and cross section that will be capable of routing flow as intended.

RECOMMENDED IMPROVEMENTS Improvements to the strom drain system at Finona Street and Jose A Quintana Street are needed. Recommend replacement of the cross-gutter located at the site with one that has a defined alignment and cross section capable of routing the expected flow. A 1,000 linear foot concrete ditch needs to be constructed leading to a 100 square foot rip rap energy dissipator to satisfy these needs.

COST: \$55,900



UM-105

LOCATION: Jose A Quintana St & Finona St

MITIGATION TYPE: Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: A 24" RCP cross culvert runs under Jose A Quintana St. The upstream end of the culvert is not visible, and the downstream end is more than half its depth covered with sediment. This culvert need embankment stabilization upstream and downstream(riprap) and its needs to be extended to the Umatac river. Also it needs debris, sediment, and overgrown vegetation removed upstream and downstream.

RECOMMENDED IMPROVEMENTS To prevent further erosion of the channel embankments and sedimentation of the existing culverts, erosion control and conveyance maintenance and improvements are required. The existing culvert under Jose A Quintana St. should be replaced with a larger 30" culvert (approximately 100- feet long) equipped with upstream and downstream headwall/wingwall structures with 100 SF rip rap energy dissipation placed on the downstream side. One quarter acre debris/ sediment removal will be required as part of the improvements.

COST: \$144,000



UM-106

LOCATION:

RT 2 & Jagar Dr

MITIGATION TYPE:

Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT:

At the interchange of Route 2 and Jagar Drive a two drainage systems need to be modified to prevent homes from flooding downstream . There is a 36" RCP cross culvert that crosses RT2 and discharges to the west of Rt2, this culvert has headwalls both upstream and downstream which both end have excessive overgrown vegetation. There is another 30" RCP culvert coming from Jagar Drive, this culvert ends with a headwall and then runoff continues on a ditch along RT2 east side flowing north. Both of this systems are causing homes to get flooded downstream, a solution will be to abandon the 36" RCP and route that flow to a new 36" cross culvert that will run under Jagar DR and connect to the 30" Headwall(this headwall will need to be modified). Then downstream from the 30" Cross culvert the existing ditch will be replaced with 100' of trapezoidal concrete lined channel that will route runoff to the Umatac river.

RECOMMENDED IMPROVEMENTS

Recommend modification of the 2 drainage systems located at Route 2 and Jagar Drive in order to minimize future flooding of homes located west of Route 2. Improvements would include abandonment of the existing 36" RCP under Rte 2, placement of a new 36" RCP (estimated at 200 LF in length) under Jagar Drive at its intersection with Route 2 (routing flow northerly along the east side of Rte 2). The outlet of the new 36" RCP would be adjacent to the outlet of the existing 30" RCP that runs diagonally under Jagar Drive. Recommend replacement of the outlet structure with a new, larger headwall/wingwall stucture that can accomodate the 30" and 36" RCP. Recommend replacement of the downstream ditch (conveying flow northerly to the Umatac River) with a concrete trapezoidal channel (estimated at 100 feet in length) and a 100 sq ft rip rap energy dissipator located at the outlet of the concrete ditch. A quarter acre of debris removal is also needed to clear out debris and vegetation that have accumulated around the upstream and downstream headwalls of the existing culverts. A headwall/wingwall structure will also be required at the upstream end of the new 36" RCP culvert.

COST:

\$379,000



UM-107

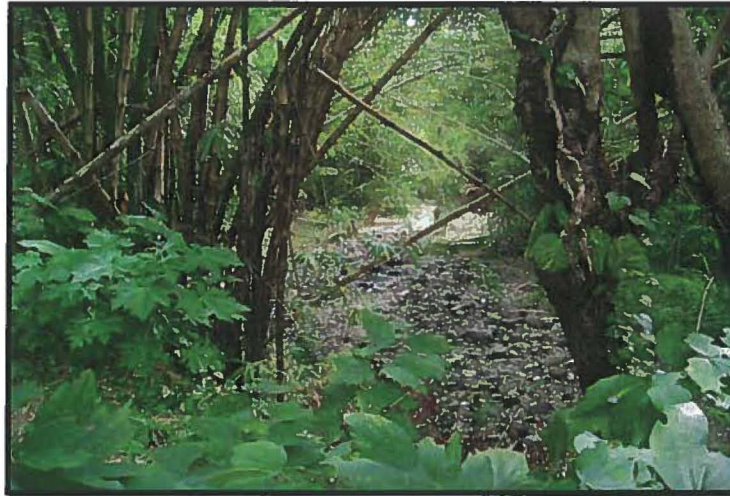
LOCATION: Road A

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: At the end of this Cul-de-sac, there is an existing catch basin that can not handle all the runoff that is routed to this inlet and floods 4 homes. This catch basin besides being undersized, gets clogged with debris. A solution to prevent the homes from getting flooded is to build a small wall behind the sidewalk to keep the runoff on the street, and to add more grated inlets adjacent to the existing inlet.

RECOMMENDED IMPROVEMENTS Place a storm drain system at the cul de sac of Road A consisting of 4 catch basins connected by 150 LF of 12" - 24" RCP, outleting to 1000' of concrete ditch that routes flow around the existing homes in an existing drainage easement. A culvert may be required at the downstream end of the channel (assume 50' of 24" RCP equipped with headwall/wingwall structures). This system will ultimately route the flow to the system at Jaguar Drive.

COST: \$288,000



UM-108

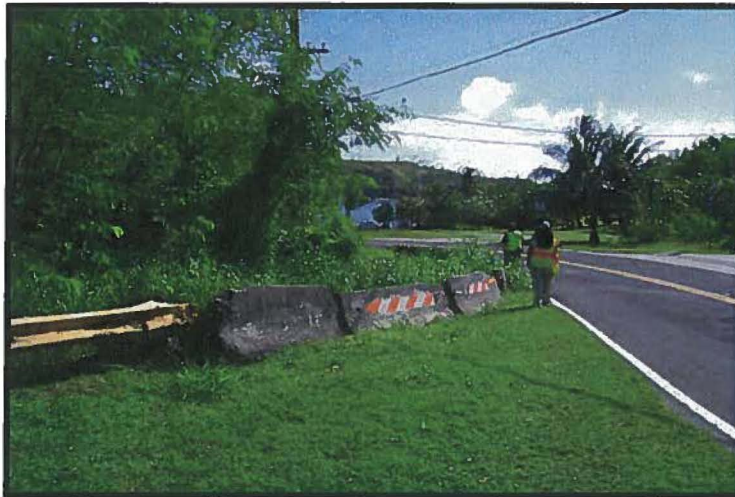
LOCATION: Jose Q Aguon St & Laelae River

MITIGATION TYPE: Erosion Control/ Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT: Along the end of Jose Q Aguon St, the Laelae River is encroaching into the road and eventually it will undermine the road. Embankment stabilization(riprap) is needed to prevent the river from undermining the street. The river floods the street but it has not flooded homes.

RECOMMENDED IMPROVEMENTS To prevent further encroachment of the Laelae River into Jose Q Aguon Street, maintenance consisting of a quarter acre of debris removal along with installation of 1,000 square feet rip rap channel stabilization along the river embankment is recommended.

COST: \$143,000



UM-109

LOCATION: RT 2

MITIGATION TYPE: Erosion Control/ Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT: At a location along Route 2 north of the Umatac river there is a 5'x5' RCB cross culvert. Both upstream and downstream it needs embankment stabilization, and debris and overgrown vegetation removal. Downstream it needs about 200' of embankment stabilization, and upstream probably around 50' of embankment stabilization. Roadway is undermined on both sides of the RCB, roadway also needs to be stabilized.

RECOMMENDED IMPROVEMENTS One acre of debris removal is needed to clear out accumulated debris and the overgrown vegetation. Embankment stabilization of the channel upstream and downstream of the existing culvert under Rte 2 is needed for a distance of 200 linear feet downstream (requiring approximately 4000 sq ft of rip rap stabilization) and about 50 linear feet upstream (requiring approximately 1,000 square feet of rip rap stabilization).

COST: \$741,000



UM-110

LOCATION:

RT 2 & La Sa Fua River

MITIGATION TYPE:

Storm Drain Improvement/ Erosion Control

SITE ASSESSMENT:

Along Route 2 the road has a low area with step grades, at this location the roadway only has one overside drain and the upstream side of La Sa Fua river the roadway embankment needs stabilization. More overside drains need to be added to roadway in order to discharge all the runoff from the roadway at more than one location and prevent any flooding of the roadway.

RECOMMENDED IMPROVEMENTS

Recommend placement of four AC spillways along Route 2 with approximately 100 SF of rip rap stabilization placed downstream of the spillways for energy dissipation. The additional spillways and stabilization will prevent further erosion and flooding of the road at the outlet to the La Sa Fua River.

COST:

\$61,600



UM-111

LOCATION: RT 2 & Observation Rest Area

MITIGATION TYPE: Erosion Control

SITE ASSESSMENT: Along Route 2 by the observation rest area , on the west side of the road the hillside has mass erosion. This erosion needs to be stabilized with probably filter fabric and ground cover in order to stop the erosion and preventing sediment to run down the road.

RECOMMENDED IMPROVEMENTS Recommend placement of hydroseed w/ a bonded fiber matix over approximately 1 acre of the hillside where groundcover does not exist in an effort to control mass erosion along the hillside.

COST: \$636,000



UM-112

LOCATION: RT 2 & Cetti River

MITIGATION TYPE: Erosion Control/ Conveyance Maintenance/ Conveyance Improvement

SITE ASSESSMENT: Route 2 over the Cetti river is being undermined, half of the road(west side) is undermined that it can collapse at any time. At this location a new bridge is needed (note this is part of another contract) and culverts need to be extended along with erosion control (gabions) along embankment.

RECOMMENDED IMPROVEMENTS To prevent further undermining of the roadway over the Cetti River, erosion control and conveyance maintenance and improvements are required. Existing culverts must be extended to a stabilized embankment. For cost estimating purposes, the extension is estimated at 200-feet and the culvert size is estimated at 5- 48" diameter pipelines. For embankment stabilization, placement of 8000 sq ft of gabions and 1000 sq ft of rip rap at the bottom. An outlet structure (headwall and 2 wingwalls) has also been included.

COST: \$661,000



UM-113

LOCATION:

RT 2 & Tributary to Sella River

MITIGATION TYPE:

Conveyance Maintenance

SITE ASSESSMENT:

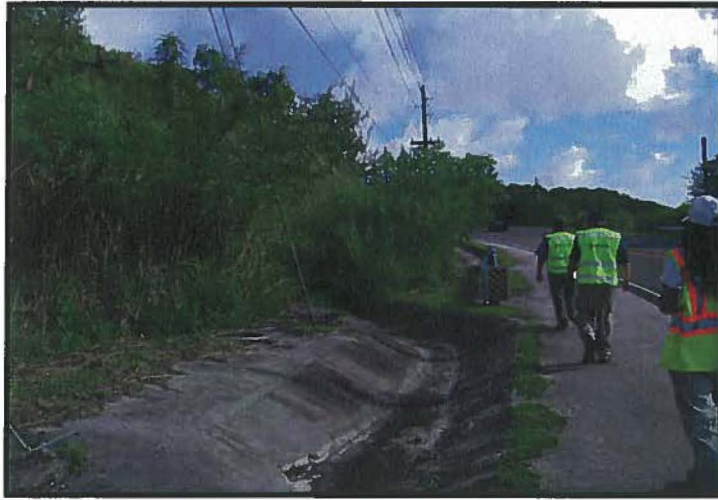
A cross culvert under Route 2 routes runoff from a tributary to the Sella River. This cross culvert is in good condition, and no erosion issues are visible; it only needs vegetation removal to prevent any clogging.

RECOMMENDED IMPROVEMENTS

To prevent future clogging of the cross culvert at this site it is recommended that a quarter acre of debris/ sediment be removed to promote proper drainage.

COST:

\$1,940



UM-114

LOCATION: RT 2 & Sella River

MITIGATION TYPE: Conveyance Maintenance

SITE ASSESSMENT: A 48" RCP cross culvert routes Sella River flow under Route 2 towards Sella bay. The cross culvert and Headwall/wingwalls are in good condition. Vegetation removal is needed to prevent any debris accumulation and clogging.

RECOMMENDED IMPROVEMENTS To prevent future clogging of the cross culvert at this site it is recommended that a quarter acre of debris/ sediment be removed to promote proper drainage.

COST: \$1,940

YIGO VILLAGE



YI-101

LOCATION:

RT 9

MITIGATION TYPE:

Conveyance Improvement/ Conveyance Maintenance

SITE ASSESSMENT:

36" CSP cross culvert under Rt 9. The upstream earthen channel to this cross culvert overtops and floods neighboring 2-3 properties. The channel base seems to be a few inches lower than the 36" CSP cross culvert. This reason for the flooding is that the receiving drainage system downstream at the airforce base is not maintained properly and the system clogs, creating the channel upstream to overtop. The solution will be to regularly maintain the systems downstream within the airforce base.

RECOMMENDED IMPROVEMENTS

To prevent further flooding of neighboring properties at this site, approximately 1,000 square feet of debris removal along the downstream side of the culvert (on airforce base property) is needed along with drainage improvements at the culvert inlet including the addition of a headwall and two wingwalls with a 100 square foot rip rap energy dissipator.

COST:

\$41,500



YI-102

LOCATION:

Azud St

MITIGATION TYPE:

Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT:

This is a low point along the street where ponding creates the flooding of 5-9 properties. There are no existing drainage systems at this location. The solution will be to add infiltration trenches along the street at the lowest location, on both sides of the street.

RECOMMENDED IMPROVEMENTS

To prevent further flooding of properties, two 200 linear foot infiltration basins are recommended for construction along the crowned street at its low point.

COST:

\$39,100



YI-103

LOCATION: Chalan Santa Bernardita

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: This is a low point along the street where ponding creates the flooding of 5-9 properties. There are no existing drainage systems at this location. The solution will be to add infiltration trenches along the street at the lowest location, on both sides of the street.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties, two 200 linear foot infiltration basins are recommended for construction along the crowned street at its low point.

COST: \$39,100



YI-104

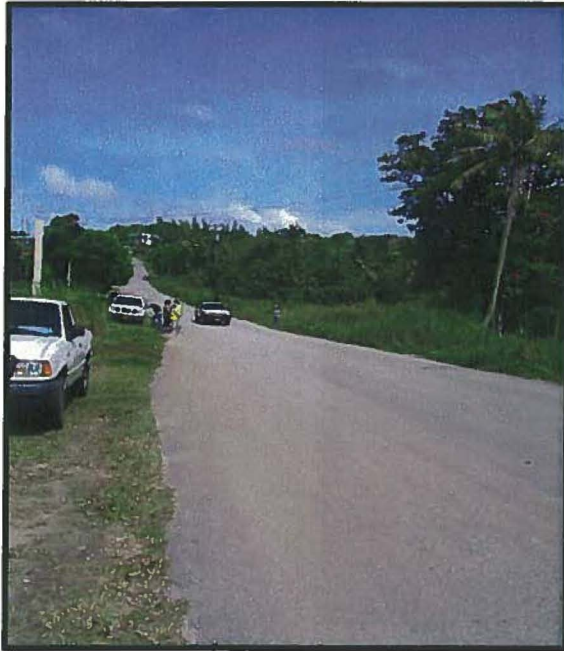
LOCATION: Chalan Tun Luis Duenas & Kiko Isabela loop

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: This is a low point along the street, thus creating ponding and flooding of one property. There are no existing drainage systems at this location. A possible solution will be to add infiltration trenches along the street at the lowest location, on both sides of the street.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties, two 200 linear foot infiltration basins are recommended for construction along the crowned street at its low point.

COST: \$39,100



YI-105

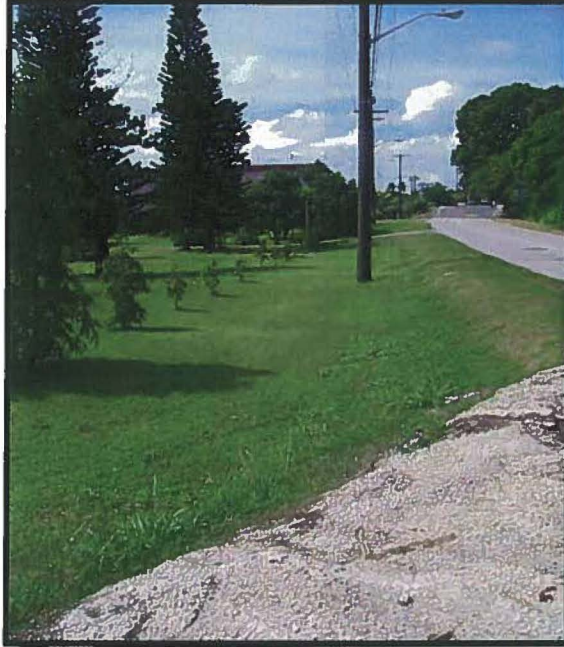
LOCATION: Chalan Tun Luis Duenas & RT 29

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Improvement

SITE ASSESSMENT: This is a low point along the street thus creating ponding and flooding 2-4 properties. There are no existing drainage systems at this location. A possible solution will be to route the flow via a conveyance drainage system to an existing infiltration behind a school's football field, an easement will be needed to run the conveyance line through a private property.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties at this site, construct a storm drain system consisting of 2 catch basins (placed at the low point of the crowned road) connected by approximately 100 linear feet of 24" RCP routing flow to a drainage ditch approximately 1000 feet in length to an existing infiltration basin located adjacent to a school yard (requiring an easement along the edge of a private property). Place a 100 sq ft rip rap energy dissipator at the outlet to the infiltration basin.

COST: \$171,000



YI-106

LOCATION: RT 29 & Chalan tun Jose Anaco

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Maintenance

SITE ASSESSMENT: This is a low point along the street thus creating ponding and flooding 3-4 properties. There are no existing drainage systems at this location. A possible solution will be to add a conveyance system at the low point and route the runoff through a private property where in the backyard there is an existing natural depression.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties at this site, construct a storm drain system consisting of 2 catch basins (placed at the low point of the crowned road) connected by approximately 200 linear feet of 24" RCP routing flow along the edge of a private property (requiring an easement) to outlet to a sink located behind the property. The outlet shall include a headwall and approximately 1/4 acre of debris removal will be needed for construction and to promote drainage.

COST: \$225,000



YI-107

LOCATION: Gayinero Dr(RT 29) & Chalan Padiron Lagu(RT 15)

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: At this intersection all four corners flood, and possibly one property. No existing drainage conveyance systems. Add infiltration trenches along both streets.

RECOMMENDED IMPROVEMENTS To prevent further flooding of properties, two 200 linear foot infiltration basins are recommended for construction (one along each street at its low point).

COST: \$39,100



YI-108

LOCATION: Tun Luis Duenas Rd & RT 1

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: There is a low point along Tun Luis Duenas Rd where a home gets flooded. Need to add infiltration trench to prevent ponding, will need to acquire r/w.

RECOMMENDED IMPROVEMENTS To prevent further flooding, one 200 linear foot infiltration basin is recommended for construction along the street at its low point.

COST: \$19,600



YI-109

LOCATION:

RT 1 & Chalan Chamorri

MITIGATION TYPE:

Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT:

Low point along Route 1. There is no existing drainage conveyance system along Rt1. Chalan Chamorri is higher than Rt1. No obvious solution to ponding.

RECOMMENDED IMPROVEMENTS

To prevent further flooding, one 200 linear foot infiltration basin is recommended for construction along the street at its low point.

COST:

\$19,600

YONA VILLAGE



YO-101

LOCATION:

RT 4

MITIGATION TYPE:

Erosion Control

VILLAGE RANKING

3

SITE ASSESSMENT:

New development along Rt4. Major grading of slopes, no visible signs of temporary erosion control measures. Sediment will go to the bay downstream if no control measures implemented.

**RECOMMENDED
IMPROVEMENTS**

Recommend improvements to the existing stormwater pollution prevention strategy for this existing construction site in the form of 1 acre of hydromulch and 2000 LF of silt fence to prevent sediment from entering downstream waters.

COST:

\$11,300



YO-102

LOCATION: Chalan Telefofo

MITIGATION TYPE: Storm Drain Improvement

VILLAGE RANKING 6

SITE ASSESSMENT: At low point of street six homes get flooded, homes are lower than the road. Need to add a drainage conveyance system along road and route it to the natural flow path, inside a private property where easement will need to be acquired.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP outleting to natural drainage path through a headwall/wingwall structure equipped with a 100 SF rip rap energy dissipator.

COST: \$137,000



YO-103

LOCATION: Jesus Santos Rd

MITIGATION TYPE: Storm Drain Improvements/ Treatment BMP Improvements

SITE ASSESSMENT: The low area of this street is flat and five properties get flooded. Add a drainage conveyance system along road and route it to existing ponds at the end of the street.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 400 LF of 24" RCP outleting to an existing infiltration system located at the end of the street. Equip outlet with

COST: \$427,000



YO-104

LOCATION: Balajadia Rd

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Maintenance/ Erosion Control

VILLAGE RANKING 7

SITE ASSESSMENT: Road embankments are very steep. To prevent erosion from continuing, asphalt dikes should be added on both sides of road at low point of road and overside drains with riprap added.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along the road. Place 2 overside drains (AC spillways) at low points in road, each outletting to a 100 SF rip rap energy dissipator at bottom of embankment.

COST: \$33,500



YO-105

LOCATION:

RT 4

MITIGATION TYPE:

Erosion Control/ Conveyance Maintenance

SITE ASSESSMENT:

Ylig bridge, undermining of approach slabs on both north and south embankments. Need to add more gabions to approach slabs embankments, north section is in worse conditions.

RECOMMENDED IMPROVEMENTS

Embankment stabilization is needed in the vicinity of the bridge approach slabs. Recommend the placement of approximately 400 sq ft of gabions along the north and south embankments and 500 sq ft of rip rap at the bottom of each embankment. A quarter acre of debris removal is required for maintenance.

COST:

\$215,000



YO-107

LOCATION: Salas Road

MITIGATION TYPE: Storm Drain Improvement

SITE ASSESSMENT: Constant undermining of roadway from proximity to Ylig river. Need permanent soil stabilization, possibly riprap along roadway.

RECOMMENDED IMPROVEMENTS Recommend soil stabilization along roadway edge (where undermining is occurring) and placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP outleting to stabilized embankment of Ylig River.

COST: \$134,000



YO-108

LOCATION: Chalan Aguon

MITIGATION TYPE: Storm Drain Improvement/ Conveyance Maintenance/ Erosion Control

SITE ASSESSMENT: Just east of Ylig river crossing at a roadway curve a low point is created inside the curve and ponding is created and erosion evident. Need to add an overside drain with riprap to route flow to the Ylig river downstream and remove debris.

RECOMMENDED IMPROVEMENTS Recommend placement of a storm drain system along the road. Place an overside drain along inside of curve outleting to a rip rap channel approximately 50 feet in length, routing flow to Ylig River. Remove approximately 1000 SF of debris at site.

COST: \$141,000

Appendix D

Cost Estimation Spreadsheets

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AGANA HEIGHTS VILLAGE

AGANA HEIGHTS VILLAGE										
LOCATION		COST ESTIMATES								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNITS	COST / UNITS	COST	TOTAL COST	TOTAL COST W/ENGINEERING & CONTINGENCIES
AG-101	San Vicente Solomon Street & Francisco Javier Ave	6 NEW INJECTION WELLS	INJECTION WELLS		1200	LF	\$1,000.00 / LF	\$1,200,000.00	\$1,386,473.02	\$2,357,004.13
		INCREASE BASIN SIZE BY 5000 SF (6' DEEP)	INFILTRATION BASIN	EXCAVATION	1111.11	CY	\$27.53 / CY	\$30,588.86		
				FENCING	10448	LF	\$14.92 / LF	\$155,884.16		
AG-102	Joseph Cruz Ave NEAR As Kettle Court	2 INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22	CY	\$27.53 / CY	\$6,117.72	\$41,228.74	\$70,088.85
				0.75" ROCK	222.22	CY	\$41.00 / CY	\$9,111.02		
				EROSION CONTROL (HYDROSEED)	5200	SF	\$5.00 / SF	\$26,000.00		
AG-103	Rte 6 & Rte 7	10,000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		1	AC	\$4,562.38 / AC	\$4,562.38	\$107,516.00	\$182,437.19
		3,000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62		
		2-HEADWALL/W/ WINGWALL	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / EA	\$20,000.00		
AG-104	Agana Heights Ponding Basin	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59	\$83,894.21	\$142,620.16
		3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62		

AGAT VILLAGE

LOCATION		COST ESTIMATE								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNITS	COST / Unit	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
AV-102	Tun Rumon Chele Rd and Rte 2	3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62	\$82,753.62	\$140,681.15
AV-109, AV-125 (Cost Estimate for Each Project)	Baubata Road (AV-109), Salinas Rd (AV-125)	100' BIOSWALE	BIOSWALE	EXCAVATION	48.14	CY	\$27.53 / CY	\$1,325.29	\$78,960.72	\$134,233.22
		100'x24" RCP	24" RCP	EROSION CONTROL (HYDROSEED)	1600	SF	\$5.00 / SF	\$8,000.00		
		1 CATCH BASIN	CATCH BASIN	100	LF	\$554.79 / LF	\$55,479.38			
		HEADWALL W/WINGWALL	HEADWALL W/WINGWALL	1	EA	\$3,500.00 / EA	\$3,500.00			
		300 CF RSP	ROCK SLOPE PROTECTION (RSP) METHOD B 1/4 TON (AKA RIP RAP)	1	EA	\$10,000.00 / EA	\$10,000.00			
AV-101	Chalan Josen Milagro	2500'x3'x5' RCB	REINFORCED CONCRETE BOX CULVERT		11.11	CY	\$59.05 / CY	\$656.05	\$1,577,698.30	\$2,682,087.11
		2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		1388.89	CY	\$1,103.85 / CY	\$1,533,126.23		
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		2	EA	\$10,000.00 / EA	\$20,000.00		
		2 CATCH BASINS	CATCH BASIN		0.25	AC	\$4,562.38 / AC	\$1,140.59		
		2000' DITCH	DITCH		2	EA	\$3,500.00 / EA	\$7,000.00		
		300 CF RIP RAP	RIP RAP		296.29	CY	\$27.53 / CY	\$8,156.86		
AV-104	Paqacho Drive and Kalachucho	1 AC HYDROMULCH W/BFM	HYDROMULCH (BFM)		43560	SF	\$1.00 / SF	\$43,560.00	\$43,560.00	\$74,052.00
AV-119, AV-120, AV-127 (Cost Estimate for Each Project)	Father Follard & Bruce Street (AV-119), Father Follard & Route 2 (AV-120), Rte 2 & Rte 12 (AV-127)	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59	\$148,005.02	\$251,608.53
		3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62		
		2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00		
		100'x24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479.38		
		400' DITCH	DITCH		59.26	CY	\$27.53 / CY	\$1,631.43		
AV-113	Finile Orong Circle	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59	\$96,580.94	\$164,187.59
		2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00		
		100'x18" RCP	18" RCP		100	LF	\$536.16 / LF	\$53,616.49		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,274.62		
		600 CF RIP RAP	RIP RAP		22.22	CY	\$744.79 / CY	\$16,549.23		
AV 110	Ausu Creek & Route 2	3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62	\$93,765.62	\$159,401.55
		400 CY EXCAVATION	EXCAVATION		400	CY	\$27.53 / CY	\$11,012.00		
AV-129	North Perino	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59	\$33,340.97	\$56,679.64
		600 CF RIP RAP	RIP RAP		22.22	CY	\$744.79 / CY	\$16,549.23		
		200 LF BIOSWALE	BIOSWALE	EXCAVATION	96.3	CY	\$27.53 / CY	\$2,651.14		
AV-106	Pagachao Road			EROSION CONTROL (HYDROSEED)	2600	SF	\$5.00 / SF	\$13,000.00	\$47,531.27	\$80,803.15
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59		
		0.5 AC HYDROMULCH W/BFM	HYDROMULCH (BFM)		21780	SF	\$1.00 / SF	\$21,780.00		
				EXCAVATION	74.07	CY	\$27.53 / CY	\$2,039.15		
				CONCRETE (DITCH LINING)	35.84	CY	\$633.32 / CY	\$22,571.52		
AV-121	Rte 2 and Erskin			EXCAVATION	74.07	CY	\$27.53 / CY	\$2,039.15	\$106,996.10	\$181,893.36
				CONCRETE (DITCH LINING)	35.84	CY	\$633.32 / CY	\$22,571.52		
		1000 LF CONCRETE DITCH	CONCRETE DITCH		2	EA	\$3,500.00 / EA	\$7,000.00		
		2 CATCH BASINS	CATCH BASIN		100	LF	\$554.79 / LF	\$55,479.38		
		100'x24" RCP	24" RCP		1	EA	\$10,000.00 / EA	\$10,000.00		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		11.11	CY	\$744.79 / CY	\$8,274.62		
AV-126	Togcha River	300 CF RIP RAP	RIP RAP		59.26	CY	\$27.53 / CY	\$1,631.43	\$138,459.21	\$235,380.66
		400 LF DITCH	DITCH		100	CY	\$345.65 / CY	\$34,565.00		
		100 LF 12" CONCRETE ENCASEMENT	MINOR CONCRETE (PIPE ENCASEMENT)		0.25	AC	\$4,562.38 / AC	\$1,140.59		
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		2	EA	\$10,000.00 / EA	\$20,000.00		
		2 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		111.11	CY	\$744.79 / CY	\$82,753.62		
AV-123	VT Baubata Lane	3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62	\$83,894.21	\$142,620.16
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59		
AV-108	Route 2 @ Chaligan Creek	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59	\$88,894.21	\$142,620.16
		3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62		
AV-112	Route 2 @ Finile Road			EXCAVATION	74.07	CY	\$27.53 / CY	\$2,039.15	\$118,459.21	\$201,380.66
				CONCRETE (DITCH LINING)	35.84	CY	\$633.32 / CY	\$22,571.52		
		100 LF 12" CONCRETE ENCASEMENT	MINOR CONCRETE (PIPE ENCASEMENT)		100	CY	\$345.65 / CY	\$34,565.00		
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59		
		3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,753.62		

LOCATION		COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / Unit	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
AV-128	Rte 2, North of Rte 12	1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00	\$82,753.62	\$157,681.15
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62		
AV-115	Tomas Mesa Street	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$151,864.42	\$258,169.52
		100 LF 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL	HEADWALL		1 EA	\$5,000.00 / EA	\$5,000.00		
		400 LF DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62		
AV-107	Route 2 N O Marina & S O Chalan Leta	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$37,689.83	\$64,072.71
		600 CF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549.23		
AV-124	RR Cruz & Baubata Lane	1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00	\$132,753.62	\$225,681.15
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62		
AV-111	Gaan River & Route 2	5 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		5 EA	\$10,000.00 / EA	\$50,000.00	\$103,894.21	\$176,620.16
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62		
AV-117	Salinas River & Route 2	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$83,894.21	\$142,620.16
		2 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00		
AV-122	Route 2 South of Atao Rd	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$186,647.83	\$317,301.91
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62		
AV-116	San Roque Street	2 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00	\$64,110.81	\$108,988.37
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
		6000 CF RIP RAP	RIP RAP		222.22 CY	\$744.79 / CY	\$165,507.23		
		400 LF DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
		100 LF 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
AV-130	South Perino	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$119,099.35	\$202,468.90
		200 LF 24" RCP	24" RCP		200 LF	\$554.79 / LF	\$110,958.76		
AV-114	Rte 2 and Finile Creek	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$205,507.23	\$349,362.30
		4 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		4 EA	\$10,000.00 / EA	\$40,000.00		
AV-105	Paquecho Drive and Mike Cruz	6000 CF RIP RAP	RIP RAP		222.22 CY	\$744.79 / CY	\$165,507.23	\$14,595.88	\$24,812.99
		1 MANHOLE	MANHOLE		1 EA	\$3,500.00 / EA	\$3,500.00		
AV-131	Tun Leon Road	20 LF 24" RCP	24" RCP		20 LF	\$554.79 / LF	\$11,095.88	\$198,504.49	\$337,457.63
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
		300 LF 24" RCP	24" RCP		300 LF	\$554.79 / LF	\$166,438.14		
		200 LF BIOSWALE	BIOSWALE	EXCAVATION	96.3 CY	\$27.53 / CY	\$2,651.14		
		2 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00		
AV-118	Erskin	300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62	\$213,623.10	\$363,159.27
		300 LF 24" RCP	24" RCP		300 LF	\$554.79 / LF	\$166,437.00		
		2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
		6 HEADWALL	HEADWALL		6 EA	\$5,000.00 / EA	\$30,000.00		
		2500 LF CONC DITCH	DITCH		370 CY	\$27.53 / CY	\$10,186.10		

ASAN VILLAGE

LOCATION		COST ESTIMATE						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES	UNITS	COST / UNIT	COST	TOTAL COST W/ENGINEERING CONTINGENCIES
AS-103	Leon Guerrero @ Asan River Bridge	100' x 8" DIP WATER	DIP WATER	100	LF	\$52.77 / LF	\$5,277.00	\$6,277.00
		AIR RELEASE VALVE	AIR RELEASE VALVE	1	EA	\$1,000.00 / EA	\$1,000.00	
AS-109	Senator Juan Tim Toves Street	100'x3'x3' RCB (PER FCD)	REINFORCED CONCRETE BOX CULVERT	33.33	CY	\$1,103.85 / CY	\$36,791.32	\$51,199.08
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,140.59	
		NEW HEADWALL	HEADWALL	1	EA	\$5,000.00 / EA	\$5,000.00	
		100 SF RIP RAP	RIP RAP	11.1	CY	\$744.79 / CY	\$8,267.17	
AS-108	Santa Ana Street	100'x3'x3' RCB (PER FCD)	REINFORCED CONCRETE BOX CULVERT	33.33	CY	\$1,103.85 / CY	\$36,791.32	\$99,759.25
		1 AC HYDROMULCH (BFM)	HYDROMULCH (BFM)	43560.17	SF	\$1.00 / SF	\$43,560.17	
		2 NEW HEADWALLS	HEADWALL	2	EA	\$5,000.00 / EA	\$10,000.00	
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,140.59	
		100 SF RIP RAP	RIP RAP	11.1	CY	\$744.79 / CY	\$8,267.17	
AS-107	W. San Carlos Ct and Msgr Leon Guerrero St	1000 LF 30" RCP (PER FCD)	30" RCP	1000	LF	\$679.63 / LF	\$679,625.40	\$686,625.40
		2 CATCH BASINS	CATCH BASIN	2	EA	\$3,500.00 / EA	\$7,000.00	
AS-106	Santa Ana & Nino Perdido	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,140.59	\$100,180.14
		1 AC HYDROMULCH (BFM)	HYDROMULCH (BFM)	43560.17	SF	\$1.00 / SF	\$43,560.17	
		100 LF 24" RCP (PER FCD)	24" RCP	100	LF	\$554.79 / LF	\$55,479.38	
AS-104	Msgr. Leon Guerrero Street	100 LF 6'x4' RCB (per FCD)	REINFORCED CONCRETE BOX CULVERT	88.89	CY	\$1,103.85 / CY	\$98,121.23	\$166,806.09
AS-105	Consolacion & Msgr. Leon Guerrero Street	100 LF 4'x4' RCB (PER FCD)	REINFORCED CONCRETE BOX CULVERT	59.26	CY	\$1,103.85 / CY	\$65,414.15	\$93,103.98
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,140.59	
		2 HEADWALLS	HEADWALL	2	EA	\$5,000.00 / EA	\$10,000.00	
		200 SF RIP RAP	RIP RAP	22.22	CY	\$744.79 / CY	\$16,549.23	
AS-112	Route 1 @ Fonte River	10,000 SF RIP RAP STABILIZATION	RIP RAP	111	CY	\$744.79 / CY	\$82,753.62	\$83,802.96
		10,000 SF DEBRIS REMOVAL	DEBRIS REMOVAL	0.23	AC	\$4,562.38 / AC	\$1,049.35	
AS-111	Route 1; north of Church and in-between property @ 176 Route 1.	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,140.59	\$59,700.76
		1 AC HYDROMULCH (BFM)	HYDROMULCH (BFM)	43560.17	SF	\$1.00 / SF	\$43,560.17	
		1 HEADWALL	HEADWALL	1	EA	\$5,000.00 / EA	\$5,000.00	
		2 WINGWALLS	WINGWALL	2	EA	\$5,000.00 / EA	\$10,000.00	
AS-110	Route 1 @ Asan River	200'x3'x3' RCB	REINFORCED CONCRETE BOX CULVERT	66.67	CY	\$1,103.85 / CY	\$73,593.68	\$91,868.30
		2 HEADWALLS	HEADWALL	2	EA	\$5,000.00 / EA	\$10,000.00	
		300 CF RIP RAP	RIP RAP	11.11	CY	\$744.79 / CY	\$8,274.62	
AS-102	Coast Line Along Route 1 Masso River to Fonte River	50,000 SF RIP RAP	RIP RAP	5,556	CY	\$744.79 / CY	\$4,137,725.53	\$7,034,133.41

BARRIGADA VILLAGE									
LOCATION		COST ESTIMATES							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES	UNITS	COST / Unit	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
BV-102	Route 16 & Cepeta Way	3 CATCH BASINS	CATCH BASIN		3 EA	\$3,500.00 / EA	\$10,500.00	\$26,615.05	\$45,245.59
		100 LF x 24" RCP	24" RCP		24 LF	\$554.79 / LF	\$13,315.05		
		1 MANHOLE	MANHOLE		1 EA	\$2,800.00 / EA	\$2,800.00		
BV-106	Route 16 & N. Bana Drive	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$80,754.00	\$137,281.79
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
BV-134	Barrigada Heights next to property No. 261 C	200' LONG INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,058.86	\$11,514.37	\$19,574.43
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,555.51		
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900.00		
BV-116	Limtiaco Street	2-200' LONG INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22 CY	\$27.53 / CY	\$6,117.72	\$23,028.74	\$39,148.85
				0.75" ROCK	222.22 CY	\$41.00 / CY	\$9,111.02		
				FILTER FABRIC	5200 SF	\$1.50 / SF	\$7,800.00		
BV-103, BV-111, BV-118, BV-119, BV-131	Rte 16, Rte 10, Anderson St, Leyang St, Rte 8	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$80,754.00	\$137,281.79
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
BV-115	Westbrook (Westbrook; #239 Kaminga Area, 7 homes affected)	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$282,037.59	\$479,463.90
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
		200'x200' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631.43		
				FENCING	848 LF	\$14.92 / LF	\$12,652.16		
BV-109	Lizama Street (Radio; #214 Dimalanta residence)	800' FENCE AROUND BASIN	FENCING		848 LF	\$14.92 / LF	\$12,652.16	\$12,652.16	\$21,508.67
BV-124	Ungaguan Place	200'x5'x10' CONC CHNL	CONCRETE CHNL		74 CY	\$633.32 / CY	\$46,865.68	\$46,865.68	\$79,671.66
BV-125	Ungaguan Place (Village; Gumabon, Ricalde and Mendiola area over to Capt Reyes Wy and Aguan Store)	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$66,140.59	\$112,439.01
		10,000 SF HYDROSEED W/BFM	HYDROSEED W/BFM	EROSION CONTROL (HYDROSEED)	10,000 SF	\$5.00 / SF	\$50,000.00		
				EROSION CONTROL (BFM)	10000 SF	\$1.50 / SF	\$15,000.00		

LOCATION		COST ESTIMATES							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES	UNITS	COST / Unit	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
BV-121 & BV-127	Canada Toto Road & Dodo St (BV-127), Leon Guerrero & Layang (BV-121)	2-200' LONG INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22 CY	\$27.53 / CY	\$6,117.72	\$23,028.74	\$39,148.85
				0.75" ROCK	222.22 CY	\$41.00 / CY	\$9,111.02		
				FILTER FABRIC	5200 SF	\$1.50 / SF	\$7,800.00		
BV-128	Lujan Way (Canada; #239)	3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62	\$82,753.62	\$140,681.15
BV-133	Aschena Place (Village; #158 Galves and Santos area)	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,058.86	\$11,514.37	\$19,574.43
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,555.51		
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900.00		
BV-132	#196 San Roque Drive	2-200' LONG INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22 CY	\$27.53 / CY	\$6,117.72	\$23,028.74	\$39,148.85
				0.75" ROCK	222.22 CY	\$41.00 / CY	\$9,111.02		
				FILTER FABRIC	5200 SF	\$1.50 / SF	\$7,800.00		
BV-108	Manibusan Road (Radio; George, Bamba, Palomo and Camacho area leading to E. Rte 8, 9 homes + condominium residences affected)	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$302,473.42	\$514,204.81
		1 TRASH RACK	TRASH RACK		1 EA	\$2,000.00 / EA	\$2,000.00		
		200'x200' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631.43		
				FENCING	848 LF	\$14.92 / LF	\$12,652.16		
		100'x36" RCP	36" RCP		100 LF	\$715.00 / LF	\$71,500.00		
		1 WINGWALL/HEADWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
BV-101	Manibusan Street - Layang - Gumbon	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,058.86	\$11,514.37	\$19,574.43
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,555.51		
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900.00		
BV-120	Layang Road, #415 - Mafinas Residence	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,058.86	\$11,514.37	\$19,574.43
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,555.51		
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900.00		
BV-126	Captain Reyes Way	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,058.86	\$11,514.37	\$19,574.43
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,555.51		
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900.00		
BV-117	Vietnam Veterans Highway (Route 10; from Wendy's fronting the highway to Sgt. Robert Mendiola St. and the Angel and Amanda Santo area	1 WINGWALL/HEADWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00	\$12,000.00	\$20,400.00
		1 TRASH RACK	TRASH RACK		1 EA	\$2,000.00 / EA	\$2,000.00		

LOCATION		COST ESTIMATES							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES	UNITS	COST / Unit	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
BV-112	East Route 8 (Radio; Ignacio area to intersection of Cepeda Wy and E. Route 8, needs drainage clearing) - slated for Restoration paving	200' LONG INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,058.86	\$92,268.37	\$156,856.22
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,555.51		
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900.00		
		2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
BV-140	Punzalan Street	200'x200' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631.43	\$201,283.59	\$342,182.10
				FENCING	848 LF	\$14.92 / LF	\$12,652.16		
BV-107	Rosario Loop	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$282,037.59	\$479,463.90
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
		200'x200' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631.43		
				FENCING	848 LF	\$14.92 / LF	\$12,652.16		
BV-137	Rte 8 East of Rte 10	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$80,754.00	\$137,281.79
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
BV-130	Rte 8 & San Vicente	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$83,507.00	\$141,961.89
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
		100 CY CUT	EXCAVATION		100 CY	\$27.53 / CY	\$2,753.00		
BV-129	Canada Toto Loop (Canada; Flores and Blas residences; culverts thru out snake road vicinity needs cleaning affects 4 homes)	100'x36" RCP	36" RCP		100 LF	\$715.00 / LF	\$71,500.00	\$71,500.00	\$121,550.00

LOCATION		COST ESTIMATES								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNITS	COST / Unit	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
BV-105	Rte 16 @ Mobil Sta	2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		2 EA		\$10,000.00 / EA	\$20,000.00	\$28,274.62	\$48,066.85
		100 SF RIP RAP	RIP RAP		11.110 CY		\$744.79 / CY	\$8,274.62		
BV-104	Rte 16 @ N Sabana	4 CATCH BASINS	CATCH BASIN		4 EA		\$3,500.00 / EA	\$14,000.00	\$69,886.44	\$118,806.95
		100"x24" RCP	24" RCP		100 LF		\$554.79 / LF	\$55,479.00		
		100 LF DITCH	DITCH		14.8 CY		\$27.53 / CY	\$407.44		
BV-122	Leon Guerrero St.	1000 SF RIP RAP	RIP RAP		111.11 CY		\$744.79 / CY	\$82,753.62	\$82,753.62	\$140,681.15
BV-110	Southeast corner of Route 8 and Route 10	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC		\$4,562.38 / AC	\$1,140.59	\$28,670.59	\$48,740.01
		1000 CY DREDGING (CUT)	EXCAVATION		1000 CY		\$27.53 / CY	\$27,530.00		
		AGREEMENT W/DFW								
BV-113	Ungkulu Street	3 CATCH BASINS	CATCH BASIN		3 EA		\$3,500.00 / EA	\$10,500.00	\$26,615.05	\$45,245.59
		100 LF x 24" RCP	24" RCP		24 LF		\$554.79 / LF	\$13,315.05		
		1 MANHOLE	MANHOLE		1 EA		\$2,800.00 / EA	\$2,800.00		
BV-136	Rte 16 @ Pedang	100 LF x 36" RCP	36" RCP		100 LF		\$715.00 / LF	\$71,500.00	\$113,140.79	\$192,339.34
		4 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		4 EA		\$10,000.00 / EA	\$40,000.00		
		400 LF DITCH	DITCH		59.6 CY		\$27.53 / CY	\$1,640.79		
BV-139	Rte8 at Rte 33	1 CATCH BASIN	CATCH BASIN		1 EA		\$3,500.00 / EA	\$3,500.00	\$12,182.06	\$20,709.50
		100 LF DITCH	DITCH		14.8 CY		\$27.53 / CY	\$407.44		
		100 SF RIP RAP	RIP RAP		11.11 CY		\$744.79 / CY	\$8,274.62		

DEDEDO VILLAGE

LOCATION		COST ESTIMATE								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING & CONTINGENCIES
DE-101	Route 1 (from Route 26 to Route 30)	4 CATCH BASIN	CATCH BASIN		4	EA	\$3,500.00 / EA	\$14,000.00	\$132,190.19	\$224,723.32
		200 LF 24" RCP	24" RCP		200	LF	\$554.79 / LF	\$110,958.76		
		400' DITCH	DITCH		59.26	CY	\$27.53 / CY	\$1,631.43		
		2 MANHOLES	MANHOLE		2	EA	\$2,800.00 / EA	\$5,600.00		
DE-103	Salisbury Street	100' CONCRETE CHANNEL	CONCRETE CHANNEL	EXCAVATION	29.63	CY	\$27.53 / CY	\$815.71	\$13,835.41	\$23,520.19
				CONCRETE (DITCH LINING)	7.704	CY	\$633.32 / CY	\$4,879.10		
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59		
		2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00		
DE-104	Loreta	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00	\$136,233.38	\$231,596.74
		200 LF 24" RCP	24" RCP		200	LF	\$554.79 / LF	\$110,958.76		
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,274.62		
DE-105	Redondo Luchon	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59	\$3,336.29	\$5,671.69
		100 SF APRON	APRON	CONCRETE (DITCH LINING)	0.309	CY	\$633.32 / CY	\$195.70		
		1 TRASH RACK	TRASH RACK		1	EA	\$2,000.00 / EA	\$2,000.00		
DE-106	Route 1 at Route 27	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00	\$192,014.59	\$326,424.81
		100 LF 24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,274.62		
		10,000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,140.59		
		4000 CY DREDGING (CUT)	DREDGING (CUT)	EXCAVATION	4000	CY	\$27.53 / CY	\$110,120.00		
DE-108	Route 3	200'x200' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	6851.85	CY	\$27.53 / CY	\$188,631.43	\$272,037.59	\$462,463.90
				FENCING	848	LF	\$14.92 / LF	\$12,652.16		
		2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00		
		100'x24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479.38		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,274.62		
DE-109	Ukudo	3 INJECTION WELLS	INJECTION WELLS	CIDH PILE (16")	300	LF	\$1,000.00 / LF	\$300,000.00	\$391,960.31	\$666,332.52
		100'x100' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	1574	CY	\$27.53 / CY	\$43,332.22		
				FENCING	448	LF	\$14.92 / LF	\$6,684.16		
		200 LF BIOSWALE	BIOSWALE	EXCAVATION	96.96	CY	\$27.53 / CY	\$2,669.31		
				EROSION CONTROL (HYDROSEED)	3200	SF	\$5.00 / SF	\$16,000.00		
		3 HEADWALLS	HEADWALL		3	EA	\$5,000.00 / EA	\$15,000.00		
DE-110	Route 1 and Route 3	300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,274.62	\$66,095.09	\$112,361.66
		2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000.00		
		1 MANHOLE	MANHOLE		1	EA	\$2,800.00 / EA	\$2,800.00		
		200 LF DITCH	DITCH		29.63	CY	\$27.53 / CY	\$815.71		
DE-111	Route 1 and Route 27A	100 LF 24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479.38	\$61,779.38	\$105,024.95
		1 CATCH BASIN	CATCH BASIN		1	EA	\$3,500.00 / EA	\$3,500.00		
		100 LF 24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479.38		
		1 MANHOLE	MANHOLE		1	EA	\$2,800.00 / EA	\$2,800.00		

MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING & CONTINGENCIES
DE-113	Route 1 and Route 28	2 CATCH BASIN	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$83,526.02	\$141,994.23
		400 LF DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
		100 Lfx24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
		300 SF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
DE-115	Route 3 A and Route 9	200 LF BIOSWALES	BIOSWALE	EXCAVATION	96.96 CY	\$27.53 / CY	\$2,669.31	\$99,423.31	\$169,019.62
				EROSION CONTROL (HYDROSEED)	3200 SF	\$5.00 / SF	\$16,000.00		
		2 CATCH BASIN	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
		100 Lfx24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
DE-117	Route 3 and Bullard Avenue	3 CATCH BASINS	CATCH BASIN		3 EA	\$3,500.00 / EA	\$10,500.00	\$130,663.00	\$222,127.09
		150 LF x 24" RCP	24" RCP		150 LF	\$554.79 / LF	\$83,219.07		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		200 LF BIOSWALES	BIOSWALE	EXCAVATION	96.96 CY	\$27.53 / CY	\$2,669.31		
				EROSION CONTROL (HYDROSEED)	3200 SF	\$5.00 / SF	\$16,000.00		
DE-116	Route 3 and Chalan Kareta	2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00	\$41,689.83	\$70,872.71
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
		600 CF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549.23		
		2 TRASH RACKS	TRASH RACK		2 EA	\$2,000.00 / EA	\$4,000.00		
DE-120	Route 3 and Control Tree Drive	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$86,407.31	\$146,892.42
		100 LF CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	7.41 CY	\$27.53 / CY	\$204.00		
				CONCRETE (DITCH LINING)	3.56 CY	\$633.32 / CY	\$2,254.62		
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 MANHOLE	MANHOLE		1 EA	\$2,800.00 / EA	\$2,800.00		
		200 LF BIOSWALES	BIOSWALE	EXCAVATION	96.96 CY	\$27.53 / CY	\$2,669.31		
DE-118	Route 3 and Route 28			EROSION CONTROL (HYDROSEED)	3200 SF	\$5.00 / SF	\$16,000.00	\$102,100.54	\$173,570.92
		1000 LF BIOSWALES	BIOSWALE	EXCAVATION	484.8 CY	\$27.53 / CY	\$13,346.54		
				EROSION CONTROL (HYDROSEED)	1600 SF	\$5.00 / SF	\$8,000.00		
		2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		

MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING & CONTINGENCIES
DE-114	Route 26 and Route 25	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$81,894.59	\$139,220.81
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
DE-112	Route 27 A and Route 28	4 CATCH BASINS	CATCH BASIN		4 EA	\$3,500.00 / EA	\$14,000.00	\$130,558.76	\$221,949.89
		2 MANHOLES	MANHOLE		2 EA	\$2,800.00 / EA	\$5,600.00		
		200 LF x 24" RCP	24" RCP		200 LF	\$554.79 / LF	\$110,958.76		
DE- 102	Route 26 NEAR MAGOF Rd	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$80,754.00	\$137,281.79
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
DE-107	Route 27A	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$80,754.00	\$137,281.79
		100 LF x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		

DISTRICT CHALAN PAGO & ORDOT

LOCATION			COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE		RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ ENGINEERING & CONTINGENCIES
CP-101 CP-115	Chalan Famha	Leo Palace	500 LFx2-24" RCP	24" RCP		500 LF	\$554.79 / LF	\$277,396.90	\$325,545.35	\$553,427.09
			2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00		
			600 CF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549.23		
			1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
					EXCAVATION	193.92 CY	\$27.53 / CY	\$5,338.62		
		EROSION CONTROL (HYDROSEED)	6400 SF	\$0.80 / SF	\$5,120.00					
CP-102	Victoriano Road	Dero Road	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$82,385.42	\$140,055.22
			100' 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
CP-103	Ramirez Drive - Chalan Pago	Judge Sablan St	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$304,302.94	\$517,315.01
			500' 24" RCP	24" RCP		500 LF	\$554.79 / LF	\$277,396.90		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
CP-104	Dero Road	Route 4	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59	\$83,526.02	\$141,994.23
			2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
			100'x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
CP-105	Gogue Drive	---	400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43	\$449,885.42	\$764,805.22
			2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
CP-106	Chalan Totto	Route 4	500'x36" RCP	36" RCP		500 LF	\$715.00 / LF	\$357,500.00	\$449,885.42	\$764,805.22
			100'x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
			100 LFx24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00		
CP-107	Naki Street	Route 4	400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43	\$90,436.47	\$153,742.00
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
			100'x36" RCP	36" RCP		100 LF	\$715.00 / LF	\$71,500.00		
			100' CONCRETE CHANNEL	CONCRETE CHANNEL	EXCAVATION	29.63 CY	\$27.53 / CY	\$815.71		
CP-108	Maimal Road and Route 15	Chalan Apusento			CONCRETE (DITCH LINING)	3.85 CY	\$633.32 / CY	\$2,438.28	\$401,185.02	\$682,014.53
			100' DITCH	DITCH		14.815 CY	\$27.53 / CY	\$407.86		
					EXCAVATION	29.63 CY	\$27.53 / CY	\$815.71		
					CONCRETE (DITCH LINING)	3.85 CY	\$633.32 / CY	\$2,438.28		
			100' CONCRETE CHANNEL	CONCRETE CHANNEL		14.815 CY	\$27.53 / CY	\$407.86		
CP-108	Maimal Road and Route 15	Chalan Apusento	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$401,185.02	\$682,014.53
			500'x48" RCP	48" RCP		500 LF	\$744.50 / LF	\$372,248.55		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		

LOCATION			COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE		RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ ENGINEERING & CONTINGENCIES
CP-109	Kongga Road	...	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$115,520.69	\$196,385.17
			100"x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
			1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
CP-110	Chalan Okso	Santa Cruz Dr	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$115,520.69	\$196,385.17
			100"x 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
			100' CONCRETE CHANNEL	CONCRETE CHANNEL	EXCAVATION CONCRETE (DITCH LINING)	311 CY	\$27.53 / CY	\$8,561.83		
CP-222	Manibusan Lane	Santa Cruz Dr	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$83,526.02	\$141,994.23
			100"x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
CP-112	Chalan Chirik	Route 10	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00	\$82,385.42	\$140,055.22
			100"x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
CP-114	Chalan Nganga	Leo Palace	100'x5'x5' RCB	REINFORCED CONCRETE BOX CULVERT		92.59 CY	\$1,103.85 / CY	\$102,205.47	\$354,336.78	\$602,372.52
			1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.59		
			1000 SF GABIONS	GABION		92.9 CY	\$629.66 / CY	\$58,495.67		
			1200 CF RIP RAP	RIP RAP		44.44 CY	\$744.79 / CY	\$33,098.47		
			2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000.00		
			100'x3'x5' RCB	REINFORCED CONCRETE BOX CULVERT		55.55 CY	\$1,103.85 / CY	\$61,318.87		
			300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
			100' CONCRETE DITCH	CONCRETE CHANNEL	EXCAVATION CONCRETE (DITCH LINING)	29.63 CY	\$27.53 / CY	\$815.71		
			400' DITCH	DITCH		7.7 CY	\$633.32 / CY	\$4,876.56		
			400' DITCH	DITCH		59.26 CY	\$27.53 / CY	\$1,631.43		
			2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000.00		
			100"x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		

Hagatna Village

LOCATION		COST ESTIMATES							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNITS	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
HA-101	Route 4 & Route 1	300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62	\$8,275	\$14,100
		200"x12" RCB	RCB		118.52 CY	\$1,108.85 / CY	\$130,828.30		
HA-102	Route 2 & Route 7B	1 HEADWALL	HEADWALL		1 EA	\$5,000.00 / EA	\$5,000.00	\$144,103	\$245,000
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
HA-103	Sixth Street	2-100' BIOSWALES (HOTSPOT)	BIOSWALE	EXCAVATION	96.3 CY	\$27.53 / CY	\$2,651.14		
		ABANDON DRY WELLS (6 TOTAL)	ABANDON DRY WELLS	EROSION CONTROL (HYDROSEED)	2600 SF	\$5.00 / SF	\$13,000.00	\$728,277	\$1,240,000
		UPSIZE PIPE IN Rte 7A (1000"x30")	UPSIZE PIPE	ABANDON WATER WELL	6 EA	\$5,500.00 / EA	\$33,000.00		
				30" RCP	1000 LF	\$679.63 / LF	\$679,625.40		
HA-104	Aniceto Street	4-100' BIOSWALES (HOTSPOT)	BIOSWALE	EXCAVATION	192.6 CY	\$27.53 / CY	\$5,302.28		
		2 CATCH BASINS	CATCH BASIN	EROSION CONTROL (HYDROSEED)	5200 SF	\$5.00 / SF	\$26,000.00	\$149,261	\$254,000
		200"x24" RCP	24" RCP		2 EA	\$9,500.00 / EA	\$7,000.00		
					200 LF	\$554.79 / LF	\$110,958.76		
HA-105	Route 7A & Detention Facility	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,140.60	\$83,894	\$149,000
		3,000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62		
		UPSIZE PIPE IN Rte 7A (4000"x48")	UPSIZE PIPE	48" RCP	4000 LF	\$744.50 / LF	\$2,977,888.40		
HA-106	Route 7 A and O'Brien Drive	1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00	\$2,996,283	\$8,100,000
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62		
HA-107	Minondo Bridge	4 NEW WINGWALLS @ ABUTMENT	WINGWALL		4 EA	\$5,000.00 / EA	\$20,000.00	\$53,098	\$90,300
		1200 CF RIP RAP	RIP RAP		44.44 CY	\$744.79 / CY	\$33,098.47		
HA-108	Agana River Bridge	1 AC DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562.38		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00	\$70,042	\$119,000
		100"x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479.38		
HA-109	Route 7 & Route 33	ADD 5,000 SF to INFILTRATION BASIN (6' DEEP)	INFILTRATION BASIN	EXCAVATION	1111.11 CY	\$27.53 / CY	\$30,588.86		
		INSTALL 6 INJECTION WELLS (200 LF EA)	INJECTION WELL	FENCING	10,448 LF	\$14.92 / LF	\$155,884.16	\$1,886,473	\$2,360,000
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		1200 LF	\$1,000.00 / LF	\$1,200,000.00		
HA-110	Route 7 & Fonte River	3,000 CF RIP RAP	RIP RAP		0.25 AC	\$4,562.38 / AC	\$1,140.60		
		2 - 200"x9"x4" RCB	RCB		111.11 CY	\$744.79 / CY	\$82,753.62	\$692,611	\$1,180,000
		2 HEADWALL/WINGWALL STRUCTURES	HEADWALL/WINGWALL		533.33 CY	\$1,103.85 / CY	\$588,716.32		
					2 EA	\$10,000.00 / EA	\$20,000.00		
HA-111	Route 1 & East Hagatna Beach	300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62	\$18,275	\$31,100
		1 HEADWALL/WINGWALL STRUCTURE	HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
HA-112	Chen's Furniture	10,000 SF ROCK BLANKET	ROCK BLANKET		1111.11 SY	\$79.51 / SY	\$81,677.70		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62	\$104,876	\$178,000
		1 HEADWALL/WINGWALL STRUCTURE	HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		200 LF CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	14.81 CY	\$27.53 / CY	\$407.72		
				CONCRETE (DITCH LINING)	7.13 CY	\$633.32 / CY	\$4,515.57		
HA-113	Route 1 & Mobil Gas Station	10,000 SF ROCK BLANKET	ROCK BLANKET		1111.11 SY	\$79.51 / SY	\$81,677.70		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62	\$104,876	\$178,000
		1 HEADWALL/WINGWALL STRUCTURE	HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		200 LF CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	14.81 CY	\$27.53 / CY	\$407.72		
				CONCRETE (DITCH LINING)	7.13 CY	\$633.32 / CY	\$4,515.57		
HA-115	Route 1 & Citibank	10,000 SF ROCK BLANKET	ROCK BLANKET		1111.11 SY	\$79.51 / SY	\$81,677.70		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,274.62	\$104,876	\$178,000
		1 HEADWALL/WINGWALL STRUCTURE	HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000.00		
		200 LF CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	14.81 CY	\$27.53 / CY	\$407.72		
				CONCRETE (DITCH LINING)	7.13 CY	\$633.32 / CY	\$4,515.57		
HA-116	Shell Gas Stn and Route 1	1 AC DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562.38		
		200 LF CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	14.81 CY	\$27.53 / CY	\$407.72	\$26,992	\$45,900
		10'x10' APRON AROUND EXIST CATCH BASIN	APRON	CONCRETE (DITCH LINING)	7.13 CY	\$633.32 / CY	\$4,515.57		
		10,000 SF HYDROMULCH W/BFM	HYDROMULCH (BFM)		4.17 CY	\$1,800.00 / CY	\$7,506.00		
					10,000 SF	\$1.00 / SF	\$10,000.00		
HA-117	Route 4 & Route 1	3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,753.62	\$82,800	\$141,000

LOCATION		COST ESTIMATES							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES UNITS	COST / UNITS	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES	
HA-118	Route 1 & District Court House	300 CF RIP RAP	RIP RAP	11.11 CY	\$744.79 / CY	\$8,274.62	\$18,275	\$31,100	
		1 HEADWALL/WINGWALL STRUCTURE	HEADWALL/WINGWALL	1 EA	\$10,000.00 / EA	\$10,000.00			
HA-119	Route 1 & Sewage Treatment Plant	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.58 / AC	\$1,140.60	\$83,894	\$143,000	
		3,000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,753.62			
HA-120	Route 1 & Gregorio Perez Marina	200'x6'x4' RCB	RCB	118.52 CY	\$1,109.85 / CY	\$130,828.30	\$135,828	\$231,000	
		1 HEADWALL	HEADWALL	1 EA	\$5,000.00 / EA	\$5,000.00			
HA-121	Route 1 & Padre Palomo Memorial Park	1/2 ACRE DEBRIS REMOVAL	DEBRIS REMOVAL	0.5 AC	\$4,562.58 / AC	\$2,281.19	\$167,788	\$285,000	
		5,000 CF RIP RAP	RIP RAP	222.22 CY	\$744.79 / CY	\$165,507.25			

INARAJAN VILLAGE								
LOCATION		\$ COST ESTIMATE \$						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COSTS / UNITS	COST	TOTAL COST W/ENGINEERING CONTINGENCIES
IV-112	Agfayan River Bridge	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	
IV-117	Route 4 and Tongan Creek	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$103,894
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	
		4 WINGWALLS	WINGWALL		4 EA	\$5,000.00 / EA	\$20,000	
IV-113	Route 4 near Tun Santiago N Paulino	1/2 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.5 AC	\$4,562.38 / AC	\$2,281	\$167,788
IV-114		3,000 CF RIP RAP	RIP RAP		222.22 SF	\$744.79 / SF	\$165,507	
IV-109	Route 4 at Tinago River	1/2 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.5 AC	\$4,562.38 / AC	\$2,281	\$179,505
		1,000 SF CHANNEL LINING	CONCRETE CHANNEL LINING		18.5 CY	\$633.32 / CY	\$11,716	
		6,000 CF RIP RAP	RIP RAP		222.22 CY	\$744.79 / CY	\$165,507	
IV-107	Route 4 & Aslinger River	250,000 SF HYDROSEED (W/BFM)	HYDROSEED (W/BFM)		250000 SF	\$1.50 / SF	\$375,000	\$637,500
IV-102, IV 103, IV-104, IV-106	Rte 4 & Ates Ln, Rte 4 @ Dan Dan Store, Rte 4 & NO Malojloj Wall, Rte 4 & Chargala	2-200 INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22 CY	\$27.53 / CY	\$6,118	\$26,629
				0.75" ROCK	222.22 CY	\$41.00 / CY	\$9,111	
				FILTER FABRIC	7600 SF	\$1.50 / SF	\$11,400	
IV-108	Route 4 at Aslinger River	6,000 CF RIP RAP	RIP RAP		222 CY	\$744.79 / CY	\$165,507	\$177,788
		1/2 ACRE DEBRIS REMOVAL	DEBRIS REMOVAL		0.5 AC	\$4,562.37 / AC	\$2,281	
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALLS		1 EA	\$10,000.00 / EA	\$10,000	
IV-101	Route 4 at unnamed tributary near Asalonso River	100'x6'x6' RCB	REINFORCED CONCRETE BOX CULVERT		133.33 CY	\$1,103.85 / CY	\$147,176	\$251,071
		2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALLS		2 EA	\$10,000.00 / EA	\$20,000	
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	
		1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
IV-121	Route 4 at Belen Avenue	2-200' INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22 CY	\$27.53 / CY	\$6,118	\$26,629
				0.75" ROCK	222.22 CY	\$41.00 / CY	\$9,111	
				FILTER FABRIC	7600 SF	\$1.50 / SF	\$11,400	
IV-118	Route 4 at Bisbesbes	100'x3'x6' RCB	REINFORCED CONCRETE BOX CULVERT		66.67 CY	\$1,103.85 / CY	\$73,594	\$111,284
		2 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALLS		2 EA	\$10,000.00 / EA	\$20,000	
		600 CF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
IV-122	Route 4 at Chagaminlago Street	1 AC DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562	\$1,659,650
		60,000 CF RIP RAP	RIP RAP		2222.22 CY	\$744.79 / CY	\$1,655,087	
IV-110	Route 4 at Jamie Ann's	1,000'x4' RECTANGULAR CONCRETE CHANNEL	CONCRETE CHNL LINING		266.5 CY	\$633.32 / CY	\$168,780	\$286,926
IV-120	Route 4 at Ahayan River	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,569
		100 LF 24" RCP	RCP		100 LF	\$554.79 / LF	\$55,479	
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALLS		1 EA	\$10,000.00 / EA	\$10,000	
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275	
		200 LF DITCH	DITCH		29.63 CY	\$27.53 / CY	\$816	
IV-123	Apman Dr	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	
IV-119	Route 4 S O Bisbesbes	100'x6'x3' RCB	RCB		65.00 CY	\$1,103.85 / CY	\$71,750	\$122,754
		2-HEADWALL/WINGWALLS	HEADWALL W/WINGWALLS		2 EA	\$10,000.00 / EA	\$20,000	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
		600 CF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549	
		1-200' INFILTRATION TRENCH	INFILTRATION TRENCH		1 EA	\$13,314.00 / EA	\$13,314	

LOCATION		\$ COST ESTIMATE \$							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COSTS / UNITS	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
IV-105 IV-111	Rte 4 & Chalan Tun Pedro Riviera Dr. & Rte 4 & S. Tinago River	1-200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,059	\$13,314	\$22,634
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,556		
				FILTER FABRIC	3800 SF	\$1.50 / SF	\$5,700		
IV-116	Rte 4 & Tun Mariano D. Leon Guerrero Rd.	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,570	\$138,669
		100 LF 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALLS		1 EA	\$10,000.00 / EA	\$10,000		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
		200 LF DITCH	DITCH		29.63 CY	\$27.53 / CY	\$816		
IV-124	Enemicio & Regina Diego Drive	1500' CONCRETE CHANNEL	CONCRETE CHANNEL	EXCAVATION	4000 CY	\$27.53 / CY	\$110,120	\$816,945	\$1,388,806
				CONCRETE (DITCH LINING)	833 CY	\$633.32 / CY	\$527,556		
		1 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562		
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		100 LF 48" RCP	48" RCP		100 LF	\$146.00 / LF	\$14,600		
		6 HEADWALLS/WINGWALLS	HEADWALL W/WINGWALLS		6 EA	\$10,000.00 / EA	\$60,000		
		100 CY CUT	EXCAVATION		100 CY	\$27.53 / CY	\$2,753		
		100 LF 36" RCP	36" RCP		100 LF	\$146.00 / LF	\$14,600		

MANGILAO VILLAGE

LOCATION		COST ESTIMATE						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST W/ENGINEERING CONTINGENCIES
MO-101	Spanish Lane & Rt 15	2 Catch Basins; 100 LF 24" RCP; 1 Headwall/Wingwall, 100 SF Rip Rap, 200 LF Ditch	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,569
			24" RCP		100 LF	\$554.79 / LF	\$55,479	
			HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000	
			RIP RAP		11.11 CY	\$744.79 / CY	\$8,275	
			DITCH		29.6 CY	\$27.53 / CY	\$815	
MO-103	Kotpus Street	2 Catch Basins; 100 LF 24" RCP; 1/4 AC Debris Removal; 200'x200' Infiltration Basin; 800' Fence	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$264,904
			24" RCP		100 LF	\$554.79 / LF	\$55,479	
			DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
			INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631	
			FENCE		848 LF	\$14.92 / LF	\$12,652	
MO-104	Chargualaf Street & Chalan Kareta	50'x400' Infiltration Basin w/900' Fence; 1 AC Debris Removal	INFILTRATION BASIN	EXCAVATION	9210 CY	\$27.53 / CY	\$253,551	\$272,258
			FENCE		948 LF	\$14.92 / LF	\$14,144	
			DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562	
MO-105	Chargualaf Street	2 Catch Basins; 100 LF 24" RCP; 1/4 AC Debris Removal; 200'x200' Infiltration Basin; 800' Fence	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$263,763
			24" RCP		100 LF	\$554.79 / LF	\$55,479	
			INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631	
			FENCE		848 LF	\$14.92 / LF	\$12,652	
MO-106	Tangerine Lane & Rt 10	200'x200' INFILTRATION BASIN	INFILTRATION BASIN	EXCAVATION	6851.85 CY	\$27.53 / CY	\$188,631	\$701,284
		800' FENCE	FENCING		848 LF	\$14.92 / LF	\$12,652	
		8 INJECTION WELLS	INJECTION WELLS	16" INJECTION WELL	500 LF	\$1,000 / LF	\$500,000	
MO-107	Mandarine Lane & Chero Lane	1000 LF CONCRETE DITCH	EXCAVATION		74 CY	\$27.53 / CY	\$2,037	\$50,828
			CONCRETE (DITCH LINING)		77.04 CY	\$633.32 / CY	\$48,791	
MO-110	Kita L G Court	1000 LF CONCRETE TRAP CHANNEL	EXCAVATION		1777.78 CY	\$27.53 / CY	\$48,942	\$934,749
			CONCRETE (DITCH LINING)		718.52 CY	\$633.32 / CY	\$455,053	
		8000 CF RETAINING WALL	RETAINING WALL		296.3 CY	\$1,003.50 / CY	\$297,337	
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
MO-111	Manha Lane	1000 SF HYDROMULCH W/BFM	HYDROMULCH (BFM)		1000 SF	\$1.00 / SF	\$1,000	\$88,768
		1 CATCH BASIN	CATCH BASIN		1 EA	\$3,500.00 / EA	\$3,500	
		100 LF 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479	
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000	
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275	
MO-112	Route 10 & Lalo Street	200' LONG INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 CY	\$27.53 / CY	\$3,059	\$11,716
				0.75" ROCK	111.11 CY	\$41.00 / CY	\$4,556	
				FILTER FABRIC	2600 SF	\$1.50 / SF	\$3,900	
MO-112	Route 10 & Lalo Street	100' CONCRETE CROSS GUTTER	CONCRETE CROSS GUTTER	Concrete (Ditch Lining)	18.5 CY	\$633.32 / CY	\$11,716	\$11,716
MO-113	Intersection of Route 15 & Route 10	3 CATCH BASINS	CATCH BASIN		3 EA	\$3,500.00 / EA	\$10,500	\$121,459
		200'x24" RCP	24" RCP		200 LF	\$554.79 / LF	\$110,959	

LOCATION		COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
MO-116	Southern Cross Lane	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$458,476	\$779,000
		400 LF 24" RCP	24" RCP		400 LF	\$554.79 / LF	\$221,918		
		100 SF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
		2 HEADWALL/WINGWALL	HEADWALL/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
		200x200' INFILTRATION BASIN	INFILTRATION BASIN		6851.85 CY	\$27.53 / CY	\$188,631		
		800' FENCE	FENCING		848 LF	\$14.92 / LF	\$12,652		
MO-114	Intersection of Route 15 & Route 26 (Carnation Lane)	4- 200 LF Bioswales (800 LF BIOSWALE)	EXCAVATION		533.33 CY	\$27.53 / CY	\$14,683	\$37,333	\$63,500
			EROSION CONTROL (HYDROSEED)		15100 SF	\$1.50 / SF	\$22,650		
MO-115	Old Route 26	2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,570	\$139,000
		100 LF 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
		200 LF DITCH	DITCH		29.63 CY	\$27.53 / CY	\$816		
MO-102	Farfan St & Rt 15	2 Catch Basins; 100 LF 24" RCP; 1 Headwall/Wingwall, 100 SF Rip Rap, 200 LF Ditch	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,569	\$139,000
			24" RCP		100 LF	\$554.79 / LF	\$55,479		
			HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000		
			RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
			DITCH		29.6 CY	\$27.53 / CY	\$815		
MO-108	Lemon Lane & Chero Lane	2 Catch Basins; 100 LF 24" RCP; 1 Headwall/Wingwall, 100 SF Rip Rap, 200 LF Ditch	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,569	\$139,000
			24" RCP		100 LF	\$554.79 / LF	\$55,479		
			HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000		
			RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
			DITCH		29.6 CY	\$27.53 / CY	\$815		
MO-109	Aga Lane & Mngga Lane	2 Catch Basins; 100 LF 24" RCP; 1 Headwall/Wingwall, 100 SF Rip Rap, 200 LF Ditch	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000	\$81,569	\$139,000
			24" RCP		100 LF	\$554.79 / LF	\$55,479		
			HEADWALL/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000		
			RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
			DITCH		29.6 CY	\$27.53 / CY	\$815		

MERIZO VILLAGE

LOCATION		COST ESTIMATE					
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS	QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING & CONTINGENCIES
ME-113 ME-119 ME-121 ME-122	Rt 4 & Juan Baubata St Rt 4 & SO Benny Espinoza Ave Rt 4 & NO Benny Espinoza Ave Rt 4 & Chalan Joseph A Cruz	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0 AC	\$4,562.38 / CY	\$1,141	\$83,894 \$142,620
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / LF	\$82,754	
ME-101	Rt 4 & Asmaile Creek	1/2 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.5 AC	\$4,562.38 / AC	\$2,281	\$167,788 \$285,240
		6000 CF RIP RAP	RIP RAP	222.22 CY	\$744.79 / CY	\$165,507	
ME-124	Culvert at Mobil Station	100"x12"x6' RCB	REINFORCED CONCRETE BOX CULVERT	266.67 CY	\$1,103.85 / CY	\$294,364	\$398,258 \$677,038
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL	2 EA	\$10,000.00 / EA	\$20,000	
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754	
ME-130	Rt 4 & Ajayan River	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894 \$142,620
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754	
ME-111	Emma Juan Reyes Street	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$84,429 \$143,529
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754	
		3000 CF FILL	STRUCTURAL FILL	11.11 CY	\$48.14 / CY	\$535	
ME-114	Mannell Channel	4000 CY ROCK REMOVAL	ROCK REMOVAL	4000 CY	\$14.53 / CY	\$58,120	\$4,487,587 \$7,628,897
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	
		15000 CF RIP RAP	RIP RAP	555.56 CY	\$744.79 / CY	\$413,776	
		20 CY CUT	EXCAVATION	20 CY	\$27.53 / CY	\$551	
		4000 CY RETAINING WALL	RETAINING WALL	4,000 CY	\$1,003.50 / CY	\$4,014,000	
ME-115	North of Mannell Channel	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$6,489 \$11,032
		3,000 CF RIP RAP	RIP RAP	111.11 CY	\$48.14 / CY	\$5,349	
ME-128	N O Bile River	2 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL	2 EA	\$10,000.00 / EA	\$20,000	\$98,466 \$167,393
		600 CF RIP RAP	RIP RAP	22.22 CY	\$744.79 / CY	\$16,549	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	
		100"x5"x3' RCB	RCB	54.56 CY	\$1,103.85 / CY	\$60,226	
		20 CY CUT	EXCAVATION	20 CY	\$27.53 / CY	\$551	
ME-117	N O Geus River	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894 \$142,620
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754	
ME-116	Rte 4 and Achang River at Jesus R Quinene	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$9,415 \$16,006
		300 CF RIP RAP	RIP RAP	11.11 CY	\$744.79 / CY	\$8,275	
ME-102	Rte 4 and Asgado Creek	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$27,690 \$47,073
		600 CF RIP RAP	RIP RAP	22.22 CY	\$744.79 / CY	\$16,549	
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL	1 EA	\$10,000.00 / EA	\$10,000	

LOCATION		COST ESTIMATE						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING & CONTINGENCIES
ME-120	Rte 4 & Benny Espinoza Ave	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$1,141	\$1,939
ME-103	Rte 4 and Llyog River	100 CY CUT	EXCAVATION	100 CY	\$27.53 / CY	\$2,753	\$86,647	\$147,300
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754		
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141		
ME-126	Rte 4 and Pigua River	100 CY CUT	EXCAVATION	100 CY	\$27.53 / CY	\$2,753	\$319,653	\$543,410
		300 CF RIP RAP	RIP RAP	11.11 CY	\$744.79 / CY	\$8,275		
		100'x6'x12' RCB	RCB	266.67 CY	\$1,103.85 / CY	\$294,364		
		800 CF GABIONS	GABIONS	22.65 CY	\$629.66 / CY	\$14,262		
ME-106	Rte 4 and Sumay River	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.00 / AC	\$1,141	\$83,894	\$142,620
		3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / AC	\$82,754		
ME-110	Rte 4 and Suyafe River	3000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754	\$83,894	\$142,620
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141		
ME-118	Rte 4 and Geus River	1/2 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.5 AC	\$4,562.38 / AC	\$2,281	\$167,788	\$285,240
		6000 CF RIP RAP	RIP RAP	222.22 CY	\$744.79 / CY	\$165,507		
ME-104 ME-107	Rte 4 Coastal Issues	1 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	1 AC	\$4,562.38 / AC	\$4,562	\$418,338	\$711,174
		15000 CF RIP RAP	RIP RAP	555.56 CY	\$744.79 / CY	\$413,776		
ME-125	Rte 4 & NO Merizo Catholic Church	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$9,513	\$16,172
		300 CF RIP RAP	RIP RAP	11.11 CY	\$744.79 / CY	\$8,275		
		100 SF APRON	CONCRETE (DITCH LINING)	0.1543 CY	\$633.32 / CY	\$98		
ME-112	Rte 4 S O Baubata	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894	\$142,620
		3000 SF RIP RAP	RIP RAP	111.11 CY	\$744.79 / LF	\$82,754		
ME-105	Rte 4 S O Sumay River	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894	\$142,620
		3,000 CF RIP RAP	RIP RAP	111.11 CY	\$744.79 / CY	\$82,754		
ME-108	Rte 4 S O Suyafe River	1/2 AC DEBRIS REMOVAL	DEBRIS REMOVAL	0.5 AC	\$4,562.38 / AC	\$2,281	\$167,788	\$285,240
		6000 CF RIP RAP	RIP RAP	222.22 CY	\$744.79 / CY	\$165,507		
ME-129	Toguan River	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$115,411	\$196,199
		600 CF RIP RAP	RIP RAP	22.22 CY	\$744.79 / CY	\$16,549		
		10000 SF Ditch Lining	CONCRETE (DITCH LINING)	154.3 CY	\$633.32 / CY	\$97,721		

MONGMONG VILLAGE								
LOCATION		COST ESTIMATE						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
MM-101	Sergeant Roy T. Damian (Rt 33) & Rt 8	2 CATCH BASINS	CATCH BASIN	2 EA	\$3,500.00 / EA	\$7,000	\$636,233	\$1,081,597
		200' - 24" RCP	RCP	200 LF	\$554.79 / LF	\$110,959		
		300 CF RIP RAP	RIP RAP	11.11 CY	\$744.79 / CY	\$8,275		
		1 HEADWALL/WINGWALL	HEADWALL W/WINGWALL	1 EA	\$10,000.00 / EA	\$10,000		
		UNDERGROUND INFILTRATION CHAMBER	INFILTRATION CHAMBER	1 EA	\$500,000.00 / EA	\$500,000		

PITI VILLAGE									
LOCATION		COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNITS	COST / UNIT	COST	TOTAL COST W/ENGINEERING CONTINGENCIES
PI-116	Rt 1 & Tepungan Beach Park	2 - 100' - 36" RCP	36" RCP		100	LF	\$715.00 / LF	\$71,500	\$109,190
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / LF	\$20,000	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
		600 CF RIP RAP	RIP RAP		22.22	CY	\$744.79 / CY	\$16,549	
PI-111	c/o Assumption Drive & Spruance Drive	100"x24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479	\$93,169
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / EA	\$20,000	
		600 CF RIP RAP	RIP RAP		22.22	CY	\$744.79 / CY	\$16,549	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
PI-104 PI-105 PI-106 PI-108	A Quenga St. & Assumption Dr (PI-104) Assumption Drive (PI-105) Assumption Drive & Masso River (PI-106) Rt.1 & Atantano River (PI-108)	3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,754	\$83,894
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
PI-114	JC Santos & J.M. Tuncap St	100"x36" RCP	36" RCP		100	LF	\$715.00 / LF	\$71,500	\$298,366
		6000 CF RIP RAP	RIP RAP		276.22	CY	\$744.79 / CY	\$205,726	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / EA	\$20,000	
PI-115	Route 1 & Taguag River	1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	\$83,894
		3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,754	
PI-101	Route 1	10,000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		1	AC	\$4,562.38 / AC	\$4,562	\$842,106
		30,000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$827,544	
		HEADWALL/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000	
PI-109 PI-110 PI-112 PI-113	Route 1 @ Masso River	3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,754	\$83,894
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
PI-103	Marin Peling Street (Mary Pelen)	100"x 2-36" RCP	36" RCP		100	LF	\$715.00 / LF	\$71,500	\$109,190
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / EA	\$20,000	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
		600 CF RIP RAP	RIP RAP		22.22	CY	\$744.79 / CY	\$16,549	
PI-118	Rt11 & Commercial Port	200' BIOSWALE	BIOSWALE	EXCAVATION	96.96	CY	\$27.53 / CY	\$2,669	\$22,267
				EROSION CONTROL (HYDROSEED)	3200	SF	\$5.00 / SF	\$16,000	
		100 SF APRON	APRON	CONCRETE (DITCH LINING)	0.1543	CY	\$633.32 / CY	\$98	
		1 CATCH BASIN	CATCH BASIN		1	EA	\$3,500.00 / EA	\$3,500	
PI-107	Route 1 at Chalan Soling	100"x3'x3' RCB	REINFORCED CONCRETE BOX CULVERT		33.33	CY	\$1,153.35 / CY	\$38,441	\$76,131
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / EA	\$20,000	
		600 CF RIP RAP	RIP RAP		22.22	CY	\$744.79 / CY	\$16,549	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
PI-102	Rt11	200"x3'x5' RCB	REINFORCED CONCRETE BOX CULVERT		111.11	CY	\$1,153.35 / CY	\$128,149	\$232,043
		2 HEADWALL/WINGWALLS	HEADWALL W/WINGWALL		2	EA	\$10,000.00 / EA	\$20,000	
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141	
		3000 CF RIP RAP	RIP RAP		111.11	CY	\$744.79 / CY	\$82,754	
PI-119	Rt 1 & Polaris Point	6500"x24" RCP	24" RCP		6,500	LF	\$554.79 / CY	\$3,606,160	\$19,006,989
		22 CATCH BASINS	CATCH BASIN		22	EA	\$3,500 / EA	\$77,000	
		8 Media Filters or Underground Vaults	MEDIA FILTERS		8	EA	\$400,000.00 / EA	\$3,200,000	
		43,000 CY FILL	FILL		43,000	CY	\$27.53 / CY	\$1,183,790	
		1,200 CY RIP RAP	RIP RAP		1,200	CY	\$744.79 / CY	\$893,748	
		11,000 CY GABIONS	GABIONS		11,000	CY	\$629.66 / CY	\$6,926,291	
		30,000 SY PAVEMENT	PAVEMENT, FRICTION COURSE & SUBBASE		30,000	SY	\$104 / SY	\$3,120,000	

SANTA RITA VILLAGE

LOCATION		COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
SR-101	746 Bishop Olano Drive & Pale Medina	200' conc ditch	CONCRETE DITCH	CONC LINING	1.5 CY	\$633.32 / CY	\$950	\$83,704	\$142,296
		1000 SF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
SR-102	DS of Pale Medina	20'x100' gabion wall	GABION		22.22 CY	\$629.66 / CY	\$13,991	\$97,885	\$166,405
		111 CF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		0.009290304 HA Debris Removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
SR-113	Felix T Dydasco	100'x6"x4" RCB (per FCD)	REINFORCED CONCRETE BOX CULVERT		88.89 CY	\$1,153.35 / CY	\$102,521	\$152,121	\$258,606
		100' conc ditch, 2:1 SIDE SLOPES, 4' deep	CONCRETE DITCH	EXCAVATION	178 CY	\$27.53 / CY	\$4,900		
				CONCRETE (DITCH LINING)	39 CY	\$633.32 / CY	\$24,699		
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
SR-112	Felix T Pellinginan	100'x6"x4" RCB (per FCD)	REINFORCED CONCRETE BOX CULVERT		88.89 CY	\$1,153.35 / CY	\$102,521	\$128,639	\$218,686
		500' ditch	DITCH		222.22 CY	\$27.53 / CY	\$6,118		
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
SR-116	Jct Route 12 at Naval Gate Entry	1/4 Ac Debris Removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$4,641	\$7,889
		Add 1 catch basin	CATCH BASIN		1 EA	\$3,500.00 / EA	\$3,500		
SR-117	Jose Sarmiento Drive_Gregoria Barajo	100'x8'x5' RCB	REINFORCED CONCRETE BOX CULVERT		148.15 CY	\$1,153.35 / CY	\$170,869	\$273,622	\$465,158
		1/4 Ac RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
SR-105	Nemo Falls Road	100' x 36" RCP	36" RCP		100 LF	\$715.00 / LF	\$71,500	\$239,268	\$406,755
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
		1/4 Ac Debris Removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
		3 catch basins	CATCH BASIN		1 EA	\$3,500.00 / EA	\$3,500		
		100'x24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479		
		1000 SF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		400 LF Ditch	DITCH		177.78 CY	\$27.53 / CY	\$4,894		
SR-107	Pale Ferinan_SR 2	RCB 100' x double 5'x3.5' (per FCD)	REINFORCED CONCRETE BOX CULVERT		64.81 CY	\$1,153.35 / CY	\$74,749	\$112,438	\$191,145
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
			DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
		1/4 Ac Debris Removal, 200 SF Rip Rap	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549		
SR-103	Pale Roman	100' x 8'x5' RCB	REINFORCED CONCRETE BOX CULVERT		148.15 CY	\$1,153.35 / CY	\$170,869	\$595,346	\$1,012,088
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
		4000 CF Gabions	GABION		113.27 CY	\$629.66 / CY	\$71,322		
		4000 SF rip rap	RIP RAP		444.44 CY	\$744.79 / CY	\$331,014		
		1/4 Ac Debris Removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
		1000 SF Hydromulch w/ BFM	HYDROMULCH (BFM)		1000 SF	\$1.00 / SF	\$1,000		
SR-119	Route 5 and Route 17	100'x 3'x3' RCB	REINFORCED CONCRETE BOX CULVERT		33.33 CY	\$1,153.35 / CY	\$38,441	\$142,335	\$241,970
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
		1/4 Ac Debris Remval	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
		1000 SF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
SR-110	Route 17 Cross Drains	500'x36" RCP	36" RCP		500 LF	\$715.00 / LF	\$357,500	\$407,500	\$692,750
		10 HEADWALLS	HEADWALL		10 EA	\$5,000.00 / EA	\$50,000		
SR-120	Route 12 and Namo Falls Road	1 Ac Spillway	AC SPILLWAY		1 EA	\$1,000.00 / EA	\$1,000	\$167,648	\$285,001
		2000 SF Rip Rap, 1/4 Ac Debris Removal	RIP RAP		222.22 CY	\$744.79 / CY	\$165,507		
			DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
SR-115	Route 12 W	2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000	\$99,029	\$168,349
		200 SF Rip Rap, 400 LF Ditch	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549		
		2 CATCH BASINS	CATCH BASIN		2 EA	\$3,500.00 / EA	\$7,000		
		100 LF 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479		

LOCATION		COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
SR-114	Rt 17 & Felix T Dydasco Dr	1000 LF DITCH, 2 HEADWALLS, 200 SF RIP RAP, 100 LF 36" RCP	1000 LF DITCH	DITCH	148.15 CY	\$27.53 / CY	\$4,079	\$102,128	\$173,617
			2 HEADWALLS	HEADWALLS	2 EA	\$5,000.00 / LF	\$10,000		
			600 CF RIP RAP	RIP RAP	22.22 CY	\$744.79 / EA	\$16,549		
			100 LF 36" RCP	RCP	100 LF	\$715.00 / CY	\$71,500		
SR-106	Sgt Quenga and Pale Duenas Haya	100 LF 3"x5" RCB	REINFORCED CONCRETE BOX CULVERT		55.56 CY	\$1,153.35 / CY	\$64,080	\$166,834	\$283,617
		1000 SF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
SR-109	SR 7	2 AC Spillways	AC SPILLWAY		2 EA	\$1,000.00 / EA	\$2,000	\$85,894	\$146,020
		1/4 Ac Debris Removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
		1000 SF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
SR-108	Sumay Memorial Street	100'x36" RCP	36" RCP		100 LF	\$715.00 / LF	\$71,500	\$175,394	\$298,170
		1000 SF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		1/4 Ac debris removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141		
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
SR-111	Vicente Borja	200 LF ditch	DITCH		88.89 CY	\$27.53 / CY	\$2,447	\$97,344	\$165,485
		100'x4'x4' RCB	REINFORCED CONCRETE BOX CULVERT		59.26 CY	\$1,153.35 / CY	\$68,348		
		2 HEADWALLS	HEADWALL		2 EA	\$5,000.00 / EA	\$10,000		
		200 SF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549		
SR-118	Vicente Lizama	1/4 Ac Debris Removal	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$103,894	\$176,620
		1000 SF Rip Rap	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754		
		2 headwalls/wingwalls	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		

SINJANA VILLAGE

SINJANA VILLAGE							
LOCATION		COST ESTIMATE					
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS	QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
SV-101	Chalan Guma Yuos	400 SF Gabions, 1/4 Ac Debris Removal, 100 SF Rip Rap	GABION	34 CY	\$629.66 / CY	\$21,409	\$30,824
			DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	
			RIP RAP	11.11 CY	\$744.79 / CY	\$8,275	
SV-102	Route 24A	1/4 Ac Debris Removal, 500 SF Rip Rap	DEBRIS REMOVAL	0.25 AC	\$4,562.38 / AC	\$1,141	\$42,521
			RIP RAP	55.56 CY	\$744.79 / CY	\$41,381	

TALOFOFO VILLAGE

LOCATION		COST ESTIMATE							
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES UNIT	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
TA-116	Rt 4 & Talofoto Beach Park	60,000 CF RIP RAP	RIP RAP		2222.22 CY	\$744.79 / CY	\$1,655,087	\$1,655,087	\$2,813,648
TA-108	David Gorton Street S O JP Cruz	100'x48" RCP	48" RCP		100 LF	\$744.50 / LF	\$74,450	\$110,821	\$188,396
		2 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000		
		200' BIOSWALE	BIOSWALE	EXCAVATION	48.48 CY	\$2.00 / CY	\$97		
				EROSION CONTROL (HYDROSEED)	1600 SF	\$5.00 / SF	\$8,000		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
TA-112	Rte 4 & Togcha River	3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	\$83,894	\$142,620
		1/4 Ac Debris Removal	DEBRIS REMOVAL		0.25 EA	\$4,562.38 / AC	\$1,141		
TA-110	Ernest Santos Street & Siguenza Court	1 CATCH BASIN	CATCH BASIN		1 EA	\$3,500.00 / EA	\$3,500	\$188,213	\$319,962
		300'x24" RCP	24" RCP		300 LF	\$554.79 / LF	\$166,438		
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
TA-101	E Johnny Taitague	1000' CONCRETE CHANNEL	CHANNEL	EXCAVATION	296.3 CY	\$27.53 / CY	\$8,157	\$78,665	\$133,731
				CONCRETE (DITCH LINING)	77 CY	\$633.32 / CY	\$48,766		
		1 CATCH BASIN	CATCH BASIN		1 EA	\$3,500.00 / EA	\$3,500		
		1 APRON	APRON	CONCRETE (DITCH LINING)	1 CY	\$633.32 / CY	\$633		
		1 BIOSWALE	BIOSWALE	EXCAVATION	48.48 CY	\$27.53 / CY	\$1,335		
				EROSION CONTROL (HYDROSEED)	1600 SF	\$5.00 / SF	\$8,000		
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
TA-102	Ignacio Quinata Street S O JP Cruz	NEW INFILTRATION BASIN (6' DEEP)	INFILTRATION BASIN	EXCAVATION	2222 CY	\$27.53 / CY	\$61,172	\$70,348	\$119,591
				FENCING	548 LF	\$14.92 / LF	\$8,176		
		AC SPILLWAY	AC SPILLWAY		1 EA	\$1,000.00 / EA	\$1,000		
TA-104	Francisco Reyes East	1000' CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	37 CY	\$27.53 / CY	\$1,019	\$101,590	\$172,703
				CONCRETE (DITCH LINING)	35.64 CY	\$633.32 / CY	\$22,572		
		100 LF 12" RCP	12" RCP		100 LF	\$300.00 / LF	\$30,000		
		6 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL	(SMALL SIZE @ \$8000)	6 EA	\$8,000.00 / EA	\$48,000		
TA-105, TA-106, TA-109	Francisco Reyes West, Tenorio, David Gordon Street	2000' CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	148.14 CY	\$27.53 / CY	\$4,078	\$229,221	\$389,676
				CONCRETE (DITCH LINING)	71.28 CY	\$633.32 / CY	\$45,143		
		200 LF 12" RCP	12" RCP		200 LF	\$300.00 / LF	\$60,000		
		12 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		12 EA	\$10,000.00 / EA	\$120,000		
TA-113	Rte 4 & Pacifico	4 CATCH BASINS	CATCH BASIN		4 EA	\$3,500.00 / EA	\$14,000	\$254,191	\$432,124
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275		
		400 LF 24" RCP	24" RCP		400 LF	\$554.79 / LF	\$221,916		
		1 HEADWALLS W/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000		

LOCATION		COST ESTIMATE								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNIT	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
TA-107	Jose P Cruz	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000	\$90,089	\$153,151
		100 LF 24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479		
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,275		
		100 LF BIOSWALES	BIOSWALE	EXCAVATION	48.48	CY	\$27.53 / CY	\$1,335		
				EROSION CONTROL (HYDROSEED)	1600	SF	\$5.00 / SF	\$8,000		
TA-111	Ernest Santos Street and Pasadero Francisco Diego	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000	\$145,568	\$247,466
		200 LF 24" RCP	24" RCP		200	LF	\$554.79 / LF	\$110,959		
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,275		
		100 LF BIOSWALE	BIOSWALE	EXCAVATION	48.48	CY	\$27.53 / CY	\$1,335		
				EROSION CONTROL (HYDROSEED)	1600	SF	\$5.00 / SF	\$8,000		
TA-103	Monte Drive	1 CATCH BASIN	CATCH BASIN		1	EA	\$3,500.00 / EA	\$3,500	\$188,213	\$319,962
		300'x24" RCP	24" RCP		300	LF	\$554.79 / LF	\$166,438		
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1	EA	\$10,000.00 / EA	\$10,000		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,275		
TA-114	Route 4 A S O Route 17	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000	\$51,048	\$86,782
		12,000 LF DITCH	DITCH		1600	CY	\$27.53 / CY	\$44,048		
TA-115	Route 4 A North Low Points	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000	\$7,000	\$11,900

TAMUNING VILLAGE

LOCATION		COST ESTIMATE						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS		QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
TV-101	Pizza Hut	200' CONCRETE TRAP CHANNEL	CONCRETE TRAP CHANNEL	EXCAVATION	355.56 / CY	\$27.53 / CY	\$9,789	\$184,754
		1/4 AC DEBRIS REMOVAL	DEBRIS REMOVAL	CONCRETE (DITCH LINING)	143.8 / CY	\$633.32 / CY	\$91,071	
		3000 CF RIP RAP	RIP RAP		0.25 / AC	\$4,562.38 / AC	\$1,141	
		2 CATCH BASINS	CATCH BASIN		111.11 / CY	\$744.79 / CY	\$82,754	
TV-102	Tun Jose Coves Way	100' 24" RCP	24" RCP		2 / EA	\$3,500.00 / EA	\$7,000	\$185,128
		200' x DOUBLE 3'x5' RCB	REINFORCED CONCRETE BOX CULVERT		100 / LF	\$554.79 / LF	\$55,479	
					111.11 / CY	\$1,103.85 / CY	\$122,649	
TV-103	Tamuning Outlet Channel	300,000 CF RIP RAP	RIP RAP		11111.11 / CY	\$744.79 / CY	\$8,275,444	\$8,298,255
		5 AC DEBRIS REMOVAL	DEBRIS REMOVAL		5 / AC	\$4,562.28 / AC	\$22,811	
TV-104	Estrellita Court	400' 24" RCP	24" RCP		400 / LF	\$554.79 / LF	\$221,918	\$247,192
		2 CATCH BASINS	CATCH BASIN		2 / EA	\$3,500.00 / EA	\$7,000	
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALLS		1 / EA	\$10,000.00 / EA	\$10,000	
		300 CF RIP RAP	RIP RAP		11.11 / CY	\$744.79 / CY	\$8,275	
TV-105	N. Sgt David Camacho Street	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 / CY	\$27.53 / CY	\$3,059	\$12,330
				0.75" ROCK	111.11 / CY	\$41.00 / CY	\$4,556	
		200' DITCH	DITCH	FILTER FABRIC	2600 / SF	\$1.50 / SF	\$3,900	
TV-106	Sand Castle	2 CATCH BASINS	CATCH BASIN		2 / EA	\$3,500.00 / EA	\$7,000	\$62,479
		100' 24" RCP	24" RCP		100 / LF	\$554.79 / LF	\$55,479	
TV-108	McDonald's (Rte 27)	2 CATCH BASINS	CATCH BASIN		2 / EA	\$3,500.00 / EA	\$7,000	\$351,322
		400' 36" RCP	36" RCP		400 / LF	\$815.12 / LF	\$326,048	
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALLS		1 / EA	\$10,000.00 / EA	\$10,000	
		300 CF RIP RAP	RIP RAP		11.11 / CY	\$744.79 / CY	\$8,275	
TV-109	McDonald's (Rte 27 @ Anthurum Ln)	2 CATCH BASINS	CATCH BASIN		2 / EA	\$3,500.00 / EA	\$7,000	\$248,707
		400' 24" RCP	24" RCP		400 / LF	\$554.79 / LF	\$221,918	
		300 CF RIP RAP	RIP RAP		11.11 / CY	\$744.79 / CY	\$8,275	
		200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 / CY	\$27.53 / CY	\$3,059	
				0.75" ROCK	111.11 / CY	\$41.00 / CY	\$4,556	
TV-110	Rte 27	2 CATCH BASINS	CATCH BASIN	FILTER FABRIC	2600 / SF	\$1.50 / SF	\$3,900	\$82,268
		100' 24" RCP	24" RCP		2 / EA	\$3,500.00 / EA	\$7,000	
		300 CF RIP RAP	RIP RAP		100 / LF	\$554.79 / LF	\$55,479	
					11.11 / CY	\$744.79 / CY	\$8,275	
		200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11 / CY	\$27.53 / CY	\$3,059	
TV-107	Fujita Ponding Basin			0.75" ROCK	111.11 / CY	\$41.00 / CY	\$4,556	\$80,754
				FILTER FABRIC	2600 / SF	\$1.50 / SF	\$3,900	
		2 CATCH BASINS	CATCH BASIN		2 / EA	\$3,500.00 / EA	\$7,000	
		100' 24" RCP	24" RCP		100 / LF	\$554.79 / LF	\$55,479	
		1 HEADWALL W/WINGWALL	HEADWALL W/WINGWALLS		1 / EA	\$10,000.00 / EA	\$10,000	
	Lot 2151-36	300 CF RIP RAP	RIP RAP		11.11 / CY	\$744.79 / CY	\$8,275	\$137,282

UMATAC VILLAGE

LOCATION		COST ESTIMATE						
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATION			QUANTITIES UNITS	COST / UNIT	COST	TOTAL COST W/ENGINEERING CONTINGENCIES
UM-108	Jose Q. Lellei River	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$83,894
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	
UM-113	Route 2 Tributary of Sella River	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$1,141
UM-112	Route 2 and Cetti River	30' x 5 - 48" RCP	48" RCP		150 LF	\$744.50 / LF	\$111,675	\$389,263
		HEADWALL W/WINGWALL	HEADWALL W/WINGWALL		1 EA	\$10,000.00 / EA	\$10,000	
		8000 SF GABIONS	GABIONS		286.3 CY	\$629.66 / CY	\$180,272	
		1 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562	
		3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	
UM-114	Route 2 and Sella River	1000 SF DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$1,141
UM-101	Route 2 and Umatac River	1 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562	\$1,661,690
		60,000 CF RIP RAP	RIP RAP		2222.22 CY	\$744.79 / CY	\$1,655,087	
		2000 CF DREDGING (EARTHWORK)	DREDGING (EARTHWORK)	EXCAVATION	74.1 CY	\$27.53 / CY	\$2,040	
UM-102	Finona St NEAR Madog River	30,000 CF RIP RAP	RIP RAP		1111.11 CY	\$744.79 / CY	\$827,544	\$833,126
		1 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		1 AC	\$4,562.38 / AC	\$4,562	
		1000 CF DREDGING (EARTHWORK)	DREDGING (EARTHWORK)	EXCAVATION	37.04 CY	\$27.53 / CY	\$1,020	
UM-103	Finona St NEAR Jose A Quintana St	2 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000	\$93,169
		600 CF RIP RAP	RIP RAP		22.22 CY	\$744.79 / CY	\$16,549	
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
		100 LF - 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479	
UM-104	Finona St NEAR Jose A Quintana St	1000' CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	74.07 CY	\$27.53 / CY	\$2,039	\$32,885
				CONCRETE (DITCH LINING)	35.64 CY	\$633.32 / CY	\$22,572	
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275	
UM-105	Jose A Quintana St NEAR Finona St	100' - 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479	\$84,895
		2 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000	
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275	
UM-106	Rt 2 Near Jagar Dr	100' Concrete Trap Channel	CONCRETE TRAP CHANNEL	EXCAVATION	177.78 CY	\$27.53 / CY	\$4,894	\$222,845
				CONCRETE (DITCH LINING)	71.9 CY	\$633.32 / CY	\$45,536	
		200'x36" RCP	36" RCP		200 LF	\$715.00 / LF	\$143,000	
		2 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000	
		300 CF RIP RAP	RIP RAP		11.11 CY	\$744.79 / CY	\$8,275	
UM-107	Road A	1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	\$169,569
		4 CATCH BASIN	CATCH BASIN		4 EA	\$3,500.00 / EA	\$14,000	
		100' 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479	
		1000' CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	74.07 CY	\$27.53 / CY	\$2,039	
				CONCRETE (DITCH LINING)	35.64 CY	\$633.32 / CY	\$22,572	
UM-108	Jose Q. Aguan St NEAR Laelae River	2 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000	\$83,894
		100 LF - 24" RCP	24" RCP		100 LF	\$554.79 / LF	\$55,479	
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25 AC	\$4,562.38 / AC	\$1,141	
UM-109	Rte 2	3000 CF RIP RAP	RIP RAP		111.11 CY	\$744.79 / CY	\$82,754	\$436,057
		0.5 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.5 AC	\$4,562.38 / AC	\$2,281	
		15000 CF RIP RAP	RIP RAP		555.56 CY	\$744.79 / CY	\$413,776	
		2 HEADWALLS W/WINGWALLS	HEADWALL W/WINGWALL		2 EA	\$10,000.00 / EA	\$20,000	\$741,296

LOCATION		COST ESTIMATE								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATION			QUANTITIES	UNITS	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
UM-110	Rte 2 NEAR La Sa Fua River	2 AC SPILLWAYS	AC SPILLWAY		2	EA	\$1,000.00 / EA	\$2,000	\$36,239	\$61,606
		1200 CF RIP RAP	RIP RAP		44.44	CY	\$744.79 / CY	\$33,098		
		1/4 Ac DEBRIS REMOVAL	DEBRIS REMOVAL		0.25	AC	\$4,562.38 / AC	\$1,141		
UM-111	Rte 2 NEAR Observation Rest Area	1 AC HYDROSEED W/BFM	HYDROSEED W/BFM	EROSION CONTROL (HYDROSEED)	43560.1	SF	\$5.00 / SF	\$217,801	\$374,181	\$636,108
				EROSION CONTROL (BFM)	43560.1	SF	\$3.59 / SF	\$156,381		

YIGO VILLAGE

LOCATION		COST ESTIMATE								
MAP DESIGNATION	STREET/ROUTE	RECOMMENDATIONS			QUANTITIES	UNIT	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
YI-108	Chalan Tun Luis Duenas Street & Route 1	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11	CY	\$27.53 / CY	\$3,059	\$11,514	\$19,574
				0.75" ROCK	111.11	CY	\$41.00 / CY	\$4,556		
				FILTER FABRIC	2600	SF	\$1.50 / SF	\$3,900		
YI-102	Azud Street	2 - 200' INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22	CY	\$27.53 / CY	\$6,118	\$23,029	\$39,149
				0.75" ROCK	222.22	CY	\$41.00 / CY	\$9,111		
				FILTER FABRIC	5200	SF	\$1.50 / SF	\$7,800		
YI-103	Chalan Sta. Bernadita	2 - 200' INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22	CY	\$27.53 / CY	\$6,118	\$23,029	\$39,149
				0.75" ROCK	222.22	CY	\$41.00 / CY	\$9,111		
				FILTER FABRIC	5200	SF	\$1.50 / SF	\$7,800		
YI-105	Chalan Tun Luis Duenas Street at Route 29 (cont'd)	1000 LF CONCRETE DITCH	CONCRETE DITCH	EXCAVATION	74.07	CY	\$27.53 / CY	\$2,039	\$100,365	\$170,620
				CONCRETE (DITCH LINING)	35.64	CY	\$633.32 / CY	\$22,572		
		100"x24" RCP	24" RCP		100	LF	\$554.79 / LF	\$55,479		
		2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000		
		1 HEADWALL	HEADWALL		1	EA	\$5,000.00 / EA	\$5,000		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,275		
YI-106	Route 29 and Chn. Tun Jose Anaco	2 CATCH BASINS	CATCH BASIN		2	EA	\$3,500.00 / EA	\$7,000	\$132,374	\$225,036
		200"x24" RCP	24" RCP		200	LF	\$554.79 / LF	\$110,959		
		1 HEADWALL	HEADWALL		1	EA	\$5,000.00 / EA	\$5,000		
		300 CF RIP RAP	RIP RAP		11.11	CY	\$744.79 / CY	\$8,275		
					0.25	AC	\$4,562.38 / AC	\$1,141		
YI-104	Chalan Tun Luis Duenas NEAR Kiko Isabela Loop	2 - 200' INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22	CY	\$27.53 / CY	\$6,118	\$23,029	\$39,149
				0.75" ROCK	222.22	CY	\$41.00 / CY	\$9,111		
				FILTER FABRIC	5200	SF	\$1.50 / SF	\$7,800		
YI-107	Gaytnero Dr (Rt29) & Chalan Padiron Lagu (Rt 15)	2-200' INFILTRATION TRENCHES	INFILTRATION TRENCH	EXCAVATION	222.22	CY	\$27.53 / CY	\$6,118	\$23,029	\$39,149
				0.75" ROCK	222.22	CY	\$41.00 / CY	\$9,111		
				FILTER FABRIC	5200	SF	\$1.50 / SF	\$7,800		
YI-109	Rt 1 & Chalan Chamorri	200' INFILTRATION TRENCH	INFILTRATION TRENCH	EXCAVATION	111.11	CY	\$27.53 / CY	\$3,059	\$11,514	\$19,574
				0.75" ROCK	111.11	CY	\$41.00 / CY	\$4,556		
				FILTER FABRIC	2600	SF	\$1.50 / SF	\$3,900		

YONA VILLAGE

LOCATION		COST ESTIMATE							
MAP DESIGNATION STREET/ROUTE		RECOMMENDATIONS		QUANTITIES	UNIT	COST / UNIT	COST	TOTAL COST	TOTAL COST W/ENGINEERING CONTINGENCIES
YO-101	Route 4 (Route 10 to Ylig)	1 Ac Hydromulch, 2000 LF Silt Fence	Hydromulch	1	AC	\$1,000.00 / AC	\$1,000	\$6,640	\$11,300
			TEMPORARY SILT FENCE	2000	LF	\$2.82 / LF	\$5,640		
Y-108	Route 4 near Chalan Aguon	1000 SF Debris Removal, 1000 SF Rip Rap	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,141	\$83,894	\$143,000
			RIP RAP	111.11	CY	\$744.79 / CY	\$82,754		
YO-102	Chalan Teleforo	2 catch basins, 100 LF 24" RCP, 1 Headwall/wingwall, 100 SF Rip Rap	CATCH BASINS	2	EA	\$3,500.00 / EA	\$7,000	\$80,672	\$137,000
			24" RCP	100	LF	\$554.79 / LF	\$55,479		
			HEADWALL/WINGWALL	1	EA	\$10,000.00 / EA	\$10,000		
			RIP RAP	11	CY	\$744.79 / CY	\$8,193		
YO-103	Jesus Santos Road	2 catch basins, 400 LF 24" RCP, 1 Headwall/wingwall, 100 SF Rip Rap, 250 LF Inf Trench	CATCH BASINS	2	EA	\$3,500.00 / EA	\$7,000	\$251,418	\$427,000
			24" RCP	400	LF	\$554.79 / LF	\$221,918		
			HEADWALL/WINGWALL	1	EA	\$10,000.00 / EA	\$10,000		
			INFILTRATION TRENCH	138.89	CY	\$90.00 / CY	\$12,500		
YO-104	Balajadia Road	2 Ac Spillways, 200 SF Rip Rap, 1/4 Ac Debris Removal	AC SPILLWAY	2	EA	\$1,000.00 / EA	\$2,000	\$19,690	\$33,500
			RIP RAP	22.22	CY	\$744.79 / CY	\$16,549		
			DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,141		
Y-105	Route 4 @ Ylig River	1/4 Ac Debris Removal, 1000 SF Rip Rap, 800 SF Gabions	DEBRIS REMOVAL	0.25	AC	\$4,562.38 / AC	\$1,141	\$126,604	\$215,000
			RIP RAP	111	CY	\$744.79 / CY	\$82,672		
			GABIONS	67.96043	CY	\$629.66 / CY	\$42,792		
Y-107	Salas Road	2 catch basins 100 LF 24" RCP 200 SF Rip Rap	CATCH BASINS	2	EA	\$3,500.00 / EA	\$7,000	\$78,865	\$134,000
			24" RCP	100	LF	\$554.79 / LF	\$55,479		
			RIP RAP	22	CY	\$744.79 / CY	\$16,385		

Appendix E

Prioritization Spreadsheets

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Guam Stormwater Drainage Master Plan
Agaña Heights Village
Site Evaluations

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Aqat Village *Site Evaluations*

Appendix E - Page 2

Asian Village
Site Evaluations

TOTAL	\$9,300.000
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Gum Stormwater Drainage Master Plan
Chalan Pago Village
Site Evaluations

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Gum Stormwater Drainage Master Plan
Dededo Village
Site Evaluations

[illegible]

Site ID	Site Name	Loc A	Loc B	Site Score	Type of Boundary	No. of Affected Properties	Vehicle Flood Zone A	Public Safety Threat	Flood Hazard	Existing Severity	Env. Impacts	ROW Needed	COST	Site Assessment	Mitigation Type	Mitigation Effort	Proposed Improvements	Cost
05-114	RT 3	RT 3	RT 3	149	Highway	N/A	No	Low	Medium	Low	N/A	No	Low	At the intersection of Route 3 and Route 34, there is a low point along Rt. 34. There is no existing drainage conveyance system, need to add a concrete to prevent flooding of the intersection. A solution will be to clear vegetation in the possible infiltration area, add catch basins along the north-west corner along Route 34 and clear debris from existing concrete head channel.	Storm Drain Improvements/ Treatment BMP	2 Catch Basins; 1/4 AC Culvert; Headwall; 100 LF 24" RCP; 1 Headwall/Wingwall; 100 SF Rip Rap	To prevent further flooding at this site, debris first needs to be removed from the existing concrete head channel and infiltration basin. A quarter acre of debris will need to be removed. A new storm drain system including two catch basins will need to be added at the northwest corner of the 26 and 35, connecting to a 24" RCP for approximately 100 feet. This system should route flow to the infiltration basin through a headwall/wingwall structure and a 100 square foot rip rap area. Estimated cost of this system is \$125,000.	\$125,000
05-115	RT 3	RT 3	RT 3	149	Highway	N/A	No	Low	Medium	Low	N/A	No	Low	At the intersection of Route 3 and Route 34, there is a low point along Rt. 34. There is no existing drainage conveyance system, need to add a concrete to prevent flooding of the intersection. A solution will be to clear vegetation in the possible infiltration area, add catch basins along the north-west corner along Route 34 and clear debris from existing concrete head channel.	Storm Drain Improvements/ Treatment BMP	2 Catch Basins; 1/4 AC Culvert; Headwall; 100 LF 24" RCP; 1 Headwall/Wingwall; 100 SF Rip Rap	Estimated placement of 2 catch basins located at the low point along Route 34, connecting to a 24" RCP for 100 feet extending into a 100 square foot rip rap area (per displayer equipment with rip rap) to prevent flooding. Estimated cost of this system is \$100,000.	\$100,000
05-116	Chadwick Creek	RT 3	RT 3	141	Collector	N/A	No	N/A	Medium	Medium	Medium	No	Low	At the northwest intersection south of Chadwick Creek and RT 3 there are signs of flooding. A 100' RCP run under Route 3, and is dug about 500' and does not seem to have any longitudinal slope. RCP needs to be cleared of debris and entrance and exit of cross RCP needs to be graded to prevent flooding of RCP.	Storm Drain Improvements/ Treatment BMP	1 Headwall/Wingwall; 1/4 AC Culvert; Headwall; 200 SF RIP RAP; 2 Trash Baskets	Estimated improvements to the existing conveyance system: 1) Remove a quarter acre of debris and sediment from culvert and upstream and downstream channels; 2) Add two headwall/wingwall structures on the upstream and downstream side of the culvert; 3) Add 100' RCP rip rap upstream and downstream of the culvert headwall/wingwall structures; and 4) Add a trash rack at the inlet and outlet side of the culvert.	\$75,000
05-117	RT 3	RT 3	RT 3	153	Highway	1	No	Medium	Low	Medium	N/A	No	Medium	The intersection of RT 3 and Route 46 is a low point area. There is no drainage conveyance system. Need to add a drainage conveyance system to prevent flooding. Need to add three catch basins, two at Roadway low points and one along RT 3 north side where a median low point is located. Estimated cost of this system is \$222,000.	Storm Drain Improvements/ Treatment BMP	3 Catch Basins; 150 LF 24" RCP; 100 SF Rip Rap; 1 Headwall/Wingwall; 200 LF Rip Rap	Estimated improvements to the storm drain system at the corner of RT 3 and RT 34 including two catch basins along RT 3 connecting to a 24" RCP for 150 feet connecting the flow to an outlet structure consisting of a 100 square foot rip rap area (per displayer equipment with an upstream headwall/wingwall structure and a downstream headwall) (100 LF length) or a downstream headwall/wingwall structure.	\$222,000
05-118	RT 3	RT 3	RT 3	149	Highway	N/A	No	Low	Medium	Low	N/A	No	Low	At the intersection of RT 3 and Route 34, there is a low point along Rt. 34. There is no existing drainage conveyance system, need to add a concrete to prevent flooding of the intersection. A solution will be to clear vegetation in the possible infiltration area, add catch basins along the north-west corner along Route 34 and clear debris from existing concrete head channel.	Storm Drain Improvements/ Treatment BMP	2 Catch Basins; 1/4 AC Culvert; Headwall; 100 LF 24" RCP; 1 Headwall/Wingwall; 100 SF Rip Rap	To prevent further flooding at this site, recommended placement of a catch basin on Royal Palm Drive at the intersection with RT 3, connecting to 200' 24" RCP storm drain routing flow under RT 3 to a 200 LF Headwall for infiltration trench. The outlet of the storm drain system should consist of a headwall/wingwall structure with a 100 square foot rip rap area (per displayer equipment) (100 LF length) or a downstream headwall/wingwall structure and a downstream headwall (100 LF length) or a downstream headwall/wingwall structure. Estimated cost of this system is \$174,000.	\$174,000
05-119	RT 3	RT 3	RT 3	149	Highway	N/A	No	Low	Medium	Low	N/A	No	Low	At the intersection of RT 3 and Route 34, there is a low point along Rt. 34. There is no existing drainage conveyance system, need to add a concrete to prevent flooding of the intersection. A solution will be to clear vegetation in the possible infiltration area, add catch basins along the north-west corner along Route 34 and clear debris from existing concrete head channel.	Storm Drain Improvements/ Treatment BMP	2 Catch Basins; 1/4 AC Culvert; Headwall; 100 LF 24" RCP; 1 Headwall/Wingwall; 100 SF Rip Rap	Estimated improvements to the storm drain system at the corner of RT 3 and RT 34 including two catch basins along RT 3 connecting to a 24" RCP for 150 feet connecting the flow to an outlet structure consisting of a 100 square foot rip rap area (per displayer equipment with an upstream headwall/wingwall structure and a downstream headwall) (100 LF length) or a downstream headwall/wingwall structure. Estimated cost of this system is \$174,000.	\$174,000
05-120	RT 3	RT 3	RT 3	138	Highway	N/A	No	N/A	Medium	Low	N/A	No	Low	At the intersection of RT 3 and Route 34, there is a low point along Rt. 34. There is no existing drainage conveyance system, need to add a concrete to prevent flooding of the intersection. A solution will be to clear vegetation in the possible infiltration area, add catch basins along the north-west corner along Route 34 and clear debris from existing concrete head channel.	Storm Drain Improvements/ Treatment BMP	2 Catch Basins; 1/4 AC Culvert; Headwall; 100 LF 24" RCP; 1 Headwall/Wingwall; 100 SF Rip Rap	Estimated improvements to the storm drain system at the corner of RT 3 and RT 34 including two catch basins along RT 3 connecting to a 24" RCP for 150 feet connecting the flow to an outlet structure consisting of a 100 square foot rip rap area (per displayer equipment with an upstream headwall/wingwall structure and a downstream headwall) (100 LF length) or a downstream headwall/wingwall structure. Estimated cost of this system is \$174,000.	\$174,000

TOTAL \$3,790,000

Guam Stormwater Drainage Master Plan
Hagatña Village
Site Evaluations

Site ID	Loc A	Loc B	Site Score	Type of Boundary	No. of Affected Properties	Within Flood Zone A	Public Safety Threat	Maintenance	Resolving Severity	Erosion Severity	Bar Impact	ROW Modified	Cost
1	HA-205	RT 7A	152	Highway	1	Yes	Low	Medium	Medium	Medium	Control	No	\$143,000
2	HA-108	RT 73	152	Highway	N/A	Yes	Medium	High	Medium	Medium	Aggravate	No	\$2,300,000
3	HA-103	RT 7A	153	Highway	N/A	Yes	Medium	Medium	Medium	N/A	Aggravate	No	\$1,240,000
4	HA-110	Frontier Blvd	142	Highway	1	Yes	Medium	Medium	Medium	Medium	Control	No	\$1,100,000
5	HA-115	RT 1	139	Highway	N/A	Yes	Low	Low	N/A	Medium	Control	No	\$143,000
6	HA-118	RT 1	139	Highway	N/A	Yes	Low	Medium	N/A	Low	Control	No	\$31,100
7	HA-104	Archieville St	118	Highway	N/A	Yes	Low	Medium	Medium	Medium	Control	No	\$254,000
8	HA-117	Chickadee	115	Collector	N/A	Yes	Low	Medium	N/A	Medium	Control	No	\$141,000
9	HA-106	Poplar Blvd	115	Collector	N/A	Yes	Low	Medium	Low	Low	Control	No	\$110,000
10	HA-111	RT 1	112	Highway	N/A	Yes	N/A	Medium	N/A	Medium	Control	No	\$31,100
11	HA-107	RT 4	119	Highway	N/A	Yes	N/A	Low	N/A	Medium	Control	No	\$14,100
12	HA-102	RT 7B	115	Highway	1	Yes	N/A	Medium	Low	High	Control	Yes	\$255,000
13	HA-130	Grangeville	113	Highway	N/A	Yes	N/A	Medium	Low	Medium	Control	No	\$231,000
14	HA-116	RT 1	123	Highway	N/A	Yes	Low	High	Low	High	Control	Yes	\$45,000
15	HA-107	RT 7A	102	Highway	N/A	Yes	Low	Low	Medium	N/A	Surface	No	\$80,300
16	HA-106	OTR Drive	123	Highway	N/A	Yes	N/A	Medium	Medium	N/A	Control	No	\$5,100,000
17	HA-121	RT 1	123	Highway	N/A	Yes	N/A	Medium	N/A	Medium	Control	No	\$265,000
18	HA-121	Chickadee	123	Highway	N/A	Yes	N/A	Medium	N/A	Medium	Control	No	\$170,000

Guam Stormwater Drainage Master Plan
Itanahan Village
Site Evaluations

Site ID	Loc A	Loc B	Site Score	Type of Roadway	No. of Affected Properties	Within Flood Zone A	Public Safety Threat	Maintainance	Flooding Severity	Erosion Severity	Bar Water Impact	R/W Encroachment	Cost
1	IV-116	RT 4	Itanahan Rd	133	Highway	3	Yes	Medium	Low	Medium	N/A	No	Low
2	IV-102	RT 4	Alto Ln	131	Highway	3	Yes	Medium	Low	Medium	N/A	No	Low
3	IV-124	RT 4	North of Itanahan Rd	138	Collector	10	Yes	High	Medium	Low	Medium	No	High
4	IV-104	RT 4	North of Itanahan Rd	137	Highway	2	Yes	Medium	Medium	Low	N/A	No	Low
5	IV-120	RT 4	Alto Ln	135	Highway	1	Yes	Medium	Low	Medium	No	No	Low
6	IV-118	RT 4	Itanahan Rd	135	Highway	N/A	Yes	Medium	Medium	Low	Medium	No	Low
7	IV-121	RT 4	Itanahan Rd	133	Highway	1	Yes	Medium	Medium	Low	Medium	No	Low
8	IV-121	RT 4	Itanahan Rd	130	Highway	2	Yes	Low	Medium	Low	Medium	No	Low
9	IV-105	RT 4	Pedro Rivera Dr.	149	Highway	N/A	Yes	Medium	Low	N/A	No	No	Low
10	IV-122	RT 4	Alto Ln	145	Highway	N/A	Yes	Low	Medium	Low	Medium	No	Low
11	IV-119	RT 4	South of Itanahan Rd	145	Highway	N/A	Yes	Medium	Low	Medium	No	No	Low
12	IV-128	RT 4	Alto Ln	142	Highway	N/A	Yes	Medium	Medium	Low	Medium	No	Low
13	IV-127	RT 4	Itanahan Rd	143	Highway	N/A	Yes	Low	Medium	Low	Medium	No	Low
14	IV-106	RT 4	Itanahan Rd	139	Highway	N/A	Yes	Low	Medium	Low	Medium	No	Low
15	IV-106	RT 4	Itanahan Rd	139	Highway	N/A	Yes	Low	Medium	Low	Medium	No	Low

Gum Stormwater Drainage Master Plan
Manqilac Village
Site Evaluations

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TOTAL

\$7.37M

Guam Stormwater Drainage Master Plan
Puerto Village
Site Evaluations[illegible]

Site ID	Loc A	Log B	Sta Score	Type of Roadway	No. of Affected Properties	Within Flood Zone A	Public Safety Threat	Flooded Severity	Erosion Severity	Env Water Impact	ROW/ Roadbed	Cost
Site Assessment												
North of Miami Channel along 261 Street crossing SW 8th Street culverts and stormwater drainage system. The culverts are in poor condition and need removal and replacement with a new structure. The stormwater drainage system is in good condition and needs maintenance. The site is in a flood zone and needs protection.												
1	ME-115	RT-4	332	Highway	N/A	Yes	N/A	Medium	Medium	Critical	No	Low
2	ME-116	RT-4	332	Highway	N/A	Yes	N/A	Medium	Medium	Critical	No	Low
3	ME-121	RT-4	332	Highway	N/A	No	Medium	Medium	Medium	Critical	No	Low
4	ME-222	RT-4	332	Highway	N/A	Yes	N/A	Medium	Medium	Critical	No	Low
5	ME-517	RT-4	329	Highway	N/A	Yes	N/A	Medium	Medium	Critical	No	Low
6	ME-320	RT-4	329	Highway	N/A	Yes	N/A	Medium	Medium	Critical	No	Low
7	ME-324	RT-4	329	Highway	1	No	Low	Medium	Medium	Critical	No	Medium
8	ME-311	RT-4	329	Collector	1	Yes	Medium	High	High	Critical	Yes	Low
9	ME-104	RT-4	319	Highway	N/A	Yes	Medium	Medium	High	Critical	Yes	Medium
10	ME-107	RT-4	319	Highway	N/A	Yes	Medium	Medium	High	Critical	Yes	Medium
11	ME-118	RT-4	319	Highway	N/A	Yes	N/A	Medium	Medium	Critical	No	Medium
TOTAL												\$13,168,000

Gum Stormwater Drainage Master Plan
Liongming Village
Site Evaluations

TOTAL	\$1,082,000
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Guam Stormwater Drainage Master Plan
Piti Village
Sys Evaluations

Site ID	Loc. A	Loc. B	Flow Score	Type of Runoff	No. of Affected Properties	Public Safety Threat	Water Quality	Erosion Severity	Flow	Water	Cost	CDM Assessment	Mitigation Type	Mitigation Effort	Description of Project to Report	Cost
1	P-107	Chalco Subdiv	174	Highway	5	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	100% 3" RCP; 200 SF Rip Rap; 1/4 AC Debris Removal	In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 1800 linear feet of 36" RCP equipped with hand-hinged wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 200 sq ft of energy dissipator located at the downstream side of the culvert is recommended.	\$13,000
2	P-103	Mary Helen Pkwy	157	Collector	5	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	100% 3" RCP; 200 SF Rip Rap; 1/4 AC Debris Removal	In order to provide sufficient conveyance capacity, the existing 24" culvert should be replaced with 1200 linear feet of double 36" RCP culvert with hand-hinged wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 200 sq ft of energy dissipator located at the downstream side of the culvert is recommended.	\$13,000
3	P-104	Amazons River	158	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 50 feet upstream of the bridge is required.	\$14,000
4	P-111	Amazons River	155	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	100% 3" RCP; 200 SF Rip Rap; 1/4 AC Debris Removal	In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 1800 linear feet of 36" RCP equipped with hand-hinged wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 200 square feet of rip rap channel stabilization for a distance of 50 feet upstream of the culvert is required.	\$13,000
5	P-102	Sanito Municipal Park	155	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	100% 3" RCP; 200 SF Rip Rap; 1/4 AC Debris Removal	In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 1800 linear feet of 36" RCP equipped with hand-hinged wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 200 square feet of rip rap channel stabilization for a distance of 50 feet upstream of the culvert is required.	\$13,000
6	P-102	Mano River	145	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1,000 SF Rip Rap; 1/4 AC Debris Removal	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.	\$14,000
7	P-109	Sanito River	145	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1,000 SF Rip Rap; 1/4 AC Debris Removal	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.	\$14,000
8	P-116	Topoguan Branch Pkwy	135	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	100% 3" RCP; 200 SF Rip Rap; 1/4 AC Debris Removal	In order to provide sufficient conveyance capacity, the existing culvert should be replaced with 1800 linear feet of 36" RCP equipped with hand-hinged wingwall structures on the upstream and downstream sides of the culvert. To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 200 square feet of rip rap channel stabilization for a distance of 50 feet upstream of the culvert is required.	\$13,000
9	P-105	Mano River	135	Collector	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1,000 SF Rip Rap; 1/4 AC Debris Removal	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.	\$14,000
10	P-101	Mano River	133	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1,000 SF Rip Rap; 1/4 AC Debris Removal	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the bridge is required.	\$14,000
11	P-113	A Quanga	129	Collector	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.	\$14,000
12	P-115	Tiguan Branch	129	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.	\$14,000
13	P-118	Camacho Port	125	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	100% 3" RCP; 200 SF Rip Rap; 1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.	\$17,500
14	P-110	Mano River	120	Highway	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.	\$14,000
15	P-104	Amazons River	122	Collector	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.	\$14,000
16	P-105	Amazons River	122	Collector	N/A	Yes	Medium	Medium	Medium	Control	No	Low	Conveyance/ Maintenance/ Erosion Control/ Vegetation	1/4 AC Debris Removal, 1000 SF Rip Rap	To prevent further erosion, maintenance including 1/4 acre of debris removal and erosion control including 1,000 square feet of rip rap channel stabilization for a distance of 25 feet upstream and 25 feet downstream of the culvert is required.	\$14,000

Guam Stormwater Drainage Master Plan
Santa Rita Village
Site Evaluations

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Guam Stormwater Drainage Master Plan
Sitio Villages
Site Evaluations

Site ID	Loc A	Loc B	Type of Boundary	No. of Affected Properties	Within Flood Zone A	Public Safety Threat	Medium	Flooding Severity	Exposure Frequency	Env. Water Impact	ICM Required	COSE	Site Assessment	Mitigation Type	Mitigation Effect	Proposed Improvements	Cost
1	51A-025	BT 23A	180	1	No	High	Medium	N/A	High	Angular	No	Low	Overlaid embankment on the east side nearly stabilizes the slope in very steep and eroded area. Embankment has been eroding and may begin undermining roadway.	Erosion Control	2 1/2 AC Curb Retention 500 SF per 100 LF	To prevent further erosion, a quarter acre of debris removal followed by placement along the road embankment of approximately 500 square feet of rip stabilization is needed.	\$72,300
2	51A-026	Chloro	143	1	No	Medium	Medium	N/A	High	Angular	No	Low	Underlain by loose soil and the house has been eroding. Road to stabilize basin embankment next to the front property with rip stabilization.	Erosion Control/Treatment BMP Improvement	400 SF Gabions, 2 1/2 AC Curb Retention 500 SF per 100 LF	To prevent further erosion, a quarter acre of debris removal followed by placement of 400 SF of gabions along the infiltration basin embankment and placement of approximately 500 square feet of rip stabilization along the road to stabilize the basin is recommended.	\$52,400
TOTAL																	\$124,700

Gum Stormwater Drainage Master Plan
Taloicio Village
Site Evaluations

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Glam Stormwater Drainage Master Plan
Tambunan Village
Site Evaluations

Site ID	Loc A	Loc B	Site Score	Type of Roadway	No. of Affected Properties	Within Flood Zone A	Public Safety Threat	Flooded	Erosion Severity	Low Water Impact	ROW Available	COST	Site Assessment	Mitigation Type	Anticipated Effect	Proposed Improvements	Cost
TV-101	RT 27	Intersection Loc 182	182	Highway	4	No	High	Medium	High	Medium	No	Medium	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 400' x 24" RCP, 100' SF Bay; 200' Bay Trench	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$433,000
TV-110	RT 27	Intersection Loc 185	185	Highway	4	No	Medium	Low	Medium	Medium	No	Medium	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 200' x 24" RCP	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$201,000
TV-103	Turnaround	Intersection Loc 189	189	Highway	4	Yes	Medium	High	High	Medium	No	Very High	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Conveyance Maintenance/Improvement	100' x 36" RCP, 100' SF Bay; 5' x 4' clearing	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$14,100,000
TV-108	RT 27	Intersection Loc 192	192	Highway	4	No	Low	Low	Low	Medium	No	Medium	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 400' x 24" RCP, 100' SF Bay; 200' Bay Trench	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$597,000
TV-105	State Route	Intersection Loc 198	198	Collector	1	No	Medium	Low	Medium	Medium	No	Low	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 100' x 24" RCP	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$106,000
TV-104	County Road	Intersection Loc 143	143	Collector	2	No	Low	Low	Low	Medium	No	Medium	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 100' x 24" RCP	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$420,000
TV-105	County Road	Intersection Loc 150	150	Collector	2	No	Low	Medium	Low	Medium	No	Low	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 100' x 24" RCP	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$31,000
TV-101	RT 27	Intersection Loc 178	178	Highway	20	Yes	Medium	Medium	Medium	Medium	Yes	Medium	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Conveyance Maintenance/Improvement	200' x 36" RCP, 100' SF Bay; 5' x 4' clearing	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$311,000
TV-107	Highway	Intersection Loc 215	215	Collector	N/A	No	Low	Low	Medium	Medium	No	Low	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 100' x 24" RCP	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$113,000
TV-105	Turnaround	Intersection Loc 192	192	Collector	N/A	No	Medium	Low	Medium	Medium	Yes	Medium	There is a local depression at the intersection of RT 27 and BCL. Need to add a drainage system to capture water at the low point (catch basin) and connect this system to the storm drain system along RT 27. This new point is causing pooling of water in the intersection area.	Storm Drain Improvement	2 Catch Basins: 100' x 24" RCP	The back of drainage system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface. The storm drain system is recommended to be 27' above the road surface.	\$113,000
TOTAL																	\$16,600,000

Guam Stormwater Drainage Master Plan
Umatac Village
Site Evaluations

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Yicko Village
Site Evaluations

TOTAL	\$600,000
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Gum Stormwater Drainage Master Plan

Yona Village
Site Evaluations

Site ID	Site Name	Loc A	Loc B	Site Score	Type of Runoff	No. of Affected Properties	Within Flood Zone A	Public Safety Threat	Minimum Exposure	Flooding Severity	Erosion Severity	Env. Water Impact	R/W Flooded	CCST	Site Assessment	Mitigation Type	Mitigation Effort	Proposed Improvements	Cost
1	YD-201	Area 1		151	Collector	5	No	Medium	Medium	Medium	N/A	Aggravate	No	Medium	The low area of this street is flat and low properties get flooded. Add a drainage conveyance system along road and route it to existing storm at the end of the street.	Storm Drain Improvement	2 Catch Basins 400 L x 24" RCP; 1 Handhole/Wingwall; 100 SF RCP; 250 SF 18" Trench	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place wingwall at end of road. Place 250 SF of 18" trench to route storm to existing storm.	\$47,000
2	YD-207	Area 2		146	Collector	N/A	Yes	Medium	Low	N/A	High	Control	No	Low	Consistent undermining of roadway from proximity to Yig River. Road permanent and improvements, possibly lifting along roadway.	Storm Drain Improvement	2 Catch Basins; 100 LF 24" RCP; 250 SF 18" Trench	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place 250 SF of 18" trench to route storm to existing storm.	\$14,000
3	YD-205	Area 3		135	Highway	N/A	Yes	Medium	Medium	Medium	Medium	Control	No	Medium	Yig bridge, undermining of approach slabs on both north and south embankments. Need to add more gabions to approach slabs embankments, north section is in worse condition.	Erosion Control/Conveyance Maintenance	1.4 AC Gabion Removal; 1,000 SF 18" RCP; 250 SF Gabion	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place 250 SF of 18" trench to route storm to existing storm.	\$215,000
4	YD-203	Area 4		123	Highway	N/A	No	Low	Low	N/A	High	Control	No	Low	Water development along SR. Major grading of slopes, no visible signs of temporary erosion. Need to add more gabions to approach slabs embankments, north section is in worse condition.	Erosion Control	1.4 AC Gabion Removal; 1,000 LF 18" RCP	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place 250 SF of 18" trench to route storm to existing storm.	\$11,500
5	YD-208	Area 5		89	Collector	N/A	Yes	Low	Low	Low	N/A	Surface	No	Low	Just east of Yig River crossing, a low point is created under the curve and pooling is created and erosion evident. Need to add an over-side drain with riprap to route storm to the Yig River downstream and remove debris.	Storm Drain Improvement/Conveyance Maintenance	1,000 SF Debris Removal; 1,000 SF 18" RCP	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place 250 SF of 18" trench to route storm to existing storm.	\$143,000
6	YD-204	Area 6		81	Collector	N/A	No	Low	Medium	Medium	High	Surface	No	Low	Based embankments are very steep. To prevent erosion from undermining, asphalt dikes should be added on both sides of road at low point of road and concrete drains with 24" RCP outlets.	Storm Drain Improvement/Conveyance Maintenance	2 AC Gabions; 400 LF 18" RCP; 1 AC Gabion Removal	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place 250 SF of 18" trench to route storm to existing storm.	\$31,500
7	YD-202	Area 7		78	Collector	6	No	Medium	Low	Medium	N/A	Surface	Yes	Low	At low point of street in houses get flooded, homes are lower than the road. Need to add a drainage conveyance system along road and route it to the natural flow path, provide a private property access statement will need to be reviewed.	Storm Drain Improvement	2 Catch Basins; 100 LF 24" RCP; 1 Handhole/Wingwall; 100 SF RCP	Recommend placement of a storm drain system along the road. Place 2 catch basins at low point, connected by 100 LF of 24" RCP. Place 250 SF of 18" trench to route storm to existing storm.	\$27,000
TOTAL																			\$1,010,000

