

## Appendix G

### EIS Resource Technical Appendix

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# Guam and CNMI Military Relocation EIS

## Volume 9: EIS Resource Technical Appendix

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# CHAPTER 1.

## RECREATIONAL RESOURCES

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### 1.1 INTRODUCTION

### 1.2 NORTH

#### 1.2.1 Andersen AFB

##### 1.2.1.1 Trails

###### Tarague Embayment Interpretive Trail

This 1.5-mile (2.4-kilometer [km]) trail traverses along Tarague Beach.

###### Anao Trail

This 1.4-mile (2.3-km) hike commences from a limestone forest plateau to the edge of the Anao cliff line.

##### 1.2.1.2 Historic and Cultural Attractions

###### Arc Light Memorial

This site is dedicated to the 75 airmen who lost their lives flying B-52 missions over North Vietnam from 1965 to 1973.

###### F-4 Memorial

This site memorializes Andersen Air Force Base (AFB) support to U.S. Forces in Southeast Asia during the Vietnam Conflict.

##### 1.2.1.3 Scenic Points

###### Tarague Embayment Overlook

This overlook contains a view of Ritidian Point with Tarague Beach in the distance.

###### Ritidian Point Scenic Vista

This vista near Achae Point on the northwest corner of Guam provides a view of Ritidian Point and Ritidian Beach. The Island of Rota can be seen on a clear day.

##### 1.2.1.4 Beaches and Parks

###### Tarague Beach

This beach is the only area on Andersen AFB where swimming is allowed.

###### Pati Point Preserve and Pati Point Marine Preserve

The Pati Point Preserve was established in 1973 by the Air Force to protect the beach strand and limestone forest, natural habitat for deer, monitor lizards, Marianas fruit bats, and birds. In 1993, the Pati Point Marine Preserve was established as a sanctuary for tropical marine life. The Marine Preserve extends from Tarague Beach east to Anao Point and seaward to the 600 feet (ft) (183 meters [m]) depth. Composed of reef flats and offshore waters, the Marine Preserve is a spawning area for marine life.

### Sirena Beach

Sirena Beach is a private beach located approximately a mile north of Tarague Beach at Andersen AFB. Sirena Beach includes restrooms with showers, a screened pavilion with patio, barbecue grill, electricity, water, volleyball net, and a large play area. No swimming is permitted at Sirena Beach unless a 36th Force Support Squadron employed lifeguard is present.

### Scout Beach

Scout Beach is located on the northern coast of Guam inside of Anderson Air Force Base, so access is available only to the military or by special permission. Pati Point Beach

#### Pati Point Beach

Pati Point Beach is located on the northern coast of Guam inside of Anderson Air Force Base, so access is available only to the military or by special permission.

### Guam National Wildlife Refuge Overlay

Department of Defense, Air Force and Navy installations own 224,456 acres of refuge overlay.

#### 1.2.1.5 Others

### Palm Tree Golf Course

This 18-hole golf course is located on the east side of the base.

### Coco Palm Resort

Coco Palm Resort, also known as Coco Palm Beach Garden, is a privately owned resort located in a secluded area in Urunao. The area around the facilities is beautifully landscaped with tropical flowers and plants and because it is located along the beach, it gives guests a front-row seat of Guam's northwestern coastline.

## **1.2.2 Finegayan**

### 1.2.2.1 Trails

#### Haputo Trail

This 0.6-mile (1-km) trail leads to the Haputo Beach. Noted activities at the terminus of the trail are swimming, snorkeling, and SCUBA diving. Haputo Beach is situated in the Haputo ERA and fishing is prohibited.

#### Double Reef Beach

The 2.4-mile (3.9-km) hike leads to a remote beach where visitors can enjoy snorkeling and swimming.

### 1.2.2.2 Dive Spots

#### Shark's Hole

Located off Hilaan Beach, the dive site reaches a depth of 30 ft (9 m).

#### Double Reef

This beginner dive spot ranges in depths from 15 to 70 ft (5 to 21 m) with colorful corals filled with small invertebrates and reef fish.

### 1.2.2.3 Beaches and Parks

#### Guam National Wildlife Refuge Overlay

Department of Defense, Air Force and Navy installations own 224,456 acres of refuge overlay.

### **1.2.3 Non-DoD Land**

#### 1.2.3.1 Trails

##### Ritidian to Falcona Trail

This 6-mile (10-km) trail begins at the Ritidian Point in the Guam National Wildlife Refuge and traverses the Uruno and Falcona Beaches.

##### Ague Cove

The 0.4-mile (0.6-m) trail begins from the former Oceanview Housing Area. Visitors can enjoy snorkeling and swimming at the Ague Cove, where the trail ends.

##### Hilaan

A 2.6-mile (4.2-km) hike starts from the Tanguisson Power Plant at the Guam Fahou beach to Danu Charu Point. At the trail terminus, visitors can enjoy snorkeling, SCUBA diving, swimming, fishing, picnicking, and camping. A trail in the middle of the Hilaan trail leads to Lost Pond, a natural freshwater pool. Hilaan hike is considered Guam's best hike (Lotz 2001).

#### 1.2.3.2 Scenic Points

##### Uruno Scenic Vista

This scenic vista provides a view of northern Guam cliffs to Hilaan Beach to Orote Point. The vista is on a private property and access may be restricted.

#### 1.2.3.3 Dive Spots

##### Dolphin Point

Located off Ague Point, this site is noted for numerous corals and fish in clear water ranging in depth from 25 to 75 ft (8 to 23 m).

##### Northern Cave

This cave diving spot for advanced divers leads to an inland passage and a clear fresh water spring. The water depth ranges from 20 to 60 ft (6 to 18 m).

#### 1.2.3.4 Beaches and Parks

##### Dededo Veterans' Memorial Park (formerly known as Dededo Buffer Strip Park)

Also known as South Daiog Dededo Buffer Strip, is a strip of land extending partially across Block 16A in the municipality of Dededo. The Park has been renamed "Dededo Veterans' Memorial Park" during the 2010 Second Regular Session of the Guam Legislature in April (Bill 362). Under the legislation, the administration of the Park has been transferred from the Government of Guam, Department of Parks and Recreation to the Dededo Veterans' Organization and the Dededo Municipal Planning Council. Dededo Buffer Strip Park is located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Dededo Central Park

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

GHURA 501 Park

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

GHURA 502 Park

Located in Yigo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

GHURA 503 Park

Located in Yigo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

GHURA 505 Park

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

GHURA 506 Park

Located in Yigo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Governor Joseph Flores Beach Park (Ypao Beach Park)

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Guam Sports Complex

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Guam National Wildlife Refuge, Ritidian Unit

Located at the northernmost tip of Guam, the refuge preserves pristine sand beaches, limestone forests, coral reefs, ancient pictographic caves, and habitat for endangered birds and fruit bats at Ritidian Point. Picnicking and fishing are allowed at the refuge. Waters are normally dangerous due to strong waves and currents, and there are no lifeguards on duty.

Guam Fahou

Situated north of Tanguisson Beach, this site is used for picnics, fishing, snorkeling, and hiking north to Hilaan.

Liguan Terrace Ra#1 Park

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Liguan Terrace Ra#2 Park

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Liguan Terrace Ra#3 Park

Located in Dededo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

South Pacific Memorial Park

This park was established to memorialize the half million Japanese and American soldiers and local people who died during World War II.

### Tanguisson Beach

Adjacent to Hilaan, an ancient Chamorro settlement, the surrounding area of the beach has been relatively undisturbed. The beach is noted for its snorkeling.

### Y-Piga Conservation Reserve

This interior limestone forest is situated in Yigo Village.

### Yigo Park

Located in Yigo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

#### 1.2.3.5 Others

### Jinapsan Beach Resort

This private beach resort offers water activities.

### Guam International Country Club

This 18-hole golf course is in Dededo.

### Alte Guam Golf Resort

This 18-hole golf course is recognized by the United States Golf Association and features a driving range.

## **1.3 CENTRAL**

### **1.3.1 Non-DoD Land**

#### 1.3.1.1 Trails

##### Fadian Cove Trail

This 1-mile (1.6-km) trail from Route 16 and Ignacio Way leads to a scenic vista containing a view of the coastline and cliffs, to Huchunao, the Hawaiian Rock Quarry, Mangilao Golf Course, and Taguan. Visitors can enjoy snorkeling and picnicking at Fadian Cove.

##### Taguan

This 1.2-mile (1.9-km) trail has been provided by the Mangilao Golf Course as public shoreline access. The trail encounters rugged limestone terraces towards the coastline before the shoreline is reached.

##### Gun Beach to Tanguisson

This 1.8-mile (2.9-km) coastal trail begins from the east end of the Tumon Bay to the Tanguisson Beach.

##### Dos Amantes Biking and Hiking Trail

This 5.5-mile (8.9-km) trail serves as a hike and bike trail. The parking lot at Puntan Dos Amantes serves as the starting point.

#### 1.3.1.2 Historic and Cultural Attractions

##### Fo Guang Shang Guam Temple

This Buddhist temple is operated by the Guam Buddhist Society.

### Father Duenas Memorial School and Statue

Guam's only all-boy preparatory high school has a statue of Father Jesus Duenas who became a martyr during World War II.

### War in the Pacific National Historic Museum

*The description of the Park and its assets on Guam and Saipan have been provided by the National Park Service.*

The park's seven units preserve and interpret significant World War II invasion sites and have the most diverse coral reef system within the National Park System. Submerged resources encompass a portion of a Marine Protected Area, sunken WWII artifacts, two culturally significant traditional fishing areas, and habitat for over 3,500 marine species, including over 200 coral species and threatened hawksbill and green sea turtles. The visitor center is located adjacent to the main gate of Naval Base Guam in a facility leased from the Navy. It houses an exhibit area and theater, a small bookstore, offices for interpretive staff, and museum collections for both War in the Pacific NHP and American Memorial Park. Individuals and large tour groups visit the center during its open hours seven days a week, year-round. In 2011, the center will house new, permanent exhibits that should attract increased visitation and provide more opportunities for visitors to learn about park resources and values. Parking at visitor center is presently limited on weekdays when adjacent naval offices are busy.

The park unit at Asan Beach preserves the site of northern landing beach for U.S. forces during the 1944 liberation of Guam. In addition to significant historical value, the area also provides a physical setting that is used for healthful activities such as running, walking, flying kites, and water recreation when conditions permit. Many people enjoy beach for picnicking and scenery. Often during the year, large group-sanctioned events are held on the open field. NPS stages 'Movies in the Park' periodically, where family-oriented and conservation-themed movies draw people into the park for evening activities. This unit contains marine acreage used for fishing and marine wildlife watching, while divers and snorkelers are particularly drawn to Marine Preserve and Camel Rock. The area is clearly a focal point for local community and island visitors alike.

In order to support visitors at this site, a number of facilities are present including parking, restrooms, trails, picnic tables, and trash receptacles. The facilities are maintained to a high standard to protect the integrity of resources, and provide quality experience that most people expect and are entitled to.

Similarly, the Agat Unit preserves site of U.S. forces southern landing beach in 1944. In addition, the area contains marine acreage with popular dive sites, including Hap's Reef. Fishing from beach and from sea by boat is also a popular activity for island residents. This unit, though smaller, contains a variety of facilities such as restrooms, tables, grills, and trash receptacles. These facilities are found near historic guns displayed alongside the Japanese fortifications at Ga'an Point. With these attractions and facilities in close proximity, multiple uses can be found at this unit, which also includes similar fortifications and facilities at Apaca Point.

Other park units at War in the Pacific NHP (Piti Guns, Fonte Plateau, Mt. Chachao/Mt. Tenjo, and Mt. Alifan) are each considerably smaller than Asan Beach and Agat Units, but they contain wartime artifacts and structures and are attended by interpretive exhibits that draw visitors into drama and horror of what occurred there. The story is one that appeals to all former wartime antagonists, including the Japanese who defended Guam during occupation and subsequent American assault. The Asan Bay Overlook (located on a ridge at the top of Asan Inland Unit), is significant in that it memorializes those who died in conflict while defending Guam during the Japanese invasion, who suffered from atrocities of occupation,

and those who died in retaking it from the Japanese. The memorial wall here is composed of engraved panels giving the names of those casualties; it is this wall that was vandalized in 2008 by metal thieves in an unconscionable and incomprehensible disregard of history and culture. This site also, as indicated by its name, provides a panoramic view of the invasion beach along with several interpretive panels that explain the campaign. This memorial is at the core of the mission for War in the Pacific NHP, and as such is the location for numerous ceremonies and functions commemorating sacrifice.

These four smaller units are enjoyed less for recreation and social purposes, and more for education, quiet commemoration, reverie, and appreciation of history, and display and preservation of war artifacts. For the most part, NPS is required to protect visual quality of setting, and maintain a solemn and respectful sound environment in order to meet fundamental park purposes. Present visual quality is suitable to the need, except for times at the Asan Bay Overlook and Asan Beach when emissions from Piti Power Station are particularly high. At most times, the sound environment is suitable except for occasional vehicular noise, infrequent direct overflights and sounds of other visitors. The visual and audible quality of the setting, and the maintained state of its facilities, make the park an enjoyable place to engage in numerous activities that may be observed there.

The sites described here are held in high regard particularly by veterans groups. Organized veterans groups are sensitive to care, maintenance, and sustained quality of these units as a reflection of high value placed on their service during wartime. To allow them to deteriorate, apart from being a breach of law and policy, would be taken as an unacceptable affront to the memory of their comrades and brothers in arms. Less critical, but undeniably significant, is importance placed on national park units and visitor centers to the local economy. The parks represent additional opportunities for tourist activities, which are taken advantage of by local guides. Finally, parks bring a needed focus to local history and culture because both are purposefully celebrated there, and kept in a state whereby they can be appreciated by people who lived the history and their descendents.

#### American Memorial Park - Saipan

Visitation and use of American Memorial Park on Saipan is similar to that of Asan Beach and Asan Overlook combined. An additional feature is co-located Visitor Center, which houses a collection of war artifacts placed in interpretive displays. There is also an amphitheater that is available for community events of all types. A great deal of social interaction by Saipan residents occurs here, including extensive use of tennis courts that are maintained by NPS within park boundary. A great deal of use is also made of open fields located within the park by sports enthusiasts, and marina is extensively used by boaters and fishermen.

#### White Lady Bridge

This bridge is located in a secluded valley surrounded by bamboo groves. It is alleged that a sighting of the “White Lady” at the bridge signals a dangerous storm approaching the island.

#### Korean Air Lines Crash Memorial

This site of the KAL Flight 801 crash on August 6, 1997 can be viewed across the valley of the Fonte River on the far slope. Access on the pipeline access road is closed except for the annual remembrance ceremony of the disaster.

#### Agana Naval Cemetery

This pre-World War II Naval Cemetery was used primarily for U.S. military and dependents. The graves of German sailors killed in the scuttling of the SMS Cormoran in 1917 are also contained there.

### Chief Quipuha Park

Located on the Paseo de Susana peninsula stands the statue of Chief Quipuha (Imahen Madalahi as Kepuha), the highest ranking chief in the Hagåtña area at the time the first Spanish settlers came to Guam. The park was dedicated in 1977 to recognize Chief Quipuha, who welcomed the first Jesuit missionaries to introduce Christianity in the Mariana Islands. He donated the land where the present Dulce Nombre de Maria Basilica stands.

### Chamorro Village (I Sengsong Chamorro Village)

This shopping village is situated adjacent to Paseo Susana; the market is a popular lunch spot for local residents and visitors. On the main mall, local artisans demonstrate and teach their crafts. Cultural demonstrations by local entertainers are provided weekly.

### San Antonio Bridge (To'lai Acho)

Built in 1800 by Spanish Governor Manuel Muro, this bridge connects the San Ignacio and Bilibic districts across Agana River. The river was filled in during the post-war rehabilitation of Agana in 1945.

### Sirena Statue

Guam's legendary mermaid statue depicts Sirena who was cursed by her mother and turned into a fish for neglecting her chores to go swimming. Sirena's godmother overheard this curse and asked that the gods spare the part of Sirena that belonged to her. Sirena was turned into a mermaid and can only be caught with a net of human hair.

### Plaza de Espana

Situated in the middle of Hagatna's business district, this plaza hosts social and civic functions, including the inauguration of the Governor of Guam.

### Pope John Paul II Statue

This statue marks the site where Pope John Paul II celebrated Mass on February 23, 1981. He was the first pontiff to visit the island. The bronze statue rotates at a rate of one full revolution every 12 hours.

### Skinner Plaza

Within this Plaza is a marker to Governor Skinner, Guam's first civilian governor, and a replica of a memorial to the Chamorro people who died at Wake Island while serving the U.S. during World War II. The Plaza also has a Korean War Memorial.

### Hagåtña Historic District

This area contains several pre-war Chamorro homes, notable among which are the Rosario House, Martinez-Notley House, Leon Guerrero House, Lujan House, L.D. Flores House (Kamalen Karidat), Shimizu House, and Ungacta House.

### Padre Palomo Grave

This site pays tribute to the first ordained Chamorro priest, Padre Jose Torres Palomo, who aided Lieutenant Governor William E. Safford in appeasing the Chamorro people with the new government.

### Adelup Point

The Governor's Office and other government agencies are located at Adelup Point. A cluster of pavilions is available below the Adelup Complex for use by the public. This site is also used for outdoor Government of Guam ceremonies.

### Government House

Combining Spanish and Chamorro architecture, the Government House is the symbolic home of the people of Guam and the official residence of the Governor of Guam.

### Japanese Fortifications

Numerous fortifications were constructed to defend Guam against an American invasion during World War II. Fortifications like these are dispersed along Tumon Bay.

### Padre San Vitores Shrine

This shrine marks the spot where the leader of Spain's first Jesuit mission, Padre Diego Luis de San Vitores, was martyred on April 2, 1672 by Chamorro Chief Matapang, who opposed the unapproved baptism of his daughter.

#### 1.3.1.3 Scenic Points

### Bayview Baptist Church Scenic Vista

This scenic vista provides an expansive view from Paseo Stadium in Hagatna to Tamuning.

### Top O' the Mar

The scenic vista from the Navy Club provides a view of Guam's western coastline.

### Asan Bay Overlook

This scenic overlook provides a view of Asan Beach to Orote Peninsula. The overlook contains the Memorial Wall with the names of those who died fighting to liberate Guam during World War II.

### Two Lovers Point (Puntan dos Amantes)

This popular cliff lookout marks the spot where two legendary lovers, whose parents opposed their marriage, jumped to their deaths after tying their hair together. The lookout provides a view of the white sand beaches and lush hillsides along the Philippine Sea and Central Guam.

### Old Guam Memorial Hospital Scenic Vista

This scenic vista at the west end of Pale San Vitores Road provides a view overlooking Tumon Bay.

### Palace Hotel Scenic Vista

This scenic vista that provides a view of East Hagatna Bay can be reached by way of the public access adjacent to the Palace Hotel. The access also leads to the Palace Wall and Rick's Reef, where users can enjoy snorkeling, SCUBA diving, and surfing sites.

#### 1.3.1.4 Dive Spots

### Asan Cut

This dive spot features a coral reef wall and an American amphibious landing vehicle tracked sunk in the invasion of Guam on July 21, 1944.

### Camel Rock

This dive boat site features corals, fish, and small anemones with depths from 40 to 130 ft (12 to 40 m). The bottom is littered with dumped unexploded ordnance from World War II.

#### 1.3.1.5 Beaches and Parks

### Agana Central Park

This 45-acre (18-ha) public recreational complex has a swimming pool, four tennis courts, and two handball courts. Located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Agana Heights Recreation Area

This is a Federal Lands to Parks site in central Guam.

### Agana Marina

Located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Agana Heights Park

Located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Apotguan Park

Located on Agana Bay, this beach park has picnic facilities and restrooms. A notable feature is the 1993 statue of the Chamorro Women of Guam located in the vicinity of the old Carolinian settlement.

### Archbishop Felixberto C. Flores Par

This park is noted for the statue of the first Chamorro Archbishop of the Catholic Church holding images of Pale San Vitores with Santa Maria Kamalen in his hands.

### Asan Beach Unit

This site contains gun encasements, caves, and pill boxes, over an area of 445 acre (180 ha). There are a number of World War II memorials, relics, and informational signs scattered around the park. The beach area is lined with coconut trees to provide shade. Additionally, the site hosts a park used by the public for active outdoor activities Asan Beach Unit is part of the War in the Pacific National Historic Park.

### Chinese Park

This park was developed in 1978 by the Chinese Community of Guam. Notable features include a statue of Confucius and several pagodas. The park features a panoramic view of Tumon Bay and has restrooms on-site. Chinese Park is located in Tamuning and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Cushing Zoo

This zoo features sharks, monkeys, turtles, tropical fish, lizards, tortoise, and a crocodile.

### East Agana Beach Park

Located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### East Hagatna Beach

This beach is one of two sites in Agana Bay where regulated jet skiing is allowed. Previously, East Hagatna Beach was used by net fishermen, who still have priority use of the site during the runs of manahak (juvenile rabbitfish) which occur three times a year—April-May, June, and October.

### Fafai Beach

Situated nearby Tumon Bay, Fafai Beach is a prehistoric coastal site as evidenced by the remains of six to eight latte structures. These sets, and the deep midden deposits, are remnants of a prehistoric village of the Chamorro people.

### Fort Santa Agueda Park

Located in Agana Heights and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Francisco F. Perez Beach

This is a 2-acre (0.8-hectare [ha]) site with a pavilion, picnic tables, benches, and restrooms located just north of the mouth of the Pago River. The site is the only public vehicle access to the shores of Pago Bay. Perez Beach is used for picnics, snorkeling, and fishing.

### Matabang Beach Park

Located in Tamuning and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Mongmong , Site 5

Located in Mongmong and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Mongmong, Site 7

Located in Mongmong and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Padre Palomo Park

This beach park offers shelters for picnicking. Padre Palomo Park is located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Paseo de Susana Park

This site is on a man-made peninsula constructed with bulldozed debris of war-time Hagåtña after the liberation of Guam in 1944. The annual Liberation Day festivities and parade are held during the month of July. Paseo de Susana Park is located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Puntan dos Amantes Park

Located in Tamuning and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Japanese Caves Park

This park features several interconnected caves that were dug by Chamorro people under forced labor by the Japanese during World War II. These sites served as air raid shelters and defensive strong points.

### Senator Angel Leon Guerrero Santos Latte Stone Park

This park contains eight latte stones, transferred from the remote Me'pu village, an ancient Chamorro settlement in the southern interior valley of Guam.

Gun Beach

This secluded beach is named for an anti-aircraft military gun found next to the cliff wall.

Matabang Beach

Located along Tumon Bay, this beach contains shelters and restrooms.

Governor Joseph Flores Park (Ypao Beach Park)

Used widely to host concerts and other events, this is one of the most popular recreational areas on Guam (Guam Visitors Bureau). Ypao Beach has pavilions, restrooms, and shower amenities. The beach is also noted for its snorkeling.

Angel Santos Memorial Park

Located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act. The Park is a Federal Lands to Parks site in central Guam.

Sinajana, Site 1

Located in Sinajana and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Tamuning Park

Located in Tamuning and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Tanguisson Beach Park

Located in Tamuning and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Tiyan Park Territorial Recreation Area

The site is a Federal Lands to Parks site in central Guam.

Toto, Site 6

Located in Toto and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

Tumon Bay Marine Preserve

This preserve was established in 1997 to protect the coral reef and aquatic creatures contained within the preserve area.

West Agana Beach Park

The site is an 8-acre (3-ha) beach provides swimming, snorkeling, and fishing uses. The beach is located in Hagatna and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

## 1.3.1.6 Spelunking

Marbo Cave

This limestone cave is filled with freshwater, with a depth up to 30 ft (9 m), from the underground lens. Smaller caves are connected to the main cave.

## 1.3.1.7 Others

Guam International Raceway

The Guam International Raceway, Guam's only automobile raceway, is on a 250-acre (101-ha) parcel of land leased from the Chamorro Land Trust and operated under a 21-year commercial license administered

by the Guam Economic Development Authority (also see Sections 2.8, Land and Submerged Land Use and 2.16, Socioeconomics and General Services).

In February 1998, Bill No. 435 was passed by the Guam Legislature and signed by Governor Carl Gutierrez, providing credits against Guam's Gross Receipts Tax for contractors, designers, and material suppliers who work on the Guam International Raceway in addition to exceptions from real estate taxes on the race facility's property. Raceway construction began in 2001 and continued through March of 2007. To date, the Government of Guam has spent approximately \$7.3 million and volunteers have donated many hours developing the Raceway's facilities.

The Raceway began holding events in 2002 and has since operated continuously. The Raceway offers a variety of race venues on asphalt and dirt tracks capable of accommodating a range of ages and skill levels, including a 14-mile (22-km) dirt track; a 0.5-mile (0.8-km) asphalt NASCAR type track; a 1-mile (2-km) long off-road course; and a paved 2.2-mile (3.6-km) Formula Three track.

These race venues provide a variety of activities for various user groups, including participation in soap box derbies and mini bike races for children; quarter mile drag racing, drifting, obstacle course maneuvering, four wheeling rock crawl and mud events, stock car racing, and off-road racing for adults and young adults; and construction vehicle events for spectators of all ages. Motocross and drag races are the most frequently held events. International motorcycle and off-road races promote tourism and draw professional competitors from both the U.S. and Asia.

Future plans for the Raceway include continuing the development of the 0.5-mile (0.8-km) NASCAR style track and a 2.2-mile (3.6-km) Formula Three track. The future NASCAR and Formula Three tracks are planned to provide additional international venues to increase sport tourism travel and spending on the island. Cost estimates to complete Raceway development range from \$6 to 9 million.

In addition to races, the Raceway hosts a number of special events every year, including music concerts, car shows, and driving schools. Some special events are combined with races and draw crowds of over 5,000 people. The Raceway is a popular recreational venue for tourists and Guam's local civilian and military population, and has over 100 races and events scheduled for 2009.

#### Mangilao Golf Course

This coastal 18-hole golf course is located on the coastline of Mangilao. The golf course has a restaurant in the clubhouse. A portion of the golf course protects the Chamorro archaeological site at Mochom along the bay.

#### Leo Palace Resort

This resort includes a 27-hole golf course, restaurant, tennis courts, and swimming pools.

#### Alupang Beach Club

This club offers a wide variety of activities, including dolphin watching, trolling, and parasailing.

#### Hagatna Springs and Hagatna Swamp

Water flowing from limestone forms the Hagatna Springs and flows through the Hagatna Swamp into the Hagatna River that flows into the Hagatna Bay. The springs were first used in 1914 by the Navy to overcome dry season water shortages and continued to be used until deactivation in 1957. In 1970, the springs were restored by the Guam Science Teachers Association.

### Hagatna Pool

This 45-acre (18-ha) public recreational area has a large swimming pool and several tennis courts.

### Hotel Nikko Water Park

This water park at Hotel Nikko offers multiple pools and waterslides.

### Hyatt Regency Water Park

Located at the Hyatt Regency, this water park features three free-form pools with water slides and a river pool.

### Tarza Water Park

This water park has a variety of water slides.

### Under Water World

Located at Pleasure Island, this water park has an aquarium with an underwater tunnel containing an abundance of small and large sea life.

### Pacific Islands Club

This club features day use for windsurfing, kayaking, snorkeling, in-line skating, a swim-through aquarium, a water park with water games and water slides, tennis, squash, and racquet ball.

### Onward Beach Resort

This resort offers different kinds of water activities and water slides. At low tide, visitors may walk across to the uninhabited Alupat Island.

### Hagåtña Marina

Hagåtña Marina is a public boating facility with docks, launching ramps, and a fueling facility. The Marina is also a kayaking starting point west of the Seamen's Service, east of Tumon's Beaches, and a long paddle from Merizo Pier.

## **1.3.2 Piti/Nimitz Hill**

### 1.3.2.1 Trails

#### Piti Guns

This trail is very short at 0.1 mile (0.2 km). The trail leads to one of the only two places on Guam where Japanese guns are found in their original fortification.

#### Asan Falls

This 0.9-mile (1.4-km) trail begins at Nimitz Hill. The trail is hidden in a secluded river valley above the Asan village. The trail leads through a series of waterfalls.

#### San Carlos Fall

This trail is 3.2-mile (5.1-km) long and begins at Nimitz Hill. At the trail terminus is a swimming hole and waterfall.

### Lonfit Valley

This 2.4-mile (3.9-km) trail leads through dense grass and towards red slopes to the river valley and then to a steep descent into a tributary of the Lonfit River.

#### 1.3.2.2 Scenic Points

### Mount Chachao Scenic Vista

This scenic vista provides a view of Piti and Apra Harbor. The site serves as a trailhead to several hikes leading to a mountain and waterfalls.

### Cabras Island Scenic Vista

This scenic vista at the northern edge of Cabras Island has a view of the Two Lovers Point to Ritidian Point.

#### 1.3.2.3 Dive Spots

### Glass Breakwater

This spot attracts divers and surfers, but access to the site can be difficult due to its location on Navy property. To the north of the breakwater is Luminao Reef, a barrier reef with a diversity of corals conducive to both snorkeling and SCUBA diving. To the west of Luminao Reef is a dive site called Blue and White, named for its deep blue water and white sand. Divers can explore the plateaus, slopes, and native marine life.

### Nichiyu Maru

This site hosts a 6,871-ton (6,233-metric ton) Japanese freighter torpedoed by the U.S. submarine Permit on May 5, 1943. The freighter currently lies below the Shell fuel pier in 100 ft (30 m) of water. Divers are required to obtain permission from Shell to dive the ship.

### Tokai Maru

This site hosts a 8,359-ton (7,583-metric ton) Japanese passenger-cargo ship torpedoed by the U.S. submarine *Flying Fish* on January 25, 1943. Divers can tie up to one of several mooring buoys south of the seaplane ramp.

### S.M.S. Cormoran

This site hosts a German ship that lies besides the *Tokai Maru*. A buoy chain leads to the ship with the buoy anchor lying between the *Tokai Maru* and the *S.M.S. Cormoran*.

### Japanese Tugboat

This site hosts a sunken tug that lies near *Tokai Maru*.

### Kitsugawa Maru

This site hosts a 1,915-ton (1,737-metric ton) Japanese freighter sunk by the dive bombers from the U.S. aircraft carrier *Enterprise*. The freighter lies in 140 ft (43 m) of water.

### The Val

This site hosts a Japanese Navy D3A2 dive bomber shot down on June 19, 1944 and currently lies near the Glass Breakwater in 80 ft (24 m) of water.

### American Tanker

This site hosts an American Tanker along with sunken barges in 40 to 120 ft (12 to 37 m) near the south end of the breakwater.

### The Scotia

This site hosts a sunken cable ship sent to Guam to fix a sinking buoy near the entrance of the Apra Harbor. It sank while attempting to enter the harbor in 1904.

### Western Shoals

This site is located in the middle of the harbor. The reef has several large crevices with sponges, reef fish, invertebrates, and stag horn corals that can be explored by either SCUBA diving or snorkeling. The depths of the shoals can range from 5 to 75 ft (23 m).

### Hourglass Reef

This site is located to the west of Western Shoals across a narrow and deep channel. The reef, shaped like an hourglass, reaches depths up to 100 ft (30 m). There are many anemones, barrel sponges, corals, and fish.

#### 1.3.2.4 Beaches and Parks

### Dog Leg Pier

This site features octopi, eels, parrotfish, clownfish, anemones, and other marine life in the coral reef. The pier is used by KC Water Sports, Charles Marine Sports Club, Paradise Aqua, and Dive City Academy exclusively.

### Family Beach

This beach is used by Guam Dolphins Marine for water recreational activities. The site is noted for snorkeling, SCUBA diving, and wind surfing.

### Tepungan Beach

This public beach has picnic shelters and a restroom. The park is frequently used by visitors after diving and snorkeling at the *Piti Bomb Holes*.

### Port Authority Beach

Although this beach is a public facility, a reservation is required. The beach is situated adjacent to the Navy's Delta and Echo Fuel Piers.

### Fish Eye Marine Park

This site features an underwater observatory where visitors can view tropical fish and corals beneath the surface of the water.

#### 1.3.2.5 Fishing

### Piti Bomb Holes Preserve

The Piti Bomb Holes are natural reef formations that received their name because they appear to have been created by bombs. Fishing is restricted to protect the coral reef and fish that inhabit the area.

### Masso Reservoir

Masso Reservoir is a 28-acre (11-ha) site with a 2.5-acre (1-ha) man-made reservoir in Piti. The site offers camping, picnicking, hiking, and fishing opportunities. The site is the only publicly accessible freshwater lake on Guam. Although no longer used, the reservoir was constructed in the 1950s to supply water to the village of Piti.

### Sasa Bay Preserve

Fishing in this Preserve is restricted to protect the coral reef and fish along with an estuary of mangrove swamp.

#### 1.3.2.6 Others

### Marianas Yacht Club

Located in Apra Harbor, this club sponsors races and regattas, as well as facility uses, such as mooring, tender parking, and mail holding.

### Devil's Punchbowl

This site features a vast natural limestone sinkhole.

### Seaplane Ramp

This ramp is used to launch boats into Apra Harbor.

## **1.3.3 Apra Harbor (also includes resources at Naval Base Guam)**

#### 1.3.3.1 Trails

### Orote Point

The 1-mile (2-km) hike begins at the end of Orote Peninsula. The trail leads through a forested area and through cave bases and terminates at a coral pebble beach. Hikers may swim and snorkel at the beach.

#### 1.3.3.2 Historic and Cultural Sites

### Pan Am Clipper Landing Site

This is the old Pan Am Clipper Landing Site, which was used from 1935 to 1941 by Pan American Airways for transporting passengers to and from Manila and Hawaii, and beyond. The service ended due to the Japanese bombing of Pan Am's headquarters in December 1941.

### Orote Airfield

Orote Airfield was constructed during World War II by the Japanese with forced Korean and Chamorro labor. The airfield was operational during the war and, after the U.S. liberation of Guam; it was used by Marine Corps Air Group 21 to service Navy and Marine aircraft. Today, much of the field is used as training grounds. This site is closed when the adjoining Orote Peninsula is being used to offload ammunition from ships for safety reasons.

### Sumay Village

The site of Sumay Village has several historic features. Sumay Village was a Chamorro settlement since prehistoric times (Lotz 2001). During Spanish colonial times, the village was a port of call for Spanish galleons. During World War II, the village hosted two Japanese engineer construction battalions. Currently, the former village site occupies a portion of the Navy Main Cantonment.

### War Dog Cemetery

The Cemetery memorializes 25 Marine Corps dogs killed in action on Guam. The dogs were used to find Japanese hiding in caves and in defensive positions, as scouts, sentries, messengers, and for locating mines and booby traps.

### Japanese Midget Submarine

There is a Japanese Type C two-man midget submarine on display in front of the barracks on Chapel Road. The submarine ran aground at Ipan, Talofofo in August 1944. The mission of this midget submarine is a mystery as neither the crew or documents have been found.

### Fort Santiago

This Spanish fort was constructed between 1710 and 1721 and was situated with its five cannons overlooking Apra Harbor and Orote Point. The fort fell into disrepair and was a lookout post by 1855. During World War II, the Japanese placed an anti-aircraft battery at the site to protect the nearby Orote Airfield. When the U.S. Navy had control of the fort once again, it was used to perform formal salutes for naval vessels entering the harbor until the mid-1950s. Today, all that remains are two gun emplacements, coral blocks, pieces of Spanish roofing tiles, and a view of Apra Harbor.

### Captain Glass Monument

The Monument is located at Gab Gab Beach in honor of Captain Henry Glass. He was captain of the USS *Charleston* that sailed into Apra Harbor and captured Guam from Spain on July 21, 1898 during the Spanish-American War.

#### 1.3.3.3 Scenic Points

### Orote Point Scenic Vista

This scenic vista is located at the end of Orote Point Road and contains a scenic vista of Orote Point, the Apra Harbor entrance, the Glass Breakwater, and Orote Island.

#### 1.3.3.4 Dive Spots

### Old Fuel Piers

North of the Old Fuel Piers are the remains of two Japanese seaplanes. Visitors may scuba dive or snorkel.

### Shark Pit

This dive spot marks the site where, after World War II, AMTRACS, mess hall trays, old china, food, and garbage were dumped and ultimately attracted sharks. Sharks are no longer present, but tuna, jacks, butterfly fish, and parrotfish are abundant. Water depths range from 1 to over 130 ft (40 m).

### Blue Hole and Crevice

This crevice is a deep canyon with a large boulder at the mouth off Orote Peninsula. There are sea fans, whips, fish, moray eels, shells, and corals in 60 to over 130 ft (18 to 40 m) of water.

### Sponge Reef

This 300-ft (91-m) reef is relatively flat where numerous corals, anemones, and fish are present at depths ranging from 40 to a 100 ft (12 to 30 m).

### Finger Reef

The water depth at this reef runs to 100 ft (30 m) at this site.

#### 1.3.3.5 Beaches and Parks

### San Luis Beach and Fort San Luis

This beach offers picnic facilities and a swimming area.

### Gab Gab Beach

This beach is noted for snorkeling and plenty of fish in waters reaching 100 ft (30 m) in depth. There are picnic tables and shelters on-site.

### Dadi Beach

Dadi Beach is a kayak starting point to Turtle Rock, North Tupalao Cave, and Agat Marina.

### Polaris Point Beach

A small beach located at Polaris Point. There is a small MWR club there with cabanas, canoes, and fishing boats to rent.

#### 1.3.3.6 Others

### Sumay Cove Marina

Sumay Cove is the Marina which offers sailboats for rent for recreational use to military personnel and their dependents.

## **1.4 SOUTH**

### **1.4.1 Naval Munitions Site (NMS)**

#### 1.4.1.1 Historic and Cultural Attractions

### Fena Massacre Site

Several Chamorro men were massacred by Japanese soldiers in a cave nearby Harmon during the American bombardment of Guam.

#### 1.4.1.2 Scenic Points

### Japanese Lookout

Contrary to the belief that the lookout constructed on top of Mt. Alifan was use by the Japanese soldiers, the lookout was actually an American military communications installation built after the U.S. liberation of Guam. From the lookout is a scenic vista of Orote Peninsula, Santa Rita, and Agat.

#### 1.4.1.3 Fishing

### Fena Reservoir

Constructed in 1951, this reservoir provides a dependable water supply for the Navy on Guam. Between 1956 and 1968, several species of fish, including tilapia, peacock bass, small and large mouth bass, and channel catfish, were introduced to the reservoir. Fresh water fishing is popular at the Fena Reservoir.

#### 1.4.1.4 Others

##### Almagosa and Dobo Springs

These two springs lie deep within the Fena Valley. In 1931, pipes were installed to connect the springs to the Maanot Water Reservoir to supply water to Apra Harbor. Nearby are the Dobo latte site and Almagosa Waterfall, which are points of interest.

#### 1.4.2 Non-DoD Land

##### 1.4.2.1 Trails

##### Sella Bay Trailhead

The terminus of the 1.5-mile (2.4-km) trail within the Guam Seashore Park at Sella Bay is noted for swimming, snorkeling, and SCUBA diving with ledges, tubes, and underwater caves to explore. The river contains tilapia and freshwater shrimp and attracts fishing activities. Sella Bay is also remembered as a site of a leper colony during the time of Spanish rule.

##### Tarzan Valley Bike Trail

The trail starts near the former Smoking Wheels track and ends at Route 17.

##### Atilling Acho

The 2.2-mile (3.5-km) trail begins from the Cetti Bay Overlook to the Cetti Bay, where hikers can snorkel.

##### Cetti Fall

Located within the Guam Seashore Park, a series of seven falls make up the Cetti Falls. The trail begins at the Cetti Bay Overlook.

##### Umatac to Toguan Bay

The 1.2-mile (1.9-km) coastal trail begins at either Umatac Village or Toguan Bay. Hikers are advised to stay along the beach as most of the inland area is under private ownership. Depending on where the hike begins, visitors may rest and snorkel near the Toguan Bay or Umatac trail ends.

##### Faha and Tinta

The 0.8-mile (1.3-km) trail leads to massacre sites of the Chamorro people by the Japanese soldiers during World War II.

##### Priest's Pools

The 0.6-mile (1-km) trail from Pigua to a series of eight pools located in a pillow basalt cave. The top pool, with clear and cool water, is the largest and is ideal for swimming.

##### Mt. Lamlam

The 2.2-mile (3.5-km) trail leads to Mt. Lamlam, Guam's highest point at 1,334 ft (407 m) above sea level. The summit offers a panoramic view of Guam's hilly interior toward the north and a panoramic view of the southern coastline. Although a portion of the trail is located on a Navy property, there is no access restriction

### Southern Mountains

The series of hikes along the southern mountains of Guam begins at the Cetti Bay Overlook trailhead. The total length of the trail is 23.8 miles (38.3 km).

#### Mt. Schroeder

The 1-mile trail to Mt. Schroeder begins at the end of Cruz Avenue in Merizo. A scenic point on Mt. Schroeder provides a view of the southern mountains and Cocos Lagoon.

#### Mt. Sasalaguan

The 4.2-mile (6.8-km) trail begins at Ija and ends at Mt. Sasalaguan within the Guam Seashore Park.

#### Ricky's Beach and Ylig Bay

The 2.2-mile (3.5-km) trail commences from Tagachang Beach on the eastern shoreline of Yona. Ricky's Beach is at the base of the cliff tucked between the ocean and the shore. Ylig Bay can be reached by retracing steps to Tagachang Beach and heading south along the coastline.

#### Paicpouc Cove and Matala Beach

The 2-mile (3-km) trail commences at Talofofu Bay. Along the trail near Paicpouc Cove are the remains of the *Aratama Maru*, a Japanese ammunition ship that was torpedoed by a Navy submarine.

#### Inarajan Falls

The 5-mile (8-km) trail begins at the Inarajan Middle School. *Inarajan Falls* can be seen along the trail. A short distance from the falls is the longest series of latte stones, consisting of the 14 pieces found on Guam. Hikers can enjoy shallow pools and the river at the trail terminus.

#### Asiga

The 1.5-mile (2.4-km) trail begins at the Malojloj Coral Pit trailhead. The trail leads to cliff faces, which hikers can climb to reach a series of several caves.

#### Waterfall Valley

Five waterfalls can be seen during the 0.8-mile (1.3-km) trail along the green gorge of the Aslinget River just north of Inarajan Village.

#### Fintasa and Laolao Falls

These waterfalls are located in the rolling hills west of Inarajan Village. Hikers have an unobstructed view of the Inarajan Village and the Fintasa Falls valley, and a small island where the Laolao Falls are located.

#### Sigua Valley Bike Trail

This trail begins at Mt. Chachao Scenic Vista and terminates at Mt. Tenjo. There are also a series of bike trails in the easterly direction from the trail end.

#### Upper Sigua and Alutom Falls

This 2.5-mile (4-km) trail commences at Mt. Chachao and follows along a series of falls at Upper Sigua Falls and Alutom Falls.

### Sigua River

This 5-mile (8-km) trail begins at Mt. Chachao.

### Upper and Lower Sigua Falls

This trail along the central grasslands and jungle leads to the waterfalls at the junction of the Upper Sigua River and the Lower Sigua River.

### Lower Sigua Falls, Sinisa Falls, and Tank Farm

This 6.2-mile (10-km) trail leads to Lower Sigua Falls, Sinisa Falls, and Tank Farm, which consists of American military vehicles used for target practice after Guam's liberation. Visitors can swim and picnic at the trail terminus.

### Maguagua Falls

The 2.5-mile (4-km) trail that begins west of Mt. Chachao and ends at Maguagua Falls.

### Mt. Chacho and Mt. Tenjo

Hikers may encounter one of several relics from World War II during the hike on this three mile remote and hilly trail, including an American gun encasement. The hike traverses the War in the Pacific National Historical Park.

### Guatali Falls

The 3.2-mile (5.1-km) trail commences at the War in the Pacific National Historical Park. Notable features along the hike are Malaa Falls, Upper Guatali Falls, and Lower Guatali Falls.

### Tarzan Falls

The 1.4-mile (2.3-km) trail is a boonie trail. The trail begins at the Cross Island Road and runs through a series of waterfalls along Tarzan River within the Government of Guam Coastal Conservation Reserve.

### Tarzan Swim Hole

The 2-mile (3.2- km) trail begins at the Cross Island Road.

#### 1.4.2.2 Historic and Cultural Attractions

### Gaan Point

The flags of the U.S., Japan, and Guam fly in memory of those killed during the U.S. liberation of Guam. There are remnants of an extensive fortified knoll, a Japanese naval coastal defense gun, and a Japanese dual mount anti-aircraft cannon. The park also features picnic facilities and a restroom.

### Inarajan Village

This site is considered to be the primary example of a Spanish-influenced village on Guam. The *Inarajan Village* offers historical insight on the architectural design and development of structures built during the late Spanish and early American periods. The site was placed in the National Register of Historic Places in 1977 as a Historic District.

### Malesso Kombento

Built in 1856 shortly after the smallpox epidemic that killed two-thirds of the population, *Malesso* (Merizo) *Kombento* provided housing for Catholic missionaries and village priests in Guam.

### Merizo Bell Tower (Kanapanayan Malesso)

The site was built around 1910 under the direction of Father Cristobal de Canals; restored in 1981; and is included on the National Register of Historic Places.

### Fort Nuestra Senora de la Soledad

Fort Nuestra Senora de la Soledad was one of the last Spanish Forts constructed in the 19th Century in support of the Spanish Galleon trade. Sitting on the cliff just to the South of Umatac, Fort Soledad has a commanding view of the Bay and all Ocean approaches. The Fort was restored in 1995 and today the cannon of Fort Soledad still point out over the Pacific Ocean and Umatac Bay where Magellan landed in 1521 to make the first contact between Guam and the West.

#### 1.4.2.3 Scenic Points

### Cetti Bay Overlook

This scenic point provides a spanning view of Cetti Bay, from Cocos Island to the Merizo barrier reef in the distance.

### Fouha Bay Scenic Vista

This scenic point contains a view of the Fouha Bay.

### Talofofu Bay Scenic Vista

This scenic vista features Talofofu Bay and the southern mountains to the west.

### Mt. Alifan Unit

The scenic vista on the top of the hill provides a view to the north of Orote Point, Facpi Point to the south, Agat, and Mt. Alifan to the east. The Marines landed along the coast to liberate Guam on July 21, 1944.

### Inarajan Scenic Vista

This scenic point provides a view of Inarajan village.

### Pago Bay Overlook

This scenic overlook from the largest bay on the central windward side of the island provides a view of Pago Bay. In the distance is Mangilao, the University of Guam, and Iates Point.

### Ylig Bay Scenic Vista

This scenic vista provides a view of Ylig Bay.

### Ija Scenic Vista

This scenic vista provides a view of the coastline of Inarajan and of the southern mountains.

#### 1.4.2.4 Dive Spots

### The AMTRAC

This dive site hosts snorkeling and SCUBA diving. An AMTRAC sunk by a Japanese shell rests on the ocean floor at a depth of 50 ft (15 m).

### Hap's Reef

This bread loaf-shaped reef is located offshore of Tongcha Beach and north of Gaan Point. Divers may enjoy swimming alongside tropical fish in depths between 25 and 60 ft (8 to 18 m).

### Pete's Reef

This reef features a mixture of coral heads, sandy patches, and marine life including an occasional eel and dolphin in the depths ranging from 20 to 80 ft (6 to 24 m).

### Japanese Zero

This is an offshore dive site from San Jose in 50 ft (15 m) of water. The site is home to a Mitsubishi A6M5, a Japanese Navy fighter from World War II.

### Fouha Bay

This dive spot contains corals, ledges, and caverns in the depth to 40 ft (12 m).

### Nathan's Dent

This site is situated south of Facpi Point, and contains corals, caves, and sea life up to 80 ft (24 m) in depth.

### Mana Bay Cut

This site offers free diving off the shore of Ipan Beach Resort with water depth of 80 ft (24 m). Mana Bay Cut is noted for soft corals, schools of angel fish, clownfish, stone fish, and an occasional octopus.

### Aratama Maru

This site contains a 6,783-ton (6,153-metric ton) Japanese ammunition ship that was damaged and abandoned after an attack by a U.S. submarine on April 8, 1944. The ship lies broken up in 50 ft (15 m) of water.

### Cocos Lagoon

Cocos Lagoon was created by the offshore barrier reef. The site is noted for its broad expanse of extensive corals, sand flats, and sea grass beds. Two channels cut through the barrier reef. Cocos Lagoon attracts snorkeling, SCUBA diving, surfing, and windsurfing uses.

#### 1.4.2.5 Beaches and Parks

### Achang Reef Flat Preserve

The Preserve spans from Achang Bay to Ajayan Channel and inland from the 33-ft (10-m) line, or the nearest public right-of-way (ROW), seaward to the 600 ft (183 m) depth. The Achang Reef Flat is noted for its extensive sea grass beds especially between Agrigan Island and Guam. These sea grasses are protected as they function as nurseries for replenishing fish stock (Lotz 2001). The Preserve was established in 1997 to protect the coral reef and aquatic creatures contained within the area.

### Aflleje Park at Rizal Beach

This site features the Friendship Pavilion, restrooms, and the Aflleje Beach Memorial Park Peace Memorial. Rizal Beach is noted for its snorkeling and SCUBA diving. Offshore, the Rizal reef has a depth of about 40 ft (12 m) and a sandy bottom containing clams, shrimp, eagle rays, sting rays, manta rays, fish, and finger corals.

### Agat Recreation Area

Located in Agat and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Agat Small Boat Harbor

The site is a Federal Lands to Parks site in southern Guam.

### Agfayan Bay and Bear Rock

Agfayan Bay is noted for fishing, swimming, surfing, and snorkeling.

### Asquiroga Cove (Devil's Cove or First Beach)

Situated towards the south end of the Asanite Bay, this cove features an area to swim and snorkel.

### Dano Park

Located in Cocos Island and is protected by Section 6(f) of the Land and Water Conservation Fund Act. The park is also a Federal Lands to Parks site in southern Guam.

### I Memorias Para I Lalahita

Dedicated in 1971, this park memorializes those men from Guam who died during the Vietnam War.

### Ipan Beach

Situated near Asquiroga Cove, Ipan Beach is a long, strand beach. The beach features a World War II rest camp for Navy submariners, Camp Dealy, as well as a Japanese fortification near Tongcha Bay. Along the beach are swimming holes and old drums. The beach is located in Inarajan and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Merizo Pier Park

Located in Guam's barrier reef, this park is the gateway to Cocos Island. The park is a protected recreational area for various water sports. Each year, the park hosts the Malessio Fiestan Tasi (Merizo Water Festival). The park is noted for the large monkey pod trees and the historic Merlyn G. Cook Schoolhouse along with a children's playground, boat ramp, pier, restroom, and picnic facilities. The park also serves as the starting point for kayak trips to explore Cocos Lagoon and Cocos Island. The park is located in Merizo and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Namo Falls Botanic Park

This park is privately owned and a user fee is required. Namu Falls Botanic Park provides a walk through a botanic garden featuring tropical flowers and two waterfalls, Guello and Guella Falls.

### Nimitz Beach Park

This park offers a view of the small islands located in Agat Bay and the Orote Peninsula. The 10-acre (4-ha) beach park is noted for its monkey pod and coconut trees, a pavilion, shelters, and restrooms. The beach is a Federal Lands to Parks site in southern Guam.

### Pauliluc Bay

This bay is placid; visitors can swim and fish.

### Salinas Beach

Visitors to this small and secluded beach may enjoy swimming and snorkeling.

### Saluglula (Inarajan) Pool

This natural marine waterhole is noted for picnic and swimming sites. The public park also hosts a pavilion, restrooms, shelters, and barbecue pits. The site is located in Inarajan and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Santa Rita Park

Located in Santa Rita and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Tagachang Beach Park

Located in Yona and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Tagachan Beach

The park has a pavilion, restrooms, picnic shelters, and a location for swimming, snorkeling, and scuba diving when the waters are calm. The coastline at Tagachan is ideal for beachcombing.

### Talofof Beach Park

The Talofof River, Guam's longest and widest, empties into the bay, considered to be one of Guam's most picturesque body of water. The beach is a popular surfing beach. Talofof Beach Park is located in Inarajan and is protected by Section 6(f) of the Land and Water Conservation Fund Act.

### Talofof Falls Park

Visitors to the park picnic and swim at the waterfall, cascading from the Ugum River. Other features include the Guam Historical Museum, Yokoi's Cave, Observation Tower, and Ghost House.

### Toguan Bay

The bridge over the Toguan River marks the boundary between Umatac and Merizo. Toguan Bay is where the Toguan River enters the ocean. Toguan Bay, along with Bile Bay to the south, is normally protected water for snorkeling and SCUBA diving.

### Tongcha Beach

Formerly known as the Agat Family Beach, Tongcha Beach offers shelters and a restroom.

### Umatac Bay Park

Every year, Umatac Bay Park hosts the Magellan Monument commemorating the explorer's landing in 1521. The Park also contains the Mayor's office, picnic facilities, restrooms, and a boat ramp. The park is the starting point for kayak trips to Sella and Cetti Bays.

### Ylig Bay

Visitors can fish, swim, and surf at the bay. There is a boat ramp on the south side of the Ylig River Bridge. The dirt road north of the bridge and the paved road south of the bridge lead to undeveloped beaches. The Ylig River is also a kayaking route.

#### 1.4.2.6 Spelunking

### Gadao's Cave

This cave is one of the more famous caves on Guam because of ancient Chamorro petroglyphs on the cave walls. The petroglyphs depict the legendary tale of Chief Gadao of Inarajan and Chief Malaguana of Tumon. A massive statue of Chief Gadao paddling his half of the canoe is situated in the Inarajan Village.

### Talofofu Caves

This series of six caves is located north of the Route 4 and 4A intersection in Talofofu. The caves are accessed through private properties and Government of Guam (GovGuam) lands that represent important archaeological and pictographic resources. There are no access restrictions within the trail. There are numerous sinkholes, caves, and stalactites in the Mariana Reef limestone formation.

#### 1.4.2.7 Others

### Talofofu Golf Resort

This resort features an 18-hole golf course with a pro shop.

### Country Club of the Pacific

This 18-hole golf course with a pro shop is noted for the spacious and soaring roof design of the club house.

### Windward Hills Country Club

This 18-hole golf course also has a pro shop.

### Ipan Beach Resort

This resort occupies Jones Beach and offers day uses including tennis courts, a swimming pool overlooking the beach, volleyball court, and picnic facilities. Rustic huts for overnight stays are also offered.

### Cocos Island

This 100-acre (40-ha) island resort is surrounded by a clear, turquoise lagoon off of Merizo. Available activities include jet skiing, windsurfing, and snorkeling.

### Bangi Island

Bangi Island is closest to the Guam shore. There is a Japanese fortification from World War II that was taken by the 4<sup>th</sup> Marines on July 21, 1944. Although the islands are within the authorized boundaries of the War in the Pacific National Historical Park, Bangi Island is private property so access may be restricted. Kayaking is also popular around the island.

### Anae Island

This island is extremely rugged, eroded limestone, covered with a variety of plants. Near the center of the island is a cave that descends to salt water. The cave contains unique orange stalactites. A stalactite is a deposit of calcium carbonate (as calcite) resembling an icicle hanging from the roof or sides of a cave. The entire island's edge is an overhanging limestone cliff about 12 ft (4 m) above the water, with interesting caves along the its edge. The offshore patch reef is not connected with the fringe reef around Guam. The reef offers a diversity of coral species located in numerous underwater ridges. Depths range from 15 to 55 ft (5 to 17 m), and the water is ideal for SCUBA diving and snorkeling. Visitors can also find windsurfing and kayak outfitters on the island.

### Agat Small Boat Harbor

Built in 1990, this harbor lies adjacent to Nimitz Beach and provides docking facilities for boaters. Docks, boat ramps, and a fueling facility are present for public use. Agat Small Boat Harbor is a starting point to kayak to Bile Bay and further south to the Pier in Merizo.

Gef Pa'go

Located on the Inarajan Bay, *Gef Pa'go* is a “living museum” that consists of eight thatched huts. Each hut demonstrates ancient Chamorro crafts and practices.





## CHAPTER 2. BIOLOGICAL RESOURCES

### 2.1 SPECIES LISTS

English/Chamorro Name	Scientific Name
<b>PLANTS</b>	
- /Mapunyo	<i>Aglaia mariannensis</i>
- /Putting	<i>Barringtonia asiatica</i>
- /Gausali	<i>Bikkia tetrandra</i>
- /da"ok	<i>Calophyllum inophyllum</i>
- /Ilang ilang	<i>Cananga odorata</i>
- /Chiuti	<i>Cerbera dilatata</i>
- /Panao	<i>Claoxylon marianum</i>
- /Fadang	<i>Cycas circinalis</i> (= <i>micronesica</i> )
- /Gulos	<i>Cynometra ramiflora</i>
- /Yoga	<i>Elaeocarpus joga</i>
/tupun ayuyu	<i>Elatostema calcareum</i>
- /Chosga	<i>Glochidion marianum</i>
- /paipai	<i>Guamia mariannae</i>
- /Ufa halomtano	<i>Heritiera longipetiolata</i>
- /Ifit, Ifil	<i>Intsia bijunga</i>
- /chopak	<i>Mammea odorata</i>
- /Faniok	<i>Merrilliodendron megacarpum</i>
- /Fago	<i>Neisosperma oppositifolia</i>
- /Langiti	<i>Ochrosia mariannensis</i>
- /Nigas	<i>Pemphis acidula</i>
- /Umumu	<i>Pisonia grandis</i>
- /Langsat	<i>Pisonia umbellifera</i>
- /Ahgao	<i>Premna obtusifolia</i>
- /Aplokating palaon	<i>Psychotria hombroniana</i>
- /Faia	<i>Tristiropsis acutangula</i>
African tulip tree/ -	<i>Spathodea campanulata</i>
Alexandrian laurel/Daog	<i>Calophyllum inophyllum</i>
Banyan/Nunu	<i>Ficus</i> spp.
Bay rum tree/ -	<i>Pimenta racemosa</i>
Beach heliotrope/Hunig, hunik	<i>Tournefortia argentea</i>
Beach naupaka/Nanaso	<i>Scaevola taccada</i>
Betelnut/Pugua	<i>Areca catechu</i>
Breadfruit/Lemmai	<i>Artocarpus altilis</i>
Coconut/Niyog	<i>Cocos nucifera</i>
Coral tree or tiger's claw/Gabgab	<i>Erythrina variegata</i> var. <i>orientalis</i>
Fig/Nunu	<i>Ficus prolixa</i>
Flametree/Arbol de fuego	<i>Delonix regia</i>
Formosa acacia/ -	<i>Acacia confusa</i>
Fountaingrass/ -	<i>Pennisetum</i> spp.
Giant swampfern/langayao	<i>Acrostichum aureum</i>
Hibiscus, sea/Pago	<i>Hibiscus tiliaceus</i>
Indian mulberry/Ladda	<i>Morinda citrifolia</i>
Ironwood or Australian pine/Gago	<i>Casuarina equisetifolia</i>
Limeberry/Lemon china	<i>Triphasia trifolia</i>
Marianas breadfruit/Dokdok	<i>Artocarpus mariannensis</i>
Madras thorn/Kamachile	<i>Pithecellobium dulce</i>
Nipa palm/ -	<i>Nypa fruticans</i>
Pandanus/Kafu	<i>Pandanus</i> spp.
Papaya/ -	<i>Carica papaya</i>
Para grass/ -	<i>Brachiaria</i> ( <i>Panicum</i> ) <i>mutica</i>
Portia tree/Banalo	<i>Thespesia populnea</i>

English/Chamorro Name	Scientific Name
Reed/Karriso	<i>Phragmites karka</i>
Serianthes tree (fire tree)/Hayun lago	<i>Serianthes nelsonii</i>
Siam weed/Masiksik	<i>Chromolaena odorata</i>
Siris tree/Tronkon mames	<i>Albizia lebbek</i>
Sword grass/Neti	<i>Miscanthus floridulus</i>
Tangantangan/Tangantangan	<i>Leucaena leucocephala</i>
Tree fern/ -	<i>Cyathea lunulata</i>
Tropical almond/Talisai	<i>Terminalia catappa</i>
Vitex/ -	<i>Vitex parviflora</i>
<b>INVERTEBRATES</b>	
Artichoke coral, Pineapple coral, Starry cup coral, Favia	<i>Acanthastrea echinata</i>
Asian cycad scale	<i>Aulacaspis yasumatsui</i>
Blue-banded king crow butterfly/Ababang	<i>Euploea eunice</i>
Branched sandpaper coral/ -	<i>Psammocora contigua</i>
Broadhand coral hermit/ -	<i>Pylopaguropsis kiejii</i>
Caribbean barnacle/ -	<i>Chthamalus proteus</i>
Cauliflower coral/ -	<i>Pocillopora</i>
Chinese slipper lobster/ -	<i>Panulirus guttatus</i>
Coconut crab/Ayuyu	<i>Birgus latro</i>
Common emigrant butterfly/ Ababang	<i>Catopsilia pomona</i>
Common mormon butterfly/ Ababang	<i>Papilio polytes</i>
Crow eggfly butterfly/Ababang	<i>Hypolimnas anomala</i>
Crown-of-thorns starfish	<i>Acanthaster planci</i>
Double-spined rock lobster/ Mahongang	<i>Panulirus penicillatus</i>
Formosa staghorn coral/ -	<i>Acropora formosa</i>
Fragile tree snail/Akaleha'	<i>Samoana fragilis</i>
Galaxy coral/ -	<i>Galaxea fascicularis</i>
Giant African snail/Akaleha'	<i>Achatina fulica</i>
Great eggfly butterfly/Ababang	<i>Hypolimnas bolina</i>
Guam tree snail/Akaleha'	<i>Partula radiolata</i>
Hump coral	<i>Porites cylindrica</i>
Humped tree snail/Akaleha'	<i>Partula gibba</i>
Knob coral/ -	<i>Porites convexa</i>
Kona crab/ -	<i>Ranina ranina</i>
Lace coral/ -	<i>Pocillopora damicornis</i>
Land hermit crab/Umang	<i>Coenobita brevimanus</i>
Lesser grass blue butterfly/ Ababang	<i>Zizina otis</i>
Mangrove crab/ -	<i>Scylla serrata</i>
Mantis shrimp/ -	<i>Squilla empusa</i>
Mariana eight-spot butterfly/ Ababang	<i>Hypolimnas octocula mariannensis</i>
Mariana wandering butterfly/ Ababang	<i>Vagrans egistina</i>
Monarch butterfly/Ababang	<i>Danaus plexippus</i>
Reticulate moray eel	<i>Muraena retifera</i>
Rosy wolf snail/ -	<i>Euglandina rosea</i>
Scalloped spiny lobster/ -	<i>Panulirus homarus</i>
Spider conch	<i>Lambis</i> sp.
Spiny lobster/Mahongang	<i>Panulirus marginatus</i>
Sponge, puff or yellow tough	<i>Neofibularia hartmani</i>
Top shell	<i>Trochus niloticus</i>

English/Chamorro Name	Scientific Name
Three-spot grass yellow butterfly/Ababang	<i>Eurema blanda</i>
Tiny grass blue butterfly/Ababang	<i>Zizula hylax</i>
Turban shell	<i>Turbo torquata</i>
<b>FISH</b>	
Albacore tuna/ -	<i>Thunnus alalunga</i>
Bigeye scad/ -	<i>Selar crumenophthalmus</i>
Bigeye tuna/ -	<i>Thunnus obesus</i>
Bighead catfish/ -	<i>Clarias macrocephalus</i>
Black-tailed snapper	<i>Lutjanus fulvus</i>
Blue devil damsel	<i>Chrysiptera cyanea</i>
Brassy trevally	<i>Caranx papuensis</i>
Broadbill swordfish/ -	<i>Xiphias gladius</i>
Daisy parrotfish	<i>Chlorurus sordidus</i>
Golden goby/Atot	<i>Stiphodon percnopterygionus</i>
Green chromis	<i>Chromis viridis</i>
Guam goby/Atot	<i>Awaous guamensis</i>
Humphead parrotfish/Atuhong	<i>Bolbometopon muricatum</i>
Indo-Pacific blue marlin/ -	<i>Makaira mazara</i>
Marbled eel/Hasule	<i>Anguilla marmorata</i>
Mosquito fish/ -	<i>Gambusia affinis</i>
Napolean wrasse/Tanguisson	<i>Cheilinus undulatus</i>
Northern bluefin tuna/ -	<i>Thunnus thynnus</i>
Peacock bass/ -	<i>Cichla ocellaris</i>
Red-breasted wrasse	<i>Cheilinus fasciatus</i>
River goby/ -	<i>Stiphodon elegans</i>
Rock flagtail/Umatang	<i>Kuhlia rupestris</i>
Scalloped hammerhead/ -	<i>Sphyrna lewini</i>
Skipjack tuna/ -	<i>Katsuwonus pelamis</i>
Snake mackerel	<i>Gempylus serpens</i>
Staghorn damsel	<i>Amblyglyphidodon curacao</i>
Striped marlin/ -	<i>Tetrapturus audax</i>
Walking catfish/ -	<i>Clarias batrachus</i>
Yellowfin tuna/ -	<i>Thunnus albacares</i>
Yellowtail rock-climbing goby/Atot	<i>Sicyopterus macrostetholepis</i>
<b>REPTILES AND AMPHIBIANS</b>	
Azure-tailed skink/ Guali'ek halom tano'	<i>Emoia cyanura</i>
Blind snake/Ulo' attelong	<i>Ramphotyphlops braminus</i>
Brown tree snake/Kolepbla	<i>Boiga irregularis</i>
Cane or marine toad/Kairo	<i>Chaunus (Bufo) marinus</i>
Crab-eating frog/ -	<i>Fejervarya cancrivora</i>
Curious skink/ Guali'ek halom tano'	<i>Carlia fusca</i>
Eastern dwarf tree frog/ -	<i>Litoria fallax</i>
Greenhouse frog/ -	<i>Eleutherodactylus planirostris</i>
Green sea turtle/Haggan betde	<i>Chelonia mydas</i>
Gunther's Amoy frog	<i>Sylvirana guentheri</i>
Hawksbill sea turtle/Hagan karai	<i>Eretmochelys imbricata</i>
House gecko/Guali'ek	<i>Hemidactylus frenatus</i>
Leatherback sea turtle	<i>Eretmochelys imbricata</i>
Littoral or tidepool skink/ Guali'ek kantun tasi	<i>Emoia atrocostata</i>
Loggerhead sea turtle	<i>Dermochelys coriacea</i>
Micronesian gecko/Guali'ek	<i>Perochirus ateles</i>
Monitor lizard/Hilatai	<i>Varanus indicus</i>
Moth skink/Guali'ek halom tano'	<i>Lipinia noctua</i>
Mourning gecko/Guali'ek	<i>Lepidodactylus lugubris</i>
Mutilating gecko/Guali'ek	<i>Gehyra mutilata</i>
Oceanic gecko/Achiak	<i>Gehyra oceanic</i>
Oceanic snake-eyed skink/ Guali'ek halom tano'	<i>Cryptoblepharus poecilopleurus</i>

English/Chamorro Name	Scientific Name
Pacific blue-tailed skink/ Guali'ek halom tano'	<i>Emoia caeruleocauda</i>
Pacific slender-toed gecko/Guali'ek	<i>Nactus pelagicus</i>
Slevin's skink/Guali'ek halom tano'	<i>Emoia slevini</i>
<b>BIRDS</b>	
American golden plover/Dulili	<i>Pluvialis dominica</i>
Barn swallow/ -	<i>Hirundo rustica</i>
Black drongo/Salin Taiwan	<i>Dicrurus macrocercus</i>
Black francolin/ -	<i>Francolinus francolinus</i>
Black noddy/Fahang dikike'	<i>Anous minutus</i>
Brown booby/Lu'ao	<i>Sula leucogaster</i>
Brown noddy/Fahang dankolo	<i>Anous stolidus</i>
Collared kingfisher/ -	<i>Todiramphus chloris</i>
Eurasian tree-sparrow/ Ga'ga' pale'	<i>Passer montanus</i>
Fish crow	<i>Corvus ossifragus</i>
Fork-tailed swift/ -	<i>Apus pacificus</i>
Great egret/ -	<i>Ardea modesta</i>
Great frigatebird/Ga'ga' manglo'	<i>Fregata minor</i>
Greenshank/ -	<i>Tringa nebularia</i>
Grey-tailed tattler/Dulili	<i>Heteroscelus brevipes</i>
Guam bridled white-eye/Nossa	<i>Zosterops conspicillatus conspicillatus</i>
Guam Micronesian kingfisher/Sihok	<i>Halcyon cinnamomina cinnamomina</i>
Guam rail/Ko'ko	<i>Rallus owstoni</i>
Intermediate or yellow-billed egret/ -	<i>Egretta intermedia</i>
Island-collared dove/Paluman senesa	<i>Streptopelia bitorquata</i>
Lesser sand plover/ -	<i>Charadrius mongolus</i>
Little egret/ -	<i>Egretta garzetta</i>
Mariana common moorhen/Palattat	<i>Gallinula chloropus guami</i>
Mariana crow/Aga	<i>Corvus kubaryi</i>
Mariana fruit-dove/Totot	<i>Ptilinopus roseicapilla</i>
Mariana swiftlet/Yayaguak	<i>Aerodramus bartschi</i>
Masked booby/ -	<i>Sula dactylatra</i>
Micronesian honeyeater/Egigi	<i>Myzomela rubrata</i>
Micronesian megapode/Sasangat	<i>Megapodius laperouse</i>
Micronesian starling/Sali	<i>Aplonis opaca guami</i>
Osprey/ -	<i>Pandion haliaetus</i>
Pacific reef-heron/ Chuchuko atilong	<i>Egretta sacra</i>
Red-footed booby/Lu'ao talisai	<i>Sula sula</i>
Red-tailed tropicbird/ -	<i>Phaethon rubricauda</i>
Ruddy turnstone/Dulili	<i>Arenaria interpres</i>
Rufous fantail/Chichirika	<i>Rhipidura rufifrons uraniae</i>
Tinian monarch/Chuchurikan	<i>Monarcha takatsukasae</i>
White-tailed tropicbird/ Fakpe or Utag	<i>Phaethon lepturus</i>
White tern/Chunge'	<i>Gygis alba</i>
White-throated grounddove	<i>Gallinula xanthonura</i>
Yellow bittern/Kakkak	<i>Ixobrychus sinensis</i>
Wandering tattler/Dulili	<i>Tringa incana</i>
Whimbrel/Kalalang	<i>Numenius phaeopus</i>
<b>MAMMALS</b>	
Bottlenose dolphin/Toninos	<i>Tursiops truncatus</i>
Feral cat/ -	<i>Felis catus</i>
Feral dog/ -	<i>Canis familiaris</i>
Feral goat/ -	<i>Capra hircus</i>
Little Mariana fruit bat/Fanihi	<i>Pteropus tokudae</i>
Mariana fruit bat/Fanihi	<i>Pteropus mariannus mariannus</i>

<i>English/Chamorro Name</i>	<i>Scientific Name</i>
Musk shrew/Cha'ka akaleha'	<i>Suncus murinus</i>
Pacific sheath-tailed bat/Payesyeyes	<i>Emballonura semicaudata rotensis</i>
Philippine deer/Binadu	<i>Rusa marianna</i>
Spinner dolphin/Toninos	<i>Stenella longirostris</i>
Water buffalo/Karabao	<i>Bubalus bubalis</i>

<i>English/Chamorro Name</i>	<i>Scientific Name</i>
Wild pig/Babuen halumtano	<i>Sus scrofa</i>

Falanruw et al. 1990 (including Stone [1970] and Fosberg [1946]); Raulerson and Rinehart 1991; Vogt and Williams 1990; Lutz and Musick 1997; Rice 1998; Nelson et al. 2004; FishBase 2006; GDAWR 2006; Peterson 2006; Gill et al. 2009; Raulerson, undated; names from comments on DEIS.

## 2.2 TERRESTRIAL BIOLOGICAL RESOURCES

### 2.2.1 Species Profiles

**Common Name:** Coconut crab

**Chamorro Name:** Ayuyu

**Scientific Name:** *Birgus latro*



#### Species Description

The largest terrestrial crab, and the most terrestrial of the decapod crustaceans due to well-developed thoracic lungs. Considered a hermit crab, but only use the shell of other mollusks during very early life stages. Body color varies between shades of light violet to deep purple to brown. Body length can be up to 16 in (400 mm) and weight on the order of 8.8 lbs (4 kg). Males and females are difficult to distinguish from one another, but males are generally larger.<sup>(1)</sup>

#### Threats

Threats include overharvesting and modification of habitat. Highly prized as a food item, as large body size provides substantial amounts of flesh. Commercial interest has led to declining numbers.<sup>(1)</sup>

#### Ecology

Found on land after the juvenile phase. Older juveniles begin the move from water, and adults only visit the ocean to hatch eggs and drink seawater as needed. Forage for fruits, nuts, and seeds, and occasionally eat dead animals.<sup>(2)</sup> Individuals hide and rest during the day and emerge at night to feed. Eggs are hatched in the ocean where the larvae are planktonic. Lifespan is thought to be around 30-40 years.<sup>(1)</sup>

#### Historical and Current Distribution

Found on oceanic islets and atolls and along the coasts of islands in the tropical Indo-Pacific area.<sup>(1)</sup> This species occurs regularly on Guam and CNMI.<sup>(3)</sup>



#### References

- Schiller, C. 1992. Assessment of the status of the coconut crab *Birgus latro* on Niue Island with recommendations regarding an appropriate resource management strategy. South Pacific Aquaculture Development Project. Suva, Fiji. <http://www.fao.org/docrep/field/003/AC281E/AC281E00.HTM>.
- Wilde, J.E., S.M. Linton, and P.G. Greenaway. 2004. Dietary assimilation and digestive strategy of the omnivorous anomuran land crab *Birgus latro* (Coenobitidae). *Journal of Comparative Physiology and Biology* 174:299-308.
- CNMI DFW. 2009. Game Species Profiles: Coconut Crab. [ftp://ftp-fc.sc.gov.usda.gov/GU/features/land\\_animals/CNMI/Coconut\\_Crab.PDF](ftp://ftp-fc.sc.gov.usda.gov/GU/features/land_animals/CNMI/Coconut_Crab.PDF).  
*Photo:* <http://media-2.web.britannica.com/eb-media/58/125658-004-25041ADE.jpg>.  
*Map:* <http://www.fao.org/docrep/field/003/AC281E/AC281E06.jpg>.

**Common Name:** Mariana eight spot butterfly, Forest flicker

**Chamorro Name:** Ababang

**Scientific Name:** *Hypolimnas octucula mariannensis*



### SPECIES DESCRIPTION

A very rare butterfly, endemic to the islands of Guam and Saipan. Body color is primarily orange and black, with differences exhibited by males and females. Males are black with an orange stripe on each wing, and small black dots accompanying the stripe on the hindwings. Females are more orange overall, and display black bands scattered with white dots across the top of both pairs of wings. Males are smaller than females by at least a third in body size.<sup>(1)</sup>

### LISTING STATUS

A federal candidate for Endangered Species Act listing.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

Threats include habitat degradation and removal, competition from introduced butterfly species, disease, predation by ants, and parasitism by wasps.<sup>(1)</sup>

### ECOLOGY

Larvae feed on two native forest herbs that grow only on karst limestone.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically, found on Guam and CNMI but now occurs with any certainty only on Guam.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2008. Species Assessment and Listing Priority Assignment Form: Mariana Eight Spot Butterfly (*Hypolimnas octucula mariannensis*). Portland, OR.
2. USFWS. 2008. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered and threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions. Federal Register 73:75175-75244.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* <http://www.botany.hawaii.edu/basch/uhnpscesu/htms/parkrota/butterfly.htm#top>.

**Common Name:** Mariana wandering butterfly, Marianas rusty  
**Chamorro Name:** Ababang  
**Scientific Name:** *Vagrans egestina*



### SPECIES DESCRIPTION

A very rare butterfly, endemic to the islands of Guam and Rota. Body color is primarily orange and black, with black bordering the wings. A large orange irregular shape extends from the forewings to the hindwings. Females and males are similar in body color and size.<sup>(1)</sup>

### LISTING STATUS

A federal candidate for Endangered Species Act listing.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

Threats include habitat degradation and removal, competition from introduced butterfly species, disease, predation by ants, and parasitism by wasps.<sup>(1)</sup>

### ECOLOGY

Larvae feed on a plant species (*Maytenus thompsonii*) that is endemic to the Mariana Islands. Adults are good fliers and can move considerable distances.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically, found on Guam and CNMI (Rota), but now occurs with any certainty only on Rota.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2008. Species Assessment and Listing Priority Assignment Form: Mariana Wandering Butterfly (*Vagrans egestina*). Portland, OR.
2. USFWS. 2008. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered and threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions. Federal Register 73:75175-75244.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* Schreiner, I.H. and D.M. Nafus. 1997. Butterflies of Micronesia. Agricultural Experiment Station, College of Agriculture and Life Sciences, University of Guam.

**Common Name:** Guam tree snail, Pacific tree snail

**Chamorro Name:** Akaleha'

**Scientific Name:** *Partula radiolata*



### SPECIES DESCRIPTION

Endemic to Guam, this species is a small snail. The shell is slightly oblong with a conical shape, and has five whorls that are slightly convex. Shell color is pale yellow with dark axial rays and brown lines. Body size is approximately 0.8 in (19 mm) in length, with a shell diameter of 0.4 in (10 mm).<sup>(1)</sup>

### LISTING STATUS

A federal candidate for Endangered Species Act listing.<sup>(2)</sup> Listed as critically endangered globally by the IUCN.<sup>(3)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(4)</sup>

### THREATS

Threats include habitat degradation and removal, predation by native and introduced flatworms and other snails, and typhoons negatively impacting the forest.<sup>(1)</sup>

### ECOLOGY

Preferred habitat is cool, shaded forest with high humidity. These snails also prefer subcanopy vegetation. Diet consists of decaying material, and foraging occurs primarily at night. Life history includes hermaphroditism, with reproduction occurring within the first year of life. Lifespan is thought to be up to five years. This species gives birth to live young.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically and currently on Guam.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2008. Species Assessment and Listing Priority Assignment Form: Guam Tree Snail (*Partula radiolata*). Portland, OR.
2. USFWS. 2008. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered and threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions. Federal Register 73:75175-75244.
3. Mollusc Specialist Group. 1996. *Partula radiolata*. In IUCN Red List of Threatened Species. Version 2009.1. www.iucnredlist.org.
4. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* <http://www2.hawaii.edu/~capers/PacEco/wesa/pacSnails.html>.

**Common Name:** Humped tree snail, Mariana Islands tree snail

**Chamorro Name:** Akaleha'

**Scientific Name:** *Partula gibba*



### SPECIES DESCRIPTION

Named for the enlarged last whorl of its shell forming a “hump”. The shell is a conical shape, and has four to four and a half whorls. Primary shell color is chestnut brown to whitish yellow, and occasionally purple. All forms are accented by white or brown lines along the suture between shell whorls.<sup>(1)</sup>

### LISTING STATUS

A federal candidate for Endangered Species Act listing.<sup>(2)</sup> Listed as critically endangered globally by the IUCN.<sup>(3)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(4)</sup>

### THREATS

Threats include habitat degradation and removal, predation by native and introduced flatworms and other snails, and typhoons negatively impacting the forest.<sup>(1)</sup>

### ECOLOGY

Preferred habitat is cool, shaded forest with high humidity. These snails also prefer subcanopy vegetation. Diet consists of decaying material, and foraging occurs primarily at night. Life history includes hermaphroditism, with reproduction occurring within the first year of life. Lifespan is thought to be up to five years. This species gives birth to live young.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically on Guam and numerous islands within the CNMI including Rota, Aguiguan, Tinian, Saipan, Anatahan, Sarigan, Alamagan, and Pagan. At present, found in the areas listed above, with the exception of Tinian and Anatahan, where the species is thought to be extirpated.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2008. Species Assessment and Listing Priority Assignment Form: Humped Tree Snail (*Partula gibba*). Portland, OR.
2. USFWS. 2008. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered and threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions. Federal Register 73:75175-75244.
3. Mollusc Specialist Group. 1996. *Partula gibba*. In IUCN Red List of Threatened Species. Version 2009.1. [www.iucnredlist.org](http://www.iucnredlist.org).
4. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* <http://www2.hawaii.edu/~capers/PacEco/wesa/pacSnails.html>.

**Common Name:** Mariana Islands fragile tree snail

**Chamorro Name:** Akaleha'

**Scientific Name:** *Samoana fragilis*



### SPECIES DESCRIPTION

Named for its thin, semi-transparent shell making the animal appear “fragile”. The shell is a conical shape, and has four whorls that spiral to the right. Primary shell color is buff, and other markings are created by internal organs visible through the shell. Shell size is 0.5-0.6 in (12-16 mm) long and 0.4-0.5 in (10-12 mm) wide.<sup>(1)</sup>

### LISTING STATUS

A federal candidate for Endangered Species Act listing.<sup>(2)</sup> Listed as critically endangered globally by the IUCN.<sup>(3)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(4)</sup>

### THREATS

Threats include habitat degradation and removal, predation by native and introduced flatworms and other snails, and typhoons negatively impacting the forest.<sup>(1)</sup>

### ECOLOGY

Preferred habitat is cool, shaded forest with high humidity. These snails also prefer subcanopy vegetation. Diet consists of decaying material, and foraging occurs primarily at night. Adults are sexually mature before reaching maximum shell size. Eggs are large and tough, and are reabsorbed before the snail gives birth to live young. Lifespan is thought to be up to five years.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically and currently on Guam and the CNMI (Rota).<sup>(1)</sup>

### REFERENCES

1. USFWS. 2008. Species Assessment and Listing Priority Assignment Form: Fragile Tree Snail (*Samoana fragilis*). Portland, OR.
2. USFWS. 2007. Endangered and threatened wildlife and plants; review of native species that are candidates for listing as endangered and threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions. Federal Register 72:69033-69106.
3. Mollusc Specialist Group. 2000. *Samoana fragilis*. In IUCN Red List of Threatened Species. Version 2009.1. www.iucnredlist.org.
4. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* <http://www2.hawaii.edu/~capers/PacEco/wesa/pacSnails.html>.

**Common Name:** Tree fern, Tsatsa

**Chamorro Name:** Chacha

**Scientific Name:** *Cyathea lunulata*



### SPECIES DESCRIPTION

An extremely rare organism, this tree fern is fairly large with a physical appearance typical of tree ferns. This species has a tall trunk (on average 26.2-32.8 ft [8-10 m]) and giant leaves.<sup>(1)</sup>

### LISTING STATUS

*Cyathea lunulata* was considered for listing, but determined to have an “undefined status”.<sup>(2)</sup>

### THREATS

Threats include typhoons and wildland fires which reduce available habitat.

### ECOLOGY

Preferred habitat is on hills, wet ravines and muddy drainage slopes.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically in American Samoa, Fiji, Guam, Federated States of Micronesia, New Caledonia, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga and Vanuatu.<sup>(3)</sup> In Guam, it is found in the southern hills.<sup>(1)</sup>

### REFERENCES

1. Stone, B.C. 1970. The flora of Guam. *Micronesica* 6:1-659.
2. USFWS. 1983. Findings on certain petitions and reviews of status for several species. *Federal Register* 48:6752-6753.
3. UNEP-WCMC. 2009. Species Database. <http://sea.unep-wcmc.org/isdb/Taxonomy/index.cfm?displaylanguage=ENG>. Accessed July 31.

*Photo:* <http://www.tropicalcentre.com/boomvarens/cyathealunulata/cyathealunulata3.jpg>.

**Common Name:** Cycad  
**Chamorro Name:** Fadang  
**Scientific Name:** *Cycas micronesica*



### SPECIES DESCRIPTION

A cycad reaching heights of 26-39 ft (8-12 m). Leaves are deep green, highly glossy, and constructed of tough tissue. Seeds are flattened and long, reaching 2.4 in (60 mm). Pollen cones are orange.<sup>(1)</sup>

### LISTING STATUS

Listed as endangered globally by the IUCN.<sup>(2)</sup>

### THREATS

The most serious threats are introduced pests, including the diapsid scale. This insect voraciously infests and kills the plant. Other threats include the cycad blue butterfly eating the leaves, habitat destruction, direct removal of plants, and reduced numbers of the Marianas fruit bat.<sup>(2, 3)</sup>

### ECOLOGY

Preferred habitat is in closed forest country, coral limestone or coral sand. Use insects to transfer pollen, and in effect make seeds for reproduction.<sup>(1, 3)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically in Micronesia, the Mariana Islands group, and the western Caroline Islands. Current population on Guam is thought to be greater than 20,000, and populations on other Mariana Islands are unknown.<sup>(1)</sup>

### REFERENCES

1. Hill, K.D. *Cycas micronesica*. Australian Systematic Botany 7:554-556.
2. Marler, T., J. Haynes, and A. Lindstrom. 2006. *Cycas micronesica*. In IUCN Red List of Threatened Species. Version 2009.1. [www.iucnredlist.org](http://www.iucnredlist.org).
3. WPTRC. 2007. Western Pacific Tropical Research Center News. University of Guam. <http://www.wptrc.org/article.asp?artID=35>

*Photo:* T. Marler

**Common Name:**

Chamorro Name: Ufa-halomtano

Scientific Name: *Heritiera longipetiolata***SPECIES DESCRIPTION**

A tall tree reaching heights of 40 ft (12 m). The bark is mottled brown in color. Leaves are silvery below and dark green above. Roots are massive and grow above-ground. The fruit is approximately 2-3 in (51-76 mm) long and 2 in (51 mm) wide.<sup>(1)</sup>

**LISTING STATUS**

Listed as vulnerable globally by the IUCN.<sup>(2)</sup>

**THREATS**

The most serious threats are habitat loss and that pollinator-controls are affected by the non-native brown treesnake.<sup>(1)</sup>

**ECOLOGY**

Habitat is moist forest on limestone cliffs and coastal sites with windy conditions.<sup>(2)</sup> Very little is known about the ecology of this species.<sup>(1)</sup>

**HISTORICAL AND CURRENT DISTRIBUTION**

Found historically on Guam, Rota, Saipan and Tinian. Currently trees have been confirmed on Guam, Tinian and Saipan, but not on Rota.<sup>(2)</sup>

**REFERENCES**

1. CPC. 2009. Center for Plant Conservation National Collection Plant Profile: *Heritiera longipetiolata*. [http://www.centerforplantconservation.org/asp/CPC\\_ViewProfile.asp?CPCNum=2219](http://www.centerforplantconservation.org/asp/CPC_ViewProfile.asp?CPCNum=2219).
2. Wiles, G.1998. *Heritiera longipetiolata*. In IUCN Red List of Threatened Species. Version 2009.1. [www.iucnredlist.org](http://www.iucnredlist.org).

Photo: Waimea.

**Common Name:** None

**Chamorro Name:**

**Scientific Name:** *Nesogenes rotensis*



### SPECIES DESCRIPTION

A low-growing herbaceous plant in the verbena family. Leaves are small, lance-shaped and coarsely toothed. Flowers are white and tubular, and plants branch near the base. Plants measure up to 3 ft (1 m) in diameter.<sup>(1)</sup>

### LISTING STATUS

Listed as endangered by the Endangered Species Act.<sup>(1)</sup>

### THREATS

The most serious threats are habitat destruction or alteration, often caused by agriculture or non-native plant introductions.<sup>(1)</sup>

### ECOLOGY

Habitat is exposed, raised limestone flats in non-forested coastal strand habitat. Grows in association with several other species. Known to flower in March, April, May and November. Fruiting has been observed in January, March and November. Above-ground parts are thought to die back annually. Little is known about the life history or ecology.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically and currently on Rota. Only two known populations of 15-20 plants are thought to exist currently.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2007. Recovery Plan for Two Plants from Rota (*Nesogenes rotensis* and *Osmoxylon mariannense*). Portland, OR.

*Photo:* <http://www.parasiticplants.siu.edu/Scrophulariaceae/Hemipar.html>.

**Common Name:**

**Chamorro Name:**

**Scientific Name:** *Osmoxylon mariannense*



### SPECIES DESCRIPTION

A spindly, soft-wooded tree in the ginseng family. Height is up to 33 ft (10 m). Leaves vary in size, but mature leaves are approximately 1 ft (300 mm) long. Leaves are alternate or whorled. Flowers are yellow and fruits are round and maroon in color.<sup>(1)</sup>

### LISTING STATUS

Listed as endangered by the Endangered Species Act.<sup>(1)</sup> Listed as critically endangered globally by the IUCN.<sup>(2)</sup>

### THREATS

The most serious threats are habitat destruction or alteration, often caused by agriculture or non-native plant introductions. A particular threat is the construction of roads through suitable habitat.<sup>(1)</sup>

### ECOLOGY

Habitat is limestone forests on the Sabana (cloudswept plateau located on the western half of Rota). Grows as understory in forests. Known to flower in February, March, and October. Fruiting has been observed November-March. Seeds are thought to be difficult to germinate. Little is known about the life history or ecology.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically and currently on Rota. Only 10 individual plants are known to exist currently.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2007. Recovery Plan for Two Plants from Rota (*Nesogenes rotensis* and *Osmoxylon mariannense*). Portland, OR.
2. Wiles, G.1998. *Osmoxylon mariannense*. In IUCN Red List of Threatened Species. Version 2009.1. [www.iucnredlist.org](http://www.iucnredlist.org).

*Picture:* G. Koob.

**Common Name:** Fire tree

**Chamorro Name:** Hayun lagu (Guam), Tronkon guafi (Rota)

**Scientific Name:** *Serianthes nelsonii*



### SPECIES DESCRIPTION

One of the largest native trees in the Marianas, with reported heights of 118 ft (36 m) and trunk diameters of 6.6 ft (2 m). One or more large roots are exposed above ground, and roots possess nitrogen-fixing nodules. Bark is smooth and light brown in color. Rust-colored “hairs” cover the flowers, seed pods, and newer vegetative growth. Flowers are brush-like and pinkish in color.<sup>(1)</sup>

### LISTING STATUS

Listed as endangered by the Endangered Species Act.<sup>(1)</sup> Listed as critically endangered globally by the IUCN.<sup>(2)</sup>

### THREATS

The most serious threats are insect predation on seeds, seedling mortality caused by introduced mealybugs, and overgrazing by introduced ungulates (e.g. Philippine deer).<sup>(1,2)</sup>

### ECOLOGY

Habitat is primarily mature limestone forests near steep hillsides or cliffs. New leaves are produced year-round, but production is lower during the dry season. Flowers and flower buds may be present during all months. Epiphytic ferns and other plants are known to grow in the crowns. Little is known about the life history or ecology.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically and currently on Rota and Guam. Only one tree exists on Guam and over 100 on Rota.<sup>(1,2)</sup>

### REFERENCES

1. USFWS. 1994. Recovery Plan for *Serianthes nelsonii*. Portland, OR.
2. Wiles, G. 1998. *Serianthes nelsonii*. In IUCN Red List of Threatened Species. Version 2009.1. [www.iucnredlist.org](http://www.iucnredlist.org).

*Photo:* <http://www.uog.edu/herbarium/dynamicdata/Online%20exhibit.asp>.

**Common Name:**  
**Chamorro Name:**  
**Scientific Name:** *Tabernaemontana rotensis*



### SPECIES DESCRIPTION

A medium sized tree growing up to 30 ft (9 m) tall. Flowers are white and mature fruits are bright orange-red colored.<sup>(1, 2)</sup>

### THREATS

The most serious threats are habitat destruction or alteration.<sup>(1)</sup>

### ECOLOGY

Habitat is primarily raised limestone terraces. Little is known about the life history or ecology.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically and currently on Rota and Guam.<sup>(1, 2)</sup>

### REFERENCES

1. Union of Concerned Scientists. 2009. Scientific Integrity.  
[http://www.ucsusa.org/scientific\\_integrity/abuses\\_of\\_science/political-interference-in.html](http://www.ucsusa.org/scientific_integrity/abuses_of_science/political-interference-in.html).
2. Tuquero, J. 2005. Forestry Native Plants of Guam Series: *Tabernaemontana rotensis*.  
[http://www.guamforestry.org/docs/publications/tabernae\\_FINAL.pdf](http://www.guamforestry.org/docs/publications/tabernae_FINAL.pdf).

*Photo:* [http://www.guamforestry.org/docs/publications/tabernae\\_FINAL.pdf](http://www.guamforestry.org/docs/publications/tabernae_FINAL.pdf).

**Common Name:** Brown tree snake

**Chamorro Name:** Culepla

**Scientific Name:** *Boiga irregularis*



### SPECIES DESCRIPTION

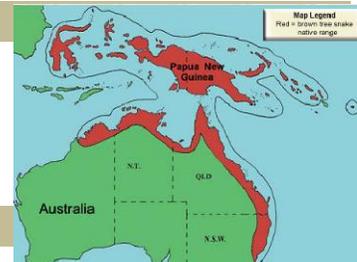
A seemingly harmless snake typically ranging in length from 3-6 ft (0.9-1.8 m). On Guam, such an abundance of prey items are available that individuals are known to grow to lengths of 10 ft (3.0 m). Body type is long and slender, and body color ranges from patterned brown to yellow-green to beige with red markings. On Guam, the coloration is typically brown/olive green with markings. This species does have relatively weak venom, but only the last two teeth are used to inject it, making it rather difficult to use. The venom poses a risk for small children.<sup>(1)</sup>

### ECOLOGY

Preferred habitat is cool, shaded areas during the day for resting. Most feeding and other activities take place at night. Diet includes a large variety of prey organisms, such as small mammals, birds, bird eggs, and other reptiles. On Guam, these snakes are voracious eaters and have been discovered rummaging through garbage. They have also created a major threat to the existence of many native species on Guam, limiting the number of small mammals and the Mariana fruit bat and the extirpation of numerous native birds,. Reproduction is not well documented, but females are thought to produce two clutches of eggs each year.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically in the South Pacific, including coastal Australia, Papua New Guinea, and numerous islands in northwestern Melanesia. This species was unintentionally introduced to Guam in the 1950s.<sup>(1)</sup>



### REFERENCES

1. Fritts, T.H. and D. Leasman-Tanner. 2001. The Brown Treesnake on Guam: How the arrival of one invasive species damaged the ecology, commerce, electrical systems, and human health on Guam: A comprehensive information source. [http://www.fort.usgs.gov/resources/education/bts/bts\\_home.asp](http://www.fort.usgs.gov/resources/education/bts/bts_home.asp).
  2. USGS. 2009. Biology of brown treesnake. <http://www.fort.usgs.gov/resources/education/bts/bioeco/btsnake.asp>.
- Map: <http://www.fort.usgs.gov/resources/education/bts/bioeco/btsnake.asp#>.

**Common Name:** Micronesian gecko

**Chamorro Name:** Guali'ek

**Scientific Name:** *Perochirus ateles*



### SPECIES DESCRIPTION

A relatively large gecko with mottled brown body color. Length is typically 3.5 in (90 mm), and total body length up to 7.5 in (190 mm).<sup>(1)</sup> The tail is flattened with enlarged scales on its ventral surface. Toes are webbed, and it has clearly reduced toes and fingers. Males can be distinguished by possessing two to five enlarged pores in front of their vent.<sup>(2)</sup>

### LISTING STATUS

In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

Threats include predation by the brown treesnake, oceanic gecko, and feral cats.

### ECOLOGY

Preferred habitat is thought to be limestone forests and beach strands, and there is a possible association with large trees.<sup>(2)</sup> Other habitat associations include palm leaf axils, shrubs and bushes, and under loose bark. This species is found in association with other geckos, and therefore does not appear to compete with conspecifics.<sup>(4)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically on the Marianas Islands, including Guam, Rota, Tinian, and Saipan, and Micronesia. Current distributional information is lacking, but this species is thought to be rare throughout its present distribution. This species has not been collected or sighted on Guam in recent years.<sup>(2)</sup>

### REFERENCES

1. Goris, R.C. and N. Maeda. 2004. Guide to the Amphibians and Reptiles of Japan. Krieger Publishing Company. Malabar, Florida. 285 p.
2. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
4. Buden, D. 1998. The reptiles of Kapingamarangi Atoll, Micronesia. Atoll Research Bulletin 453:1-8.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

**Common Name:** Oceanic gecko, Island gecko

**Chamorro Name:** Achiak

**Scientific Name:** *Gehyra oceanic*



### SPECIES DESCRIPTION

One of the largest geckos with a fairly distinct appearance with a rounded tail. Coloration ranges from grey to tan to dark brown, and the dorsal surface is spotted white. Body lengths reach nearly 4 in (100 mm).<sup>(1)</sup> This species has elongated scales behind the tip of the chin. Toes are webbed, and it has clearly reduced toes and fingers. Males can be distinguished by possessing 26-42 enlarged pores in front of their vent.<sup>(3)</sup>

### THREATS

The major threat is predation by the brown treesnake.

### ECOLOGY

Preferred habitat is thought to be along limestone cliffs and in dense clusters of screw pine (*Pandanus*). This species is found in association with other geckos, and therefore does not appear to compete with conspecifics, but is known to prey on other gecko species.<sup>(3)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically on Cocos, Guam, Rota, Tinian, Saipan, Guguan, Alamagan, and Asuncion. This species has not been collected or sighted on Guam in recent years, but was last collected in 1989. It is thought to be common where it does occur.<sup>(3)</sup>

### REFERENCES

1. Vogt, S.R. and L.L. Williams. 2004. Common flora and fauna of the Mariana Islands. Published by Laura L. Williams and Scott R. Vogt. Saipan, CNMI.
2. Reptilesdownunder.com. 2009. Oceanic gecko (*Gehyra oceanic*).  
<http://www.reptilesdownunder.com/arod/reptilia/Squamata/Gekkonidae/Gehyra/oceanica>.
3. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>

**Common Name:** Pacific slender-toed gecko, Rock gecko

**Chamorro Name:** Guali'ek

**Scientific Name:** *Nactus pelagicus*



### SPECIES DESCRIPTION

One of the most distinctly colored geckos in the region, with alternating dark and light markings. The tail is narrow and rounded with small bumps along the surface. Length averages 2.2 in (57 mm).<sup>(1)</sup> This species lacks widened digital pads on the hands and feet, unlike other geckos in the region. No males have been identified.<sup>(2)</sup>

### THREATS

The major threat is predation by the brown treesnake and the musk shrew (*Suncus murinus*).<sup>(2)</sup>

### ECOLOGY

Preferred habitat is thought to be rough rock substrates for foraging, and areas with crevices and hiding places during the day for a resting period. Cryptic coloration allows for blending into the environment. This species is particularly prone to hiding or running from man or other animals it sees as a threat. This is an all-female species.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found historically on Guam, Rota, and Tinian. This species is rare on Guam in recent years, but was common prior to 1945. Thought to possibly occur on other islands, but to go undetected due to its tendency to hide during the day.<sup>(2)</sup>

### REFERENCES

1. Reptilesdownunder.com. 2009. Pelagic gecko (*Gehyra oceanic*).  
<http://www.reptilesdownunder.com/rood/reptilia/Squamata/Gekkonidae/Nactus/pelagicus>.
2. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

**Common Name:** Azure-tailed skink  
**Chamorro Name:** Guali'ek halom tano'  
**Scientific Name:** *Emoia cyanura*



### SPECIES DESCRIPTION

Easily confused with the blue-tailed skink, this species is small with a wide, light colored stripe down the length of its body. The main coloration is dark grey or brown.<sup>(1)</sup>

### LISTING STATUS

In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

The major threats are habitat loss, competition with non-native skinks, and predation by non-native species such as the musk shrew.<sup>(3)</sup>

### ECOLOGY

Preferred habitats appear to be the forest edge rather than interior, and hot and dry open areas near the coast.<sup>(1,4)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Endemic to Guam, this species has only been documented from Cocos Island, although its absence from the main island of Guam is difficult to explain. This species is currently only found on Cocos Island off the southern tip of Guam.<sup>(1)</sup>

### REFERENCES

1. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
3. Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. *Annual Review of Ecological Systems* 29:113-140.
4. McCoy, M. 1980. Reptiles of the Solomon Islands. Wau Ecology Institute Handbook No. 7. Wau, Papua New Guinea.
5. Rodda, G.H, T.H. Fritts, and J.D. Reichel. 1991. The distributional patterns of reptiles and amphibians in the Marianas Islands. *Micronesica* 24:195-210.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

**Common Name:** Moth skink  
**Chamorro Name:** Guali'ek halom tano'  
**Scientific Name:** *Lipinia noctua*



### SPECIES DESCRIPTION

A small skink with a yellow dot on the top of the head which extends down the length of the body as a stripe. Body length is typically 2.2 in (55 mm)<sup>(1)</sup>. The main coloration may be brown or tan with flecks of other colors. The belly color ranges from yellow to orange under the body and legs, and a pale blue-green under the tail and head. This species will break off its toes and/or tail when threatened by a predator.<sup>(2)</sup>

### LISTING STATUS

In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

The major threats are habitat loss, competition with non-native skinks, and predation by non-native species.<sup>(4)</sup>

### ECOLOGY

Preferred habitats appear to be on the ground or in low trees, using tree trunks for shelter. Like many skink species, they are known to hide from predators and become active at night. This species gives birth to live young.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Known to occur in most of the western Pacific, but in the Marianas is only found on Guam. Only several specimens have been sighted on Guam.<sup>(5)</sup>

### REFERENCES

1. Vogt, S.R. and L.L. Williams. 2004. Common flora and fauna of the Mariana Islands. Published by Laura L. Williams and Scott R. Vogt. Saipan, CNMI.
2. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
4. Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. Annual Review of Ecological Systems 29:113-140.
5. Vogt, S.R. and L.L. Williams. 2004. Common Flora and Fauna of the Mariana Islands. Self Published.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

**Common Name:** Slevin's and Mariana skink

**Chamorro Name:** Guali'ek halom tano'

**Scientific Name:** *Emoia slevini*



### SPECIES DESCRIPTION

Large body size with brown or tan body coloration covered with white square blotches. Body length can be up to 2.95 in (75 mm)<sup>(1)</sup>. The sides of the body are often black. Some individuals exhibit bright orange coloration along the rear part of the belly. The smallest and largest individuals resemble other skink species.<sup>(2)</sup>

### LISTING STATUS

In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

The major threats are competition with non-native skinks and predation by non-native species such as the musk shrew or brown treesnake.<sup>(4)</sup>

### ECOLOGY

Preferred habitats appear to be low on tree trunks, old fields or on the forest floor. Like many skink species, they are known to hide from predators and become active at night. Other ecological information for this species is lacking.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Known to occur historically on Cocos Island, Guam, Rota, Tinian, Guguan, Alamagan, Asuncion, and Maug. Although known to occur at one time on the island of Guam, was never very common and was not sighted in recent surveys.<sup>(2)</sup>

### REFERENCES

1. Vogt, S.R. and L.L. Williams. 2004. Common flora and fauna of the Mariana Islands. Published by Laura L. Williams and Scott R. Vogt. Saipan, CNMI.
2. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
4. Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. Annual Review of Ecological Systems 29:113-140.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

**Common Name:** Snake-eyed skink  
**Chamorro Name:** Guali'ek halom tano'  
**Scientific Name:** *Cryptoblepharus poecilopleurus*



### SPECIES DESCRIPTION

Very slender-bodied with small limbs. Body length is up to approximately 1.8 in (45 mm)<sup>(1)</sup>, and shape is slightly flattened dorso-ventrally. Body color is dark brownish-black with three gold colored stripes that run down the body and merge into two down the tail. The stripes are rough along the bottom edges and clearly defined along the top. The name is derived from eyes that appear to be open at all times due to the eyelids being fused over the eyes.<sup>(2)</sup>

### LISTING STATUS

In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

The major threats are competition with non-native skinks and intense predation by the brown treesnake.<sup>(4)</sup>

### ECOLOGY

Preferred habitats appear to be located in loose, sandy soil near coastal strands. This species is highly mobile and known to climb over matter such as rocks or tree trunks. Like many skink species, they are known to hide from predators and become active at night. One known hiding place is under the bark of Australian pine trees.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Known to occur in Cocos Island, Guam, Rota, Aguijan, Tinian, Saipan, Anatahan, Sarigan, Guguan, Alamagan, Agrihan, Asuncion, and Maug. Although known to occur at one time on the island of Guam, it was never very common and has not been sighted since the late 1960s.<sup>(1, 2)</sup>

### REFERENCES

1. Vogt, S.R. and L.L. Williams. 2004. Common flora and fauna of the Mariana Islands. Published by Laura L. Williams and Scott R. Vogt. Saipan, CNMI.
2. USGS. 2009. Extinctions and loss of species from Guam.  
<http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
4. Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. Annual Review of Ecological Systems 29:113-140.

*Photo:* <http://www.fort.usgs.gov/resources/education/bts/impacts/herps.asp>.

**Common Names:** Littoral skink  
**Chamorro Name:** Guali'ek kantun tasi  
**Scientific Name:** *Emoia atrocostata*



### SPECIES DESCRIPTION

Relatively slender shape and small in size, with a typical body length of 3.3 in (85 mm)<sup>(1)</sup>. Bodies appear to be “shiny”, as bronze is the main body color. Scales are large, limbs are long, and eyelids are clear and movable.<sup>(2)</sup>

### THREATS

The major threats are competition with non-native skinks and predation by non-native species such as the musk shrew.<sup>(3, 4)</sup>

### ECOLOGY

Preferred habitats are near the coast in mangroves or other vegetation and on mudflats during low tide. Capable of swimming, but prefers to stay above water most of the time. Uses the ocean to move around and escape predators. Unlike many skink species, tidepool skinks are known to be active during the day, and have been sighted sunning themselves. Diet consists of insects and small crabs captured during low tide.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Known to occur historically from Japan and Taiwan, down the Malayan peninsula to Australia and the Pacific Islands. Endemic to the Marianas, but is not presently common on Guam.<sup>(3)</sup>

### REFERENCES

1. Vogt, S.R. and L.L. Williams. 2004. Common flora and fauna of the Mariana Islands. Published by Laura L. Williams and Scott R. Vogt. Saipan, CNMI.
2. Sungei Buloh Nature Park. 2001. Species fact sheet.  
[http://www.naturia.per.sg/buloh/verts/mangrove\\_skink.htm](http://www.naturia.per.sg/buloh/verts/mangrove_skink.htm).
3. Martin, G. 2006. Saving Saipan's White-eye. *Endangered Species Bulletin* 31(3):8-11.
4. Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. *Annual Review of Ecological Systems* 29:113-140.

*Photo:* [http://www.naturia.per.sg/buloh/verts/mangrove\\_skink.htm](http://www.naturia.per.sg/buloh/verts/mangrove_skink.htm).

**Common Name:** Green sea turtle

**Chamorro Name:** Haggan betde

**Scientific Name:** *Chelonia mydas*



### SPECIES DESCRIPTION

The largest of all the hard-shelled sea turtles at over 3 ft (0.9 m) in length and 300 lbs (136 kg). Their name stems from green-colored fat, which reportedly occurs from their primarily herbivorous diet. The carapace ranges from shades of black, grey, green, brown and yellow, while their ventral surface (plastron) is yellowish-white.<sup>(1)</sup>

### LISTING STATUS

Protected under the Endangered Species Act, with breeding populations in Florida and the Pacific coast of Mexico listed as endangered, and all others listed as threatened.<sup>(2)</sup> Listed as endangered globally by the IUCN.<sup>(3)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(4)</sup>

### THREATS

The major threats are alteration or loss of nesting habitat, decreased quality of sensitive marine habitats such as seagrass, vessel strikes, hunting for commercial or subsistence use, take of eggs, incidental take in fisheries, and diseases such as fibropapillomatosis, which results in internal and/or external tumors.<sup>(2)</sup>

### ECOLOGY

Preferred habitat varies by life stage, and highly mobile. All young are born on the beach, and females return to land to nest. Adults primarily occur in coastal waters, but do make long migrations over deep waters to transit to and from foraging, nesting and mating areas. Limited nesting activity has been confirmed on the beaches of Guam and Tinian from January-March. Adults feed primarily on seagrass and a variety of algae, although some have been documented eating invertebrates. Juveniles are thought to remain in convergence zones for many years, feeding on pelagic prey items such as floating mats of algae (e.g. *Sargassum*) or ctenophores.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Occurs in most oceans, including the western, central and eastern Atlantic, Mediterranean Sea, western, northern and eastern Indian, southeast Asia, and the western, central and eastern Pacific. In the Pacific, occurs around most of the islands, including the Hawaiian Island chain, American Samoa, Guam, and CNMI. The most abundant sea turtle species on Guam.<sup>(2)</sup>

### REFERENCES

1. NMFS. 2009. Office of Protected Resources. Species profile.  
<http://www.nmfs.noaa.gov/pr/species/turtles/green.htm>
2. NMFS and USFWS. 2007. Green sea turtle (*Chelonia mydas*), 5-year review: summary and evaluation. August.
3. Seminoff, J.A. 2004. *Chelonia mydas*. In IUCN Red List of Threatened Species. Version 2009.1.  
[www.iucnredlist.org](http://www.iucnredlist.org).
4. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* [http://www.nmfs.noaa.gov/pr/species/turtles/green\\_photos.htm](http://www.nmfs.noaa.gov/pr/species/turtles/green_photos.htm).

**Common Name:** Hawksbill sea turtle  
**Chamorro Name:** Haggan karai  
**Scientific Name:** *Eretmochelys imbricata*



### SPECIES DESCRIPTION

A smaller sea turtle, measuring less than 3 ft (0.9 m) in length and 150 lbs (68 kg). Their name stems from the shape of the head, which is elongated and narrows to a point. Carapace has tortoiseshell coloring, ranging from dark to gold-brown with streaks of colors including orange, red and black, while their ventral surface (plastron) is a clear yellow color.<sup>(1)</sup>

### LISTING STATUS

Protected under the Endangered Species Act, with all populations listed as endangered.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

The major threats are alteration or loss of nesting habitat, decreased quality of sensitive marine habitats such as seagrass, vessel strikes, hunting for commercial or subsistence use, take of eggs, incidental take in fisheries, and diseases such as fibropapillomatosis, which results in internal and/or external tumors.<sup>(2)</sup>

### ECOLOGY

Preferred habitat is varies by life stage, and this species is highly mobile. All young are born on the beach, and only females return to land to nest. Adults are found in coastal and offshore waters, and are known to make long migrations over deep waters to transit to and from foraging, nesting and mating areas. Limited nesting activity has been confirmed on the beaches of Guam from January-March. Adults forage on the seafloor on corals and other invertebrates. Adults are known to frequent ledges and caves of coral reefs, and to return to the same areas nightly to rest. Juveniles are thought to feed on the surface, but in the Pacific little is known about the juvenile phase.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Occur circumtropically, from 30°N to 30°S in the Atlantic, Pacific, and Indian Oceans and associated water bodies, including the Caribbean Sea and Gulf of Mexico. In the Pacific, occurs around most of the islands, including the Hawaiian Islands, American Samoa, Guam, and CNMI. Although rarely sighted, individuals have been documented nesting on Guam.<sup>(1)</sup>

### REFERENCES

1. NMFS. 2009. Office of Protected Resources. Species profile. <http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill.htm>.
2. NMFS and USFWS. 2007. Hawksbill sea turtle (*Eretmochelys imbricata*), 5-year review: summary and evaluation. August.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* [http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill\\_photos.htm](http://www.nmfs.noaa.gov/pr/species/turtles/hawksbill_photos.htm).

**Common Name:** Guam rail  
**Chamorro Name:** Ko'ko'  
**Scientific Name:** *Rallus owstonii*



### SPECIES DESCRIPTION

A flightless bird with no external sexual dimorphism. Coloration is grey on the upper breast, lower neck and eyebrow, and brown on the head, neck, eye stripe, iris, legs and feet. The stomach is distinctly white-striped. Although outward appearance is indistinguishable between sexes, males weigh on average more than females (8.5 vs 7.5 oz [241 vs. 213 g]).<sup>(1)</sup>

### LISTING STATUS

Listed as endangered under the Endangered Species Act, and an experimental population in Rota listed as "Experimental Population, Non-essential".<sup>(2)</sup> Currently the species is only found in captive breeding facilities in zoos on the U.S. Mainland and at GDAWR on Guam. In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

The major threats are predation by non-native species such as dogs, cats, rats, a monitor lizard, and the brown treesnake, past hunting efforts, and impacts of typhoons to populations with such low numbers.<sup>(2)</sup>

### ECOLOGY

Preferred habitats are numerous, and include all habitats located on Guam except for wetlands. Diet is omnivorous, consisting of snails, skinks, geckos, insects, seeds, and palm leaves. Nesting occurs year-round, with males and females sharing in the nesting duties. Young leave the nest to learn to forage within 24 hours of hatching.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Endemic to Guam, and was once found throughout the island. Currently the species is extirpated from Guam and captive breeding programs were created to prevent extinction of this species.<sup>(1)</sup>

### REFERENCES

1. GDAWR. 2009. Species fact sheet- Guam rail.  
[http://www.guamdawr.org/learningcenter/factsheets/birds/rail\\_html](http://www.guamdawr.org/learningcenter/factsheets/birds/rail_html)
2. USFWS. 2009. Species profile- Guam rail. [http://ecos.fws.gov/docs/life\\_histories/B063.html](http://ecos.fws.gov/docs/life_histories/B063.html)
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* Smithsonian National Zoo.

**Common Name:** Mariana common moorhen

**Chamorro Name:** Pulattat

**Scientific Name:** *Gallinula chloropus guami*



### SPECIES DESCRIPTION

A member of the rail family, although slightly resembles a duck. Coloration is primarily slate black, with white undertail coverts and a white line along the flank. Legs are long and olive green or yellow colored. The most distinguishing feature is a red frontal “shield” on the bill. Toes are lobed, making it possible for walking across plants that are floating on top of the water. Females closely resemble males, but have a smaller frontal shield. Overall body length is typically 14 in (350 mm).<sup>(1,2)</sup>

### LISTING STATUS

Listed as endangered under the Endangered Species Act.<sup>(3)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(4)</sup>

### THREATS

The most serious threat is habitat loss, particularly loss of wetlands. Other threats include encroachment of non-native vegetation and human disturbance.<sup>(1,2)</sup>

### ECOLOGY

Preferred habitats include natural and manmade wetlands, including freshwater lakes, marshes and swamps, and some brackish areas such as tidal channels or mangrove wetlands. Diet is omnivorous, consisting of such items as grass, insects, and insect larvae. Nesting occurs year-round, and nests are created on or near standing water. Young leave the nest to learn to forage soon after hatching.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historic distribution was Guam, Saipan, Tinian and Pagan. Populations on Guam were once large and occurred in many wetland locations on the island. Current distribution includes Guam and the northern Mariana Islands, but numbers are much fewer than in the past.<sup>(1)</sup>

### REFERENCES

1. USFWS. 1992. Recovery plan- Mariana Common Moorhen (*Gallinula chloropus guami*). September.
2. GDAWR. 2009. Species fact sheet- Guam rail.  
[http://www.guamdawr.org/learningcenter/factsheets/birds/moorhen\\_html](http://www.guamdawr.org/learningcenter/factsheets/birds/moorhen_html).
3. USFWS. 2009. Species profile- Mariana common moorhen.  
<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spscode=B062>.
4. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

Photo: S. Vogt.

**Common Name:** Mariana crow  
**Chamorro Name:** Aga  
**Scientific Name:** *Corvus kubaryi*



### SPECIES DESCRIPTION

Known as a small crow. Coloration is various shades of black, from greenish black on the head to bluish black on the wings and tail. The bases of the feathers are light grey to white, which can give a “ragged” appearance. Females and males are difficult to distinguish, but females are smaller.<sup>(1)</sup>

### LISTING STATUS

Listed as endangered under the Endangered Species Act. Critical habitat was designated on Guam and Rota.<sup>(1)</sup> Listed as critically endangered globally by the IUCN.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

The most serious threats include predation by non-native organisms such as the brown treesnake, cats, rats and a monitor lizard. Preventative efforts have included “snake-proofing” trees where nests are located. Other threats include habitat destruction and human disturbances.<sup>(4, 5)</sup>

### ECOLOGY

Preferred habitats include forested areas such as limestone, strand, ravine, and secondary forests, although limestone forests seem to be the most preferred habitat type. Diet is omnivorous, consisting of a large variety of plants and animals such as grasshoppers, skinks, and a variety of foliage and fruits. Foraging occurs primarily in native trees. Nesting is thought to occur year-round, and nests are created over a week-long period in native trees.<sup>(1, 5)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historic distribution was on Guam and Rota, where populations were once large. Current population on Guam limited to only several individuals that originated from a translocation program from Rota.<sup>(5)</sup>

### REFERENCES

1. USFWS. 2009. Species Profile- Mariana Crow.  
<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=B05X>.
2. Birdlife International. 2008. *Corvus kubaryi*. In IUCN Red List of Threatened Species. Version 2009.1.  
[www.iucnredlist.org](http://www.iucnredlist.org).
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
4. GDAWR. 2009. Species fact sheet- Guam rail.  
[http://www.guamdawr.org/learningcenter/factsheets/birds/crow\\_html](http://www.guamdawr.org/learningcenter/factsheets/birds/crow_html).
5. USFWS. 2005. Draft revised recovery plan for the Mariana crow (*Corvus kubaryi*). May.

Photo: C. Kessler.

**Common Name:** Guam Micronesian kingfisher  
**Chamorro Name:** Sihek  
**Scientific Name:** *Todiramphus cinnamomina cinnamomina*



### SPECIES DESCRIPTION

Known as a small to medium-sized kingfisher. Coloration varies by sex, with males exhibiting a cinnamon-brown head, neck and upper parts, a black line that extends around the nape, a greenish-blue lower back, shoulder, and underwings, and a blue tail. Females are very similar to males, with the major differences being a paler upper chest, chin and throat, and underparts and underwing linings white instead of cinnamon-brown. Body length is approximately 8 in (200 mm) and weight is on the order of 1.8-2.7 oz (50-76 g).<sup>(1)</sup>

### LISTING STATUS

Listed as endangered under the Endangered Species Act. Critical habitat was designated on Guam.<sup>(1)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

Primary threats are habitat destruction and modification, predation by non-native species such as cats, rats a monitor lizard and brown tree snakes, and limited population growth in the captive-bred population.<sup>(1)</sup>

### ECOLOGY

Preferred habitats include a wide variety of forested areas such as limestone, strand, ravine, agricultural and secondary forests, edge habitats, and forest openings. Diet is carnivorous, consisting of a large variety of animals such as skinks, insects, and hermit crabs. Foraging occurs primarily in native trees. Nesting takes place in cavities created in standing dead trees.<sup>(1,3)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historic distribution was on Guam only. Populations were once large, but have been extirpated from the wild. Captive individuals number just over 100.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2008. Revised Recovery Plan for the Sihek or Guam Micronesian kingfisher (*Halcyon cinnamomina cinnamomina*). October.
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
3. GDAWR. 2009. Species fact sheet- Guam rail.  
[http://www.guamdawr.org/learningcenter/factsheets/birds/crow\\_html](http://www.guamdawr.org/learningcenter/factsheets/birds/crow_html).

Photo: K. Ilio.

**Common Name:** Micronesian megapode  
**Chamorro Name:** Sasangat  
**Scientific Name:** *Megapodius laperouse laperouse*



### SPECIES DESCRIPTION

A medium-sized megapode measuring approximately 1.2 ft (38 cm) in body length, with an average body weight of 0.8 lbs (350 g). The primary colors of plumage are dark grey-brown to black, with an ash grey head. The crest is dark grey, wings are short and rounded, and the bill, legs and feet are yellow. Feathers on the head are patchy or absent, which reveals red skin.<sup>(1)</sup>

### LISTING STATUS

Listed as endangered under the Endangered Species Act.<sup>(1)</sup>

### THREATS

Most serious threats include modification or destruction of habitat, past hunting practices, predation by native and non-native species including to a greater extent the brown treesnake, and competition with non-native birds.<sup>(1)</sup>

### ECOLOGY

Preferred habitat is limestone forest, although they are known to use native or non-native secondary forest adjacent to limestone forest. Have been described as “birds of the forest floor”. Known to “burrow nest” in areas warmed by the sun or to place nests among rotting roots of trees or logs, and in patches of rotting sword grass. External heat is thought to be necessary for egg incubation. Male-female pairs are monogamous for a prolonged period, and both sexes are territorial. Feeding habits are omnivorous, and food items include seeds, ants and other insects, and various plant matter.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically found on all of the Mariana Islands, this species was extirpated from all of the large islands, and presently occurs only on small uninhabited islands in the Northern Mariana Island chain. Was thought to have been extirpated on Guam prior to the introduction of the brown treesnake.<sup>(1)</sup>

### REFERENCES

1. USFWS. 1998. Recovery plan for the Micronesian megapode (*Megapodius laperouse laperouse*). Portland, OR.

*Photo:* S. Vogt.

**Common Name:** Mariana swiftlet  
**Chamorro Name:** Yayaguak  
**Scientific Name:** *Aerodramus vanikorensis bartschi*



### SPECIES DESCRIPTION

A small bird with primarily dark grey-brown body color. Plumage is paler on the ventral surface. A dark line crosses through the eye, and the tail is squared off. Males and females are similar in external appearance. 1.2 ft (38 cm) in body length, with an average body weight of 0.8 lbs (350 g).<sup>(1)</sup>

### LISTING STATUS

Listed as endangered under the Endangered Species Act.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

Most serious threats include modification or destruction of habitat and disturbance of caves from guano mining or other human interference. Predation by non-native species may have also played a role in this species' decline.<sup>(1)</sup>

### ECOLOGY

Preferred habitat is in limestone caves with entrances measuring approximately 6.6 ft (2 m) high. Known to nest and roost inside these caves, and to leave the caves to eat and drink. Foraging occurs over many habitat types, although preferred foraging habitat appears to be ridge crests and open grassy areas. Diet includes various insects. This species uses echolocation for navigation, further enabling successful living inside caves.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically found on the Mariana Islands of Guam, Rota, Aguijan, Tinian, and Saipan. Individuals from Guam were transplanted to Hawaii in the 1960s. This species presently occurs on Guam and the Saipan, but is considered extirpated from Tinian and Rota.<sup>(1, 3)</sup>

### REFERENCES

1. USFWS. 1992. Recovery plan for the Mariana Islands population of Vanikoro swiftlet (*Aerodramus vanikorensis bartschi*). USFWS. Portland, OR. September.
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
3. Cruz, J.B., S.R. Kremer, G. Martin, L.L. Williams, and V.A. Camacho. 2008. Relative abundance and distribution of Mariana swiftlets (Aves: Apodidae) in the Northern Mariana Islands. *Pacific Science* 62:233-246.

*Photo:* <http://www.mesc.usgs.gov/resources/education/bts/impacts/birds.asp>

**Common Name:** Micronesian starling  
**Chamorro Name:** Sali  
**Scientific Name:** *Aplonis opaca guami*



### SPECIES DESCRIPTION

A small bird with primarily glossy black body color in adults. Tail is short and they eye is distinctly yellow. Body length is approximately 9 in (230 mm).<sup>(1)</sup>

### LISTING STATUS

Federal status is undefined.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

Most serious threats include modification or destruction of habitat and predation by the brown treesnake and other non-native species.<sup>(1)</sup>

### ECOLOGY

Known to use all habitat types, although most common in forested areas. Foraging occurs over many habitat types, but preferred foraging habitat appears to be ridge crests and open grassy areas. Diet is omnivorous and includes various insects, seeds and fruits. Known as a cavity nester, and both parents incubate the eggs. Cavity nesting may be the main reason this species has not been extirpated like other bird species in the region.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically found on the Mariana Islands of Guam, Tinian, and Saipan. This species presently occurs on Guam and Cocos Island, and hopes are high for future populations.<sup>(1)</sup>

### REFERENCES

1. Grim, G. 2009. Guam birds: Micronesian starling. ©2008 Guampedia™.  
<http://www.guampedia.com/category/122-guam-s-birds/entry/468-guam-birds-micronesian-starling2>.
2. USFWS. 1983. Endangered and threatened wildlife and plants; findings on certain petitions and reviews of status for several species. Federal Register 48:6752-6753.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* <http://www.mesc.usgs.gov/resources/education/bts/impacts/birds.asp>.

**Common Name:** Tinian monarch  
**Chamorro Name:** Chichurikan Tinian  
**Scientific Name:** *Monarcha takatsukasae*



### SPECIES DESCRIPTION

A small forest songbird with body length of approximately 6 in (150 mm). Coloration includes light underparts, olive-brown upperparts, dark brown wings and tail, and white bars on the wings, and a white rump and undertail coverts.<sup>(1)</sup>

### LISTING STATUS

Federal status is “delisted- taxon recovered”. Was listed as endangered in 1970, but was later reassessed and deemed recovered in 2004.<sup>(1)</sup> Listed as critically vulnerable globally by the IUCN.<sup>(2)</sup>

### THREATS

Most serious threats included modification or disturbance of native forests. The brown treesnake is not known to have invaded Tinian, thus this non-native predator is not currently a threat.<sup>(1)</sup>

### ECOLOGY

Known to use many forest habitat types including native limestone, secondary vegetation, a variety of native tree forests, and some non-native tree forests. Foraging and nesting occurs in several habitat types, but preferred habitat appears to be native limestone forest.<sup>(1)</sup> Diet includes foraging for various insects. Nests are small and cup-shaped, nesting appears to occur year-round, and both parents tend to the nest.<sup>(3)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically found on the Mariana Islands of Tinian, Saipan and possibly Aguiguan. This species presently occurs in relatively large numbers on Tinian.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2005. Post de-listing monitoring for the Tinian monarch (*Monarcha takatsukasae*). Endangered Species Division. Pacific Islands Fish and Wildlife Office. Honolulu, HI. May.
2. Birdlife International. 2008. *Monarcha takatsukasae*. In IUCN Red List of Threatened Species. Version 2009.1. [www.iucnredlist.org](http://www.iucnredlist.org).
3. CNMI DFW. 2009. Tinian monarch fact sheet.  
<http://www.dfw.gov.mp/Downloads/Species%20Handouts/TIMO.pdf>

*Photo:* S. Vogt.

**Common Name:** Mariana fruit bat  
**Chamorro Name:** Fanihi  
**Scientific Name:** *Pteropus mariannus mariannus*



### SPECIES DESCRIPTION

A medium sized fruit bat, with body weight in the range of 0.9-1.2 lbs (408-544 g). Body color is black or brown on the ventral surface with some grey hair, and the neck is bright golden brown. The head is brown or dark brown. Appearance has led to a nickname of “flying foxes”. Males are slightly larger than females.<sup>(1)</sup>

### LISTING STATUS

Protected under the Endangered Species Act, listed as threatened. Critical habitat is designated in Guam.<sup>(2)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(3)</sup>

### THREATS

Most serious threats include modification or disturbance of habitat, predation by the brown treesnake on juveniles, the use of pesticides and fertilizers, and poaching.<sup>(1)</sup>

### ECOLOGY

Known to use native forest habitat types including native limestone, and also are known to frequent coconut groves. Highly colonial, colonies of several to over 800 individuals exist. The typical social behavior is grouping into harems, with one male grouping with 2-15 females, although some males remain “bachelors”.<sup>(1)</sup> Diet includes foraging for various fruits, flowers and other plant materials. Reproduction appears to occur year-round, and breeding typically occurs after 18 months of age.<sup>(2)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Historically and currently found on the CNMI and Guam.<sup>(1)</sup>

### REFERENCES

1. USFWS. 2005. Mariana fruit bat 5-year review. Federal Register 70:1180-1210.
2. USFWS. 2009. Species profile for Mariana fruit bat.  
<http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?sPCODE=A07X>.
3. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* USFWS.

## 2.3 MARINE BIOLOGICAL RESOURCES

### 2.3.1 Species Lists

Refer to the Species List in Section 2.1 for a listing of common and scientific names of marine species discussed in the EIS.

### 2.3.2 Non-Native Species – Marine and Estuarine

#### 1. *Aedes albopictus* (insect)

The Asian tiger mosquito is spread via the international tire trade (due to the rainwater retained in the tires when stored outside). In order to control its spread such trading routes must be highlighted for the introduction of sterilization or quarantine measures. The tiger mosquito is associated with the transmission of many human diseases, including the viruses: Dengue, West Nile and Japanese Encephalitis.

**Common Names:** Asian tiger mosquito, forest day mosquito, mosquito tigre, moustique tigre, tiger mosquito, tigmücke, zanzare tigre

**Synonyms:** *Culex albopictus* Skuse, 1895, *Culex albopictus* Skuse, 1895

#### 2. *Chthamalus proteus* (crustacean)

*Chthamalus proteus* is a barnacle native to the Caribbean and western Atlantic. It was introduced to the Pacific in 1970s and first reported in Hawaii in 1995. It is now one of the most abundant organism in the upper intertidal harbors and bays throughout the Hawaiian Islands. *C. proteus* are likely to be spread by ship hull fouling and larvae by ballast water.

**Common Names:** Atlantic barnacle, Caribbean barnacle

#### 3. *Oreochromis mossambicus* (fish)

*Oreochromis mossambicus* has spread worldwide through introductions for aquaculture. Established populations of *Oreochromis mossambicus* in the wild are as a result of intentional release or escapes from fish farms. *Oreochromis mossambicus* is omnivorous and feeds on almost anything, from algae to insects.

**Common Names:** blou kurper, common tilapia, fai chau chak ue, Java tilapia, kawasuzume, kurper bream, malea, mojarra, mosambik-maulbrüter, Mozambikskaya tilapiya, Mozambique cichlid, Mozambique mouth-breeder, Mozambique mouthbrooder, Mozambique tilapia, mphende, mujair, nkobue, tilapia, tilapia del Mozambique, tilapia du Mozambique, tilapia mossambica, tilapia mozámbrica, trey tilapia khmao, weißkehlbarsch, wu-kuo yu

**Synonyms:** *Chromis dumerilii* Steindachner, 1864, *Chromis natalensis* Weber, 1897, *Chromis vorax* Pfeffer, 1893, *Sarotherodon mossambicus* (Peters, 1852), *Tilapia arnoldi* Gilchrist & Thompson, 1917, *Tilapia mossambica* (Peters, 1852)

#### 4. *Tilapia zillii* (fish)

In its native, tropical range, *Tilapia zillii* is important as a food fish as well as for aquaculture. *Tilapia zillii* provided 70% of Egypt's fish production, however outside its native range, this freshwater fish has the ability to establish itself even in highly salinated waters, only being held back by a low tolerance to cold water. Often introduced for use in aquatic weed control, *Tilapia zillii* can alter native benthic communities through the elimination of macrophytes and exhibits aggressive behaviour towards other fish species.

**Common Names:** akpadi sila, akpasila, amnun matzui, a-sannoh, bere, biare, biering, bugu, bulti, cichlid, didee, disiwulen, Engege, Epia, Erihere, falga, garagaza, gargaza, gba gba ferah, gbatchekede, guring, ifunu, isiswe, karfasa, karwa, ka-yainkain, kido, kokine, kpro ibre, kuda, loroto, mango fish, mojarra, mojarrita, mpupa, ngege, ngipie, ngorkei, njabb, obrouyou, pastenague boulee, perege, punavatsatilapia, redbelly tilapia, sato, sili, silla, sohn, striped tilapia, tegr-pere, tha thompo, tihil, tilapia, tome, tsokungi, ukuobu, waas, waas gnoul, wesafun, Zilles Buntbarsch, zilli's cichlid, zill's tilapia

**Synonyms:** *Acerina zilli* (Gervais, 1848), *Chromis andreae* (Gunther, 1864), *Chromis coeruleomaculatus* (Rochebrune, 1880), *Chromis faidherbii* (Rochebrune, 1880), *Chromis melanopleura* (Dumeril, 1861), *Chromis menzalensis* (Mitchell, 1895), *Chromis tristrami* (Gunther, 1860), *Chromis zillii* (Gervais, 1848), *Coptodon zillii* (Gervais, 1848), *Coptodus zillii* (Gervais, 1848), *Glyphisidon zillii* (Gervais, 1848),

*Haligenes tristrami* (Gunther, 1860), *Sarotherodon zillei* (Gervais, 1848), *Sarotherodon zillii* (Gervais, 1848), *Tilapia faidherbi* (Rochebrune, 1880), *Tilapia melanopleura* (Dumeril, 1861), *Tilapia menzalensis* (Mitchell, 1895), *Tilapia multiradiata* (Holly, 1928), *Tilapia shariensis* (Fowler, 1949), *Tilapia sparrmani multiradiata* (Holly, 1928), *Tilapia tristrami* (Gunther, 1860)

## 2. *Bubulcus ibis* (bird)

*Bubulcus ibis* are small stocky herons that associate with grazing species of mammals both domestic and wild. They have strong migratory instincts and disperse thousands of miles in the direction of their choosing. They are, for the most part, self-introduced. They have been observed 'feeding on' native species of birds. They are known to host ticks that could introduce and spread certain tick-borne diseases.

**Common Names:** Afrikaanse koereiger, buff-backed heron, cattle egret, depulgabuey, elephant bird, garcilla bueyera, garcilla garrapatera, garcita de ganado, garrapatera, garrapatosa, garza de ganado, garza de vaquèra, garza ganadera, héron garde-boeufs, hippopotomus egret, Indian cattle egret, rhinoceros egret

**Synonyms:** *Ardea ibis*, *Ardeola ibis*, *Bulbucus ibis*

## 4. *Clarias batrachus* (fish)

*Clarias batrachus* a voracious predator native to southeastern Asia has been introduced into many places for fish farming. Walking catfish, as it is commonly known (named for their ability to move over land), is an opportunistic feeder and can go for months without food. During a drought large numbers of walking catfish may congregate in isolated pools and consume other species. They are known to have invaded aquaculture farms, entering ponds where they prey on fish stocks. *C. batrachus* has been described as a benthic, nocturnal, tactile omnivore that consumes detritus and opportunistically forages on large aquatic insects, tadpoles, and fish.

**Common Names:** alimudan, cá trê trắng, cá trèn trang, clarias catfish, climbing perch, freshwater catfish, Froschwels, hito, htong batukan, ikan keling, ikan lele, Ito, kawatsi, keli, klarievyi som, koi, konnamonni, kug-ga, leleh, magur, mah-gur, mangri, marpoo, masarai, mungri, nga-khoo, pa douk, paltat, pantat, pla duk, pla duk dam, pla duk dan, pla duk nam jued, pla duk nam juend, Thai hito, Thailand catfish, trey andaing roueng, trey andeng, walking catfish, wanderwels, Yerivahlay

**Synonyms:** *Clarias assamensis* Day, 1877, *Clarias jagur* (Hamilton, 1822), *Clarias magur* (Hamilton, 1822), *Clarias punctatus* Valenciennes, 1840, *Macropteronotus jagur* Hamilton, 1822, *Macropteronotus magur* Hamilton, 1822, *Silurus batrachus* Linnaeus, 1758

## 5. *Cyprinus carpio* (fish)

The common carp (*Cyprinus carpio*) has been introduced as a food and ornamental fish into temperate freshwaters throughout the world. It is considered a pest because of its abundance and its tendency to reduce water clarity and destroy and uproot the aquatic vegetation used as habitat by a variety of species.

**Common Names:** carp, carpa, carpat, carpe, carpe, carpe commune, carpeau, carpo, cerpyn, ciortan, ciortanica, ciortocrap, ciuciulean, common carp, crap, crapcean, cyprinos, escarpo, Europäischer Karpfen, European carp, German carp, grass carp, grivadi, ikan mas, kapoor-e-maamoli, kapor, kapr obecny, karp, karp, karp, karp, karp dziki a. sazan, karpa, karpar, karpe, Karpe, karpén, karper, karpfen, karpion, karppi, kerpaille, koi, koi carp, korop, krap, krapí, kyprinos, læderkarpe, lauk mas, leather carp, leekoh, lei ue, mas massan, mirror carp, olocari, pa nai, pba ni, pla nai, ponty, punjabe gad, rata pethiya, saran, Saran, sarmão, sazan, sazan baligi, scale carp, sharan, skælkarpe, soneri masha, spejlkarpe, sulari, suloi, tikure, trey carp samahn, trey kap, ulucari, weißfische, wild carp, wildkarpfen

**Synonyms:** *Carpio carpio gibbosus* (Kessler, 1856), *Carpio flavipinna* Valenciennes, 1842, *Carpio vulgaris* Rapp, 1854, *Cyprinus acuminatus* Heckel & Kner, 1858, *Cyprinus acuminatus* Richardson, 1846, *Cyprinus angulatus* Heckel, 1843, *Cyprinus atrovirens* Richardson, 1846, *Cyprinus bithynicus* Richardson, 1857, *Cyprinus carpio anatolicus* Hanks, 1924, *Cyprinus carpio aralensis* Spiczakow, 1935, *Cyprinus carpio brevicirri* Misik, 1958, *Cyprinus carpio elongatus* Walecki, 1863, *Cyprinus carpio fluviatilis* Pravdin, 1945, *Cyprinus carpio longicirri* Misik, 1958, *Cyprinus carpio monstrosus* Walecki, 1863, *Cyprinus carpio oblongus* Antipa, 1909, *Cyprinus chinensis* Basilewsky, 1855, *Cyprinus conirostris* Temminck & Schlegel, 1846, *Cyprinus festetitsii* Bonaparte, 1845, *Cyprinus flamm* Richardson, 1846,

*Cyprinus fossicola* Richardson, 1846, *Cyprinus haematopterus* Temminck & Schlegel, 1846, *Cyprinus melanotus* Temminck & Schlegel, 1846, *Cyprinus nordmannii* Valenciennes, 1842, *Cyprinus sculponeatus* Richardson, 1846, *Cyprinus thermalis* Heckel, 1843, *Cyprinus tossicole* Elera, 1895, *Cyprinus vittatus* Valenciennes, 1842

#### 6. *Eichhornia crassipes* (aquatic plant)

Originally from South America, *Eichhornia crassipes* is one of the worst aquatic weeds in the world. Its beautiful, large purple and violet flowers make it a popular ornamental plant for ponds. It is now found in more than 50 countries on five continents. Water hyacinth is a very fast growing plant, with populations known to double in as little as 12 days. Infestations of this weed block waterways, limiting boat traffic, swimming and fishing. Water hyacinth also prevents sunlight and oxygen from reaching the water column and submerged plants. Its shading and crowding of native aquatic plants dramatically reduces biological diversity in aquatic ecosystems.

**Common Names:** aguapé, bekabe kairanga, bung el ralm, bung el ralm, floating water hyacinth, jacinthe d'eau, jacinto de agua, jacinto-aquatico, jal khumbe, jal kumbhi, lechuguilla, lila de agua, lirio acuatico, mbekambekairanga, riri vai, wasserhyazinthe, water hyacinth, water orchid, wota haisin

**Synonyms:** *Eichhornia speciosa* Kunth, *Heteranthera formosa*, *Piaropus crassipes* (Mart.) Raf., *Piaropus mesomelas*, *Pontederia crassipes* Mart. (basonym)

#### 7. *Gambusia affinis* (fish)

*Gambusia affinis* is a small fish native to the fresh waters of the eastern and southern United States. It has become a pest in many waterways around the world following initial introductions early last century as a biological control of mosquito. In general, it is considered to be no more effective than native predators of mosquitoes. The highly predatory mosquito fish eats the eggs of economically desirable fish and preys on and endangers rare indigenous fish and invertebrate species. Mosquito fish are difficult to eliminate once established, so the best way to reduce their effects is to control their further spread. One of the main avenues of spread is continued, intentional release by mosquito-control agencies. *G. affinis* is closely related to the eastern mosquitofish (*G. holbrooki*), which was formerly classed as a sub-species. Their appearance, behaviour and impacts are almost identical, and they can therefore be treated the same when it comes to management techniques. Records of *G. affinis* in Australia actually refer to *G. holbrooki*.

**Common Names:** Barkaleci, Dai to ue, Gambusia, Gambusie, Gambusino, Gambuzia, Gambuzia pospolita, Gambuzija, guayacon mosquito, Isdang canal, Kadayashi, Koboldkärpfling, Kounouopsaro, Live-bearing tooth-carp, Mosquito fish, Obyknoennaya gambuziya, pez mosquito, San hang ue, Silberkärpfling, tes, Texaskärpfling, Topminnow, western mosquitofish, Western mosquitofish

**Synonyms:** *Fundulus inurus* (Jordan & Gilbert, 1882), *Gambusia affinis affinis* (Baird & Girard, 1853), *Gambusia affinis* (Baird & Girard, 1853), *Gambusia gracilis* Girard, 1859, *Gambusia humilis* Günther, 1866, *Gambusia patruelis* (Baird & Girard, 1853), *Haplochilus melanops* Cope, 1870, *Heterandria affinis* Baird & Girard, 1853, *Heterandria patruelis* Baird & Girard, 1853, *Zygonectes brachypterus* Cope, 1880, *Zygonectes gracilis* (Girard, 1859), *Zygonectes inurus* Jordan & Gilbert, 1882, *Zygonectes patruelis* (Baird & Girard, 1853)

#### 8. *Hydrilla verticillata* (aquatic plant)

*Hydrilla verticillata* is a submerged freshwater aquatic weed that can tolerate salinity up to 7%. It crowds out native plants by shading them and out-competing them for nutrients. The dense masses it forms interfere with recreational activities such as boating, fishing and swimming. *Hydrilla verticillata* can be dispersed by river flow, waterfowl and recreational activities and is sold as an aquarium plant.

**Common Names:** Florida elodea, hydrilla, oxygen weed, water thyme, water weed

#### 10. *Paspalum vaginatum* (grass)

*Paspalum vaginatum* (seashore paspalum) is a North American grass which now has a pantropical distribution. It has been widely used for landscaping and revegetation and is a common turf grass on golf

courses. *Paspalum vaginatum* has naturalised in coastal salt marshes where it changes the composition of vegetation and in some cases dominates, impacting on fauna communities and estuarine hydrology.

**Common Names:** biscuit grass, capim-paturá, grama de costa, grama de mar, grama-rasteira, gramilla, gramilla blanca, gramón, herbe rampante, jointgrass, kambutu, knot grass, knottweed, matie, mauku ta'atai, mauku vairakau, mosie kalalahi, mutia, mutie, salt grass, saltwater couch, saltwater paspalum, seashore crowngrass, seashore grass, seashore paspalum, silt grass, swamp couch, water couch, wujoojkatejukjuk

**Synonyms:** *Digitaria foliosa* Lag. , *Digitaria tristachya* (Leconte) Schult., *Digitaria vaginata* (Sw.) Magnier, *Panicum littorale* (R.Br.) Kuntze, *Panicum vaginatum* (Sw.) Gren. & Godr., *Paspalum gayanum* E. Desv., *Paspalum boryanum* C. Presl, *Paspalum distichum* L. subsp. *vaginatum* (Sw.) Maire, *Paspalum distichum* L. var. *littorale* (R.Br.) F.M.Bailey, *Paspalum distichum* L. var. *nanum* (Döll) Stapf, *Paspalum distichum* L. var. *tristachyum* (Leconte) A.W.Wood, *Paspalum distichum* L. var. *vaginatum* (Sw.) Griseb., *Paspalum foliosum* (Lag.) Kunth, *Paspalum gayanum* E.Desv., *Paspalum inflatum* A. Rich., *Paspalum jaguaense* León, *Paspalum kleineanum* J.Presl, *Paspalum littorale* R. Br., *Paspalum reimarioides* Chapm., *Paspalum squamatum* Steud., *Paspalum tristachyum* Leconte, *Paspalum vaginatum* Sw. subsp. *nanum* (Döll) Loxton, *Paspalum vaginatum* Sw. var. *littorale* (R.Br.) Trin. ex Büse, *Paspalum vaginatum* Sw. var. *nanum* Döll, *Paspalum vaginatum* Sw. var. *reimarioides* Chapm., *Rottboellia uniflora* A. Cunn., *Sanguinaria vaginata* (Sw.) Bubani

#### 11. *Poecilia reticulata* (fish)

*Poecilia reticulata* is a small benthopelagic fish native to Brazil, Guyana, Venezuela and the Caribbean Islands. It is a popular aquarium species and is also commonly used in genetics research. In the past *Poecilia reticulata* was widely introduced for mosquito control but there have been rare to non-existing measurable effects on mosquito populations. It can occupy a wide range of aquatic habitats and is a threat to native cyprinids and killifishes. It is a carrier of exotic parasites and is believed to play a role in the decline of several threatened and endangered species.

**Common Names:** guppie , guppil , guppy, hung dzoek ue, ikan seribu, lareza tripikaloshe, lebistes, lepistes, Mexicano, miljoenvis, miljoonakala, million fish, millionenfisch, millions, poisson million, queue de voile, rainbow fish, sarapintado, Sardinita, Wilder Riesenguppy, zivorodka duhová

**Synonyms:** *Acanthophaeus guppil* (Günther, 1866), *Acanthophaeus reticulatus* (Peters, 1859), *Girardinus guppil* Günther, 1866, *Girardinus reticulatus* (Peters, 1859), *Haridichthys reticulatus* (Peters, 1859), *Heterandria guppyi* (Günther, 1866), *Lebistes poecilioides* De Filippi, 1861, *Lebistes poecilioides* De Filippi, 1861, *Lebistes reticulatus* (Peters, 1859), *Poecilia reticulatus* Peters, 1859, *Poecilioides reticulatus* (Peters, 1859)

### 2.3.3 BioStatus Not Specified

#### 1. *Acanthaster planci* (sea star)

Coral gardens from Micronesia and Polynesia provide valuable marine resources for local communities and environments for native marine species such as marine fish. In coral ecosystems already affected by coral bleaching, excess tourism and natural events such as storms and El Nino, the effects of the invasive coral-feeding starfish (*Acanthaster planci*) on native coral communities contributes to an already dire state of affairs. *Acanthaster planci* significantly threatens the viability of these fragile coral ecosystems, and damage to coral gardens by the starfish has been quite extensive in some reef systems.

**Common Names:** coral-eating starfish, coral-feeding starfish, crown of thorns starfish, crown-of-thorns starfish, giant thorny starfish, rusech

#### 2. *Acanthophora spicifera* (algae)

*Acanthophora spicifera* is a red algae which is found in most tropical or subtropical seas of the world. Its plastic morphology allows it to adapt to a variety of environmental conditions, and hence it can invade a diverse range of habitats. It is an alien invasive species in Hawaii. It is amongst the most successful alien algal species in this region, where it may modify native communities and compete with native algae.

**Common Names:** bulung tombong bideng, culot, red alga, spiny alga, spiny seaweed

**Synonyms:** *Acanthophora antillarum* Montagne ex Kützing 1865, *Acanthophora intermedia* Crouan, *Acanthophora orientalis* J. Agardh 1863, *Acanthophora orientalis* var. *wightii* (J. Agardh) Sonder 1879, *Acanthophora spicifera* f. *orientalis* (J. Agardh) Weber-van Bosse 1923, *Acanthophora spicifera* f. *wightii* (J. Agardh) Weber-van Bosse 1923, *Acanthophora spicifera* var. *orientalis* (J. Agardh) Zaneveld 1956, *Acanthophora thierryi* f. *gracilis* P.L. Crouan & H.M. Crouan 1878, *Acanthophora thierryi* J.V. Lamouroux 1813, *Acanthophora wightii* J. Agardh 1863, *Chondria acanthophorara* C. Agardh 1822, *Fucus acanthophorus* J.V. Lamouroux 1805, *Fucus spicifer* M. Vahl 1802

### 3. *Gracilaria salicornia* (algae)

The introduction of alien algae in the marine environment is a potential threat to the health and stability of near-shore ecosystems. *Gracilaria salicornia* threatens coral reefs and native benthic communities in Hawaii and elsewhere. It may reduce marine species diversity and alter marine community structure.

**Common Names:** canot-canot, red algae

**Synonyms:** *Corallopsis cacalia* Agardh, *Corallopsis concrescens* Reinbold, *Corallopsis dichotoma* Ruprecht, *Corallopsis opuntia* Agardh, *Corallopsis salicornia* Greville, *Corallopsis salicornia* var. *minor* Sonder, *Gracilaria cacalia* Dawson, *Sphaerococcus salicornia* Agardh

## 2.3.4 Apra Harbor Habitat Summary

### 2.3.4.1 Glass Breakwater

The reefs on the northwestern tip of the Glass Breakwater as well as the tip of Orote Peninsula and the northwestern sides of Orote Island are greatly influenced by the open ocean. Many species such as the sponge *Xestospongia exigua* were found only in this part of Apra Harbor yet are common outside the harbor. The Glass Breakwater is a steep, man-made shore composed of limestone boulders down to a depth of 16 to 22 feet (ft) (5-7 meters [m]). These boulders generally sit on solid reef pavement and extend outwards forming a shelf for approximately 320 to 640 ft (100-200 m). Once this shelf reaches a depth of around 32 to 48 ft (10-15 m), it slopes downwards to below 96 ft (30 m). Although the shelf and slope areas contain a diverse coral community typical of Outer Apra Harbor, the limestone boulders, which comprise the breakwater contain few corals with only *Porites rus* being common (Paulay et al. 1997).

The Glass Breakwater currently supports coral reef and colonized hardbottom along its inner edge at 10 to 50% live coverage, with an isolated area of high live coral coverage (50 to 100%). There is a coral area of special significance approximately 1,110 ft (338 m) to the east of this high coral coverage area (NOAA 2005).

### 2.3.4.2 Orote Point to the Entrance of Inner Apra Harbor

Paulay et al. (1997) surveyed biodiversity in the harbor and divided the southern portion of Apra Harbor into two zones: (1) Orote Point to San Luis Point and (2) San Luis Point to the entrance of Inner Apra Harbor. The area between Orote Point and San Luis Point contains a diverse assemblage of corals, sponges, soft corals, others invertebrates, and nearshore growth macroalgae. The area contains mostly fringing reefs and fringing reef slopes, which become more oceanic in character moving westward from San Luis Point towards Orote Point. *Porites rus* is the dominant hard coral on the slopes of the fringing reef. Although diverse, all species encountered in the survey are found on other reefs of Guam.

Other studies have also shown coral high cover in this area. Several studies looked at the area between Orote Point and Gab Gab Beach including east and west of Kilo Wharf (Navy 1999, Smith 2004, NOAA 2005). The areas surrounding Kilo Wharf contain nearly 100% live coral cover consisting mainly of *Porites rus* (>90% of the live cover) with other hard corals including *Porites lichen*, *Porites lobata*, *Platygyra pini*, *Leptoseris* spp., *Lobophyllia corymbosa*, and *Acanthastrea echinata* (Smith 2004).

Corals also occur on reefs off the tip of the Orote Peninsula along with turf algae. Paulay et al. (2000) described two macrohabitats in this area, the Orote Point reef slope and the Orote Point fringing reef. The Orote Point reef slope is found at the tip of the peninsula and extends from Spanish Steps to the western end of Orote Island. This area supports higher coral and fish diversity and higher fish biomass compared to other locations of Guam. The submerged terrace slopes gently down to a water depth of 39 to 49 ft (12 to 15 m) followed by a steep forereef slope that plunges down to 50+ ft (30+ m). The area of reef that is contiguous with Apra Harbor is populated by the biota commonly found in the harbor (e.g., *Porites rus* and sponges). The *Porites rus* dominated reef is limited to an area immediately adjacent to the harbor. Along the northern end of the Orote Peninsula west from the harbor, the coral community is more diverse. Paulay et al. (2001) observed 19 species of corals in this area and noted that this was the most diverse coral area of the coastline from Spanish Steps to Agat Bay. The diversity of fishes was also greatest in this area with 53 species observed. In addition, found in this diverse area was a possible new *Acropora* species record for Guam. The coral species appeared to be similar to *Acropora nasuta* (Paulay et al. 2000).

The Orote Point fringing reef is located between the tip of the Orote Peninsula and Orote Island. It has a reef front facing the southern coast of the Orote Peninsula and another facing the southwestern end of Apra Harbor intrinsically providing a connection between the north and south sides of the peninsula. Karstic shores flank the other two sides of the reef with a “strong gradient in species composition” on this reef. The middle and northern parts of the reef supported coral species that are typical of Apra Harbor (including *Porites rus*, *Porites cylindrica*, *Pavona venosa*, *Pavona divaricata*, *Psammocora contigua*, and *Porites damicornis*). Corals found on the southern end of the reef were characteristic of an oceanic, reef front community with corals including *A. digitifera*, *Galaxea fascicularis*, and an *Acropora* species similar to *Acropora valida* (Paulay et al. 2000).

The area between San Luis Point and Inner Apra Harbor is quite different. Much of this area has been altered or created by landfill during original construction of the inner harbor. The shallow areas contain a narrow shelf down to approximately 6 to 10 ft (2 to 3 m) in depth followed by a steeper slope characterized primarily by *Halimeda* (a slow growing calcareous macroalgae) attached to the sandy substrate. Some coral patches appear below 32 or 64 ft (10 or 20 m), again dominated by *Porites rus*, a coral common throughout the harbor (Paulay et al. 1997).

#### 2.3.4.3 Entrance Channel

The Inner Apra Harbor entrance channel is between Polaris Point and the former SRF and allows entrance by vessels with a maximum draft of 31 ft (10 m). The eastern side of the entrance channel extends for approximately 1,760 ft (550 m) while the western side extends approximately 1,280 ft (400 m). The width of the entrance channel is 960 ft (300 m). Corals are also found on sheet piles in the entrance channel of the Inner Apra Harbor and the outer reaches of the Inner Apra Harbor (Navy 2005). The entrance channel contains patches of coral cover estimated at over 60%; however these sites generally are very limited in size, at less than 1,024 ft<sup>2</sup> (100 m<sup>2</sup>). The coral community in the entrance channel, although present, is much less diverse, less complex, supports smaller individual coral colonies and has a much lower rugosity (creases, wrinkles and ridges) factor than coral communities in Outer Apra Harbor. *Porites rus* and *Porites cylindrica* are the most common and abundant corals in both the inner and outer harbor, however at least 10 additional coral families are present in the outer harbor (COMNAV Marianas 2006c) (see Volume 4, Figure 11.1-10).

The coral community in the entrance channel is routinely subjected to the types of stresses typical of a harbor entrance: abrasion from ships’ hulls, breakage from towing cables, severe propeller wash from tug

boats and large vessels, etc. Relative to Outer Apra Harbor, the Inner Apra Harbor benthic community is highly disturbed and degraded. Furthermore, the coral community within the entrance channel is not biologically significant, based upon the size of the individual coral colonies, the growth forms of the colonies, or the species present. Other benthic invertebrates are well represented in Outer Apra Harbor and very poorly represented within the Inner Apra Harbor or the entrance channel (Smith 2007).

The coral community in the entrance channel was found to be composed of four major species. The most abundant species was *Porites rus*. This coral species is ubiquitous throughout Apra Harbor, and occurs in a variety of growth forms, particularly overlapping plates and columnar spires. *Porites rus* occurred in the regions of sparse coral as isolated colonies. The abundance of *Porites rus* in the entrance channel indicates that this species is particularly well adapted to thrive in areas of low light and continuous suspended sediment deposition. Many of the colonies observed in the entrance channel had layers of silt deposited on their upper surfaces. Another dominant coral in the entrance channel was the branching species *Porites cylindrica*. This species occurs as mats of interconnected branches that extend uninterrupted for several square meters in some areas of the entrance channel floor. Third in abundance is the finely branched coral *Pocillopora damicornis*, which forms low, flat plates near the sediment surface. The relevance of these observations is that the coral species assemblages found in the entrance channel are similar to those documented in the CVN dredge area (Smith 2007).

#### 2.3.4.4 Shoals and Mounds

West of Sasa Bay in the center of the Outer Harbor is the most notable reef ecosystem in the harbor, including Western Shoals, Jade Shoals and Middle Shoals (see Volume 4, Figure 11.1-10). These shoals are patch reefs that rise from the harbor floor to approximately 32 ft (10 m) from the water surface, portions of which are exposed during extreme low tides (COMNAV Marianas 2007b). These shoals have coral reefs and colonized hardbottom with 50 to 100% live coral coverage and are identified as coral areas of special significance (NOAA 2005) (Figure 11.1-10). Each is dominated by the coral species *P. rus* and contain several other coral species including *Porites lobata*, *Porites annae*, *Porites cylindrica*, *Millepora dichotoma*, *Acropora formosa*, and *Pocillopora damicornis* (Paulay et al. 1997). These shoal areas do not contain an abundance of algal species (Navy 2009a). There are also several mounds located in deeper parts of the lagoon, including Sponge Mound, which come to within 64 ft (20 m) of the surface. Paulay et al. (1997) surveyed Sponge Mound (located west-southwest of Western Shoals) and found that the top of the mound supported the highest diversity of sponges in all of Guam with several sponge species known only from this site (COMNAV Marianas 2007b) (see Volume 4, Figure 11.1-10).

The most pristine coral reef ecosystem in Apra Harbor is located along the southern shoreline of the harbor and includes Gab Gab reef (COMNAV 2007b). These reefs are popular sites for fishing, snorkeling, and scuba diving. These fringing reef ecosystems have 50 to 100% live coral coverage and extend from San Luis Point west to Orote Point and have two areas identified as coral areas of special significance (NOAA 2005). Deeper coral reef ecosystems are present in Apra Harbor's deeper waters (greater than 40 ft [12 m]) (Paulay et al. 1997).

## 2.4 SPECIES PROFILES

**Common Name:** Common bottlenose dolphin

**Chamorro Name:** Toninos

**Scientific Name:** *Tursiops truncatus*



### SPECIES DESCRIPTION

One of the most widely known marine mammals in the world. Body type is strong and robust, with a head that ends in a “beak” which is short and thick compared to other dolphins. Body is counter-shaded, with light grey on the bottom and variations ranging from dark grey to black along the back. Body size ranges from 6-12 ft (1.8-3.6 m) in length and 300-1,400 lbs (136-636 kg) in weight. Males and females are difficult to distinguish from one another, but males are generally larger.<sup>(1)</sup>

### LISTING STATUS

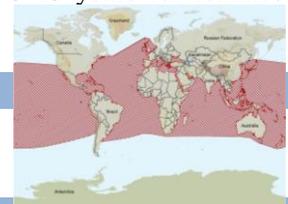
Protected under the Marine Mammal Protection Act (MMPA).<sup>(1)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

Most serious threat is incidental catch from fishing gear which use nets or long lines with large hooks pose a threat to dolphins. Although outlawed in most of the world, legal harvest still takes place in Japan and Taiwan, and illegal harvest occurs in other locations. General ocean water quality issues such as pollution also pose a risk for the health and safety of bottlenose dolphins.<sup>(1)</sup>

### ECOLOGY

Found offshore over deep waters and nearshore in coastal environments such as estuarine, bay, or river mouth. Uses echolocation to locate and capture prey, and prey items vary based on habitat but are generally various fish species. Typically found in small groups, but can form large groups with 100s of individuals, and are often associated with other marine mammal species (e.g., pilot whales). Calves are born after a 1-year gestation period, and sexual maturity is reached between 9-14 years for males and 5-13 years for females. Lifespan is thought to be around 50 years.<sup>(1)</sup>



### HISTORICAL AND CURRENT DISTRIBUTION

Found worldwide, generally ranging from latitudes 45°N to 45°S. This species occurs regularly in Guam and surrounding areas.

### REFERENCES

1. NMFS. 2009. Bottlenose Dolphin (*Tursiops truncatus*).  
<http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/bottlenosedolphin.htm>.
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.  
*Photo:* [http://www.nmfs.noaa.gov/pr/images/cetaceans/bottlenose\\_calf\\_swfsc.jpg](http://www.nmfs.noaa.gov/pr/images/cetaceans/bottlenose_calf_swfsc.jpg).  
*Map:* <http://www.iucnredlist.org/details/22563/0/rangemap>.

**Common Name:** Spinner dolphin

**Chamorro Name:** Toninos

**Scientific Name:** *Stenella longirostris*



### SPECIES DESCRIPTION

Well known and named for their impressive capability to leap out of the water and spin through the air. Body is small, with a head that ends in a “beak” which is long and narrow compared to other dolphins. Body is counter-shaded, with light grey on the bottom and variegated medium grey to dark grey along the back. Colors vary based on geographic location, with a “white belly” form inhabiting the Pacific Islands. Body size ranges from 4-7 ft (1.2-2.1 m) in length and 100-165 lbs (45-75 kg) in weight.<sup>(1)</sup>

### LISTING STATUS

Protected under the Marine Mammal Protection Act (MMPA). The Eastern stock in the Eastern Tropical Pacific Ocean is MMPA depleted.<sup>(1)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

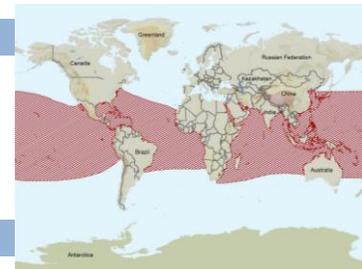
Most serious threat is incidental entanglement in fishing gear; an unexplained association between large yellowfin tuna and spinner dolphins exists. Interactions with tourists disturb this species, as ideally they should be resting during the day to prepare for night time hunting.<sup>(3)</sup> General ocean water quality issues such as pollution also pose a risk for the health and safety of spinner dolphins.<sup>(1)</sup>

### ECOLOGY

Generally found offshore over deep waters, but some populations are coastal, spending time in small groups resting in bays and other protected areas. At night, large groups feed on prey items such as fish and squid found in deep waters. Often associated with other marine mammal species such as spotted dolphins and humpback whales.<sup>(3)</sup> Calves are born after a 10.5-month gestation period. Lifespan is thought to be around 20 years.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found in all tropical and subtropical oceans. In Guam and surrounding areas, the “white belly” form is found along the coastline during the day and in deeper waters at night.<sup>(1)</sup>



### REFERENCES

1. NMFS. 2009. Spinner Dolphin.  
[http://www.fpir.noaa.gov/PRD/prd\\_spinner.html](http://www.fpir.noaa.gov/PRD/prd_spinner.html).
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
3. NMFS. 2009. Spinner Dolphin (*Stenella longirostris longirostris*).  
<http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spinnerdolphin.htm>.

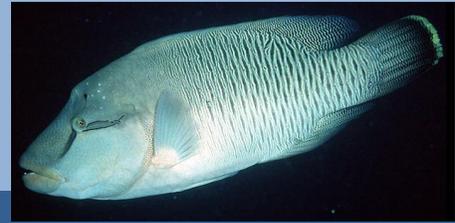
*Photo:* [http://www.fpir.noaa.gov/PRD/prd\\_spinner.html](http://www.fpir.noaa.gov/PRD/prd_spinner.html).

*Map:* <http://www.iucnredlist.org/details/20733/0/rangemap>.

**Common Name:** Humphead and Napoleon wrasse, Napoleonfish

**Chamorro Name:** Tanguisson

**Scientific Name:** *Cheilinus undulatus*



### SPECIES DESCRIPTION

The largest living wrasse, with male body length reaching over 6 ft (1.8 m) and weight over 420 lbs (190 kg); females are smaller, with a maximum length of 3 ft (0.9 m). Body coloration varies greatly by life stage. Small juveniles are black and white; larger juveniles are a pale green with black spots running vertically on each scale; adults vary between shades of olive green and blue-green with a very distinct bar running vertically on each scale.<sup>(1)</sup>

### LISTING STATUS

NOAA/NMFS Species of Concern and listed as Endangered by the International Union for Conservation of Nature (IUCN).<sup>(1)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

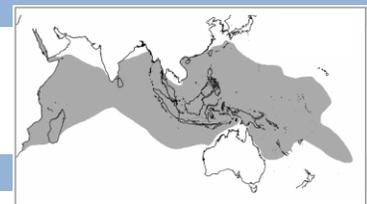
Most serious threats are from commercial and subsistence fishing, including directed live capture for food, spearfishing with scuba gear, and fishing techniques that employ destructive methods such as the use of dynamite or cyanide. This species is particularly vulnerable to overfishing due to slow growth, long lifespan, late age of sexual maturity, and a preference for immature fish by consumers. General habitat loss and degradation are also major threats to this species.<sup>(1)</sup>

### ECOLOGY

Generally found nearshore over reef and channel slopes and lagoon reefs, in depths ranging from 3-330 ft (1-100 m). Adults are found in open areas around reefs, while juveniles seek refuge from predators within dense coral or seagrass growth. Seasonal Spawning takes place in aggregations and is dependent on the tidal cycle. Adults are found in male-female pairs or in small groups of less than seven individuals. This species is a protogynous hermaphrodite, with select females changing to males. Sexual maturity occurs between 5 and 7 years of age, and lifespan is at least 30 years.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found throughout most of the tropical Pacific in low densities. In Guam and surrounding areas, this species was once very common and economically important, but today is rarely sighted.<sup>(1)</sup>



### REFERENCES

1. NOAA. 2007. Species of Concern, Humphead wrasse, *Cheilinus undulatus*. [http://www.fpir.noaa.gov/Library/PRD/SOC/Revised%20fact%20sheets\\_2007/humpheadwrasse\\_detailed.pdf](http://www.fpir.noaa.gov/Library/PRD/SOC/Revised%20fact%20sheets_2007/humpheadwrasse_detailed.pdf). November.
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.

*Photo:* Randall, J.E. 1990. Reef and Shore Fishes of the Hawaiian Islands. Seagrant College Program, University of Hawaii.

*Map:* <http://www.iucnredlist.org/details/4592/0>.

**Common Name:** Bumphead parrotfish  
**Chamorro Name:** Atuhong  
**Scientific Name:** *Bolbometopon muricatum*



### SPECIES DESCRIPTION

The largest living parrotfish, with body length reaching 4 ft (1.2 m) and weight 100 lbs (45 kg). Body coloration varies greatly by life stage, but not by sex. Juveniles are greenish to brown with 5 rows of white spots running vertically; adults are dull green with a pale yellow to pink head. The adult form has a large bulbous forehead with “buck” teeth.

### LISTING STATUS

NOAA/NMFS Candidate species.<sup>(1)</sup> In Guam, considered a Species of Greatest Conservation Need.<sup>(2)</sup>

### THREATS

Most serious threats are from commercial and subsistence fishing, including spearfishing or netting at night when fish are sleeping, the use of “bangsticks”, and fishing techniques that employ destructive methods such as the use of dynamite or cyanide. This species is particularly vulnerable to overfishing because of slow growth, long lifespan, and late age of sexual maturity. General habitat loss and degradation are also major threats to this species.<sup>(1)</sup>

### ECOLOGY

Generally found nearshore over barrier and fringing coral reefs, in depths ranging from 3-100 ft (1-100 m). Adults are found in outer lagoons and seaward reefs, while juveniles seek refuge from predators within dense seagrass growth inside lagoons. Spawning takes place in aggregations and is dependent on the lunar cycle. Adults are typically found in small groups, but are also known to form large groups of over 75 individuals. Adults sleep in groups in caves or sandy lagoon flats. Lifespan is up to 40 years.<sup>(1)</sup>

### HISTORICAL AND CURRENT DISTRIBUTION

Found in the Indo-Pacific from the Red Sea and East Africa to Samoa and the Line Islands, north to the Yaeyama and Wake islands, and south to the Great Barrier Reef and New Caledonia. In Guam, this species has been described as “virtually extinct”.<sup>(3)</sup>



### REFERENCES

1. NOAA. 2010. Endangered and Threatened Wildlife; Notice of 90-Day Finding on a Petition to List the Bumphead Parrotfish as Threatened or Endangered Under the Endangered Act (ESA). Federal Register 75(63):16713-16716. 10 February 2010.
2. GDAWR. 2006. Guam Comprehensive Wildlife Conservation Strategy (GCWCS). Department of Agriculture, Guam. 7 November.
3. Chan, T., Y. Sadovy, and T.J. Donaldson. 2007. *Bolbometopon muricatum*. In IUCN Red List of Threatened Species. Version 2009.1. www.iucnredlist.org.

*Photo:* Randall, J.E. 1990. Reef and Shore Fishes of the Hawaiian Islands. Seagrant College Program, University of Hawaii.

*Map:* <http://www.fishbase.org/Summary/SpeciesSummary.php?id=5537>.

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## CHAPTER 3.

# HAZARDOUS MATERIALS AND WASTE RESOURCES

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### 3.1 INTRODUCTION

A total of 123 potentially contaminated sites were identified in the four geographic regions of the Guam study area as having a potential for contamination. The presence of contamination could have an effect on the proposed roadway, bridge, and intersection improvements. Information on each of these sites is described herein. The site descriptions herein are based on interpretations from best available information.

### 3.2 NORTH

#### *Site No. 1 – Utility Building*

Site No. 1 is a utility building owned by the Guam Power Authority (GPA). It is located in the northeast quadrant of Route 3 and Route 28. This facility was included in the Environmental Data Resources (EDR) report prepared for this project. This facility was included in the Comprehensive Environmental Response, Compensation, and Liability Act Information Systems (CERCLIS) list. It is not on the National Priorities List (NPL); Site Reassessment Start Needed. A Site Assessment was completed in September 1991; the priority level was deferred to the Resource Conservation and Recovery Act (RCRA) (Subtitle C). During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. One 1,020-gallon aboveground storage tank (AST) containing diesel fuel was observed onsite. The AST, located approximately 135 feet (ft) (41 meters [m]) east of the Route 3 edge of pavement, was in an approximately 2.0-ft (0.6-m) high concrete secondary containment. A danger sign posted nearby read, “CHLORINE GAS.”

The extent of potential contamination is unknown; however, there was no visual evidence of remediation on-site.

#### *Site No. 2 – Jet Fuel Transmission Line*

A jet fuel transmission line is located from the Route 3/28 intersection, leading to Andersen Air Force Base (AFB). A review of aerial photography shows the jet fuel transmission line crossing Route 3 south of the Route 3/3A intersection where the transmission line enters Andersen AFB. It is unknown if there are incidents of contamination associated with this jet fuel line; however, there was no visual evidence of soil or groundwater assessment or remediation at the area where the transmission line crosses under Route 3, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 3 – Shell Gasoline Station*

This facility is a retail gasoline station. It is located on the east side of Route 3. This site was not identified in the EDR reports, and it does not have a record of documented contamination. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 4 – Tires Shop*

This facility is a small tire shop. It is located on the east side of Route 3, north of Site No. 82 – Shell Gasoline Station. During a site visit in March 2009, many abandoned vehicles and miscellaneous car parts were found on-site. The small service area is covered by a tin roof. It is unknown if there are incidents of

contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 5 – Utility Building*

This utility building with a generator and petroleum fuel AST owned and operated by GPA, is located on the east side of Route 3 (north of Site No. 83). A 1,020-gallon AST containing diesel fuel is located on-site; the facility is secured with a chain-link fence. The utility building is adjacent to the underground jet fuel transmission line (Site No. 81) approximately 100 ft (30 m) to the east of Route 3. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 6 – Utility Building*

This facility is a utility building owned and operated by GPA. This utility building is located on the east side of Route 3, adjacent to the north of Ritidian Mart. During a site visit in March 2009, a portable generator can be seen through windows and is located inside the building. Underground storage tanks (USTs) or ASTs containing fuel for the generator were not found. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 7 – Power Substation*

This facility is a power substation owned and operated by GPA. It is located at the northwest quadrant of the Route 3/3A intersection. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 8 – Potts Junction Tank Farm*

This site is located within the military installation adjacent to the south side of Route 9, just north of Chalan Kareta and south of the Route 9/3 intersection. This site is included in the Installation Restoration Program (IRP) Sites – Andersen AFB Main Base plans provided by the Department of Defense (DoD); however, the associated information regarding this site is not included in the reports reviewed for this project. According to the DoD IRP Sites – Andersen AFB Main Base plans, this site is included in the IRP. A review of aerial photography shows heavy vegetation cover and possible remnants of concrete pads. During a site visit in March 2009, this site was inaccessible and could not be seen from the roadway. It is unknown if there are incidents of contamination associated with this site; however, no groundwater monitoring wells were found on- or off-site.

#### *Site No. 9 – Site 7/Landfill 9*

This site is a landfill located in the North Field of Andersen AFB, adjacent to the north of Route 9. According to the DoD IRP Sites – Andersen AFB Main Base plans, this site is included in the IRP. This site encompasses approximately 8 acres (ac) (3 hectares [ha]). This landfill operated from 1949 to 1955. Contaminants of concern include sanitary trash, construction debris, and concrete. A Record of Decision (ROD) was issued in 2007. During a site visit in March 2009, this property was inaccessible from the roadway. The site is covered with sparse vegetation. A review of aerial photography shows minor earthwork and construction activities. The current environmental disposition of the site is unknown.

*Site No. 10 – Site 6/Landfill 8*

This site is a landfill. It is located between the North and Northwest Fields of Andersen AFB, north of Route 9. According to the DoD IRP Sites – Andersen AFB Main Base plans, this 14-ac (6-ha) site is included in the IRP. This site operated from 1946 to 1949. Contaminants of concern include asphalt and asphaltic wastes. A ROD was issued in 2007, and some remedial action is planned for fiscal year 2010. During a site visit in March 2009, this property was inaccessible or visible from the roadway. The current environmental disposition of the site is unknown.

*Site No. 11 – Site 35/Waste Pile 1*

This waste pile is located in the North Field of Andersen AFB, north of Route 9. According to the DoD IRP Sites – Andersen AFB Main Base plans, this site is included in the IRP. This site encompasses approximately 3 ac (1-ha). Contaminants of concern include asphalt tar. A ROD was issued, and some cleanup is scheduled for 2009. During a site visit in March 2009, this property was inaccessible or visible from the roadway. The current environmental disposition of the site is unknown.

*Site No. 12 – Site 2/Landfill 2*

This site is a landfill located in the North Field at Andersen AFB, on the north side of Route 9. According to the DoD IRP Sites – Andersen AFB Main Base plans, this site is included in the IRP. This site is part of Landfills 2, 4, and 5; it encompasses approximately 40 ac (16 ha). Landfill operations were from 1947 to 1975, with a small portion of the landfill being used up through 1982. Contaminants of concern include waste chemicals; pesticides; petroleum, oil, and lubricants (POL); solvents; ferrous metal; sanitary trash; construction debris; and unexploded ordnance (UXO). A remedial investigation/feasibility study is ongoing for Landfill 2. During a site visit in March 2009, this property was inaccessible or visible from the roadway. The current environmental disposition of the site is unknown.

*Site No. 13 – Site 4/Landfill 6*

This site is a landfill. It is located in the North Field of Andersen AFB, adjacent to the north side of Route 9. According to the DoD IRP Sites – Andersen AFB Main Base plans, this site is included in the IRP. This site encompasses approximately 2 ac (1 ha) and operated from 1953 to 1954. Contaminants of concern include sanitary trash. A ROD was issued in 2007. During a site visit in March 2009, this property was inaccessible from the roadway. The site was covered with sparse vegetation. There was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site. The current environmental disposition of the site is unknown.

**3.3 CENTRAL***Site No. 14 – Former Mobil Gasoline Station*

This facility was formerly a retail gasoline station. It is located in the northwest quadrant of the Route 1/11 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, a former tank pad was found approximately 60 ft (18 m) south of the Route 1 edge of pavement. This area was overgrown with grass. The closest fuel dispenser is located approximately 45 ft (14 m) south of the Route 1 edge of pavement. Five groundwater monitoring wells were found on-site. The closest monitoring well is located approximately 25 ft (8 m) south of the Route 1 edge of pavement. It could not be determined if the groundwater monitoring wells were active. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 15 – Asan Pump Station, Building 590*

This facility is a pump station and a storage yard. It is located on the south side of Route 1, across from Asan National Park. The pump station is owned by the U.S. Navy. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. The storage yard appeared to be privately owned; however, this could not be confirmed. Two tanker trailers and one large AST (contents and size unknown) were located in the storage yard. The condition of the AST could not be determined. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 16 – Automobile Repair Shop*

This facility is an automobile repair shop. It is located on the south side of Route 1, east of the Ason River. During a site visit in March 2009, containers that likely hold oil were observed inside the repair shop. Several cars were observed in various stages of repair in the storage yard. An exhaust pipe was also observed, indicating that painting may be conducted on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 17 – Automobile Repair Shop/Former Gasoline Station*

This facility is an automobile repair shop; it was formerly a retail gasoline station. It is located in the northeast quadrant of the Route 1/Ninio Perdido Road intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, a site representative was not available. A former tank pad location could not be determined. The former fuel dispenser is located approximately 50 ft (15 m) south of the Route 1 edge of pavement. Several old cars were stored on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 18 – 3-D Automobile Repair Shop*

This facility is an automobile repair shop. It is located at the Route 1/Ninio Perdido Road intersection. During a site visit in March 2009, a site representative was not available. Moderate staining was observed on the shop floor. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 19 – Wastewater Facility (GWA CD4)*

This facility is a Guam Waterworks Authority (GWA) wastewater facility pump station. It is located on the north side of Route 1, west of the Route 1/Senator Juan Tim Toves Drive intersection. During a site visit in March 2009, no treatment ponds or lagoons were observed. One approximately 1,000-gallon AST containing diesel fuel is located approximately 20 ft (6 m) north of the Route 1 edge of pavement. The AST was in an approximately 1.0-ft (0.8-m) high concrete-enclosed secondary containment. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 20 – Metal Scrap Yard*

This facility is a metal scrap yard. It is located on the north side of Route 1, west of the Route 1/6 intersection. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. No hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 21 – Tires Direct*

This facility is a tire repair shop. It is located in the southwest quadrant of the Route 1/6 intersection. During a site visit in March 2009, this facility appeared to be a former retail gasoline station. What appeared to be a former tank pad was located approximately 10 ft (3 m) from the Route 1 edge of pavement. No hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 22 – Mobil Gasoline Station*

This facility is a retail gasoline station. It is located in the southeast quadrant of the Route 1/6 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, reworked pavement was found around the USTs. The USTs and fuel islands are located approximately 30 ft (9 m) east of the Route 6 edge of pavement and 55 ft (17 m) south of the Route 1 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 23 – Jackson's Car Wash*

This facility is a car wash located on the south side of Route 1 east of the Route 1/6 intersection. During a site visit in March 2009, the facility appeared to be abandoned. The site appears to be a former gasoline station, based on the existing building and former fuel island and canopy. Areas of the pavement appeared to be reworked, and three possible groundwater monitoring wells were found on-site, adjacent to the Route 1 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of remediation.

*Site No. 24 – King's Auto Parts, Pat's Tinting, and Six Seven One Mufflers and Auto Services*

This property includes an automobile repair shop, a tinting shop, and a muffler service shop. It is located on the north side of Route 1, east of the Route 1/6 intersection. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 25 – Mobil Gasoline Station*

This facility is a retail gasoline station with an automatic car wash. It is located on the south side of Route 1, west of the Route 1/4 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009,

reworked pavement was found around the USTs. The USTs are located approximately 100 ft (30 m) south of the Route 1 edge of pavement. Used oil was contained in 55-gallon steel drums. Disposal practices, however, are unknown. Groundwater monitoring wells were found on-site; the closest well is located approximately 50 ft (15 m) south of the Route 1 edge of pavement. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 26 – Circle K/76 Gasoline Station*

This facility is a retail gasoline station with a convenience store and a car wash. It is on the north side of Route 1, west of the Route 1/4 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, reworked pavement was found around the USTs. The USTs are located approximately 35 ft (11 m) north of the Route 1 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 27 – Napa Auto Parts*

This facility is a tire shop. It is located on the south side of Route 1, west of the Route 1/4 intersection. During a site visit in March 2009, a dumped storage tank was found behind the building. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 28 – Six Seven One Motorsports/Scoot da Vill*

This facility is one building with two businesses: a motorsports store specializing in lift kids, bumpers, wells, and accessories; and a retail scooter store. It is located in the southwest quadrant of the Route 8/1 intersection. During a site visit in March 2009, small oil containers and what appeared to be a tool washing station were found in the motorsports shop. The pavement in the shop had minor staining. No other drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 29 – Shell Gasoline Station*

This facility is a retail gasoline station with a convenience store and a hand car wash. This site is located on the south side of Route 1, approximately 2,000 ft (610 m) east of the Route 1/8 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. An approximately 25-ft (8-m) by 40-ft (12-m) tank pad is located approximately 135 ft (41 m) south of the Route 1 edge of pavement. The closest fuel dispenser is approximately 40 ft (12 m) south of the Route 1 edge of pavement. Water from the hand car wash appeared to drain into a storm drain system. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 30 – East Agara Mobil Gasoline Station, Building #620*

This facility is a retail gasoline station, an automatic car wash, and a two-story office building. It is located south of Route 1, approximately 0.5-mile (0.8-km) west of the Route 1/30 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of

documented contamination. During a site visit in March 2009, water from the automatic car wash appeared to drain into a storm drain system. The tank pad is located approximately 65 ft (20 m) south of the Route 1 edge of pavement. The closest fuel dispenser is approximately 40 ft (12 m) south of the Route 1 edge of pavement. One 240-gallon AST (contents unknown) is located approximately 135 ft (41 m) south of the Route 1 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 31 – Mobil Gasoline Station, Building #706*

This facility is a retail gasoline station. It is located in the southwest quadrant of the Route 1/ Sport O Dome Drive intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. A tank pad is located approximately 25 ft (8 m) south of the Route 1 edge of pavement. The closest fuel dispenser is approximately 15 ft (5 m) south of the Route 1 edge of pavement. The area around the fuel dispensers had minor pavement staining. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site. After a review of best available information, this site received a risk rating of low.

*Site No. 32 – Circle K/76 Gasoline Station*

This facility is a retail gasoline station with an automobile repair shop. It is located in the northwest quadrant of the Route 1/Route 14B intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. A tank pad is located approximately 50 ft (15 m) from the Route 1 edge of pavement. The closest fuel dispenser is approximately 20 ft (6 m) from the Route 1 edge of pavement. An automobile shop with two maintenance bays and specializing in tire repairs, tune-ups, constant-velocity (CV) boots, brakes, radiator repairs, transmissions, oil changes, suspension, and minor repairs is also on-site. Access to the repair shop was restricted. One 55-gallon drum and a tool washing station were observed. Minor pavement staining was observed on the shop floor. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 33 – Mobil Gasoline Station, Building #101*

This facility is a retail gasoline station and a convenience store. This site is located north of the Route 1/10A intersection. Mobil Quick Lube, EZ Tire and Lube, and National Car Rental are also located on this property. Both lube centers conduct oil changes and tire repair services. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, the maintenance bays to the lube centers appeared clean. The used oil is kept in sealed containers; however, disposal practices are unknown. The tank pad is located approximately 35 ft (11 m) from the Route 1 edge of pavement. The closest fuel dispenser is located approximately 60 ft (18 m) from the Route 1 edge of pavement; another diesel fuel dispenser is located approximately 120 ft (16 m) from the Route 1 edge of pavement. Three groundwater monitoring wells were found on-site west of the convenience store. The closest monitoring well is approximately 110 ft (34 m) from the Route 1 edge of pavement. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 34 – Circle K/76 Gasoline Station*

This facility is a retail gasoline station and a convenience store. It is located in the southeast quadrant of the Route 1/10A intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, two former maintenance bays were closed. The tank pad was located approximately 75 ft (23 m) south of the Route 1 edge of pavement. The closest fuel dispenser is located approximately 35 ft (11 m) south of the Route 1 edge of pavement; another diesel fuel dispenser is located approximately 55 ft (17 m) south of the Route 1 edge of pavement. A large generator was found near the southeast area of the property; however, there did not appear to be an AST associated with the generator. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 35 – Wastewater Facility (GWA CD 25)*

This facility is a wastewater pump/transfer station owned by GWA. It is located on the northeast side of Route 1 and east of Simon Sanchez Road. During a site visit in March 2009, the property was fenced and locked, restricting access. A site representative was not available. Project team members viewed the property from the roadway. One approximately 300- to 500-gallon AST containing diesel fuel was located east of the Route 1 edge of pavement. There did not appear to be staining around the AST. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 36 – Shell Gasoline Station*

This facility is a retail gasoline station with a convenience store. This site is located on the northeast side of Route 1, west of the Route 1/14A intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, four observation wells were found within the tank pad. The tank pad is located approximately 45 ft (14 m) from the Route 1 edge of pavement. The closest fuel dispenser is located approximately 44 ft (13 m) from the Route 1 edge of pavement; one diesel fuel dispenser is located approximately 90 ft (28 m) from the Route 1 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of other soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 37 – Mobil Gasoline Station*

This facility is a retail gasoline station, a convenience store, and an automatic car wash. This site is located on the northeast side of the Route 1/14A intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, two observation wells were found within the tank pad. The tank pad is located approximately 185 ft (56 m) south of the Route 1 edge of pavement. The closest fuel dispenser is located approximately 30 ft (9 m) south of the Route 1 edge of pavement. The wash water from an on-site automatic car wash appeared to drain to a storm drain system. It is unknown if there are incidents of contamination associated with the USTs; however, there was no visual evidence of other soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells for found on- or off-site.

*Site No. 38 – Harman Substation*

This facility is an electrical substation owned by GPA. It is located on the north side of Route 1, diagonal from the Guam Micronesia Mall. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Numerous transformers were observed; however, no polychlorinated biphenyls (PCBs) were found. No hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 39 – Circle K/76 Gasoline Station*

This facility is a retail gasoline station with a convenience store. It is located in the southeast quadrant of the Route 1/26 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, four double-sided fuel islands, 12 fuel pumps, and two diesel pumps were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 40 – 1688 Laundry*

This facility is a laundromat located in the southeast quadrant of the Route 1/26 intersection. During a site visit in March 2009, one AST containing flammable gas was found in the rear of the property. The AST was enclosed by a chain-link fence. A water storage/softener tank was also found behind the building. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 41 – Shell Gasoline Station/Napa Auto Parts*

This facility is a retail gasoline station with a car wash. It is on the northeast quadrant of the Route 1/26 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, diesel fuel warnings were posted on the Napa building. A hazardous waste container (used oil), five fuel islands, nine fuel pumps, and two diesel pumps were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 42 – Mobil Gasoline Station*

This facility is a retail gasoline station. It is on the northeast quadrant of the Route 1/26 intersection (adjacent to the east of Site No. 45 – Shell Gasoline Station/Napa Auto Parts). This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, a hazardous waste container (used oil), six fuel islands, 12 fuel pumps, and two diesel pumps were observed on-site. The USTs are approximately 30 ft (9 m) from the Route 1 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 43 – Pacific Tyre LTD*

This facility is a tire service center on the northeast quadrant of the Route 1/26 intersection (adjacent to the east of Site No. 46 – Mobil Gasoline Station). During a site visit in March 2009, oil drums were observed on-site. The facility has two maintenance bays and a third bay that provides vehicle safety inspections. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 44 – Communication Transfer Station*

This site contains multiple utility facilities located across from the Puag Kaish Reservoir, approximately 150 ft (45 m) from the Route 1 edge of pavement. During a site visit in March 2009, an AST containing diesel was observed on-site. The AST was on an approximately 4-inch (in) (10-centimeter [cm]) concrete pad. The vegetation in the area of the AST did not appear to be distressed. Five groundwater monitoring wells were found on-site. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 45 – Power Substation*

This facility is a large power substation owned and operated by GPA. It is located adjacent to the Prestige BMW dealership. During a site visit in March 2009, access to the property was restricted. Project team members viewed the property from the roadway. Fuel cans and other miscellaneous liquids were being stored near a shed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no evidence of on-site soil or groundwater assessment or remediation that was visible from the roadway, and no groundwater monitoring wells were found on- or off-site.

*Site No. 46 – Utility Building*

This facility is a utility building owned by GPA. It is located north of the Route 1/26 intersection near Skate Park. During a site visit in March 2009, one 1,000-gallon AST containing diesel fuel was found on-site. It is located approximately 100 ft (30 m) from the Route 1 edge of pavement. The AST is in an approximately 2.0-ft (0.6-m) high concrete secondary containment; the entire facility is secured by a chain-link fence and is inaccessible. It is unknown if there are incidents of contamination associated with this site; however, there was no evidence of on-site soil or groundwater assessment or remediation that was visible from the roadway, and no groundwater monitoring wells were found on- or off-site.

*Site No. 47 – Mobil Gasoline Station*

This facility is a retail gasoline station. It is located in the northeast quadrant of the Route 1/27A intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, three groundwater monitoring wells and two test wells were found on-site. The fuel island is located approximately 30 ft (9 m) east of the Route 1 edge of pavement. The USTs are located approximately 20 ft (6 m) east of the Route 1 edge of pavement. Drums labeled “Hazardous Waste” were found behind the building. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 48 – Site 37/War Dog Burrow Pit*

This site is the War Dog Burrow Pit located in Andersen AFB South on the north side of Route 1, approximately 0.5-mile (0.8-km) east of the Route 1/15 intersection. This site was identified in the IRP Sites – Andersen South maps as part of the DoD IRP. This site is comprised of approximately 55 ac (22

ha). A ROD was issued in 2008. During a site visit in March 2009, this site was inaccessible from the roadway. The site was observed to be sparsely covered with vegetation and grass. There were no indications of the burrow pit. The current environmental disposition of the site is unknown.

*Site No. 49 – Site 58/Waste Pile 10, Northwest Field, DPO69*

This site is an inactive waste disposal site in Andersen AFB (Andersen South) on the south side of Route 1, approximately 0.5-mile (0.8-km) east of the Route 1/28 intersection. The waste disposal site is approximately 600 ft (180 m) northeast of the Southwest Cross-Over at the South Runway. This site was identified as an area of concern, according to the DoD IRP Sites – Andersen South plans. Contaminants of concern include partially buried drums under crushed coral and soil. A remedial investigation/feasibility study (RI/FS) is in process. During a site visit in March 2009, this site was inaccessible and could not be seen from the roadway. The current environmental disposition of the site is unknown.

*Site No. 50 – Site 55/Area Outside of Landfill 14, LF066*

This site is a landfill in Andersen AFB (Andersen South) on the south side of Route 1, approximately 1.5 miles (2.4 km) east of the Route 1/28 intersection. This site was identified in the IRP Sites – Andersen South plans as part of the DoD IRP. This site is located just outside of Landfill 14, approximately 1,500 ft (450 m) south of Route 1. A ROD was issued in 2008. During a site visit in March 2009, this site was inaccessible and could not be seen from the roadway. A review of aerial photography shows a dirt road leading to the site and several buildings. The current environmental disposition of the site is unknown.

*Site No. 51 – Site 57/Waste Pile 9, Northwest Field, DP068*

This site is in Andersen AFB (Andersen South) on the south side of Route 1, approximately 2 miles (3.2 km) east of the Route 1/28 intersection. This site was identified in the IRP Sites – Andersen South plans as part of the DoD IRP. This area is identified as an inactive waste disposal site in a former borrow pit located south of the North runway in the Northwest Field. The types of contamination found were 55-gallon drums and other items of unknown content. The RI/FS is in process. During a site visit in March 2009, this site was inaccessible and could not be seen from the roadway. The current environmental disposition of the site is unknown.

*Site No. 52 – Kilroy's Alternator and Starter Repair Shop*

This facility is a tire shop. It is located in the southwest corner of the Route 1/Chalan Lujuna intersection. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 53 – New Lujan Tire Shop*

This facility is a tire shop. It is located in the southwest corner of the Route 1/Chalan Lujuna intersection. The fuel island is located approximately 60 ft (18 m) south of the Chalan Lujuna edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 54 – Pacific Laundry – Maite Plant*

This site is a dry-cleaning facility; dry cleaning is conducted on-site. It is located at the Route 8/ Biang Street intersection. The building is located approximately 25 ft (8 m) from the Route 8 edge of pavement.

The Maite Plant houses the main dry-cleaning facility and serves as a drop-off location for customers from south and central Guam. It is equipped with a state-of-the-art dry-cleaning machine and several conventional washers, dryers, and steamed flat ironers (Pacific Laundry 2009). During a site visit in March 2009, no hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 55 – Smile Market/Guam Church of Resurrection*

This facility is a convenience store and a church. It is located south of Pacific Laundry/Dry Cleaners (Site No. 54) at the Route 8/Biang Street intersection. A painted sign on the back portion of the building said “A.T.C. Rims Ent. Inc.” During a site visit in March 2009, no hazardous waste containers or drums, ASTs, or USTs were observed. The building appeared to have been a former manufacturing facility. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 56 – A1 Maite Laundry*

This site is a wash, iron, and steam laundry facility. No dry cleaning is conducted on-site. It is located approximately 0.3-mile (0.5-km) east of the Route 8/Biang Street intersection. The building is located adjacent to the Route 8 edge of pavement. During a site visit in March 2009, no hazardous waste containers or drums, ASTs, or USTs were observed. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 57 – Mobil Mart*

This facility is a retail gasoline station/McDonalds Restaurant and a car wash. It is located in the southeast quadrant of the Route 8/Sgt. Roy T. Damian Jr. Road intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, the car wash, located approximately 28 ft (9 m) south of the Route 8 edge of pavement, did not appear to be in use. Six fuel islands and a tank farm are located approximately 40 ft (12 m) south of the Route 8 edge of pavement. A remediation shed was found on-site adjacent to Sgt. Roy T. Damian Jr. Road. Eight groundwater monitoring wells were found on-site. The closed monitoring well is located approximately 22 ft (7 m) south of the Route 8 edge of pavement. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 58 – Shell Gasoline Station*

This facility is a retail gasoline station with a convenience store. It is located on the south side of Route 8, approximately 0.2-mile (0.3-km) east of the Route 8/Sgt. Roy T. Damian Jr. Road intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, one AST and generator were found behind the building. The AST was not in secondary containment. The fuel island and tank pad are located approximately 28 ft (9 m) south of the Route 8 edge of pavement. Four fill ports are located approximately 75 ft (24 m) south of the Route 8 edge of pavement. The facility appeared to have active remediation equipment in use; however, no groundwater monitoring wells were found on- or on- or off-site.

*Site No. 59 – Abandoned Gasoline Station*

This facility is a former gasoline station and automobile repair shop. It is located in the southeast quadrant of the Route 8/Canada Toto intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, a site representative stated that this site was formerly a gasoline station. It was unknown how long ago the gasoline station closed or if the USTs had been removed. The current use appeared to be a maintenance shop used only by the owner/occupant. The three doors to the maintenance bays were closed at the time of the site visit. The former fuel island and tank pad are located approximately 25 ft (8 m) south of the Route 8 edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 60 – Abandoned Automobile Repair Shop/Possible Gasoline Station*

This facility is a former automobile repair shop/possible gasoline station. It is located on the south side of Route 8, approximately 0.2-mile (0.3-km) west of the Route 8/ADM Sherman Road intersection. During a site visit in March 2009, this facility was abandoned. Four maintenance bays and a store area were locked. The canopy suggests that this site may have previously been a gasoline station; however, there was no evidence of a former fuel island or tank farm. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 61 – Island Lube Express*

This facility is an automobile repair shop and oil change center. It is located south of Route 8 and west of ADM Sherman Road. During a site visit in March 2009, a site representative stated that this site was formerly a gasoline station. It was unknown how long ago the gasoline station closed, or if the USTs had been removed. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. The former fuel island and tank pad are located approximately 20 ft (6 m) south of the Route 8 edge of pavement. One AST (appeared to contain petroleum), approximately six 55-gallon drums (labeled oil), old cars in various stages of repair, and a pile of rubber tires were found behind the building. The AST was not in secondary containment. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 62 – Shell Gasoline Station*

This facility is a retail gasoline station with a convenience store. It is located in the southwest quadrant of the Route 8/10 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, one AST and generator were found behind the building. The fuel island is located approximately 25 ft (8 m) west of the Route 10 edge of pavement and approximately 70 ft (22 m) south of the Route 8 edge of pavement. The tank farm is located approximately 22 ft (7 m) south of the Route 8 edge of pavement. Remediation equipment appeared to be located behind the building; however, no groundwater monitoring wells were found on- or on- or off-site. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 63 – Circle K/76 Gasoline Station*

This facility is a retail gasoline station with an automobile repair shop. It is located in the southeast quadrant of the Route 8/10 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. The fuel island is located approximately 20 ft (6 m) east of the Route 10 edge of pavement, and the tank pad is located approximately 25 ft (8 m) east of the Route 10 edge of pavement. Four 55-gallon drums (labeled oil) and approximately 100 used tires were found adjacent to the repair shop. Three of the drums were sealed, and one drum appeared to contain water. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 64 – Scrapyard/Junkyard/Automobile Repair Shop*

This facility is located in the southeast quadrant of the Route 8/Jolene Leon Guerrero Road intersection. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. The site appeared to be a scrapyard/junkyard/automobile repair shop. Scrap metal, new and used drums containing oil, old construction trucks, used tires, and many other unidentifiable containers and drums were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 65 – Military Electrical Substation*

This facility is a military electrical substation. It is located on the north side of Route 8 at the entrance to the military facility. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. An electrical transformer and other unidentifiable transformers were observed on-site. No PCBs, hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 66 – Commercial Tire Depot*

This facility is a tire repair/replacement shop. It is located in the southeast quadrant of the Route 16/Sabana Barrigada Drive intersection. During a site visit in March 2009, access to the property was limited. Piles of used tires were found throughout the property. No hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 67 – Mobil Gasoline Station*

This facility is a three-story retail gasoline station (top two stories are used as offices) with a convenience store. It is located on the east side of Route 16 north of Sabana Barrigada Drive. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. The fuel island and tank pad are located approximately 45 ft (14 m) east of the Route 16 edge of pavement. The pavement around the fuel island/tank farm had minimal pavement staining. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in

March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 68 – Asia Motors*

This facility is an automobile repair center specializing in brakes, oil changes, and tire alignments. It is located on the east side of Route 16 north of Perez Coral Road. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Several 55-gallon drums containing oil and transmission fluid were observed inside of the maintenance bays. The shop floor appeared to have moderate pavement staining. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 69 – Gaja and Sons Automobile Shop*

This facility is an automobile repair center. It is located on the east side of Route 16 north of Bello Road. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Cars in various stages of repair were observed on-site. Scrap metal and drums (contents unknown) of various sizes were also stored on-site. No hazardous waste containers or drums, ASTs, or USTs were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 70 – Circle K/76 Gasoline Station*

This facility is a retail gasoline station with a convenience store and a car wash. It is located in the southwest quadrant of the Route 16/10A intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. The fuel island is located approximately 45 ft (14 m) south of the Route 10A edge of pavement and approximately 120 ft (36 m) west of the Route 16 edge of pavement. The tank pad is located approximately 90 ft (27 m) south of the Route 10A edge of pavement. A diesel fuel island is located approximately 80 ft (24 m) west of the Route 16 on-ramp. During a site visit in March 2009, the wash water from an on-site automatic car wash appeared to drain to a public sanitary or storm drain system; however, this could not be verified. A large generator and one approximately 100-gallon AST containing fuel oil was found near the rear of the property. The generator and AST were fenced and sat on an approximately 6-in (15-cm) high concrete pad. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 71 – Shell Gasoline Station/One-Stop Auto Care and Tire Outlet*

This facility is a retail gasoline station with a convenience store and an automobile repair center. This site is located at 1776 Route 16 (on the west side of Route 16 south of the Route 16/27 intersection). This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. An automobile care and tire outlet is adjacent to the Shell automobile repair center. An approximately 30-ft (9-m) by 50-ft (16 m) tank pad is located approximately 45 ft (14 m) from the Route 16 edge of pavement. The fuel island is located approximately 40 ft (12 m) from the Route 16 edge of pavement. Several 55-gallon drums appeared to be used as a washing station. The automobile care and tire outlet had two maintenance bays; the shop floors appeared to have minimal pavement staining. This facility was included in the EDR report prepared for this project. The facility was entered

into the UST Expedited Settlement Program (date not listed). During a site visit in March 2009, there was no visual evidence of remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 72 – Pacific Laundry – Harmon Plant*

This site is a dry cleaning facility. It is located in the southwest quadrant of the Route 27/16 intersection. The Harmon Plant is equipped with two tunnel washers, a 10/batch and an 8/batch, five flatwork ironers, two flatwork folders, six steam dryers, and several conventional washers and dryers. It also houses a “clean room” facility dedicated exclusively for Guam Memorial Hospital's laundry requirements (Pacific Laundry 2009). During a site visit in March 2009, the building was not accessible. One 60,000-gallon AST containing diesel fuel is located approximately 30 ft (9 m) south of Route 27. The AST is in secondary containment; no pavement staining was found near the AST. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 73 – School Bus Storage Area*

This site is a school bus storage yard owned by the Guam Public School System. It is located in the southeast quadrant of the Route 27/Metgut Road Intersection. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. There appeared to be three fuel-dispensing stations near the rear of the asphalt lot; however, this could not be verified. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 74 – Macheche Substation*

This facility is an electrical substation operated by GPA. It is located in the southeast quadrant of the Route 27/Metgut Road Intersection, west of Site No. 77 – School Bus Storage Area. According to the U.S. Environmental Protection Agency (USEPA) Enforcement and Compliance History Online (ECHO) database, a Clean Air Act (CAA) inspection was conducted in February 2007. No formal enforcement actions have been taken against the facility within the last 5 years. The Three-Year Air Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be in high-priority violation (HPV). During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Five ASTs (contents and sizes unknown) were observed on-site. Three of the five ASTs appeared to be in secondary containment. Transformers were found in the front area of the property, adjacent to Route 27; however, no PCBs were observed. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 75 – Electrical Substation*

This facility is an electrical substation operated by GPA. It is located on the north side of Route 27, east of Kayou Tun Francisco Drive. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. One 1,000-gallon AST containing diesel fuel was observed on-site. The AST appeared to be in secondary containment. Transformers and PCBs were not observed on the property. It is unknown if there are incidents of

contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 76 – Mobil Gasoline Station*

This facility is a retail gasoline station. It is located in the southwest corner of the Route 1/Chalan Lujuna intersection. This site was not identified in the EDR reports, and it does not have a record of documented contamination. The fuel island is located approximately 40 ft (12 m) south of the Chalan Lujuna edge of pavement. The USTs are located approximately 40 ft (12 m) south of the Chalan Lujuna edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 77 – Wash's and Dry's Laundromat*

This facility is a laundromat. It is located on the west side of Route 1, north of Chalan Lujuna. During a site visit in March 2009, one AST containing flammable gas was found in the rear of the property, approximately 30 ft (9 m) from the building. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 78 – Shell Gasoline Station*

This facility is a retail gasoline station with a car wash. It is located on the west side of Route 1, approximately 800 ft (240 m) north of the Route 1/Chalan Lujuna intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, five double-sided fuel islands were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 79 – Yigo Motors Auto Service*

This facility is an automobile repair shop. It is located north of the Route 1/Chalan Lujuna intersection, on the east side of Route 1. During a site visit in March 2009, cars in various stages of repair were on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 80 – Quarry*

This facility is a quarry owned and operated by Smithbridge Guam, Inc. It is located on the east side of Route 15. NIPPO Construction is located adjacent to the quarry. During a site visit in March 2009, multiple large ASTs (possible containing water) were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 81 – Yigo Speedway*

This facility is a race-car speedway. It is located on the east side of Route 15. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property

from the roadway. An area of excavation and a large pile of used tires were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 82 – Storage/Private Solid Waste*

This facility is dump/storage area. It is located on the west side of Route 15, north of Fadian Point. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Abandoned gasoline tanks, empty diesel tanks, tractors, and old trucks were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 83 – Hawaiian Rock Products*

This facility is a large construction company with an aggregate/concrete/asphalt plant. It is located on the east side of Route 15. This facility was included in the EDR report prepared for this project. According to the Material Licensing Tracking System, the license number for this site is 56-23278-01. The license use was not reported and expired in June 2003. According to the USEPA ECHO database, a CAA inspection was conducted in March 2007. No formal enforcement actions have been taken against the facility within the last 5 years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be an HPV.

During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. It is anticipated that a diesel tank is used on-site to fuel the fleet vehicles. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 84 – Amelco, Inc.*

This site is a bus and tractor maintenance facility. It is located across from Site No. 83 – Hawaiian Rock Products and adjacent to JM Sand Blasting off of Route 15. During a site visit in March 2009, diesel, oil, propane, and gasoline usages were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 85 – Black Construction*

This facility is a construction company. It is located off Route 15. This facility is registered as a conditionally exempt small generator of hazardous wastes. According to the USEPA ECHO database, an RCRA inspection has never been conducted. No formal enforcement actions have been taken against the facility within the last five years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be in significant non-compliance (SNC). During a site visit in March 2009, access was limited. Cranes, backhoes, and power poles were observed on-site. It is anticipated that a diesel tank is used on-site to fuel the vehicles. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 86 – Abandoned Tank*

This abandoned AST was found on the west side of Route 15, just north of Site No. 83 – Hawaiian Rock Products during a site visit in March 2009. The AST contains liquid oxygen and is owned by the U.S. Air Force. It is unknown if there are incidents of contamination associated with this AST; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 87 – Utility Building*

This facility is a utility building owned by GPA. It is located on the east side of Route 15, south of Maibo Cave. During a site visit in March 2009, one 1,020-gallon AST containing diesel was found on-site. Chlorine gas warnings were also posted. It is unknown if there are incidents of contamination associated with this AST; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 88 – Site 60/Cliff-Line Dump Site, LF071 or former AOC 102*

This site is located on Andersen AFB (Andersen South) on the north side of Route 15, south of the Route 15/Chalan Lujuna intersection. According to the DoD IRP Sites – Andersen South plans, this site is an area of concern. This site was used to dump a variety of wastes. It is located along the adjacent cliff. No further response action is planned according to the DoD. During a site visit in March 2009, this property was inaccessible or visible from the roadway.

*Site No. 89 – Site 46/Storm Water Retention Pond, Tumon Tank Farm, SDO57 or former AOC 69*

This site is located on Andersen AFB (Andersen South) adjacent to the south side of Route 15, north of the Route 15/26 intersection. According to the DoD IRP Sites – Andersen South plans, this site is an area of concern. This site consists of a retention pond. No further response action is planned. A review of aerial photography shows earthwork and construction activities possibly associated with construction of the retention pond; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 90 – Site 47/Cleaning West of Housing at Northwest Field, DPO58 or former AOC 80*

This site is located on Andersen AFB (Andersen South) on the south side of Route 15, north of the Route 15/26 intersection (south of Site No. 106). According to the DoD IRP Sites – Andersen South plans, this site is an area of concern. This site was the subject of concern due to the presence of surface waste debris, but that matter has been settled. Contaminants of concern include heavy metals, grease cans, metal debris, and glass bottles. A ROD was issued in 2008. During a site visit in March 2009, this property was inaccessible or visible from the roadway. The current environmental disposition of the site is unknown.

*Site No. 91 – Site 56/Waste Pile 8, Northwest Field; DP067*

This area is an inactive waste disposal site located on Andersen AFB (Andersen South), on the north side of Route 15, in a quarried area between the North Runway and North Taxiway at Northwest Field. The IRP Sites – Andersen South plans indicate that this site is under the DoD IRP. Contaminants of concern include drums, tires, canisters, and asphalt. An RI/FS is in process. During a site visit in March 2009, this property was inaccessible or visible from the roadway. The current environmental disposition of the site is unknown.

*Site No. 92 – Site 59/MSA Magazine 7 Trench, LF070*

This magazine trench is located on Andersen AFB (Andersen South) on the north side of Route 15, west of Wilson House. This site was identified as an area of concern in the IRP Sites – Andersen South plans. No further response action is planned according to the DoD. During a site visit in March 2009, this property was inaccessible or visible from the roadway.

*Site No. 93 – Utility Building*

This facility is a utility building owned by GPA. It is located on the west side of Route 10, south of the Route 10/15 intersection. During a site visit in March 2009, one 1,020-gallon AST containing diesel was found on-site. Chlorine gas warnings were also posted. It is unknown if there are incidents of contamination associated with this AST; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 94 – Wastewater Facility*

This site is a wastewater facility. It is located on the west side of Route 10, south of the Route 10/15 intersection (adjacent to the south of Site No. 110 – Utility Building). It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 95 – Utility Building*

This facility is a utility building owned by GPA. It is located on the west side of Route 10, south of the Route 10/15 intersection (south of Site No. 111 – Wastewater Facility). During a site visit in March 2009, one 1,020-gallon AST containing diesel was found on-site. Chlorine gas warnings were also posted. It is unknown if there are incidents of contamination associated with this AST; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 96 – Napa Auto Parts/Bridge Stone/Pacific Tyre/Firestone/Shell Helix Motor Oils*

This facility provides brake services, wheel alignments, and safety inspections. It is located on the east side of Route 10, north of the Route 10/Couten Tows intersection. During a site visit in March 2009, moderate pavement staining with oil was observed. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 97 – Shell Gasoline Station*

This facility is a retail gasoline station. This site is located on the east side of Route 10, north of the Route 10/32 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, three double-sided fuel islands and six pumps were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, during a site visit in March 2009, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 98 – Mobil Gasoline Station*

This facility is a retail gasoline station. It is located at the southwest quadrant of the Route 10/32 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a

record of documented contamination. During a site visit in March 2009, four double-sided fuel islands, eight gasoline pumps, two diesel fuel pumps, and a trash compactor were observed on-site. A drum labeled “Hazardous Materials” was found near the fuel island. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 99 – Utility Building*

This facility is a utility building owned by GPA. It is located on the west side of Route 10, south of the Route 10/32 intersection. During a site visit in March 2009, one 1,020-gallon AST containing diesel fuel was observed on-site. The AST was in an approximately 2.0-ft (0.6-m) high concrete secondary containment. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 100 – Friendly Laundromat*

This facility is a laundromat. It is located on the west side of Route 10, south of the Route 10/32 intersection (south of Site No. 99 – Utility Building). During a site visit in March 2009, one AST (contents unknown) and a propane tank were found on-site behind the building. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 101 – Wastewater Treatment Facility*

This site is a wastewater treatment facility owned by GWA. It is located on the east side of Route 10, north of the Route 10/4 intersection. During a site visit in March 2009, one 3,250-gallon AST containing diesel fuel was found on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 102 – Utility Building*

This facility is a utility building. It is located adjacent to the north of Untalan Middle School on the east side of Route 10. During a site visit in March 2009, one AST containing diesel fuel and one AST containing chlorine gasoline were observed on-site. GPA owns the diesel fuel tank. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 103 – Laundry World*

This site is a laundromat located south of the Route 10/15 intersection. During a site visit in March 2009, one 1,020-gallon AST containing diesel was found on-site. Two 55-gallon steel drums containing oil were found behind the building. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 104 – Rainbow Laundry & Mart*

This site is a laundromat located north of Route 15, south of Wendy’s Restaurant. During a site visit in March 2009, one portable generator was found adjacent to the building. It is unknown if there are

incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 105 – Utility Building*

This facility is a utility building owned by GPA located in the northwest quadrant of Route 10 and Route 15. During a site visit in March 2009, one 1,020-gallon AST containing diesel fuel was observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 106 – Utility Building*

This facility is a utility building owned by GPA. It is located in the southeast quadrant of Route 10 and Route 15. During a site visit in March 2009, one 1,020-gallon AST containing diesel fuel was observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

### **3.4 APRA HARBOR**

*Site No. 107 – Mobil Gasoline Station*

This facility is a retail gasoline station with a convenience store. It is located at the northeast quadrant of the Route 2A/5 intersection. This site was not identified in the EDR report prepared for this project, and it does not have a record of documented contamination. During a site visit in March 2009, one AST (contents and size unknown) and ventilation pipes were found behind the convenience store building. The AST sat on the ground and was not within secondary containment. The area around the AST was overgrown with vegetation; however, the vegetation did not appear to be distressed. The exterior of the tank appeared to be in good condition and did not have an odor. Two fuel islands are located approximately 25 ft (8 m) east of the Route 2A edge of pavement. The area surrounding the fuel islands had light pavement staining, but it did not appear to have reworked pavement. Two USTs (contents and sizes unknown) are located approximately 65 ft (20 m) north of the Route 2A edge of pavement. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 108 – Island Equipment Company*

This site is a commercial facility. It is located on the north side of Route 2A, approximately 0.2-mile (0.3-km) east of the Route 2A/1 intersection. According to the facility's Web site, Island Equipment Company serves customers in energy, healthcare, commercial, and industrial markets; products and services include industrial and medical gases, safety equipment, fire extinguisher services, and welding supplies (Island Equipment Company 2009). The two main bulk products that are produced and liquefied in the on-site air separation plant are oxygen and nitrogen. The company also has liquid argon; carbon dioxide refrigerated liquid is also produced for retail. Island Equipment Company is the only facility authorized by the U.S. Department of Transportation (DOT) for hydrostatic testing in the region. This facility was included in the EDR report prepared for this project. This facility is currently registered as a small quantity generator (SQG) of hazardous wastes. The facility registered as a conditionally exempt SQG in 2002. The reported waste types are ignitable hazardous wastes, corrosive hazardous wastes, lead, and benzene. According to

the USEPA ECHO database, an RCRA inspection has never been conducted. No formal enforcement actions have been taken against the facility within the last 5 years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be in SNC. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. A sign posted outside of the property indicated that this site is a gas manufacturing plant. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 109 – AIC International*

This site is a commercial facility. It is located on the north side of Route 2A, approximately 0.06-mile (0.09-km) east of the Route 1/2A intersection. During a site visit in March 2009, one approximately 1,000-gallon AST and one approximately 500-gallon AST containing diesel fuel were found on-site approximately 1.0-mile (1.6-km) east of the Route 2A edge of pavement. The ASTs were in concrete secondary containment, and no staining was observed. The exterior of the tanks appeared to be in good condition and did not have an odor. The vegetation in the area of the ASTs did not appear to be distressed. It is unknown if there are incidents of contamination associated with the ASTs; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 110 – Taco Bell*

This site is a fast-food restaurant. It is located in the northeast quadrant of the Route 1/2A intersection. During a site visit in March 2009, two approximately 1,000-gallon ASTs containing diesel fuel and propane were found on-site behind the building. Both ASTs were enclosed by an approximate 5.0-ft (1.5-m) concrete wall that was locked and gated. The ASTs are located approximately 100 ft (30 m) east of the Route 1 edge of pavement. The AST containing diesel fuel was in concrete secondary containment, and no staining was observed. The exterior of both ASTs appeared to be in good shape and did not have odors. It is unknown if there are incidents of contamination associated with the ASTs; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 111 – Stell Newman Master Center/Navy Housing – Navy Federal Credit Union*

This site is a visitor center; it is the entrance point to the Navy base, Navy housing, and the Federal Credit Union. It is located at the west side of the Route 1/2A intersection. According to the IRP Sites – Apra Harbor Naval Complex plans, a potential contamination site, referred to as “Abandoned UST at X-ray Wharf,” is located within this property. The IRP Sites – Apra Harbor Naval Complex plans indicate that this site is under the DoD IRP. Contaminants of concern include petroleum compounds and lead. The soil contains contaminants from the former UST. This site was transferred from the Navy’s UST program. During a site visit in March 2009, no hazardous waste containers or drums, ASTs, or USTs were observed on-site. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation. The current environmental disposition of this site is unknown.

*Site No. 112 – Valve Pits at Tenjo Vista*

This site is located within the military installation on the east side of Route 1. This site is included in the IRP Sites – Apra Harbor Naval Complex plans provided by the DoD; however, the associated information regarding this site is not included in the reports reviewed for this project. According to the DoD IRP Sites

– Apra Harbor Naval Complex plans, this site is included in the IRP. During a site visit in March 2009, this site was inaccessible and could not be seen from the roadway. The current environmental disposition of this site is unknown.

*Site No. 113 – Old NSD Drum Storage Lot*

This site is located within the military installation adjacent to the west side of Route 1. This site is included in the IRP Sites – Apra Harbor Naval Complex plans provided by the DoD; however, the associated information regarding this site is not included in the reports reviewed for this project. An open and cleared area is located just north of the Atantano River. According to the DoD IRP Sites – Apra Harbor Naval Complex plans, this site is a designated Solid Waste Management Unit. During a site visit in March 2009, a possible disposal site was found several hundred feet west of Route 1. The current environmental disposition of this site is unknown.

*Site No. 114 – Lower Sasa Fuel Burning Pond*

The former Lower Sasa Fuel Burning Pond at the former Fleet Industrial Supply Center (FISC) is located in the southwestern portion of Guam. The site is located in a military installation adjacent to the east side of Route 1, approximately 0.7-mile (1.1 km) south of the Route 1/11 (Cabras Highway) intersection and is comprised of approximately 20 ac (8 ha). This site is included in the IRP Sites – Apra Harbor Naval Complex plans provided by the DoD, and it is identified as part of the IRP. The facility managed oily wastewater from ships and the FISC Fuel Department. Waste was collected in the pond and drained through a channel to adjacent wetlands. Contaminants of concern include waste oil.

A Decision Document has been issued and will serve as the final remedy for the site. Land use controls (LUCs) are to be used as the final remedy for the site. The LUCs specify that all future property owners are responsible for implementing, maintaining, reporting, and enforcing the LUCs until such time that they are terminated. The LUCs specify that there will be no unauthorized site access. In addition, the LUCs prevent the use of the site for schools, day care, or recreational facilities. In addition, five-year site reviews will be conducted per CERCLA requirements. No highly toxic or highly mobile source material was identified at the site, so from a risk assessment perspective, LUCs were viewed to be an acceptable final remedy. The Decision Document includes use of signs to restrict access to the area, installing a locked chain across the access road, periodic maintenance of the chain and signs, and monitoring conditions within the adjacent wetlands to ensure that the LUCs remain effective. During a site visit in March 2009, the location could not be verified due to the area being heavily vegetated.

*Site No. 115 – Navy Fuel Storage*

This facility is a fuel storage yard. It is located on the east side of Route 1, south of the Route 1/6 intersection. This facility was included in the EDR report prepared for this project. It is listed in the Toxic Release Inventory System (TRIS) database, but no other information was provided. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Five large ASTs (contents and sizes unknown) were observed on-site. The ASTs were in secondary containment. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 116 – South Pacific Petroleum Corporation*

This site is a large fuel depot/distribution facility. It is located on the south side of Route 11, approximately 1.65 miles (2.65 km) west of the Route 1/11 intersection. South Pacific Petroleum

Corporation purchased the assets of Exxon Guam in December 2000 and operates 10 retail service stations under the licensed name 76 and Circle K (South Pacific Petroleum Corporation 2009). This facility was included in the EDR report prepared for this project. The Registry identification number is 110028165009. This facility is registered as an SQG of hazardous wastes. According to the USEPA ECHO database, an RCRA inspection has never been conducted. No formal enforcement actions have been taken against the facility within the last five years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be in SNC. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Several large ASTs (contents and sizes unknown) and other fuel processing equipment were observed on-site. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 117 – Guam Power Authority (Cabras Power Plant)*

This facility is the Cabras Power Plant. It is located at 322 Cabras Highway Route 11, approximately 0.4-mile (0.6-km) west of the Route 1/11 intersection. This facility was included in the EDR report prepared for this project. Violations were reported in May 1992 for PCB disposal; the violations were closed in May 1992. According to the USEPA ECHO database, an RCRA inspection was conducted in June 1992 and a CAA inspection was conducted in February 2007. No formal enforcement actions have been taken against the facility within the last 5 years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was considered to be in SNC. An SNC designation indicates that this site may pose a more severe level of environmental threat. As of March 2009, the facility was not considered to be an HPV.

During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Several ASTs (sizes unknown) that were labeled fuel oil storage, waste oil, and water were observed on-site. The ASTs appeared to be in secondary containment; however, this could not be verified. The extent of potential contamination on-site is unknown; however, there was no visual evidence of remediation.

*Site No. 118 – Piti Power Plant*

This facility is the Piti Power Plant. It is located in the southwest quadrant of the Route 1/11 intersection. According to the IRP Sites – Apra Harbor Naval Complex Plans, this site is included in the DoD IRP; however, the associated information regarding this site is not included in the reports reviewed for this project. This facility is registered with USEPA's used oil program. According to the USEPA ECHO database, an RCRA inspection was conducted in June 1992. No formal enforcement actions have been taken against the facility within the last 5 years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be in SNC.

During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Several ASTs (contents and sizes unknown), transformers, and ventilation pipes were observed on-site. Several of the ASTs and transformers are located adjacent to the Route 1 and Route 11 edges of pavement. The ASTs appeared to be in secondary containment; however, this could not be verified. It is unknown if there are incidents of contamination

associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

### 3.5 SOUTH

#### *Site No. 119 – Apra Height Substation*

This facility is an electrical substation operated by GPA. It is located at the southwest quadrant of the Route 5/17 intersection. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. PCBs are widely used for transformers; however, none were observed from the roadway. In addition, no hazardous waste containers or drums, ASTs, or USTs were observed. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 120 – Apra View*

This site is Navy housing. It is located in the northeast quadrant of the Route 5/Apra View/ Plumeria intersection. During a site visit in March 2009, access to the property was restricted. Project team members viewed the property from the roadway. No hazardous waste containers or drums, ASTs, or USTs were observed from the roadway. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 121 – Naval Facilities Engineering Command (NAVFAC)*

This site is an abandoned three-story apartment building. It is located in the northwest quadrant of the Route 5/Apra View intersection. During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. Vacant apartment buildings and a building possibly used as a former school or daycare were observed from the roadway. A posted sign stated that this site is a NAVFAC project undergoing space renovation. No hazardous waste containers or drums, ASTs, or USTs were observed from the roadway. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

#### *Site No. 122 – Pacific Foundation Company*

This site is a commercial/industrial facility. It is located on the north side of Route 5, east of Route 2A. This facility is registered as a conditionally exempt small generator of hazardous wastes. According to the USEPA ECHO database, an RCRA inspection has never been conducted. No formal enforcement actions have been taken against the facility within the last 5 years. The Three-Year Compliance Status by Quarter (April/June 2006 through January/March 2009) indicates that this facility does not have any compliance violations. As of March 2009, the facility was not considered to be in SNC. During a site visit in March 2009, the property was fenced and locked, restricting access. No one was on-site at the time of the site visit, and the property use is unknown. Project team members viewed the property from the roadway. Tractor-trailers and other equipment were in a storage yard adjacent to Route 5. No hazardous waste containers or drums, ASTs, or USTs were observed from the roadway. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

*Site No. 123 – Cell Tower*

This facility is a cell tower. It is located north of Route 5 and east of Route 2A (adjacent to a Mobil Gasoline Station). During a site visit in March 2009, the property was fenced and locked, restricting access. Project team members viewed the property from the roadway. A box that appeared to possibly be a transformer was observed on-site; however, its use could not be confirmed. No PCBs, hazardous waste containers or drums, ASTs, or USTs were observed from the roadway. It is unknown if there are incidents of contamination associated with this site; however, there was no visual evidence of soil or groundwater assessment or remediation on-site, and no groundwater monitoring wells were found on- or off-site.

## 3.6 TEC INC.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 01 (Landfill 1)	This site encompasses approximately 23 acres (ac) in the North Field of Andersen AFB. Landfill operations began in 1945. Some portions of the landfill are still operational. Non-active portions were capped in 2001.	Waste chemicals, pesticides, Petroleum, Oil, Lubricants (POL), solvents, ferrous metal, sanitary trash, and construction debris.	Responsibility was transferred to the RCRA Program in 2007 because the landfill is still active.
Site 02 (Landfills 2,4, & 5)	This site is approximately 69 ac in the North Field of Andersen AFB. Landfill operations were from 1947 to 1974, with a small portion of the landfill being used up through 1982.	Waste chemicals, pesticides, POL, solvents, ferrous metal, sanitary trash, construction debris, and Unexploded Ordnance (UXO).	Landfill 5 was capped under a Removal Action. A Remedial Investigation/Feasibility Study (RI/FS) is ongoing for Landfill 2 while no further response action is required for Landfills 4 and 5.
Site 03 (Waste Pile 3)	This site is about 19 ac and is located in the North Field of Andersen AFB. The site was actively used from 1947 to 1977.	Pesticides, POL, solvents, scrap metal, sanitary trash, construction debris, and industrial waste, pesticides, and construction debris.	RI/FS is ongoing.
Site 04 (Landfill 6)	This site encompasses approximately 10 ac and is located in the North Field of Andersen AFB. The site operated from 1953 to 1954.	Sanitary trash.	Record of Decision (ROD) was completed in 2008.
Site 05 (Landfill 7)	This site is approximately 3 ac and is located in the North Field of Andersen AFB. Years of operation were from 1956 to 1958.	Sanitary trash, metals, and dioxins in soil.	ROD was completed in 2007 that included the requirement for long-term monitoring.
Site 06 (Landfill 8)	Site 06 is about 8 ac and is located between the North and Northwest Fields of Andersen AFB. This site operated from 1946 to 1949.	Asphalt and asphaltic wastes, metals.	ROD was issued in 2007 recommending soil removal that is planned for FY 2010.
Site 07 (Landfill 9)	This site, located in the Northwest Field of Andersen AFB encompasses approximately 8 ac. This landfill operated from 1949 to 1955.	Sanitary trash, construction debris, and concrete.	ROD was issued in 2008 recommending no further action.
Site 08 (Landfills 10, 11, & 12)	This site, located in the North Field of Andersen AFB encompasses approximately 14 ac and operated from the early to late 1950s.	POL, solvents, scrap metals, pesticides, heavy metals, sanitary trash, construction debris, asphalt wastes, and 55 gallon drums.	In 2007, ROD was issued requiring long-term monitoring for Landfill 10. No further response action is planned for Landfills 11 and 12.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 09 (Landfill 13)	This site is in Andersen AFB's North Field and is approximately 4.5 ac. The landfill operated from 1951 to 1956.	Waste chemicals, metals, pesticides, POL, sanitary trash, spent equipment.	In 2007, ROD was issued. Some clean-up activities for the portion of the site below the cliff are planned in 2009.
Site 10 (Landfill 14)	This site is approximately 33 ac located within the North Field of Andersen AFB. This landfill operated in 1976.	Construction debris and concrete, metals, and PAHs.	RI/FS is in process. A ROD recommending no further action is scheduled for 2009.
Site 11 (Landfills 15 & 16)	This site operated from the late 1950s to 1970s is approximately 7 ac and is located in the main base area at Andersen AFB.	Solvents, sanitary trash, construction debris, and drums of lead-based paint.	ROD was issued in 2008. No further response action is planned for Landfill 16.
Site 12 (Landfill 17 and Pau Point Dump)	This approximately 20 ac site operated from 1945 to 1949 and is located on Andersen AFB.	Solvents, sanitary trash, UXO, airplane parts, NiCad batteries, and office waste, metals, pesticides, and PAHs.	Remedial action is at or near completion.
Site 13 (Landfill 18)	This site located in the North Field of Andersen AFB consists of 4 ac and operated from 1967 to 1968.	Asphalt wastes and waste liquids.	RI/FS report is planned for 2010.
Site 14 (Landfill 19)	This site is located in the North Field of Andersen AFB and is approximately 14 ac. The site operated in 1955.	Asphalt wastes, PCBs, arsenic, and lead.	Remedial action is recommended.
Site 15 (Landfill 20)	This site located in the North Field of Andersen AFB is approximately 10 ac. The site operated in 1968.	Sanitary trash, metals, pesticides, PCBs, and PAHs.	An interim remedial action to excavate contaminated soil is at or near completion.
Site 16 (Landfill 21)	This site is located in the Northwest Field of Andersen AFB and is approximately 19 ac. The site operated from the mid 1950s to 1963.	Sanitary trash and construction debris. PAHs, lead, and arsenic were detected. Interim soil/debris remedial action was performed.	No further action ROD was issued in 2008.
Site 17 (Landfill 22)	This site is located in the Northwest Field of Andersen AFB and is approximately 3 ac. The site operated in the mid 1950s.	Sanitary trash, UXO, scrap metal, and black powder.	A ROD was issued in 2008 recommended no further action.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 18 (Landfill 23)	This site is located in Harmon Annex and is approximately 1 ac. The site operated in the late 1950s.	Sanitary trash.	A ROD was issued in 2001 recommended no further action.
Site 19 (Landfill 24)	This site is located in Harmon Annex and consists of 26 ac. The site operated in the 1950s.	Sanitary trash, lead, antimony, and dioxins.	A ROD was issued in 2001 recommended no further action.
Site 20 (Waste Pile 7)	This site is located in Andersen South and is approximately 2 ac. The site operated from 1945 to 1962.	POL, solvents, PCBs, metals, sanitary trash, construction debris, spent equipment, scrap vehicles, dry cleaning fluids.	ROD recommending institutional controls has been issued. The site is under long-term monitoring through 2028.
Site 21 (Landfill 26)	This site is located in the Northwest Field of Andersen AFB and is approximately 18 ac. The site operated in 1966.	Sanitary trash and construction debris.	Ongoing RI/FS.
Site 22 (Waste Pile 6)	This site is located at Andersen South and consists of 20 ac.	Construction debris, sanitary trash, batteries, PAHs, and lead.	A ROD was issued in 1998 recommending soil removal. This removal was completed in 2001.
Site 23 (Waste Pile 5)	This site is located at Andersen South and consists of approximately 2 ac.	Construction debris, household waste, scrap metal, and asphalt.	A ROD was issued in 1998 that recommended no further action.
Site 24 (Landfill 29)	This site is located at Andersen South and is approximately 2 to 3 ac.	Household debris, construction debris, batteries, scrap metal, and empty crushed drums.	A ROD was issued in 1998 recommending soil removal. This removal was completed in 2001.
Site 25 (Firefighter Training Area 1)	This site is located in the North Field and consists of 2 ac. The site operated from 1945 to 1958.	POL and solvents.	A ROD was issued in 2008.
Site 26 (Firefighter Training Area 2)	This site is located in the North Field and consists of about 3 ac. The site operated from 1958 to 1988.	POL and solvents.	A ROD recommending no further action is planned.
Site 27 (Hazardous Waste Storage Area 1)	This site is located in the North Field and is approximately 1 ac. The site operated in the 1950s and also from the 1970s to 1983.	POL, solvents, and hazardous waste.	RI/FS in process.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 28 (Chemical Storage Area)	This 4 ac site is located in the North Field. The site operated in the early 1970s.	POL, solvents, scrap metal, batteries, aircraft and automotive parts, and construction debris.	A no further action ROD was issued in 2008.
Site 29 (Waste Pile 2)	This site is located in the North Field and consists of approximately 4 ac.	Asphalt, asphalt tar, and metals.	A ROD recommending land use control to prevent future residents site access was issued in 2008.
Site 30 (Waste Pile 4 also known as MMRP site MRA 253)	This 18 ac site is located in the Northwest Field. The site operated from 1950 to 1970.	Waste oils, solvents, and UXO.	Site was determined to be contaminated with MEC and was transferred from the environmental restoration program to the MMRP.
Site 31 (Chemical Storage Area 4)	This site consists of about 12 ac and is located in the Northwest Field. The site operated from 1952 to 1956.	Solvents, waste oils, and heavy metals. An interim soil remedial action was performed.	No further action ROD was issued in 2008.
Site 32 (Drum Storage Area 1)	This site consists of approximately 0.5 ac and is located between the North and Northwest Fields. Site reportedly stored and transferred hazardous waste and washing garbage trucks.	POL, solvents, asphalt, pesticides, and chemicals.	Responsibility transferred to the compliance program. No further response action is planned.
Site 33 (Drum Storage Area 2)	This site consists of approximately 6 ac and is located in the North Field.	Asphalt, waste oils, tar, and paint.	Responsibility transferred to the compliance program. Corrective action was complete in 2007.
Site 34 (PCB Storage Area)	The site is approximately 1 ac consists of a concrete pad located in the North Field that is no longer in use.	Transformer oil/transformers and PCBs.	A no further action ROD was issued in 2007. PCBs are a contaminant of concern for potential future residents.
Site 35 (Waste Pile 1)	This site is located in the North Field and consists of approximately 7 ac.	Asphalt tar and heavy metals.	A ROD recommending land use control to prevent future residents was issued in 2008.
Site 36 (Ritidian Point Dump Site)	This 6 ac site is located west of the Northwest Field.	Sanitary trash, UXO/MEC, pesticides, spent metal equipment, 55 gallon drums, batteries, tarpaper, tires, and compressed gas cylinders.	A ROD was issued in 2008 recommending no further action; however contaminants of concern for future residents include metals, dioxins, and pesticides.
Site 37 (War Dog Borrow Pit)	The site is located in Andersen South and is approximately 2 ac.	Vehicle parts.	A ROD was issued in 1998 recommended no further action.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 38 (MARBO Laundry)	This site is located in Andersen South and is approximately 3 ac.	Solvents, lead, and PCBs.	A ROD was issued in 1998 recommending soil removal which was completed in 1999. No further action is proposed.
Site 39 (Harmon Substation)	This site is comprised of approximately 9 ac in Harmon Annex area.	Sanitary trash, PAHs, PCBs, and pesticides.	ROD was issued in 2001 recommending no further action.
Site 40 (Urbana Dumpsite)	This former dump area of approximately 26 ac known as the Urbana site was used as a disposal site for a number of years and the subject of numerous characterization efforts.	Sanitary trash, construction debris, UXO, airplane parts, vehicle parts, metals, PAHs, and compressed gas cylinders.	ROD was issued in 2004 recommending soil removal. Cleanup is at or near completion.
Site 41 (Operational Support Buildings #1, DAO52)	This site includes support buildings such as food shops, a carpenter store, a generator shop, a heavy vehicle shop, vehicle maintenance shops, and a former laundry facility of about 8ac.	Lead and other wastes.	RI/FS is in process.
Site 42 (Operational Support Buildings #2)	This 1.5 ac site consists of a former gas station with two aboveground storage tanks (ASTs).	POL.	RI/FS is in process.
Site 43 (Operational Support Buildings #3, DAO54)	This 35 ac site consists of buildings including: a sign paint shop, battery shop, refrigeration shop, plumbing shop, electric shop, carpenter shop, welding shop with a concrete vault, motor pool building garage, grease stand, machine shop, maintenance shops, generator shack, paint shed, steam shop, and warehouses.	Metals, PCBs, PAHs, and other wastes.	RI/FS is in process. Contaminants of concern for future residents include arsenic and vanadium.
Site 44 (Septic System Tumon Tank Farm, FL055 or former AOC 65)	This site consists of a septic tank system.	Suspected POL and other hazardous materials.	A ROD issued in 2008 recommended no further response.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 45 (Recovery Tank Tumon Tank Farm, TAO56 or former AOC 67)	This site consists of a 23,000 gallon recovery tank.	POL in soils.	A ROD issued in 2008 recommended no further response.
Site 46 (Storm Water Retention Pond, Tumon Tank Farm, SDO57 or former AOC 69)	This site consists of a retention pond (i.e., 10'x10'x5').	Suspect POL-related wastes.	A ROD issued in 2008 recommended no further response.
Site 47 (Cleaning West of Housing at Northwest Field, DPO58 or former AOC 80)	This 1.4 ac site was the subject of concern due to the presence of surface waste debris that has subsequently been removed.	Heavy metals, grease cans, metal debris, and glass bottles.	A ROD was issued in 2007 recommending soil removal planned for 2010.
Site 48 (Tank Farm, Northwest Field, TAO59 or former AOC 83)	This approximately 14 ac site consists of an area of possible fuel releases associated with an abandoned aviation fuel storage area.	POL, heavy metals, and PAHs.	A ROD was issued in 2008 recommending no further action.
Site 49 (Native Plantation, Northwest Field, DAO60 or former AOC 84)	This 5.5 ac site is located in the Northwest Field at Andersen AFB.	Heavy metals.	A ROD was issued in 2008 recommending no further action.
Site 50 (Building 8024, Northwest Field, former AOC 85 or SS061)	This site was an area of concern due to the presence of four surface debris mounds.	Heavy metals, asphalt, batteries, scrap metal, unspecified hazardous materials, and construction debris.	A ROD was issued in 2007 recommending soil removal planned for 2010. Antimony in subsurface soils would be a concern for future residents.
Site 51 (South Runway Approach Zone, Northwest Field, LF062 and former AOC 93)	This site is approximately 16 ac and was used as a dump site for a variety of wastes.	Scrap metal, heavy metal, UXO, and glass bottles.	A ROD was issued in 2007 recommending soil removal planned for 2010. Aluminum and chromium would be a concern for future residents.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 52 (UXO, Northwest Field, LF063)	This site is located in the Northwest Field of Andersen AFB and is portion of a larger 380 ac area.	UXO.	Due to the MEC, the site has been transferred to the MMRP.
Site 53 (Service Apron "H" and Quonset Huts, former AOC 99)	This 30 ac area was likely used as a hazardous materials dump site. The site is near a group of concrete pads that are the remnants of carpentry, sheet metal, machine, plumbing, and electrical shops.	Solvents, hydraulic fluid, POL, heavy metals, and PAHs.	A ROD was issued in 2007 recommending soil removal planned for 2010.
Site 54 (Building 1806; AOCs 7A, 7B, 7C, & 7D, LF074)	This site includes an aircraft maintenance shop (AOC 7A), an aircraft maintenance and battery shop (AOC 7B), an aircraft maintenance shop and USTs (AOC 7C), and an aircraft maintenance shop and waste products storage area (AOC 7D).	Aircraft operations wastes.	RI/FS is in process.
Site 55 (Area outside of Landfill 14, LF066)	This nearly 7 ac site is located just outside of Landfill 14.	Anitmony, arsenic, lead, batteries, scrap metal, and piping.	A ROD was issued in 2007 recommending soil removal planned for 2010.
Site 56 (Waste Pile 8, Northwest Field; DP067)	This area is an inactive waste disposal site located in a quarried area between the North Runway and North Taxiway at Northwest Field.	Drums, tires, canisters, and asphalt.	No further action ROD was issued in 2008.
Site 57 (Waste Pile 9, Northwest Field, DP068)	This area is identified as an inactive waste disposal site in a former borrow pit located south of the North Runway in the Northwest Field.	55-gallon drums, light fixtures, electronic components, scrap metal, explosives, and rubber.	RI/FS is in process.
Site 58 (Waste Pile 10, Northwest Field, DPO69)	This site is an inactive waste disposal site located approximately 600 feet (ft) northeast of the Southwest Cross-Over at the South Runway.	Partially buried drums/metal debris under crushed coral and soil.	A ROD issued in 2008 recommended no further response.
Site 59 (MSA Magazine 7 Trench, LF070)	This magazine trench (i.e., 400'x60'x3') is located at the Northwest Field.	Metal debris, tin roof sheeting, and corroded metal boxes.	A ROD issued in 2008 recommended no further response.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 60 (MSA Cliff-Line Dump Site, LF071 or former AOC 102)	This 3 ac site located along a cliff-line area at the Northwest Field and was used to dump a variety of wastes.	Suspected ordnance and solid waste dump area.	Site has been transferred to the MMRP. Additional site characterization is ongoing.
Site 61 (MSA Waste Pile, DPO72)	This 3.5 ac waste pile is located at the Northwest Field.	Suspected ordnance and solid waste dump area.	A ROD issued in 2008 recommended no further response.
Site 62 (MSA UXO Burn/Dump Site)	This 6 ac site was used to deposit and burn UXO.	UXO and munitions constituents.	This site is under consideration for the MMRP.
Site 63 (MSA Coral Dump Site, LF074 or formerly AOC 105)	This site is approximately 8 ac.	Scrap metal, corrugated sheet metal, UXO, auto parts, aircraft engine parts, drums, and MEC and explosive waste.	RI/FS is in process.
Site 64 (Asphalt Drum Area; AJJYDAO75 or Site 106)	This 3.5 ac drum disposal area is on Andersen AFB containing an estimated 100 to 300 deteriorated drums that leaked tar onto the ground leaving 6 to 8 inch pools of tar.	Asphal /tar waste.	RI/FS is in process. An RI report was completed in 2009.
Site 65 (Asphalt Drum Area and OEW Area with Oil/Water Separator; AJJYDA076 or Site 107)	This 50 ac drum disposal area and oil/water separator is located within the confines of Andersen AFB was a former industrial shops area.	POL, various debris, MEC, scrap metal, tires, PAHs, heavy metals including lead, concrete, and asphalt.	RI/FS is in process. Part of this site will be transferred to the MMRP. An RI report was completed in 2009.
Site 66 (Abandoned Sewage Disposal)	This former sewage disposal area is approximately 10 ac and is located within the confines of Andersen AFB.	55-gallon drum remnants, scrap metal, construction debris, heavy metals, pesticides, and PAHs.	RI/FS is in process.
Site 67 (Quarry Cliff-line Dump, LF078)	This 4 ac dump site is located within the confines of Andersen AFB.	Scrap metal, tools, asphalt, and various other construction debris.	A ROD issued in 2008 recommended no further response.
Site 68 (Beach Road Waste Pile, DPO79)	This 10 ac waste pile is within the Andersen AFB boundary line.	Scrap metal, tools, asphalt, and suspected asbestos containing material.	A ROD issued in 2008 recommended no further response.

**Table 3.6-1. Summary of Active Environmental Restoration Sites on Andersen AFB**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>North Guam</i>			
Site 69 (Fuel Storage Tanks and Associated Piping Tumon Tank)	This site consists of 7 fuel storage tanks and associated piping located at Andersen AFB. The total capacity was approximately 2.1 million gallons.	POL.	A ROD issued in 2008 recommended no further action.
Site 70 (Waste Pile 11, Northwest Field, DP081)	This site is an inactive waste disposal area located in the Northwest Field at Andersen AFB.	Sanitary trash, scrap metal, canisters, and buckets.	A ROD issued in 2008 recommended no further response.
Site 71 (Waste Pile 12, Northwest Field, DP082)	This site consists of a former waste pit that contains a variety of waste materials.	Scrap metal, construction debris, 55-gallon drums, telephone poles, and electrical components.	RI/FS is in process.
Site 72 (Waste Pile 13, Northwest Field, DP083)	This waste pile is located in the Northwest Field at Andersen AFB.	Pumps, motors, turbine fans, refrigerators, scrap metal, drums.	RI/FS is in process.
Site 73 (Waste Pile 14, Northwest Field, DPO84)	This site is a former quarry area located approximately 150 ft from the intersection of 6 <sup>th</sup> and A streets, in the dependent housing area of Andersen AFB.	Drum pile of approximately 20 rusty, but still intact drums – Various wastes.	A ROD issued in 2008 recommended no further response.
Site 74 (UST, Northwest Field, TT085 or former AOC 13)	This site contained one UST in the vicinity of the former flight line facilities. The UST appeared to be inactive; however the UST did contain some unknown fluid inside.	Unknown wastes.	RI/FS is in process.
Site 75 (AST, Northwest Field, TAO86 or former AOC 15, 16, & 20)	This site contained four above ground storage tanks. The drums contained petroleum waste materials.	POL and other contaminants.	RI/FS is in process.
Site 76 (Mixed Waste Area, Northwest Field, WM087 or former AOCs 23, 24, 25, 26, & 27)	This site contains two waste piles, an asphalt pile, abandoned drums, and a trench used for household waste disposal.	Metal and concrete debris, asphalt waste, drums, wood, electric components, tires, household refuse, and telephone poles.	RI/FS is in process.
Site 77 (Operational Support Buildings #4, DAO88)	This 37 ac site consists of a series of operational support buildings located at Andersen AFB.	Scrap metal, aircraft and automobile parts, and UXO/MEC.	RI/FS is in process.
Site 78 (Firefighter Training Area 3)	This 10 ac site as a former firefighter Training Area.	Aircraft parts, POL, PAHs, lead, and dioxins.	RI/FS is in process.

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or former AOC 8)			
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\* These sites are associated with Andersen AFB. This list does not include the Andersen AFB stormwater drain system (Zones 1, 2, or 3), drain fields, Solid Waste Management Units (SWMUs), Areas of Concern (AOCs), or the Barrigada Communication Facility.

Sources: Andersen AFB 1993, Air Force 2008a; 2009a, b; NAVFAC Pacific 2008d, NAVFAC 2009.

**Table 3.6-2. Summary of Applicable SWMUs and Areas of Concern (AOC) Sites on Andersen AFB**

<i>Site Number or Location</i>	<i>Site Identification</i>	<i>Name/Description</i>	<i>Program or Site Status</i>
1	AOC 1	Hazardous Waste Storage Facility	RCRA
2	AOC 2	Hazardous Waste Accumulation/Storage Area	FFA
4	AOC 4	Asbestos Disposal Trench	FFA
5	AOC 5	Trench of EIS Site 4	FFA
6	AOC 7A	Aircraft Maintenance Shop – Battery Shops	RCRA
7	AOC 7B	Aircraft Maintenance Shop – USTs	FFA
8	AOC 7C	Aircraft Maintenance Shop – Waste Products Storage Area	FFA
9	AOC 7D	Aircraft Maintenance Shop – Degreasing Unit	FFA
10	AOC 8	Former Firefighter Training Area 3	FFA
11	AOC 9	Oil Blending Facility	FFA
12	AOC 29	Hazardous Waste Storage Area	RCRA
Marbo Annex	AOC 46 (previously called AOC 1)	Surficial Waste Disposal Area – 17 automobile batteries were observed and removed with no evidence of contamination.	NFA Recommended
Marbo Annex	AOC 47 (combined previously called AOCs 2, 3, 4, 5, and 6)	Surficial Waste Disposal Area - Waste includes household surface debris, applicances, abandoned vehicles and vehicle parts, metal debris, and electric equipment. Material disposed is non-hazardous and potential contamination is unlikely.	Removal of surface wastes is recommended
Northwest Field, Andersen AFB	AOC 79 Abandon AVGAS Pipeline	Identified as an AOC due to the potential release of fuel-related constituents from an abandoned aviation gas pipeline. No contaminants of concern were detected above PRGs.	NFA Recommended
Northwest Field, Andersen AFB	AOC-80 Clearing West of Housing	Identified as an AOC due to the presence of surface waste debris such as grease cans, metal debris, and glass bottles near a cleared area. Heavy metals found above preliminary remediation goals (PRGs), thus soil remedial or removal action is required.	Soil Remedial or Removal Action is recommended
Northwest Field, Andersen AFB	AOC-81 Air-to-Ground Gunnery Range	Identified as an AOC due to the presence of surface waste debris such as metal debris and glass bottles at the former air-to-ground gunnery range with trenches, mounds, and depressions. Heavy metals found above preliminary remediation goals (PRGs) thus soil remedial or removal action is required.	Soil Remedial or Removal Action recommended
Northwest Field, Andersen AFB	AOC-82 Sanitary and Burnable Dump	Identified as an AOC due to the presence of surface waste debris such as metal debris and cylinders at a former dump site with glass and metal debris. DDT, copper, and lead above residential PRGs were detected.	NFA is recommended per health risk assessment
Northwest Field, Andersen AFB	AOC-83 Tank Farm	Identified as an AOC due to the potential release of fuel-related constituents to soils from the abandoned aviation fuel storage area. Benzo(a)pyrene, Benzo(b)fluoranthene, Lead above residential PRGs has been detected.	Soil Removal Action is recommended for lead

**Table 3.6-2. Summary of Applicable SWMUs and Areas of Concern (AOC) Sites on Andersen AFB**

<i>Site Number or Location</i>	<i>Site Identification</i>	<i>Name/Description</i>	<i>Program or Site Status</i>
Northwest Field, Andersen AFB	AOC-84 Native Plantation	Identified as an AOC due to the unknown nature of the site's operation. Manganese was detected above residential PRGs.	Soil Remedial or Removal Action is recommended for manganese impacted area
Northwest Field, Andersen AFB	AOC-85 Building 8024	Identified as an AOC due to the presence of surface waste debris such as metal and construction debris near an area with four debris mounds. Antimony, Beryllium, and Manganese were detected above residential PRGs.	Soil Remedial or Removal Action is recommended
Northwest Field, Andersen AFB	AOC-86 Achae Point Quarry	Identified as an AOC due to the potential disposal of hazardous materials including pesticides, PCBs, and/or petroleum related products at an abandoned dump site with glass bottles, scrap metal, vehicle parts, and used oil filters.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-87 Radar Bomb Scoring Site Cleared Area	Identified as an AOC due to the presence of surface waste debris such as metal debris and an empty 55-gallon drum near a shallow depression area. No contaminants of concern were detected above PRGs.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-88 Radar Bomb Scoring site	Identified as an AOC due to the potential disposal of hazardous materials near a group of concrete pads containing remnants of a generator building, former automobile maintenance shop, two small tanks, a flammable storage area, and a septic tank.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-89 Lighthouse Road Quarry	Identified as an AOC due to the presence of surface waste debris such as soda bottles, a diesel engine block, tires, air brake cylinders, vehicle parts, and scrap metal near quarry. Antimony, Lead, Manganese, and Arsenic were detected at the site.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-90 Mt. Machanao Area	Identified as an AOC due to the presence of surface waste debris such as a utility pole, insulators, scrap metal, and wires near a mound. Manganese was detected at the site.	No Further Action is

**Table 3.6-2. Summary of Applicable SWMUs and Areas of Concern (AOC) Sites on Andersen AFB**

<i>Site Number or Location</i>	<i>Site Identification</i>	<i>Name/Description</i>	<i>Program or Site Status</i>
			recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-91 EOD Rifle Range	Identified as an AOC due to the potential presence of spent ordnance at two mounds suspected of a backdrop for the firing range. Beryllium and Manganese were detected above residential PRGs.	Soil Remedial or Removal Action is recommended
Northwest Field, Andersen AFB	AOC-92 Abandoned AVGAS Tanks	Identified as an AOC due to the potential release of fuel-related constituents and surface waste debris such as bottles, cans, scrap metal, and metal pieces at a former aviation fuel tank farm.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-93 South Runway Approach Zone	Identified as an AOC due to the presence of surface waste debris such as glass bottles and scrap metal near a group of trenches and mounds. Aluminum, Beryllium, Total Chromium, and Manganese were detected above residential PRGs.	Soil Remedial or Removal Action is recommended
Northwest Field, Andersen AFB	AOC-94 UXO	Identified as an AOC due to the suspected disposal of ordnance at the 380-ac area.	Needs further investigation to characterize the existence of UXO contamination or its potential for a release to the environment.
Northwest Field, Andersen AFB	AOC-95 North Buildings	Identified as an AOC due to unknown nature of the site operation near a group of concrete pads. No contaminants of concern were detected above PRGs.	No Further Action is recommended
Northwest Field, Andersen AFB	AOC-96 Earthen Mounds	Identified as an AOC due to unknown nature of the site operation near an area consisting of two linear mounds. Manganese detected slightly above the residential PRG.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-97 Waste Pile	Identified as an AOC due to the presence of surface waste debris such as concrete, rusty metal, and broken ceramic dishware near a waste disposal site. No contaminants of	No Further Action is

**Table 3.6-2. Summary of Applicable SWMUs and Areas of Concern (AOC) Sites on Andersen AFB**

<i>Site Number or Location</i>	<i>Site Identification</i>	<i>Name/Description</i>	<i>Program or Site Status</i>
		concern were detected above PRGs.	recommended
Northwest Field, Andersen AFB	AOC-98 2X Tank Farm	Identified as an AOC due to the potential release of fuel-related constituents to soils at the former location of above ground storage tanks. Benzo(a)pyrene was detected slightly above the residential PRG.	No Further Action is recommended based on health risk evaluation
Northwest Field, Andersen AFB	AOC-99 Service Apron "H" and Quonset Huts	Identified as an AOC due to the suspected disposal of hazardous materials near a group of concrete pads identified as remnants of carpentry, sheet metal, machine, plumbing, and electrical shops. Benzo(a)pyrene, Benzo(a)anthracene, Benzo(b)fluoranthene, Indeno(1,2,3-c,d)pyrene, Copper, and Manganese were detected above the residential PRGs.	Soil Remedial or Removal Action is recommended
Northwest Field, Andersen AFB	AOC-100 East Barracks	Identified as an AOC inadvertently. AOC-100 was a former residential area.	No Further Action is Recommended
Northwest Field, Andersen AFB	AOC-101 Dispensary	Identified as an AOC due to the suspected disposal of hazardous materials at the buildings near the three pits found at the site. No contaminants of concern were detected above PRGs.	No Further Action is Recommended
Northwest Field, Andersen AFB	AOC-102 West Barracks	Identified as an AOC due to presence of surface waste debris such as metal debris and deteriorated drums at the trench. No contaminants of concern were detected above PRGs.	No Further Action is Recommended
Northwest Field, Andersen AFB	AOC-103 Apron 2051	Identified as an AOC due to the potential release of fuel-related constituents to soils near an unpaved aircraft service area. No contaminants of concern were detected above PRGs.	No Further Action is Recommended
Northwest Field, Andersen AFB	AOC-104 Quarry	Identified as an AOC due to the presence of surface waste debris such as empty 55-gallon drums, grease tubes, scrap metal, vehicle parts, and bottles near a quarry. No contaminants of concern were detected above PRGs.	No Further Action is Recommended
14	SWMU 4	Outside Aircraft Washrack Oil/Water Separator	FFA
15	SWMU 6	Outside Drum Storage Area	FFA
16	SWMU 7	Inside Washrack Oil/Water Separator	RCRA
17	SWMU 8A	Outside Drum Storage Area	FFA
18	SWMU 8B	East Oil/Water Separator	FFA
19	SWMU 8C	West Oil/Water Separator	FFA
20	SWMU 9	Outside Drum Storage Area	FFA
21	SWMU 10	Outside Drum Storage Area	FFA
22	SWMU 11	Outside Drum Storage Area	FFA

**Table 3.6-2. Summary of Applicable SWMUs and Areas of Concern (AOC) Sites on Andersen AFB**

<i>Site Number or Location</i>	<i>Site Identification</i>	<i>Name/Description</i>	<i>Program or Site Status</i>
23	SWMU 12	Outside Drum Storage Area	FFA
24	SWMU 13A	Outside Drum Storage Area	FFA
25	SWMU 13B	Oil/Water Separator	RCRA
26	SWMU 15	Buildings 2550 and 2552 Oil/Water Separator	FFA
27	SWMU 16A	Oil/Water Separator	RCRA
28	SWMU 16C	Waste Oil Storage Tanks	FFA
29	SWMU 17	Oil/Water Separator	FFA
30	SWMU 18	Outside Drum Storage Area	FFA
31	SWMU 20D	Service Station: Outside Drum Storage Area	FFA
32	SWMU 20E	Service Station: In-ground Sumps and Trenches	FFA
33	SWMU 21C	USAF Clinic, Photo Lab: Incinerator	RCRA
34	SWMU 22A	Aircraft Corrosion Control: Inside Drum Storage Area	FFA
35	SWMU 22B	Aircraft Corrosion Control: Inside Storage Room	FFA
36	SWMU 22C	Aircraft Corrosion Control: Outside Drum Storage Area	FFA
37	SWMU 23A	Hazardous Waste Satellite Accumulation Point	RCRA
38	SWMU 23B	Used Petroleum Products Area	FFA
39	SWMU 25	Defensive Fire Control: Drum Storage Area	RCRA
40	SWMU 27	Corrosion Control (Hazardous Waste Accumulation Area, Flammable Storage Room)	RCRA
41	SWMU 29A	Industrial Corrosion Control – Drum Storage Area	FFA
42	SWMU 29B	Industrial Corrosion Control – Hazardous Materials Storage Areas and Associated Spill Areas	FFA
43	SWMU 29B	Industrial Corrosion Control – Hazardous Materials Storage Areas and Associated Spill Areas	FFA
44	SWMU 29C	Industrial Corrosion Control: Septic System	FFA
45	SWMU 30C	Aerospace Ground Equipment: Oil/Water Separator: Includes Settling Tank	FFA
46	SWMU 30D	Aerospace Ground Equipment: Drum Storage Areas	FFA
47	SWMU 31A	Refueling Maintenance: Drum Storage Area	RCRA
48	SWMU 31B	Refueling Maintenance: Spill Site	FFA
49	SWMU 32A	Auto Hobby Shop: Inside Drum Storage Area	RCRA
50	SWMU 32D	Auto Hobby Shop: Used Petroleum Products Storage Area	RCRA
51	SWMU 32E	Auto Hobby Shop: Abandoned Car Storage Area	FFA
52	SWMU 32G/F	Auto Hobby Shop: Used Battery Storage Area	FFA
53	SWMU 33	Fuels Laboratory	FFA
54	SWMU 34A	Liquid Oxygen (LOX) Facility: Oil/Water Separators	FFA
55	SWMU 34B	Liquid Oxygen (LOX) Facility: Septic Tank and Leach Field	RCRA

**Table 3.6-2. Summary of Applicable SWMUs and Areas of Concern (AOC) Sites on Andersen AFB**

<i>Site Number or Location</i>	<i>Site Identification</i>	<i>Name/Description</i>	<i>Program or Site Status</i>
56	SWMU 35A & B	Bomb Renovation, Paint, and Refrigeration: Inside Storage Area	FFA
57	SWMU 35C	Bomb Renovation, Paint, and Refrigeration: Outside Storage and Staging Area	FFA
58	SWMU 37A	Line Delivery and Handling: Vehicle Maintenance Pit	FFA
60	SWMU 40B	Roads and Grounds (and heavy equipment shops): Flammable Materials Storage Room	RCRA
61	SWMU 40C	Roads and Grounds (and heavy equipment shops): Equipment Washing Area – Washrack	FFA
62	SWMU 41	Fire Protection Branch	FFA
63	SWMU 42B	Oil/Water Separator	FFA
64	SWMU 42C	Battery Shop	RCRA
65	SWMU 42D	Hazardous Waste Satellite Accumulation Point	FFA
66	SWMU 42E	Drum Storage Area	FFA
67	SWMU 42F	Vehicle Salvage Area	FFA
68	SWMU 43	Dumpster Washrack	FFA
69	SWMU 44	Hanger Oil/Water Separator	FFA
70	SWMU 46A	POL Washrack Oil/Water Storage Area	FFA
71	SWMU 46B	Outside Drum Storage Area	FFA
72	SWMU 47C	Northwest Field – Power Plant: Waste Oil Storage	FFA
73	SWMU 53B	Andersen 1 Tank Farm: Drum Storage Area	FFA
74	SWMU 53C	Andersen 1 Tank Farm: Land Disposal Area	FFA
75	SWMU 53D	Andersen 1 Tank Farm: Routine Spill Site	FFA
76	SWMU 53F	Andersen 2 Tank Farm: Collection Pit	FFA
77	SWMU 56	Landfill Complex – Landfill 01	RCRA
78	SWMU 57	Drum Storage Area No. 2	FFA
79	DSA – 1	Drum Storage Area No. 1	FFA

Sources: Andersen AFB 1993, Air Force 2009 a and b; Air Force 2008a; Air Force 1997; NAVFAC Pacific 2008d.

Notes: AOCs 57, 58, 59, 60, 61, and 62 are not listed in this Table because following the PA/SI process; none of these AOCs became IRP sites. Furthermore, it was deemed that no further action was required at these AOCs.

**Table 3.6-3. Summary of Active Navy Environmental Restoration Sites in Central Guam**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminant s</i>	<i>Status</i>
<i>Central Guam</i>			
BRAC NAS Agana Site 30-37: Agana Power Plant (APP)	The Navy is the lead cleanup agency under BRAC for the APP. APP covers about 3 acres and is located in the village of Mongmong in central Guam. APP was built in 1949 to provide electricity to former Naval Air Station (NAS) Agana (now the Antonio B. Won Pat International Airport). NAS Agana was closed in 1995 eliminating the need for APP.	VOCs, SVOCs, PCBs, dioxins, and TPHs.	Investigations and cleanup activities at the site are complete. Cleanup initiatives completed included the removal and disposal off island of PCB contaminated soils. Land use controls (LUCs) serve as the final remedy for this site. The LUCs involve zoning restrictions, permit requirements, and deed restrictions. In addition statutory five-year reviews of the site are mandated.
IR PWC Site 2810: Construction Battalion (CB) Landfill	The former CB Landfill is located at the Naval Computer and Telecommunications Area Master Station (NCTAMS), Finegayan, Guam. It encompasses 2.6 ac and is located in the southwestern portion of the facility. The former CB Landfill was used primarily for disposal of wastes from a CB maintenance shop. The site was investigated from 1982 through 1995. A removal action was conducted at the site in 1998 and included a low permeability containment system consisting of a soil and synthetic cover system over buried landfill wastes. Based on results of post-removal action monitoring, the site no longer requires groundwater and gas monitoring.	POL, scrap metal, aircraft and vehicle parts, tires, concrete, glass, paint cans, and domestic trash.	The final remedy for this site is the implementation of LUCs. The site is currently maintained semiannually and five-year reviews are implemented to ensure that the site is not used. Surface soils may pose unacceptable risk to human health and the environment due to concentrations of metals, polycyclic aromatic hydrocarbons, and pesticides.
BRAC NAS Agana Site 28: POI-26 Lead-Based Paint Residue in the Enlisted Family Housing Area	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana. Constructed in the 1950s and 1960s and used for housing until the base closed in April 1995. The units are now occupied by GovGuam and are used as offices. Some units have been demolished and the remaining units are scheduled to be demolished.	Lead	Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 7: POI-05 Former Auto Hobby Shop	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam. A 1959 Master Shore Station Development Plan shows five structures in the location of the Former Auto Hobby Shop. According to historical maps and aerial photographs, the Auto Hobby Shop was used from at least the early 1970s until 1977. It is not known whether these structures were associated with	Waste oil	The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.

**Table 3.6-3. Summary of Active Navy Environmental Restoration Sites in Central Guam**

Site ID	Site Description	Contaminants	Status
Central Guam			
	<p>the Auto Hobby Shop. Although vehicle fluids were supposed to have been containerized in drums, cars were reportedly parked above the two trenches and their vehicle fluids were drained directly into them. These trenches terminate at a ravine, which in turn, drain into the adjacent wetland. The amount of waste oil disposed of into the trenches has not been determined.</p> <p>The trenches were cleaned in 1988 and filled with rocks to prevent further use. No evidence of any oil migrating from the trenches was noted at that time.</p>		
<p>BRAC NAS Agana Site 8: POI-06 GSE Maintenance Facility</p>	<p>This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam.</p> <p>The facility provided maintenance functions for all ground support equipment from 1965 to 1994. Prior to 1962, waste dry-cleaning solvents were discharged to the ground surface around the facility, and waste oil was reportedly used for weed control in the area before 1963.</p> <p>A hazardous-materials storage locker that stored chemical conversion coatings was located on site. The concrete apron between the two buildings slopes down toward the center where it discharges to two unlined culverts at the fence line. From approximately 1978 to 1991, a sandblast booth was operated on site to strip equipment of enamel paint. No records exist that document the removal and/or disposal of the sandblast grit mounds at the facility.</p>	<p>Waste oil and solvents</p>	<p>Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.</p>
<p>BRAC NAS Agana Site 12: POI-10 Former Fire Fighting Training Pits</p>	<p>This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam.</p> <p>From 1955 to base closure, the NAS Agana crash crew regularly conducted fire fighting training activities in four burn pits.</p> <p>Activities included burning 500–1,000 gallons of aviation fuel at a time mixed with approximately ten percent waste oils, Freon, and hydraulic fluids.</p>	<p>Waste oils, Freon, hydraulic fluids, aviation fuels (JP-4 and JP-5)</p>	<p>Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.</p>
<p>BRAC NAS</p>	<p>This site is one of 11 LUC sites that are part of Operable Unit 2</p>	<p>Asbestos</p>	<p>Investigations and cleanup activities at the site were</p>

**Table 3.6-3. Summary of Active Navy Environmental Restoration Sites in Central Guam**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>Central Guam</i>			
Agana Site 13: POI-11 Former Coral Pit/Dump	and IRP Site 2 that are located at the former NAS Agana in central Guam. The Coral Pit/Dump site was created following cessation of fire fighting training in Burn Pit No. 1 in the 1950s. The burn pit was excavated for coral and eventually served as a disposal site for vegetative slash. A 1957 drawing shows this dump in association with an abandoned coral pit. Several 1950s-era aerial photos show standing liquid in the coral pit/dump and four upright, aligned cylindrical objects immediately to the south; in 1959 photos, the cylindrical objects were no longer present. Both the 1956 and the 1959 aerial photos depict an AST to the south and another coral pit to the east.	containing material (ACM), Total Petroleum Hydrocarbons (TPHs)	completed in 2001 with the removal of debris, asbestos containing material, and TPH impacted soil for disposal at NAS Agana Landfill. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 20: POI-18 VQ-5 Interceptor Drainage	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam. The oil/water separator (OWS) operated for 20–30 years. The adjacent OWS was constructed in approximately 1980, and was used to separate oil and water in the aircraft wash rack effluent or storm water runoff that entered the wash rack.	Waste oils	Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 21: POI-19 PWC Maintenance Facility	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam. The hazardous waste storage area was used from the early 1960s until 1995 to store wastes generated at the repair shop prior to offsite disposal. The two USTs adjacent to Bldg. 16-6103 were investigated by the Navy's UST program, and are not addressed here.	Waste oils, solvents	Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 22: POI-20 PWC Guam Gas Station	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam. Bldg. 16-94 was used as a fuel-dispensing station from the 1960s through 1993. A leak in the piping beneath the former pump islands was discovered in 1993; an estimated 2,500 gallons of unleaded gasoline was released.	Fuels, gasoline	Investigations and cleanup activities at the site are complete. The remediation effort completed in 1997 removed TPH containing soil and the above ground storage tank system. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 23: POI-21 Former	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam. The Navy conducted the majority of aircraft	Waste oils, hydraulic fluids, and	Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are

**Table 3.6-3. Summary of Active Navy Environmental Restoration Sites in Central Guam**

Site ID	Site Description	Contaminants	Status
Central Guam			
Operations Area North of Runway	operations and maintenance activities at POI-21 until a 1962 typhoon destroyed most of the structures. Onsite maintenance of planes was also reportedly performed along the flight line. Seven areas (A–G) were identified for investigation based on the hazardous substances reportedly used, stored, generated, and potentially released or disposed of at these locations. These areas include ASTs, OWSs, drainage areas, and the runway zone.	fuels	implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 5: POI-03 Former Aircraft Graveyard	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former Naval Air Station (NAS) Agana in central Guam. In an aerial photograph from the 1950s, approximately 20 abandoned airplanes in various stages of disrepair are visible on site. In a subsequent photograph taken in 1959, the aircraft are no longer visible. Historic maps indicated no other use of the parcel than that of an aircraft graveyard. It is unknown if aircraft were removed or buried at the site.	Waste oils, hydraulic fluids	Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 2: IRP-02 Drainage Basin Holding Pond	This site is one of 11 LUC sites that are part of Operable Unit 2 and IRP Site 2 that are located at the former NAS Agana in central Guam. As early as 1944, the ponds collected storm water and other wash-down runoff water from runways, access roads, and station facilities, which drain to the interior of NAS Agana. Twenty-eight pre-1950 dry injection wells are installed in each pond to facilitate infiltration into the underlying fractured limestone aquifer. The ponds receive runoff from approximately 85 acres of taxiways.	PAHs, VOCs, semi volatile organic compounds (SVOCs), pesticides, and metals	The Navy conducted a site investigation during 1986–1989 at IRP-02 as part of the Navy IRP. Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
BRAC NAS Agana Site 1: Former NAS Agana Landfill Site located at the former NAS Agana, Guam	The former NAS Agana Landfill located at the former NAS in the area referred by locals as Tiyan. Tiyan is approximately 40 acres located approximately 4,000 ft west-northwest of the intersection of Routes 8 and 10. The site includes two formerly used refuse disposal areas referred to as the upper and lower landfills.	VOCs, semi volatile organic compounds (SVOCs), pesticides, and metals	LUCs serve as the final remedy for the site. These LUCs prohibit the development and use of the property for residential housing, schools, child care facilities, & playgrounds. Five-year site reviews will be conducted per CERCLA requirements.

**Table 3.6-3. Summary of Active Navy Environmental Restoration Sites in Central Guam**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>Central Guam</i>			
IR NCTAMS WESTPAC Site 14: RTF Barrigada Golf Course	The site is a landfill that was utilized from 1950 to 1954. The site is a depression located approx. 400 ft to the southeast of the 3rd hole and approx. 300 ft directly north of the 5th hole of the Nimitz Golf Course. It was reported that municipal “refuse” and possibly waste oil from motor pool activities were indicated that debris generated during construction of the golf course (e.g. trees, shrubs, dirt and rocks) were disposed of at the site.	Total petroleum hydrocarbons (TPH), total fuel hydrocarbons (TFH), and SVOCs.	A Site Inspection (SI) was conducted in September 1991. The SI recommended that further work be conducted to assess the nature and extent of the identified hydrocarbons. A remedial investigation (RI) is programmed to start in FY 12.  Potential media: soil and groundwater.
BRAC NAS Agana Site 38: Tamuning Telephone Exchange (TTE), Tamuning, Guam	TTE is a 2-ac land parcel that fronts Marine Corps Drive (Route 1). Hagatna, the capital of Guam is located about 2 miles to the west of TTE and the former NAS Agana is about 700 ft to the southeast of the site. The site is vacant and has a 7-ft high chain link fence surrounding the property to deter unauthorized access. The facility was constructed in 1949 to provide telephone and fire alarm services to NAS Agana until it was closed in 1995. Two USTs were installed at TTE to provide diesel fuel for the emergency generator. The site contains lead/acid batteries and spent solvents.	Sulfuric acid, solvents (carbon tetrachloride)	SI and cleanup are complete. LUCs serve as the final remedy for the site. Five-year site reviews will be conducted per CERCLA requirements.
IR PWC Site 36-40: Various Electrical Utilities	The Various Electrical Utilities include Piti Power Plant, Piti Substation, Marbo Power Plant, Harmon Substation, Barrigada Substation, and 13 transmission line sites. These sites are located throughout northern and central Guam. These sites were previously identified to have known or suspected soil contamination in an Environmental Baseline Survey (EBS) in 1996. A Removal Site Evaluation was performed in 2008 and PCBs and metals in soil were detected at concentrations higher than the action levels.	PCBs and metals	The sites are currently undergoing a removal action. Based on the results of the removal action, the sites may require implementation of LUCs as the final remedy. The LUCs may include restrictions on future land use and development and require CERCLA site reviews every five years.
MRP NCTAMS WESTPAC UXO 1: NCTAMS Trap and Skeet Range	The range is located in the area east of Haputo Point. The range was used for recreational shooting in the 1960s and 1970s. It has not been used since the 1980s.	Metals, PAHs	SI field work complete. Preliminary results indicate that elevated concentrations of lead and PAHs are present at this site and further study will be required.

**Table 3.6-3. Summary of Active Navy Environmental Restoration Sites in Central Guam**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminant s</i>	<i>Status</i>
<i>Central Guam</i>			
MRP NCTAMS WESTPAC UXO 2: NCTAMS Small Arms Range	The range purportedly exists south of the trap and skeet range. No information is available.	Metals	SI field work complete. Preliminary results indicate that no risk to human health or ecological receptors is present and no further action will be required.
NCTS Finegayan Landfill No. 1	This landfill is located along Haputo Road that parallels an exercise trail and encompasses approximately three acres. This Landfill was used from the late 1940s until 1968.	Metals, scrap wood, solvents and other industrial wastes, and municipal refuse	SI field work complete. No significant health hazards other than low levels of lead below the maximum contaminant level (MCL) have been observed from sampling events (dry and wet seasons) at this Landfill.
NCTS Finegayan Landfill No. 2	This landfill is approximately 2,000 feet northeast of NCTS Finegayan Landfill No. 1 and was in use from 1968 until 1980. This landfill is located within a naturally occurring sinkhole.	Building rubble and demolition debris, waste oils, solvents, insulation materials, PCB-containing oils, and oil filters	SI field work complete. No significant health hazards other than low levels of lead below MCL have been observed from sampling events (dry and wet seasons) at this Landfill.

Sources: Ecology and Environment, Inc. 1990; NAVFAC Pacific 2009.

**Table 3.6-4. Summary of Active Navy Hazardous Waste Sites in Apra Harbor**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>Apra Harbor</i>			
IR FISC SWMU #12 DRMO Salvage and Scrap Yard	The site was a DRMO salvage and scrap yard where hazardous materials and waste were stored and handled. Final RFI report recommended cleanup of surface soil and sediment because of SVOCs, PCBs, and lead contamination. In July 1999, about 50 cubic yards of contaminated soil at various locations within the DRMO compound and adjacent drainage swales were removed. Subsequent verification sampling determined that all contamination was removed except PCB hotspots located in adjacent drainage swales. Average concentration of 84 mg/kg in subsurface soils was not deemed hazardous to human or ecological receptors because of the existing vegetation cover	Waste oils, solvents, PCBs, metals, TPHs	. A removal action is ongoing for the removal of PCBs in surface and subsurface soil within the drainage swale.
IR NAVACTS Site 4: NEX Garage, Waste Battery Storage Area & Oil/Water Separator	Site was a former garage, waste battery storage area that also contained an oil/water separator. Final RFI report recommended removal of lead from surface soil, catch basin sediment, and drainage ditch sediment. No other contaminants were detected at hazardous concentrations. Cleanup of lead contaminated areas below site cleanup levels for continued restricted use have been completed. Site is considered response complete, no further action necessary.	Solvents, metals, PCBs, and TPHs	The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
IR NAVACTS SWMU #26: Spanish Steps Disposal Area	This site was a former disposal area of a variety of hazardous wastes and substances.	Solvents, PAHs, PCBs, waste paints, TPHs, metals	Final RFI report recommended source removal action in tidal pond. Limited sediment removal and ecological risk assessment have been performed. Draft Baseline Ecological Risk Assessment identified potential risk from PCBs to ecological receptors in tidal pond water and sediments. Additional studies are planned for this site.
IR PWC Site #16: PWC Transformer Filter Area, Building 3009	Building 3009 was used as an electrical transformer maintenance and repair shop from 1950 to 1977. Electrical transformers were overhauled there, which involved the cleaning and repairing of parts and the recycling of transformer oils. Four storage tanks were located beside the building with two filtering systems; one for mineral oil and the other for PCB oil. In 1977, the PCB filter system and piping were removed due to leakage from the PCB storage tank.	PCBs	The site is currently undergoing a removal action to address PCB soil contamination using a thermal treatment system and is anticipated to be completed in 2009. LUCs will be implemented for portions of the site as the final remedy. The LUCs will include restrictions on future land use and development and require CERCLA site reviews every five years.

**Table 3.6-4. Summary of Active Navy Hazardous Waste Sites in Apra Harbor**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>Apra Harbor</i>			
IR NAVACTS Site #31: Dry Cleaning Shop (DCS) Site Apra Harbor	<p>The DCS Site was in operation from 1952 to 1975 and processed the laundry and dry cleaning for all Naval facilities. Eight USTs were located onsite which contained Stoddard solvents (dry cleaning solvents), fuel oils (for use in the cleaner boilers), and brine storage (possibly for water softening treatment).</p> <p>An investigation was initiated because solvents were believed to have leaked from USTs or dumped on the ground as sludge and could potential have impacted to the groundwater.</p> <p>The result of the baseline human health risk assessment and preliminary ecological risk assessment showed that current contaminant levels at the site do not pose a significant risk to humans or the environment.</p> <p>Concurrence of the final remedy of no further action at the site under an industrial land use scenario was documented in the decision document signed by the Navy and Guam EPA.</p>	Fuel, TPHs, PAHs, solvent-related, and metals	The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
IR NAVACTS Site #1: Orote Landfill Waste Burning & Disposal Area	The Orote Landfill occupies approximately 7 ac of land. It was used for the disposal of residential, industrial, and construction wastes from approximately 1944 to 1969. Construction of a seawall and landfill cap was completed in 2001.	PCBs, pesticides, dioxins, PAHs, VOCs, and metals.	Long-term monitoring and maintenance of the landfill cap and seawall, long-term groundwater monitoring and LUCs are proposed as the final remedy. Long-term monitoring and maintenance of the landfill cap and seawall at this site is ongoing. The LUCs will restrictions on future land use and development and require CERCLA site reviews every five years.
IR NSRF Site #24: Area Behind NAVSHIPREP FAC Fenceline	Site was a former hazardous waste disposal area. A Removal Action was completed in 2007. Decision Document was signed in October 2007 and a Land Use Control Work Plan was finalized in March 2008. 12-month wetland restoration monitoring was completed in September 2008.	TPH, solvents, pesticides, PCBs, and metals	Long-term monitoring (annual monitoring) is in-progress. The final remedy for this site is the implementation of LUCs. The site is currently maintained semiannually and five-year reviews are implemented to ensure that the site is not used.
IR NSRF Site #26: Building 27 Boiler Facility & Demineralization Units	Site includes a former boiler facility and demineralization unit.	Petroleum contaminants	A RI is scheduled for 2010. The Final Current Conditions Report recommended no further action for the Demineralization Units.
IR FISC Site #35: UST at X-	Former UST and X-ray wharf area.	Petroleum compounds	Site transferred from UST program. Soil contains contaminants from former UST. Site schedule is:

**Table 3.6-4. Summary of Active Navy Hazardous Waste Sites in Apra Harbor**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>Apra Harbor</i>			
ray Wharf		and lead	-Fieldwork (Fall 2009) -Draft SI Report (Winter 2009) -Final SI Report (Spring 2010)
IR FISC Site 19: Former Lower Sasa Fuel Burning Pond Piti, Guam	The former Lower Sasa Fuel Burning Pond at the former Fleet Industrial Supply Center (FISC), Piti, Guam is located in the southwestern portion of Guam. The site is comprised of approximately 20 ac and is about 0.7 mile south of the intersection of Route 1 and Cabras Highway. The facility managed oily wastewater from ships and the FISC Fuel Department. Waste was collected in the pond and drained through a channel to adjacent wetlands. A Removal Action was completed in 2007. Decision Document was signed in October 2007 and a Land Use Control Work Plan was finalized in March 2008. 12-month wetland restoration monitoring was completed in September 2008.	Waste oil	Long-term monitoring (annual monitoring) is in-progress. The final remedy for this site is the implementation of LUCs. The site is currently maintained semiannually and five-year reviews are implemented to ensure that the site is not used.
MRP NAVACTS UXO 4: Orote Point Rifle and Pistol Range	The range is located on the southern portion of Orote Peninsula outside the restricted access area related to Kilo Wharf. The range was last used by Marine units in the 1980s.	Metals	SI field work complete. Preliminary results indicate that elevated concentrations of lead. Further study is required.
MRP NAVACTS Site 2: Spanish Steps Trap and Skeet Range	The range is located along the northern cliff line of the Orote Peninsula. Primarily used for recreational shooting during the 1960s and 1970s, the range was closed and deactivated in the late 1980s. The area is infrequently used as an informal overflow parking lot for the Spanish Steps, Spanish Well, and Orote Archaeology Sites (three historic sites located in this area)	Metals, PAHs	SI field work complete. Preliminary results indicate that elevated concentrations of lead and PAHs are present at this site and further study is required.

Source: NAVFAC Pacific 2009

**Table 3.6-5. Summary of Active Navy Hazardous Waste Sites in South Guam**

<i>Site ID</i>	<i>Site Description</i>	<i>Contaminants</i>	<i>Status</i>
<i>South Guam</i>			
IR NAVACTS Site 35: Tear Gas Burial Site	This site is located in the northwest corner of the Naval magazine in southern Guam. Approximately 350 pounds of tear gas were buried in the 1960s in one gallon metal canisters about 8 ft deep.	Chloroacetophenone (CN) or mace and chlorobenzylidene malononitrile (CS) and other debris and burn area-related chemicals	Planned activities include a RI to evaluate the extent of the site. If necessary, based on the results of the RI, an evaluation of cleanup alternatives will be conducted.
BRAC NAVACTS Site 28: Route 2A, formerly known as the Old WESTPAC site	The former NAVACTS is located in the New Apra Habor Complex in West-central Guam. Route 2A is located within the southernmost portion of the former NAVACTS, northeast of Agat Bay. Route 2A is a former vehicle and heavy equipment maintenance and automotive repair unit operational from 1947 to 1967 and sporadically up until 1979. Activities included steam cleaning and sand blasting. A diesel and gasoline fueling station was part of the site as well as two electrical transformers. Contaminants were dumped directly on the ground or washed down the storm drain system which discharges into wetlands immediately south of the site. Removal actions at five areas within the Route 2a site have reduced risks to ecological receptors. There are still two areas where PCB levels exceed criteria for unrestricted land usage. Approximately 1,400 cubic yards of contaminated soil were removed and disposed of off-island at an approved waste facility.	Waste oils, solvents, paints, battery acid, brake and transmission fluids, hydraulic fluids, chlordane, Dichloro-Diphenyl-Trichloroethane (DDT), lead, copper, and PCBs	Investigations and cleanup activities at the site are complete. The final remedy for this site is the implementation of LUCs. Five-year reviews are implemented to ensure that the site use is restricted.
MRP NAVACTS UXO 3: Naval Magazine Small Arms Range	The range is located close to Bona Spring in the northern portion of former Naval Magazine. The range was last used by Marines units in the 1980s.	Metals	SI field work complete. Preliminary results indicate that elevated concentrations of lead may present a risk. Further study is required.

Source: NAVFAC Pacific 2009.

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## **CHAPTER 4. CULTURAL RESOURCES**

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### **4.1 INTRODUCTION**

The Cultural Resources appendix contains information supplemental to the cultural resource chapters of this EIS. Section 4.2 provides details on natural resources of cultural concern, including plants and fish. This section also provides information on traditional plants used by Juan Cepeda, a traditional healer on Guam who collected plants in the Pagat area. Section 4.3 includes the Public Involvement Plan for National Historic Preservation Act (NHPA) consultation, Section 4.4 lists mitigation measures, Section 4.5 presents the Areas of Potential Effects for Guam and Tinian, and Section 4.6 presents the Standard Operating Procedures Regarding Inadvertent Discovery of Human Remains on Guam.

4.2 PLANTS AND FISH OF CULTURAL CONCERN

Table 4.2-1. Plants of Cultural Concern

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
Aberia hebecarpa	ketambilla	Food	Cultivated	 12
Abelmoschus spp.	Ka'mang tasi	Food, Medicinal	Marshes	 5
Abrus precatorius	kolales tano halom-tano	Medicinal (poison)	Central and Southern Guam	 5
Abutilon indicum	malbas, matbas, malva	Medicinal, Cordage	Waste areas	 1
Achyranthes aspera	Laso'katu	Medicinal	Waste areas	 1

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
Aglaia mariannensis	Mapunao, mapanyao	Timber	Deep jungles as an understory plant	 12
Aidia cochinchinensis	sumak	Medicinal, Timber*	Limestone	 1
Alocasia indica	Piga	Medicinal	Marshes	
Alocasia macrorrhiza	piga	Food	Marshes	 1
Amaranthus viridis	kuletes, kiletetes	Food	Weed, cultivated	 1
Annona muricata	soursop, laguana	Food	Cultivated	 1

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
Annona reticulata	annonas, custard apple	Food, Medicinal	Woods and along roadsides	
Annona squamosa	sugar apple, atis	Food	Limestone forests	
Arachis hypogaea	kakahuate, kakaguante	Food	Along roadsides	
Areca catechu	betelnut, pugua	Chewing	Damp woods, along streams	
Artemisia vulgaris	Hierba de Santa Maria, Yerba de Santa Maria	Medicinal	Cultivated	
Artocarpus altilis	lemai, breadfruit	Food, Medicinal, Timber	Limestone	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Artocarpus mariannensis</i>	dugdug, seeded breadfruit	Food, Timber, Cordage, Thatch, Weaving, Medicinal	Limestone	
<i>Asclepias curassavica</i>	asuncion	Medicinal	Naturalized	
<i>Asplenium nidus</i>	galak fedda', bird's nest fern	Medicinal	Limestone	
<i>Averrhoa carambola</i>	starfruit, carambola	Food, Medicinal	Cultivated	
<i>Bambusa blumeana</i>	piao tituka, piao lahe, pio titoca	Timber	Cultivated	
<i>Bambusa vulgaris</i>	pi'ao palao'an, bamboo	Food, Timber	Cultivated	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Barringtonia asiatica</i>	Putting, puting Fish-kill Tree	Medicinal, Timber, Used for killing fish	limestone	
<i>Benincasa hispida</i>	kondot, condor	Food	Cultivated	
<i>Bikkia tetrandia</i>	Gausali, torchwood	Timber	Limestone cliff faces and limestone boulders	
<i>Bixa orellana</i>	achiote, achuete	Food	Cultivated	
<i>Blechum brownii</i>	yervas babui	Medicinal	Lawns or waste areas	
<i>Boerhavia repens</i>	dafau, dafao	Medicinal	Coastal areas	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Caesalpinia bonduc</i>	pacao, pakao	Medicinal	Weedy areas	
<i>Caesalpinia major</i>	Pakao, akangkang	Medicinal	Edge of jungles, abandoned fields	
<i>Caesalpinia sappan</i>	Sibukao	Medicinal	Limestone	
<i>Colocasia esculenta</i>	taro, suni, sune	Food	Cultivated in wet or swampy soil	
<i>Callophyllum inophyllum</i>	da'ok	Timber, medicinal	Beaches, savannas	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Callicarpa candicans</i>	Hamlak	Medicinal	Coastal areas	
<i>Cananga odorata</i>	ilang-ilang	Medicinal, fragrance oil worn at ceremonies	Southern hills of Guam	
<i>Canavalia spp.</i>	akangkang	Medicinal	Coastal areas	
<i>Capparis spinosa var mariana</i>	alcaparro	Food	Coastal areas	
<i>Capsicum spp.</i>	doni	Food, Medicinal	Cultivated and naturalized	
<i>Carica papaya</i>	Papayan lahi	Medicinal	Limestone	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Cassia alata</i>	take-biha	Medicinal	Weedy areas along roadsides, abandoned fields	
<i>Cassia occidentalis</i>	amot tumaga, coffee senna	Medicinal	Abandoned clearing, waste places, along beaches	
<i>Cassytha filiformis</i>	agasi, dodder	Medicinal	Savanna	
<i>Casuarina equisetifolia</i>	gagu, ironwood	Medicinal, Timber	Eastern beaches of Guam	
<i>Ceiba pentandra</i>	Atgondon de Manila	Fiber	Cultivated and naturalized	
<i>Chenopodium album</i>	kiletas	Food	Cultivated and naturalized	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Chenopodium ambrosioides</i>	apasoti	Medicinal	Cultivated	
<i>Chromolaena odorata</i>	masiksik	Medicinal	Cultivated	
<i>Citrus aurantium</i>	kahel, kahet	Medicinal	Cultivated	
<i>Citrus aurantifolia</i>	lime	Food, Medicinal	Cultivated	

**Table 4.2-1. Plants of Cultural Concern**

Species Name	Chamorro Name	Uses	Locations found	Picture
<i>Citrus limon</i>	limon real	Food	Cultivated	
<i>Clerodendrum inerme</i>	lodugao	Medicinal	Coastal areas	
<i>Cocos nucifera</i>	niyok, coconut	Food, Medicinal, Timber, Cordage, Thatch, Weaving	Coastal areas	
<i>Coffea arabica</i>	kafe	Food	Cultivated	
<i>Colubrina asiatica</i>	gasoso	Medicinal	Coastal areas	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Cordia subcordata</i>	niyoron	Timber	Coastal areas	
<i>Crataeva speciosa</i>	Amot haga	Food, Medicinal	Limestone, Coastal Areas	
<i>Crinum asiaticum</i>	piga-palayi	Medicinal	Cultivated and naturalized	
<i>Curcuma longa</i>	Mango	Food, Medicinal	Cultivated and naturalized	
<i>Cycas micronesica</i>	fadang, cycad	Food, Medicinal	Limestone	
<i>Cynometra ramiflora</i>	gulos	Food	Limestone forest	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Cyperus kyllingia</i>	Changuan lemae, Botoncillo	Medicinal	Wet areas	
<i>Davalia solida</i>	pugua machena	Medicinal	Forested areas	
<i>Deeringia amarantoides</i>	Petchalan	Medicinal	Limestone	
<i>Derris elliptica</i>	Derris	Medicinal	Cultivated	
<i>Dioscorea esculenta</i>	nika	Food	Limestone forest	
<i>Dioscorea alata</i>	dago	Food	Cultivated and naturalized	

Table 4.2-1. Plants of Cultural Concern

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Eclipta prostrata</i>	Titimu	Medicinal	Limestone	 5
<i>Elaeocarpus joga</i>	Yoga, joga	Timber	Limestone	 12
<i>Elatostema calcareum</i>	tapun ayuyu	Medicinal	Limestone forest	 12
<i>Entada phaseoloides</i>	Bayoggon dangkulo	Medicinal	Limestone Forests	 1
<i>Entada pursaetha</i>	Bayogon Dangkulo, Gayi Dangkulo	Medicinal	Southern Guam, along streambeds	
<i>Erythrina variegata var. orientalis</i>	gabgab, gapgap, gaogao, tiger claw	Timber	Limestone	 5
<i>Eugenia palumbis</i>	Agate lang, Agatelang	Medicinal	Limestone	

Table 4.2-1. Plants of Cultural Concern

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Eugenia reinwardtiana</i>	a'abang	Timber	Limestone forest	 1
<i>Eugenia thompsonii</i>	atoto	Food, Timber	Limestone forest	
<i>Euphorbia hirta</i>	golondrina	Medicinal	Cultivated ground, waste places	 1
<i>Ficus prolixa</i>	Nunu, bayan	Medicinal	Limestone	 7
<i>Glochidion marianum</i>	chosgo, chosgu	Timber	Volcanic soils	 12
<i>Guettarda specosa</i>	Panao, zebrawood	Timber, Medicinal	Northern Guam, Limestone	 12
<i>Hedyotis foetida</i>	paudedo	Medicinal	Limestone	
<i>Hedyotis sp.</i>	Pao de' do lahi	Medicinal	Limestone	

Table 4.2-1. Plants of Cultural Concern

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Heliotropium indicum</i>	betbena	Medicinal	Weedy areas	
<i>Hernandia sonora</i>	Nonak, lantern tree	Medicinal, Timber	Beaches and limestone	
<i>Heritiera littoralis</i>	ufa, hufa	Timber	Mangrove swamps	
<i>Hibiscus tiliaceus</i>	Pago, beach or sea hibiscus	Medicinal, Timber, Cordage, Thatch, Weaving	Limestone forests, mangrove swamps	
<i>Hyptis pectinata</i>	mumutung	Medicinal	Weedy areas	
<i>Intsia bijuga</i>	ifit	Timber	Northern forests of Guam	
<i>Ipomoea hederacea</i>	fofgo	Medicinal	Limestone	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Ipomoea indica</i>	blue morning glory	Medicinal	Weedy areas	
<i>Ipomoea pes-caprae</i>	alalag tasi	Medicinal	Sandy beaches	
<i>Jatropha curcas</i>	Tuba Tuba	Medicinal	Limestone	
<i>Kalanchoe pinnata</i>	Siempre-viva	Medicinal	Coastal areas, naturalized	
<i>Lagenaria siceraria</i>	tagoa	Food, Medicinal	Cultivated and naturalized	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Leucaena leucocephala</i>	tangantangan	Timber	Edge of limestone forests	
<i>Limnophila indica</i>	gege, geugue	Fragrance	Marshes	
<i>Macaranga thompsonii</i>	pengua	Medicinal	Limestone forest	
<i>Mammea odorata</i>	chopak	Medicinal, Timber	Sheltered areas	
<i>Mariscus javanicus</i>	Chachakchak	Medicinal	Limestone	
<i>Maytenus thompsonii</i>	Luluhut, lulujut	Medicinal, Timber	limestone	
<i>Melanolepis multiglandulosa</i>	Alom, alum	Medicinal, Timber	Limestone	
<i>Melothria guamensis</i>	Agaga	Medicinal	Limestone	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Mentha arvensis</i>	Yerba buena	Food	Cultivated	
<i>Microsorium punctataum</i>	Galak Dikike'	Medicinal	Limestone	
<i>Mikania scandens</i>	mile-a-minute	Medicinal	Weedy areas	
<i>Miscanthus floridulus</i>	neti, swordgrass	Cordage, Thatch, Weaving	Savanna	
<i>Momordica charantia</i>	atmagosun	Food, Medicinal	Cultivated along fences	
<i>Morinda citrifolia</i>	lada, noni	Food, Medicinal	Limestone	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Mucuna gigantean</i>	Bayoggon dikiki, gaye	Medicinal	Coastal areas	 <span style="float: right;">12</span>
<i>Musa paradisiaca</i>	chotda	Food	Cultivated	
<i>Neisosperma oppositifolia</i>	Fago, fagot	Food, Timber	Limestone forest	 <span style="float: right;">12</span>
<i>Nervilia sp.</i>	Sensen hale' hanom	Medicinal	Wooded areas	
<i>Nervilia aragoana</i>	Seiyaihagun	Food, Medicinal	Wooded areas	 <span style="float: right;">1</span>
<i>Ochrosia mariannensis</i>	chopag	Timber	Edge of limestone forest	 <span style="float: right;">12</span>
<i>Ocimum basilicum</i>	atbahakat	Food, Medicinal	Cultivated, weedy areas	 <span style="float: right;">5</span>

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Oryza sativa</i>	fai, fae, farai	Food	Cultivated	
<i>Pachyrhizus erosus</i>	hikamas	Food	Cultivated and naturalized	
<i>Pandanus dubius</i>	Pahong, pandanus	Food, Cordage, Thatch, Weaving	Limestone forest	
<i>Pandanus tectorius</i>	Kafu, pandanus, screwpine	Food, Cordage, Thatch, Weaving	Cultivated	
<i>Pemphis acidula</i>	nigas	Timber	Scrub areas	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Peperomia mariannensis</i>	potpuput	Medicinal	Limestone	 12
<i>Phaseolus mungo</i>	monggos	Food	Cultivated	
<i>Phragmites karka</i>	karriso	Cordage	Marshes	 10
<i>Phyllanthus amarus</i>	maigo-lalo, maigu-lalo	Medicinal	Weedy areas	 1
<i>Phyllanthus marianus</i>	gaogao uchan	Medicinal	Limestone forest and savanna	 12
<i>Phymatodes scolopenidria</i>	kahlao	Medicinal	Inland and coastal areas	 12
<i>Physalis angulata</i>	tumates chaka	Food, Medicinal	Waste places	 1
<i>Physalis minima</i>	Tumates cha'ka	Food, Medicinal	Waste Places	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Piper guahamense</i>	pupulun aniti	Medicinal	Shady woods near the banks of streams	 12
<i>Pipturus argenteus</i>	Atmagayan, amahadyan	Fiber. Medicinal	Limestone and beaches	 12
<i>Pisonia grandis</i>	umumu	Timber	Limestone forest	 13
<i>Pithecellobium dulce</i>	kamachile	Medicinal	Common near villages	 1
<i>Polypodium punctatum</i>	galak dalalai	Medicinal	Rocks, trees, forest floor, beaches	
<i>Polypodium scolopendria</i>	kahlao	Medicinal	Rocks, trees, forest floor, beaches	 1

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Portulaca oleracea</i>	Botdologas	Food, Medicinal	Coastal areas	 5
<i>Premna obusifolia</i>	Ahgao, false elder	Medicinal, Timber	Coastal areas, limestone	 12
<i>Psophocarpus tetragonoloba</i>	seguidillas	Food	Cultivated	 12
<i>Psychotria mariana</i>	Aplokating, aploghating	Timber, Medicinal	Limestone	 12
<i>Saccharum officinarum</i>	tupu, tupo	Food	Cultivated	 1
<i>Scaevola taccada</i>	Nanaso, half-flower	Timber, Medicinal	Limestone	 1

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Sesbania grandiflora</i>	katurai	Food, Medicinal	Along roadsides	
<i>Sida rhombifolia</i>	escobilla	Cordage, Medicinal	Weedy areas	
<i>Stachytarpheta cayennensis</i>	Katson	Medicinal	Limestone	
<i>Stictocardia tiliifolia</i>	Alalak abubu	Medicinal	Coastal areas	
<i>Tacca leontopetaloides</i>	Gapgap	Food, Medicinal	Beaches and limestone	
<i>Taeniophyllum mariannensis</i>	kamuke nanofe, Sanye'ye	Medicinal	Tree trunks and branches	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Terminalia catappa</i>	Talisai, tropical almond	Timber, food	Cultivated	
<i>Theobroma cacao</i>	kakao	Food	Cultivated	
<i>Thespesia populnea</i>	binalo	Timber	Coastal areas	
<i>Tournefortia argentea</i>	Hunek, hunik	Timber, Medicinal	Coastal areas	
<i>Triphasia trifolia</i>	lemonchina	Food, Timber	Coastal areas	
<i>Tristiropsis obtusangula</i>	faia	Timber	Limestone	

**Table 4.2-1. Plants of Cultural Concern**

<i>Species Name</i>	<i>Chamorro Name</i>	<i>Uses</i>	<i>Locations found</i>	<i>Picture</i>
<i>Urena lobata</i>	Dadangse	Fiber, Medicinal	Waste areas	
<i>Wollastonia biflora</i>	Masiksik tasi	Medicinal	Coastal areas	
<i>Xylocarpus moluccensis</i>	lalanyog	Timber	Mangrove swamps	
<i>Zehneria guamensis</i>	ahgaga	Medicinal		

Notes: \*Timber could include all uses for wood

<sup>1</sup>Pictures from Wikimedia Commons

<sup>2</sup>Pictures from Tropical Forages

<sup>3</sup>Pictures from plantsystematics.org

<sup>4</sup>Pictures from phytoimages.com

<sup>5</sup>Pictures from Wikipedia

<sup>6</sup>Pictures from Cook Islands Biodiversity and Heritage website

<sup>7</sup>Pictures from tropicaldesigns.com

<sup>8</sup>Pictures from equaltorialexotics.com

<sup>9</sup>Pictures from plantgeek.net

<sup>10</sup>Pictures from agnet.org

<sup>11</sup>Pictures from oregonstate.edu

<sup>12</sup>Pictures from University of Guam

<sup>13</sup>Pictures from [hpb.narod.ru](http://hpb.narod.ru)

<sup>14</sup>Pictures from [tidechaser.blogspot.com](http://tidechaser.blogspot.com)

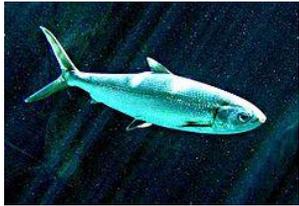
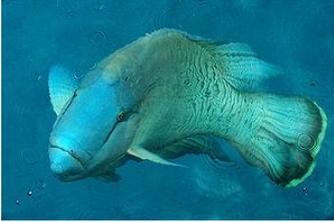
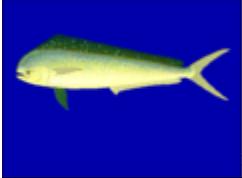
<sup>15</sup> Pictures from <http://www.natureloveyou.sg/Plants-C.html>

<sup>16</sup>Picture from <http://www.agroforestry.net/>

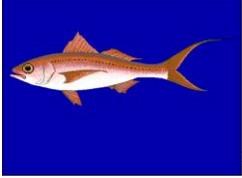
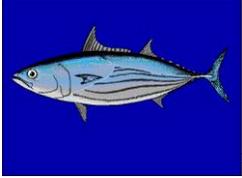
**Table 4.2-2 Historically Important Fish Species**

<i>Species/Family Name</i>	<i>Chamorro/Common Name</i>	<i>Locations found</i>	<i>Picture</i>
Acanthuridae (family)	Hugupau	Reefs	
Acanthurus guttatus	hamoktan	Reefs	
Acanthurus lineatus	hiyok	Lagoons, reef flats	
Acanthurus triostegus	Kichu	Lagoons, reef flats	
Bulbometopon muricatum	atuhong	Reefs	
Carangidae (family) immature	I'e'	Lagoons, reef flats	
Carangidae (family) mature (> 90 cm)	Mamulan	Lagoons, reef flats	

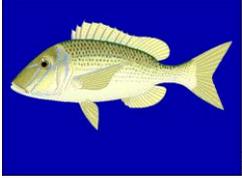
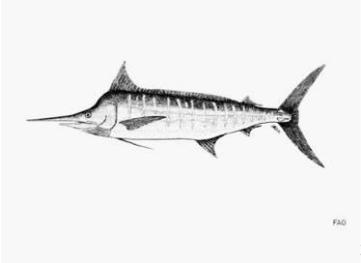
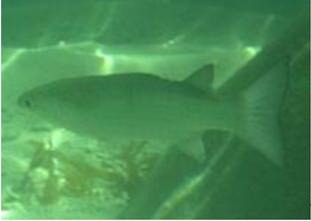
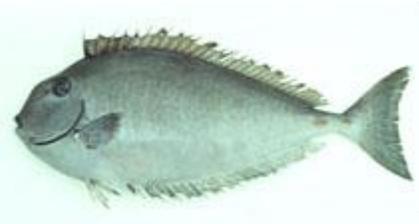
**Table 4.2-2 Historically Important Fish Species**

<i>Species/Family Name</i>	<i>Chamorro/Common Name</i>	<i>Locations found</i>	<i>Picture</i>
Carangidae (family) (mature 25-90 cm)	Tarakitu	Lagoons, reef flats	 2
Chanos chanos	Bangus	Reefs, Mangrove Swamps, Estuaries, Lakes	 1
Cheilinus spp.	Palaski	Reefs	 1
Cheilinus undulatus	tangison	Reefs	 1
Coryphaena hippurus	botague	Reef slope, offshore	 2
Elagatis bipinnulatus	Achemsom	Coastal, offshore	 1

**Table 4.2-2 Historically Important Fish Species**

<i>Species/Family Name</i>	<i>Chamorro/Common Name</i>	<i>Locations found</i>	<i>Picture</i>
Etelis coruscans	Onaga	Reefs	
Hipposcarus longiceps	Gulafi	Reefs	
Holothuroidea (family)	Balate	Sea floor	
Katsuwonus pelamis	Bonito	Reef edge, reef slope, channels, lagoons	
Kyphosidae (family)	guili	Reefs	
Lamniformes (family)	Halu-u	Ocean	
Lethrinus elongatus, Lethrinus rubioferulatus, Lethrinus xanthochilus	liliuk	Lagoon, reef flats	

**Table 4.2-2 Historically Important Fish Species**

<i>Species/Family Name</i>	<i>Chamorro/Common Name</i>	<i>Locations found</i>	<i>Picture</i>
Lethrinus nebulosus, Lethrinus harak	mafute	Lagoon, reef flats	 <p>2</p>
Makaira mazara	marlin	Ocean	 <p>3</p>
Mugilidae (family)	Laiguan	Lagoon, reef flats	 <p>5</p>
Mullidae (family) (immature)	Ti'ao	Reefs	 <p>2</p>
Naso lituratus	hangan	Reefs	 <p>1</p>
Naso spp. (mature)	Tataga'	Reefs	 <p>5</p>

**Table 4.2-2 Historically Important Fish Species**

<i>Species/Family Name</i>	<i>Chamorro/Common Name</i>	<i>Locations found</i>	<i>Picture</i>
Selar crumenophthalmus	atulai	Reef slope, lagoon, channels	 <sup>2</sup>
Serranidae (family)	gadoo	Lagoons, reef flats	 <sup>2</sup>
Siganus argenteus	Manahak lesu	Lagoon, reef flats	 <sup>3</sup>
Siganus spinus (<5 cm)	Manahak ha'tang	Lagoon, reef flats	 <sup>1</sup>

Notes:

<sup>1</sup>Picture from Wikipedia

<sup>2</sup>Picture from Wikimedia Commons

<sup>3</sup>Picture from Encyclopedia of Life

<sup>4</sup>Picture from guammarinelab.com

<sup>5</sup>Picture from fishbase.org

Table 4.2-3. Medicinal Plants Collected by Juan Q. Cepeda (McMakin 1976)

<i>Taxonomic Classification</i>	<i>English Name</i>	<i>Chamorro Name</i>	<i>Comments</i>	<i>Other Locations</i>
Entada pursaetha	Snuff-box bean Large sea bean	Bayogon dangkulo, Gayi dangkulo	A climbing vine found island-wide. The leaf and stem are used. The seeds are poisonous.	Southern Guam along streambeds
Mucuna gigantea, Canavalia maritima	Small sea bean	Bayogon dikike, Gayi dikike	Both of these species of vine are collected as one ingredient. The leaf and stem are used (see note a bottom of page).	Coastal areas
Peperomia mariannensis	Peperomia	Potpupot	A fleshy herb collected at Pagat. It has moisturizing qualities.	Limestone
Piper guahamense	Wild Piper	Pupulu n aniti	This member of the pepper family is collected at Pagat. Both the stem and leaf are used and have a aromatic fragrance.	Shady woods near the banks of streams
Melothria guamensis		Ahgaga	A rare climbing vine only found in northern Guam. Both the leaf and stem are used.	Limestone
Cassytha filiformis		Mayagas	A leafless wirelike vine collected at Pagat.	Savanna
Randia cochinchinensis		Sumak	A shrub, both the leaf and stem are collected at Pagat.	Limestone
Hedyotis foetida var. mariannensis		Paudedo	A shrub, both the leaf and stem are collected from Pagat. It has an ill-smelling leaf.	Limestone
Elatostema calcareum		Tapun Ayuyu	An herb, both the leaf and stem are collected at Pagat. This plant has moisturizing qualities.	Limestone
Asplenium nidus	Bird's nest fern	Galak Dangkulo, Galak Feda	Both the leaf and root are collected at Pagat.	Limestone
Microsorium punctatum	Strapleaf fern	Galak Dalalay	Both the leaf and the root are collected at Pagat.	Limestone
Phymatodes scolopendria	Fern	Kajlao	Both the leaf and root are collected at Pagat.	Inland and coastal areas
Davalia solida	Fern	Pugua Machena	Both the leaf and root are collected at Pagat.	Forested areas
<b>Supplementary Ingredients</b>				
Vigna marina		Akangkang Marilasa	A yellow-flowered vine found growing on the beach. Both the leaf and stem are used.	Edges of jungles, abandoned fields

*Note:*

The leaf of both of these climbing vines is collected at the Naval Communications Center and are very similar in structure. It is difficult to determine whether it is a confusion or Juan's own taxonomic classification that causes him to consider both species as one. The Mucuna is most often called bayogon dikike or gayi dikike and the Canavalia is known as akangkang tasi, but other combinations I have recorded contain both species.

#### **4.3 PUBLIC INVOLVEMENT PLAN**

##### **1. Community Outreach**

- Anthropologists and Chamorro speakers to go into the local communities to identify individuals, groups, or NGOs that may have concerns and/or information on historic properties in the APE.
- Based on initial community interaction, ethnographers to conduct a formal ethnographic study on Guam and Tinian to capture concerns and other relevant information regarding historic properties affected.
- Additional meetings, telecons, and social networking, etc. with individuals, groups, or NGOs will be arranged as requested.

##### **2. Village Meetings**

- Public meetings for Guam in Yigo and Dededo on January 2009.
  - Allows for early face to face interaction before EIS is released.
  - Early consultation can result in modification in scope
- Public meetings for CNMI on Saipan and Tinian to occur in September 2009.
  - Allows for early face to face interaction before EIS is released.
  - Early consultation can result in modification in scope

##### **3. Integration of NEPA /NHPA engagement process**

- Tier upon NEPA public meetings after EIS is released
  - Allows APE to be fully fleshed out
  - Allows time for public to digest the scope of the EIS
  - Brings the experts and information to the public in one place
  - Allows for face to face interaction followed by written/telecon interaction
- Additional written comment period tied to EIS
- A formal letter indicating that the NEPA public process will also be leveraged as another avenue of public interaction is sent ACHP per their request.
  - JGPO does not plan to use the NEPA process in lieu of the NHPA, but to supplement the many other types of public involvement.

##### **4. Partnering Agencies**

- Partnering Agency status for the Guam SHPO, NPS, CNMI SHPO solidifies commitment of these agencies in the planning process for this project.
- Partnering Agencies pass on public questions and comment to NAVFAC PAC regarding Undertaking and function as another avenue in extending contacts to other interested parties.
- Help in arranging meetings w/ NGOs and local gov't, groups, or individuals.

**Table 4.3-1. NHPA Public Involvement Meetings**

<i>Meeting Type</i>	<i>Location</i>	<i>Date</i>
Public Scoping	Guam – Yigo	January 2009
Public Scoping	Guam – Dededo	January 2009
Public Scoping	Tinian	September 2009
Public Scoping	Saipan	September 2009
Public Meeting	Guam – Santa Rita	January 7, 2010
Public Meeting	Guam (Mangilao)	January 9, 2010
Public Meeting	Guam (near Yigo)	January 11, 2010
Public Meeting	Guam (Dededo)	January 12, 2010
Public Meeting	Tinian	January 14, 2010
Public Meeting	Saipan	January 15, 2010

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4.4 MITIGATION MEASURES

**Table 4.4-1. Summary of Impacts and Mitigation Measures by Site and Alternative – Guam (Volume 2)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type Description</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Overall	General	Various		General	Guam Synthesis	1, 2, 3, 8
Overall	General	Various		General	Cultural Landscape Report for the Northern Limestone Plateau	1, 2, 3, 8
Overall	General	Various		General	Early identification, consultation, and predictive modeling resulted in much fewer sites directly impacted by designing installations away from or around areas that contained high densities of historic properties. Thus, the vast majority of impacts to resources were avoided.	1, 2, 3, 8
Overall	General	Archaeological		Direct Impacts of Construction Including Utilities	Curation Assessment, Curation of archaeological collection for non-DoD properties at Guam Museum, Curation of cultural material/artifacts from DoD properties in facility that meets 36 CFR 79. Curation Assessment will help in making determination of where DoD collections are curated.	1, 2, 3, 8

**Table 4.4-1. Summary of Impacts and Mitigation Measures by Site and Alternative – Guam (Volume 2)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type Description</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Overall	General	Various		Indirect impact - Increased personnel in area	Historic Property Awareness Training	1, 2, 3, 8
Overall - Medium Probability Areas	N/A	N/A		Construction	Monitoring during construction	1, 2, 3, 8
Overall	N/A	N/A		Construction of Training facilities	Natural Resources of cultural concern avoided if possible.	1, 2, 3, 8
Andersen AFB	"07-2319"	Artifact Scatter	D	Airfield Training-Building construction	Data Recovery	1, 2, 3, 8
Andersen AFB	"07-1064"	North Field	A	Airfield Training-Building construction	Documentation	1, 2, 3, 8
Andersen AFB	T-9-1	Artifact Scatter	D	Construction of ECMs	Data Recovery	1, 2, 3, 8
Andersen AFB	T-9-2	Artifact Scatter	D	Construction of ECMs	Data Recovery	1, 2, 3, 8
Finegayan	N/A	N/A		Construction of cantonment	Natural Resources with cultural significance were also taken into account in the planning process. Heavily forested areas set aside for natural and cultural resources preservation.	1, 2, 3, 8
Finegayan	381	Ceramic Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 3, 8
Finegayan	08-007	Haputo	A,D	Indirect impact - Increased personnel in area	Historic Property Awareness Training, Site Documentation, Synthesis (public dissemination), Brochure	1, 2, 3, 8

**Table 4.4-1. Summary of Impacts and Mitigation Measures by Site and Alternative – Guam (Volume 2)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type Description</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Finegayan	08-0141	Latte Stone Park	A,D	Indirect impact - Increased personnel in area	Preserve site, Upgrade Interpretive Signage, Historic Property Awareness Training	1, 2, 3, 8
Finegayan	"08-2295"	Artifact Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 3, 8
Finegayan	"08-2297"	Artifact Scatter	D	Construction of cantonment	Data Recovery	1,2,3,8
Finegayan	"08-2298"	Artifact Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 3, 8
Finegayan	"08-2299"	Artifact Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 3, 8
Finegayan	"08-2301"	Artifact Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 8
Finegayan	"08-2300"	Japanese WWII defensive structures	D	Construction of Cantonment	Data Recovery	1, 2, 3, 8
Finegayan	1024 (isolate)	Mortar (lusong); cultural artifact of concern	NE	Construction of Cantonment/impact under NEPA	Avoid if possible, Relocate in Area or Curation depending on size/weight of boulder	2, 3
Finegayan	"08-2303"	Disturbed Hab / Artifact Scatter (Magua)	D	Construction of Cantonment	Data Recovery	1, 2, 3, 8
Finegayan	1032 (isolate)	Mortar (lusong); cultural artifact of concern	NE	Construction of Cantonment/impact under NEPA	Avoid if possible, Relocate in Area or Curation depending on size/weight of boulder	2, 3
Finegayan	"08-2307"	Artifact Scatter	D	Construction of Cantonment	Data Recovery	2, 3

**Table 4.4-1. Summary of Impacts and Mitigation Measures by Site and Alternative – Guam (Volume 2)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type Description</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Finegayan	"08-2308"	Artifact Scatter	D	Construction of Cantonment	Data Recovery	2,3
Finegayan	"08-1678"	Ceramic Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 8
Finegayan	"08-1681"	Ceramic Scatter	D	Construction of Cantonment	Data Recovery	1, 2, 8
Andersen South	"04-2324"	Subsurface Artifact Scatter	D	Construction of Training facilities	Data Recovery	1, 2, 3, 8
Andersen South	"04-2325"	Subsurface Artifact Scatter	D	Construction of Training facilities	Data Recovery	1, 2, 3, 8
NMS	43	Partially disturbed latte site (2 latte sets)	D	Construction of Landing Zone at NMS	Avoidance, Data Recovery	1, 2, 3, 8
NMS	83	Artifact Scatter	D	Construction of Landing Zone at NMS	Avoidance, Data Recovery	1, 2, 3, 8
Harmon	T-H-8	Ceramic Scatter/ WWII Cold War-era lancho	D	Construction of Cantonment	Data Recovery	1,3
NMS	618, 619, 620, 623, 626, 628	WWII-era open munitions pads	D	Construction of ECMS at NMS	Archival research and detailed mapping	Munitions Storage Alternative B (not preferred alternative)
NMS	General	Various		Indirect impact - Increased personnel in area	Historic Property Awareness Training	1, 2, 3, 8

**Table 4.4-1. Summary of Impacts and Mitigation Measures by Site and Alternative – Guam (Volume 2)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type Description</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Route 15	04-0021 04-0022	Pagat	A,D	Indirect Impact - Limited Access	Site Preservation, Pagat Preservation plan would be updated and executed, cultural (public) access to area when ranges not in use, Guam Synthesis (public dissemination)	Live Firing Range Alternative A,B
Route 15	04-0024 04-0642	Marbo Cave	A,D	Indirect Impacts - Limited Access	Site Preservation, Pagat Preservation Plan would also apply to Marbo Cave, cultural (public) access to area when ranges not in use, Guam Synthesis (public dissemination)	Live Firing Range Alternative B
Barrigada	Mt. Barrigada	Traditional Cultural Property	A	Construction of Cantonment	Avoidance, Reduce Visual Impacts	3

**Table 4.4-2. Summary of Impacts and Mitigation Measures by Site and Alternative – Tinian (Volume 3)**

<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternatives</i>
N/A		Construction of firing ranges	Monitoring during construction as added precaution	1, 2, 3
Various		Indirect impacts from increased personnel in area, Limited Access on Broadway Ave., but open Access via 8th Ave (even when ranges are in use)	Cultural Landscape Report, Historic Property Awareness Training, Thematic Synthesis Publications	1, 2, 3
Archaeological		Direct Impacts of Construction	Curation Assessment, Curation of cultural material/artifacts to CNMI Museum, Artifacts for display stay on Tinian for education & tourism.	1, 2, 3
Location of Former Camp Churo Cemetery - Remains have been moved and repatriated	D	Construction of Platoon Battle Course	Ground Penetrating Radar, Monitoring, Repatriation	1, 2, 3
Location of Former Churo Village Camp Churo Built Over	D	Construction of Platoon Battle Course	Data Recovery	1, 2, 3
Japanese Ag Field and Structures	D	Construction of Platoon Battle Course	Data Recovery	1, 2, 3
Japanese Ag Field and Structures	D	Construction of Platoon Battle Course	Data Recovery	1, 2, 3
Japanese Rock Shelters	D	Construction of Platoon Battle Course	Data Recovery	1
Japanese Railroad Berm	D	Construction of Platoon Battle Course	Data Recovery	1
U.S. Fuel Farm Remains	D	Construction of Field Firing Range	Data Recovery	1

**Table 4.4-2. Summary of Impacts and Mitigation Measures by Site and Alternative – Tinian (Volume 3)**

<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternatives</i>
West Field remnant features	D	Construction of Field Firing Range	Data Recovery	1
Service Corps (87, 25)	D	Construction of Field Firing Range and Pistol/Multipurpose Firearms Qual Course	Data Recovery	1, 2
Japanese Farmstead	D	Construction of Platoon Battle Course	Data Recovery	2, 3

*Note:* Within SDZ, but no impact to sites: TN0598, TN0442, TN0004, 5061, Lasu Shrine (TCP), 5059, TN0480, TN0481, TN0461, TN1025, 5031, TN0009, TN0043, 5024, 5023, TN0971, 5020, 5010, 5008, TN0623, 5013, 5017, 5018, TN0038, TN0527, TN0015, 5019

Sites within indirect APE/outside of SDZ: North Field NHL, TCPs (east and west coast)

**Table 4.4-3. Summary of Impacts and Mitigation Measures by Site and Alternative – Volume 4**

<i>Site Number</i>	<i>Site Type</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
NA	NA	None	None required	1, 2

NO HISTORIC PROPERTIES IMPACTED BY THIS PORTION OF THE UNDERTAKING

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Finegayan	"08-0141"	Latte Stone Park	A,D	Indirect impact -Increased personnel in area	Preserve site, Upgrade Interpretive Signage, Historic Property Awareness Training	1,3
Barrigada	Mt. Barrigada	TCP	A	Visual Impact - Construction of headquarters and housing	Avoidance, Reduce Visual Impacts	2, 3
Andersen AFB	T-3-1	Artifact Scatters	D	Construction of additional storage in the MSA	Data Recovery	MSA 3
Finegayan	N/A	Natural Resources			Natural Resources of cultural concern avoided if possible.	1, 2, 3
Andersen AFB	T-90-2	Artifact Scatter/possible ag field	D	Weapons emplacement	Data Recovery	1,4
Andersen AFB	T-90-3	Artifact Scatter/possible ag field	D	Weapons emplacement	Data Recovery	1,4
Andersen AFB	07-2302	Artifact scatter	D	Weapons emplacement	Data Recovery	1,2
Andersen AFB	07-2299	Artifact scatter	D	Weapons emplacement	Data Recovery	1,2
Andersen AFB	FTX-3 site 1	Artifact scatter	D	Weapons emplacement	Data Recovery	3

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	FTX-3 site 2	Artifact scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-SP-1	WWII-era Japanese defensive position	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-SP-2	WWII-era Japanese defensive position	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-SP-3	WWII-era Japanese defensive position	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-SP-4	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-2	Ceramic Scatter, midden soil, and shell adze	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-4	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-5	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-6	Ceramic Scatter, midden soil, and shell adze	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-7	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	T-NW-9	Ceramic scatter, shell adze, and midden soil; WWII artifact scatter (1945 bottles)	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-11	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-12	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-13	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-14	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-15	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-18	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-19	Ceramic Scatter and midden soil	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-20	Ceramic Scatter and pumice tool	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-21	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-22	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-23	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-24	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-26	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-27	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-28	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	T-NW-29	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-34	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-39	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-NW-40	Ceramic Scatter	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-A-1	Prehistoric artifact scatter, midden soil	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-3	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-4	Ceramic Scatter and stone tool	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-5	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-6	Ceramic Scatter	D	Weapons emplacement	Data Recovery	2
Andersen AFB	T-A-8	Ceramic Scatter and WWII-era Japanese bottle dump	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-10	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-12	Ceramic Scatter and on Spanish Period sherd	D	Weapons emplacement	Data Recovery	2
Andersen AFB	T-A-13	Ceramic Scatter, Japanese bottles, and U.S. Naval artillery shell	D	Weapons emplacement	Data Recovery	1, 2

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	T-A-14	Ceramic Scatter and stone tools	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-15	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-16	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-17	Ceramic Scatter and stone tools	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-18	Ceramic Scatter	D	Weapons emplacement	Data Recovery	2
Andersen AFB	T-A-19	Ceramic Scatter, stone tools and midden	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-20	Ceramic Scatter and pumice tool	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-21	Japanese bottles, mess kit, and canteen	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-22	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-23	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-27	Ceramic Scatter and basalt tool	D	Weapons emplacement	Data Recovery	1, 2

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	T-A-28	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-31	Ceramic Scatter with WWII to Cold War-era American roadbed, trench and bottle scatters	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-33	Ceramic Scatter, pumice and basalt tools	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-34	Ceramic Scatter, basalt tool	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-35	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-36	Ceramic Scatter	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-U1	Ceramic Scatter and basalt tool	D	Weapons emplacement	Data Recovery	1, 2
Andersen AFB	T-A-U2	Ceramic Scatter, basalt tools, and slingstone	D	Weapons emplacement	Avoidance, Data Recovery	1, 2
Andersen AFB	T-A3-1	Rock shelter with midden soil and marine shell	D	Weapons emplacement	Data Recovery	3
Andersen AFB	T-A4S-2	Ceramic Scatter	D	Weapons emplacement	Data Recovery	4

**Table 4.4-4. Summary of Impacts and Mitigation Measures by Site and Alternative – Army AMDTF (Volume 5)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	T-A4S-4	Prehistoric agricultural features and pottery	D	Weapons emplacement	Data Recovery	4
Andersen AFB	07-1065	Northwest Field	A	Weapons emplacement	HABS/HAER completed	4

**Table 4.4-5. Summary of Impacts and Mitigation Measures by Site and Alternative – Utilities and Associated Actions (Volume 6)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Overall	N/A	N/A		Construction	Monitoring during construction as added precaution	All
Andersen AFB	T-U-4	WWII-era <i>lancho</i> and U.S. artifact scatter	D	Underground power lines	Avoidance, Data Recovery	Power, Alt 1
Andersen AFB	T-U-11	WWII-era <i>lancho</i> and U.S. artifact scatter	D	Underground power lines	Avoidance, Data Recovery	Power, Alt 1
Finegayan	"08-1350"	Early American water catchment	D	Near utility line	Avoid	Power, Alt 1

**Table 4.4-5. Summary of Impacts and Mitigation Measures by Site and Alternative – Utilities and Associated Actions (Volume 6)**

<i>Location</i>	<i>Site Number</i>	<i>Site Type</i>	<i>Eligibility Criteria</i>	<i>Impact</i>	<i>Potential Mitigation</i>	<i>Alternative</i>
Andersen AFB	T-W-4	WWII and Cold War-era <i>lancho</i> (1944-51 U.S. artifacts)	D	Water wells and pipeline	Avoidance, Data Recovery	Potable water, Alt 1/Alt 2
Andersen AFB	T-U-8	WWII era artifact scatter	D	Water wells and pipeline	Avoidance, Data Recovery	Potable water, Alt 1/Alt 2
Andersen AFB	T-W-7	Ceramic Scatter	D	Water wells and pipeline	Avoidance, Data Recovery	Potable water, Alt 1/Alt 2

Note: sites T-U-12, -- No impact

No sites impacted for solid waste, off-base roadways

4.5 APE MAPS OF GUAM AND TINIAN

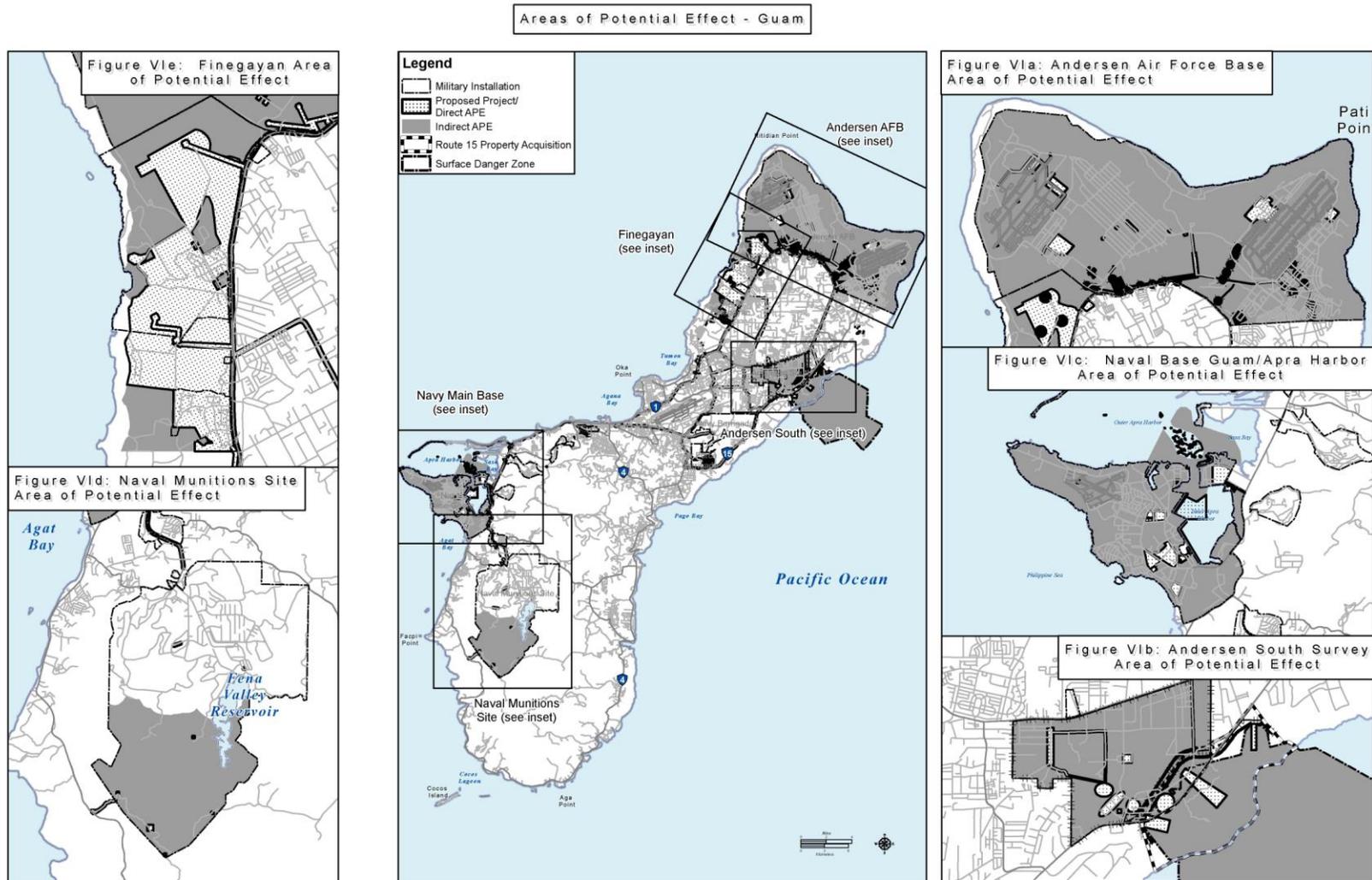


Figure 4.5-1. APE -Guam

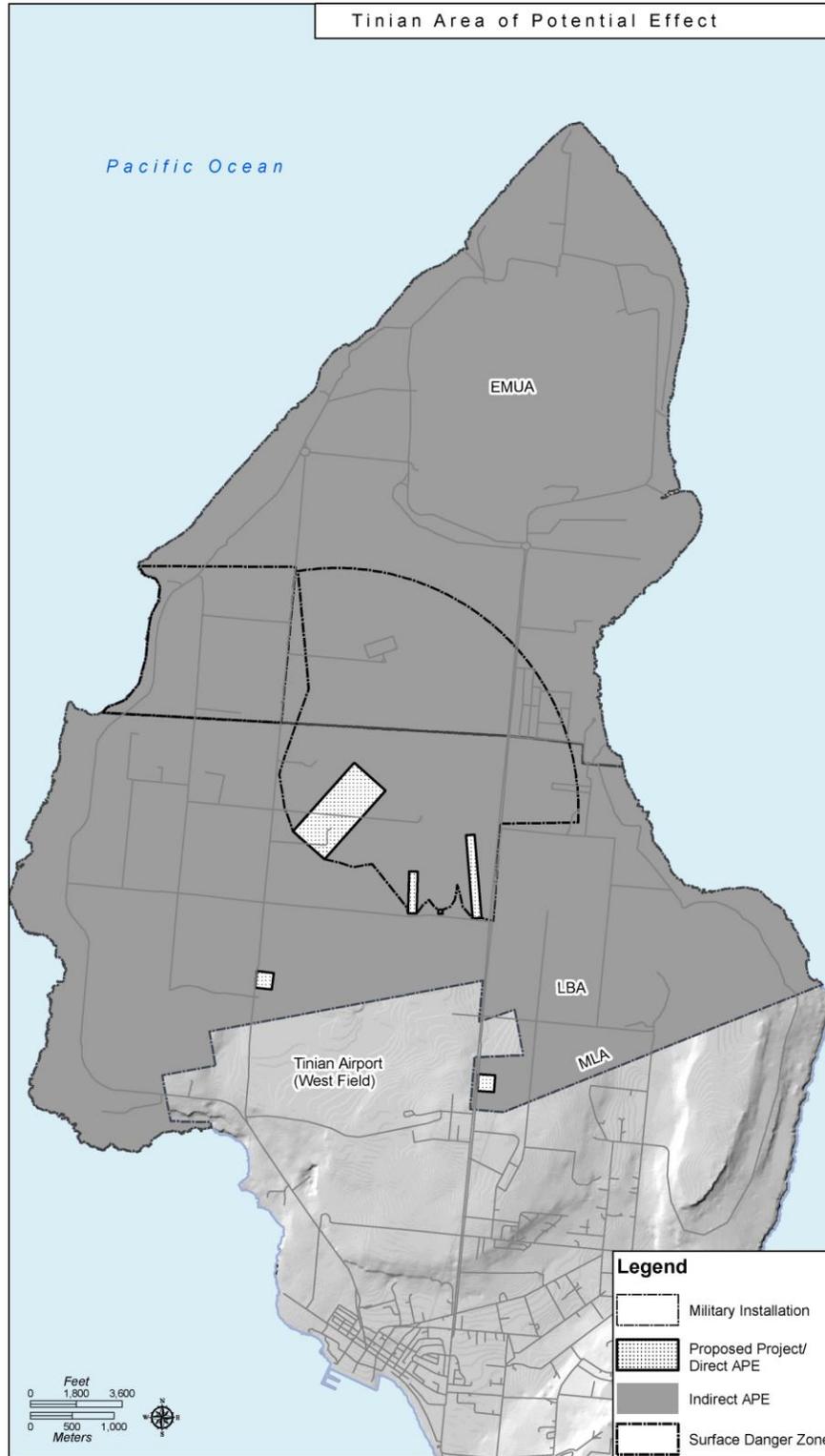


Figure 4.5-2. APE – Tinian

#### **4.6 STANDARD OPERATING PROCEDURES REGARDING INADVERTENT DISCOVERY OF HUMAN REMAINS ON GUAM**

##### **4.6.1 Purpose**

This SOP provides uniform guidelines in the event that human remains are inadvertently discovered or disturbed during the course of any action, undertaking, or activity (including those caused by natural occurrences such as erosion) on Navy-retained lands on Guam. Inadvertent discovery refers to the unintentional excavation or discovery of human remains.

##### **4.6.2 Ethics**

Any human remains regardless of ethnicity or time of deposition shall be treated with respect and dignity.

##### **4.6.3 Reference**

National Historic Preservation Act, 36 CFR Part 800; Archaeological Resources Protection Act; Certain aspects of the Native American Graves Protection and Repatriation Act and the Guam Department of Parks and Recreation General Guidelines for Archaeological Burials were also incorporated into this SOP.

##### **4.6.4 Responsibility**

Primary responsibility for carrying out this SOP lies with the Navy's cultural resource manager under Commander, Navy Region Marianas (CNRM). These procedures should be briefed to all on-site managers and supervisors who are carrying out work that could result in inadvertent discovery of remains on Navy property or during Navy sponsored projects

**STANDARD OPERATING PROCEDURES  
REGARDING THE INADVERTENT DISCOVERY OF  
HUMAN REMAINS ON GUAM**

**STEP I – INITIAL DISCOVERY**

If human skeletal remains (or remains thought to be human) are found during a Navy project or on Navy retained lands on Guam, the following procedures shall be followed:

1. The remains shall be protected from the elements and the area around the discovery shall be secured. CNRM security personnel and cultural resource manager should be notified immediately.
2. If human remains were uncovered during a Navy construction project, then the contracting officer associated with the specific project shall be notified per the contract clause referencing these procedures. A stop work order for the area within the immediate vicinity of the find shall be issued by the contracting officer, if appropriate. The contracting officer shall be notified of all subsequent consultations regarding the remains

**STEP II PRELIMINARY IDENTIFICATION**

CNRM cultural resource manager shall determine if the skeletal remains are animal or human. This shall be done through a professional trained in the identification of human remains (such as an archaeologist, physical anthropologist, forensic specialist) and such professional shall examine the remains and make a determination as to whether they are human. If the skeletal remains are identified as human, then proceed to Step III.

**STEP III IDENTIFICATION - AGE OF DEPOSITION (TIME PERIOD) & ETHNICITY**

If possible, the age of deposition (time period) and ethnicity of the remains shall be determined based on skeletal morphology, context, and associated artifacts by (or under the supervision of) an archaeologist meeting federal qualifications set forth in 36 CFR 61, Appendix A. This determination shall be made as soon as possible, taking into account specific circumstances regarding the discovery of the remains. The following steps shall be undertaken during the identification phase.

**Modern Remains**

If the skeletal remains are found to be human and are modern, then CNRM security personnel and Naval Criminal Investigative Services (NCIS) will take over the investigation.

## **World War II Remains**

If the skeletal remains are found to be human and are from World War II (WWII), then the following procedures shall be followed:

1. If there is reason to believe that the remains are from WWII and are of the indigenous origin (Chamorro) or of any other civilian present on Guam at the time, then the Community/Public Affairs office shall be notified and involved in the consultation process.
2. If there is reason to believe that the remains are of U.S. military personnel, then the Joint POW/MIA Accounting Command (JPAC) shall be notified and will take over the case.
3. If there is reason to believe that the remains are Japanese from World War II, the Consulate General of Japan (CGJ), Agana, Guam, shall be notified and consulted with as to the disposition of the remains.
4. A courtesy call will be made to the Guam [State] Historic Preservation Office (SHPO) to inform them that human skeletal remains from WWII time period were uncovered. However, human remains from this time period are usually not considered as archaeological in nature and other agencies such as JPAC or CGJ have jurisdiction over those matters.

Depending on the preliminary determination by the agencies as to whether the remains are of recent, historic, or pre-contact deposition, the following steps shall be taken:

## **Remains Older than WWII (Historic and Prehistoric)**

If the skeletal remains are found to be human and older than 50 years (and are not associated with WWII), then following procedures shall be followed:

1. The cultural resource manager shall notify the SHPO within three working days of the identification that the skeletal remains are human and are historic or prehistoric in nature.
2. If requested, the CNRM cultural resource manager shall arrange for a site visit by a SHPO representative.
3. The cultural resource manager shall consult with the SHPO and follow Section II and III of the Policy Guidance in the Guam Department of Parks and Recreation General Guidelines for Archaeological Burials.
4. If any other organization or agency comes forward and expresses an interest in participating in the consultation process, they must submit a written request expressing their desire to participate in the consultation process and explain how they are culturally affiliated with the human remains. Their comments will be considered in the overall decision making process.
5. If the remains are encountered during project construction, CNRM shall determine the feasibility of project alternatives that will avoid disturbance of the remains or whether disinterment is necessary. If a mass burial is indicated, preservation in place shall be the preferred alternative. The results of the consultation shall be placed on file at CNRM environmental office and JPAC shall be notified.

## **Undetermined Remains**

If a determination as to the age of deposition of the remains or the ethnicity of the remains cannot be determined, the procedures below shall be followed:

1. The SHPO will be notified and consulted with. Based on the consultation, a decision will be made to either preserve the remains *in situ* or to remove them for further analysis in hopes that the age of deposition and ethnicity can eventually be determined so that the appropriate protocols can be followed.
2. If it is determined that the skeletal remains and any associated artifacts will be exhumed, then the remains should be documented by (or under the supervision of) a qualified archaeologist.
3. Tests involving damage to the skeletal material are highly discouraged and will not be performed by the Navy. However, should it be necessary, performance of radiocarbon dating on any associated charcoal, midden, or artifacts may be conducted at the discretion of the Navy in consultation with the SHPO in order to determine age of deposition. The results of these tests, if any, shall be presented in the report by the recording professional. This report shall be submitted to the CNRM cultural resource manager and the SHPO as a record of the study.
4. If additional tests were conducted, another attempt to determine age of deposition and determine the ethnicity of the skeletal remains will be made based on the results. If a determination can be made on the age of deposition or ethnicity, then the disposition of the human remains will be conducted according to appropriate protocols outlined previously.
5. If a professional(s) not associated with the Navy, meeting the qualifications set forth in 36 CFR 61 Appendix A, seeks to analyze the skeletal remains they shall submit a written request to the CNRM cultural resource manager. The CNRM cultural resource manager shall notify the SHPO of the request and will follow the procedures outlined in the Research Guidelines section of the Guam Department of Parks and Recreation General Guidelines for Archaeological Burials. The applicant shall be notified within 30 days of submission of the Research Design whether it has been accepted or rejected. The cost of the tests and report preparation shall be borne by the applicant. A copy of the results and findings shall be provided to the Navy and the SHPO within six months after the tests are conducted. The remains shall be curated at the laboratory of the researcher until plans for reburial have been made.
6. If the age of deposition or ethnicity of the human remains cannot be determined, then the CNRM cultural resource manager, in consultation with the SHPO, shall curate the remains and any associated artifacts in the event that further information may come to light or rebury the remains. A record of the consultation process shall be placed on file at CNRM environmental office and at the SHPO.

## **STEP IV DISPOSITION**

CNRM shall follow Sections II and III of the Policy Guidance in the Guam Department of Parks and Recreation General Guidelines for Archaeological Burials when dealing with the disposition of human remains older than WWII. Reiterated below are procedures tailored specifically to burials found on Navy property on Guam using the Department of Parks and Recreation General Guidelines for Archaeological Burials as a general guideline.

1. If the remains are found eroding out of the soil, the Navy, in consultation with the SHPO, shall decide whether the remains can be preserved in place or whether the remains would be severely damaged by leaving them *in situ*. The results of the decision-making process shall be placed on file at the CNRM environmental office.
2. If the remains are exposed during a project, and the project can be redesigned to avoid the remains, or the remains can be left in place then the following steps shall be taken: The remains and any associated artifacts shall be recorded *in situ* by an individual meeting the qualifications set forth in 36 CFR 61.9 using standard archeological procedures set forth in 48 CFR 44720. Every effort shall be made to determine the number of individuals and the age, sex, and ethnicity of the remains. The documentation and a record of the location of the remains shall be kept on file at CNRM environmental office. A copy shall be provided to the SHPO.
3. If the project cannot be redesigned to avoid disturbing the remains the following steps shall be followed:
  - (a) The remains and any associated artifacts shall be removed by an archeologist meeting the professional qualifications set forth in 36 CFR 61.9, using standard archeological procedures set forth in 48 CFR 44720.
  - (b) A report of the excavation techniques and findings, along with a photographic record shall be submitted to CNRM within 30 days of disinterment. The documentation shall be kept on file at CNRM and a copy provided to the HPO; any associated artifacts shall be temporarily curated at the contractor's laboratory until the final disposition of the remains is determined.
4. If remains have to be moved, then through consultation with the SHPO it will be determined by CNRM that the human remains may be reburied elsewhere. COMAVMARIANAS will follow Section IV(A)(1, 3-4) or Section IV(B) of the Guam Department of Parks and Recreation General Guidelines for Archaeological Burials if determined appropriate and funds are available. Re-burial shall occur within two years. The documentation and a record of the location of the remains shall be kept on file at the CNRM environmental office. A copy shall be provided to the SHPO.





## **CHAPTER 5. STORMWATER MANAGEMENT/ROADWAYS**

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***FINAL***  
**Storm Water Implementation Plan**  
**For the**  
**Guam Road Network**

**June 2010**

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*Submitted to*

**Guam Department of Public Works**

*Submitted by*

**PARSONS TRANSPORTATION GROUP, Inc**

<p>Preliminary – Not for Construction, Subject to Independent Verification Prior to Final Design</p>
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## PREFACE

The Guam Road Network (GRN) is a collection of highway improvement projects that are being negotiated between Guam Department of Public Works (DPW) and the Department of Defense (DOD) as recommended improvements for the proposed military build up. Some of these projects are in addition to the projects currently listed in the Guam Transportation Improvement Plan. The DOD proposal would reprioritize these projects to accommodate the military build-up. This Project Report evaluates the collective impact that these projects could have on the water resources of Guam and proposes improvements to mitigate these impacts. The GRN projects primarily include pavement strengthening projects which generally do not increase the overall impervious area. The work effort includes improvements along Routes 1, 2A, 3, 5, 8, 9, 10, 11, 15, 16, 25, 26, 27, 28 and Chalan Lujana. The projects also include improvements to 8 bridges along Route 1 in the Apra Harbor area.

Parsons prepared this Draft Storm Water Implementation Plan for the GRN as part of the development of the Transportation Storm Water Drainage Manual<sup>1</sup> (TSDM) and the Storm Water Drainage Master Plan development for the Guam Department of Public Works. The Storm Water Implementation Plan for the GRN (Plan) provides source control and treatment control best management practices (BMPs) to be used for the various GRN projects.

This Plan includes a suite of treatment BMPs that can be used throughout the GRN. BMP selection, discussed herein, considers pollutants of concern, right of way constraints, maintainability, existing drainage infrastructure, proximity to wetlands, as well as existing treatment devices.

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<sup>1</sup> This Manual is in the draft development stage.

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## ACRONYMS

BMPs	best management practices
cfs	cubic feet per second
CLOMR	Conditional Letter of Map Revision
CGP	Clearing and Grading Permit
CZMA	Coastal Zone Management Act 1972
DOD	Department of Defense
DPW	Department of Public Works
EISA	Energy Independence and Security Act 2007
ESCP	Erosion and Sediment Control Plan
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
fps	feet per second
GAR	Guam Administrative Rules
GCMP	Guam Coastal Management Program
GSRD	gross solids removal device
GEPA	Guam Environmental Protection Agency
GRN	Guam Road Network
GTIP	Guam Transportation Improvement Program
HA	hydrologic area
HSA	hydrologic sub-area
LOMR	Letter of Map Revision
MCTT	multi-chambered treatment train
MEP	maximum extent practicable
NB	northbound
NGL	Northern Guam Lens
NPDES	National Pollutant Discharge Elimination System
PDF	Project Design Feature
SB	southbound
SWMM	Stormwater Management Model
SWPPP	Stormwater Pollution Prevention Plan
TDC	Targeted Design Constituent
TMDL	Total Maximum Daily Load
TSS	total suspended solids
US EPA	U.S. Environmental Protection Agency
VFS	vault flow splitter
WQF	water quality flow
WQV	water quality volume

## SECTION 1 INTRODUCTION

### 1.1 BACKGROUND

The purpose of this section is to provide a detailed description of the water resource environment that would be impacted by the roadway improvements that would support the relocation of U.S. Marines to Guam. The proposed roadway improvements are collectively referred to as the Guam Road Network (GRN), a connected action to the relocation activity. Figure 1 shows a location map of the approximate area in which the GRN will be constructed<sup>2</sup>. As shown, Guam is a small island with a coast line of only 110 miles. The major components of the proposed GRN projects are indicated in Table 1. Figures 2 and 3 on the following pages show the proposed corridors of the GRN with respect to the hydrologic regimes throughout the island. Table 2 identifies the main projects and Work Types included in the GRN along with the proposed construction scheduling for the high priority projects. As shown, the work effort includes improvements along Routes 1, 2A, 3, 5, 8, 9, 10, 11, 15, 16, 25, 26, 27, 28, Chalan Lujana along with improvements to 8 bridges along Route 1 in the Apra Harbor area. Appendix A provides a preliminary project construction schedule, the project requirements and a brief description for each project.

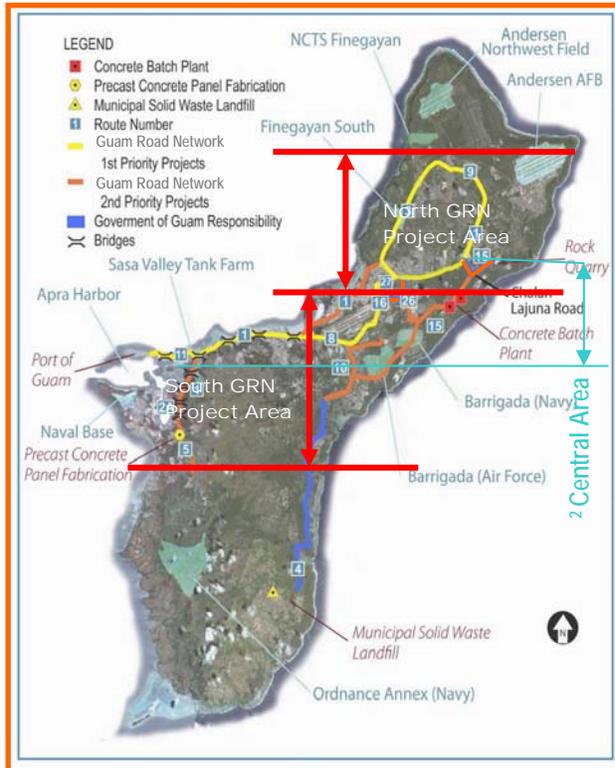


Figure 1: GRN Location Map

Table 1 - GRN Project Components

Type of Work	General Scope Elements
Pavement strengthening, no shoulder widening	Pavement rehabilitation without increasing existing pavement footprint (impervious area).
Pavement strengthening & shoulder widening	Pavement rehabilitation with a minor (2-ft to 8-ft wide) increase in impervious area.
Road widening for capacity increase	Roadway improvements with an increase in impervious area.
Intersection improvements	Reconfiguration of one or more streets; addition of turning lanes; pavement widening; clearing and grading; and an increase in impervious area.
Bridge Improvements	Beam, pier wall, wingwall and/or deck rehabilitation or replacement with upstream and/or downstream channel erosion control.
New Roadways	New paved roads with increase in impervious area.

<sup>2</sup> For simplicity, this document divides the GRN into South and North areas, only. Portions of the central area, which is designated in the DEIS, have been subdivided into the North GRN Project Area and the South GRN Project Area as shown in Figure 1.

Table 2 – Work Type Summary of GRN Projects

Route	Segment Limits	Type of Work	GRN #	Length (ft)	Construction Yr
1	Route 1 / Route 8 Intersection	Intersection Improvement	1	940	2010
1	Route 1 / Route 3 Intersection	Intersection Improvement	2	2,400	2010
1	Agana Bridge	Bridge Improvement	3	85	2010
1	Route 27 to Chalan Lujana	Pavement Strengthening, no Shoulder Widening	6	18,200	Not Scheduled
1	Route 1 / Route 28 Intersection	Intersection Improvement			
1	Route 1 / Route 26 Intersection	Intersection Improvement	7	4,600	Not Scheduled
1	Route 3 to Route 27	Pavement Strengthening, no Shoulder Widening			
1	Route 1 / Route 27 Intersection	Intersection Improvement			
1	Route 1 / Route 27A Intersection	Intersection Improvement	13	8,472	Not Scheduled
1	Route 11 to Asan River	Pavement Strengthening, no Shoulder Widening			
1	Asan River to Route 6 (Adelup)	Pavement Strengthening, no Shoulder Widening			
1	Route 6 (Adelup) to Route 4	Pavement Strengthening, no Shoulder Widening			
1	Chalan Lujana to Route 9 (AAFB)	Pavement Strengthening, no Shoulder Widening			
1	Route 11 to Route 2A	Pavement Strengthening, no Shoulder Widening			
1	Route 8 to Route 3	Pavement Strengthening, no Shoulder Widening			
1	Rte 1 / Rte 14 (NSV) Intersection	Intersection Improvement			
1	Route 1 / Route 14A Intersection	Intersection Improvement			
1	Route 1 / Route 10A Intersection	Intersection Improvement			
1	Route 1 / Route 14B Intersection	Intersection Improvement	33	31,647	Not Scheduled
1	Rte 1 / Rte 14 (ITC) Intersection	Intersection Improvement			
1	Route 1 / Route 30 Intersection	Intersection Improvement			
1	7 Bridge Improvements	Bridge Improvement			
1	Navy Main Base	Intersection Improvement	35	364	Not Scheduled
1	Route 1 / Route 16 Intersection	Intersection Improvement	50	N/A	Not Scheduled
1	Anderson South (Main Gate)	Intersection Improvement	124	N/A	Not Scheduled
1	Finegayan Connection, Rte 1 at 16	New Roadway	44	N/A	Not Scheduled
1	Finegayan Connection, Rte 1 at 16	New Roadway	124	18,910	Not Scheduled
2A	Route 1 to Route 5	Pavement Strengthening, no Shoulder Widening	26	4,577	Not Scheduled
3	Route 28 to Route 1	Pavement Strengthening, no Shoulder Widening	8	13,500	Not Scheduled
3	NCTS Finegayan to Route 28	Road Widening for Capacity Increase	9	12,300	Not Scheduled
3	Route 3 / Route 28 Intersection	Intersection Improvement			
3	NCTS Finegayan to Route 9	Road Widening for Capacity Increase	10	3,750	Not Scheduled
3	Route 3 / Route 3A Intersection	Intersection Improvement			
3	South Finegayan (Residential Gate)	Intersection Improvement	41	N/A	Not Scheduled
5	Route 2A to Route 17	Pavement strengthening & shoulder widening	25	6,379	Not Scheduled
5	Route 5 / Route 17 Intersection	Intersection Improvement			
5	Route 17 to Naval Ordinance	Pavement strengthening & shoulder widening	27	3,954	Not Scheduled
8	Tiyan Pkwy/ute 33 (east) to Rte 1	Road Widening for Capacity Increase	16	8,290	Not Scheduled
8	Rte 10 to Tiyan Pkwy/Rte 33(east)	Pavement strengthening, no Shoulder Widening	17	7,904	Not Scheduled
8A	Route 16 to NAVCAMS Barrigada	Pavement strengthening & shoulder Widening	31	8,865	Not Scheduled
9	Route 3 to AAFB (North Gate)	Road Widening for Capacity Increase	22	6,300	Not Scheduled
9	AAFB North Gate to Route 1	Road Widening for Capacity Increase	22a	9,200	Not Scheduled
9	AAFB (North Gate)	Intersection Improvement	42	N/A	Not Scheduled
10	Route 15 to Route 8 & 16	Pavement strengthening, no Shoulder Widening	30	7,847	Not Scheduled
11	Port to Intersection with Route 1	Pavement strengthening, no Shoulder Widening	4	9,150	2010
11	Route 1 / Route 11 Intersection	Intersection Improvement	5	1,480	2010
12	Route 2/ Route 12 Intersection	Intersection Improvement	110	N/A	Not Scheduled
12	Naval Munitions Site @ Rte 5	Intersection Improvement	52	N/A	Not Scheduled
15	Smith Quarry to Chalan Lujana	Pavement strengthening, no Shoulder Widening	12	6,100	Not Scheduled
15	Rte 10 to Connector	Pavement strengthening, no Shoulder Widening	32	41,500	Not Scheduled
15	Route 15 / Route 26 Intersection	Intersection Improvement			
15	Route 15 / Route 29 Intersection	Intersection Improvement	117	N/A	Not Scheduled
15	Anderson South (Secondary Gate)	Intersection Improvement	46	N/A	Not Scheduled
15	Realignment onto DOD Property	New Roadway	36	11,200	
16	Route 27 to Route 10A	Pavement strengthening, no Shoulder Widening	18	4,505	Not Scheduled
16	Route 16 / Route 27 Intersection	Intersection Improvement			
16	Rte 10A to Navy Barrigada Gate	Pavement strengthening, no Shoulder Widening	19	5,448	Not Scheduled
16	Route 16/ Route 10A Intersection	Intersection Improvement			
16	Navy Barrigada Gate to Rte 8/10	Pavement strengthening, no Shoulder Widening	20	8,691	Not Scheduled
25	Route 16 to Route 26	Road Widening for Capacity Increase	29	8,050	Not Scheduled
26	Route 1 to Route 15	Road Widening for Capacity Increase	28	12,900	Not Scheduled
26	Route 26 / Route 25 Intersection	Intersection Improvement			
27	Route 1 to Route 16	Pavement strengthening	21	5,448	Not Scheduled
28	Route 1 to Route 3	Road Widening for Capacity Increase	57	21,000	Not Scheduled
28	Route 28 / Route 27A Intersection	Intersection Improvement			
Ch Lujana	Route 1 to Route 15	Road Widening for Capacity Increase	11	4,350	Not Scheduled

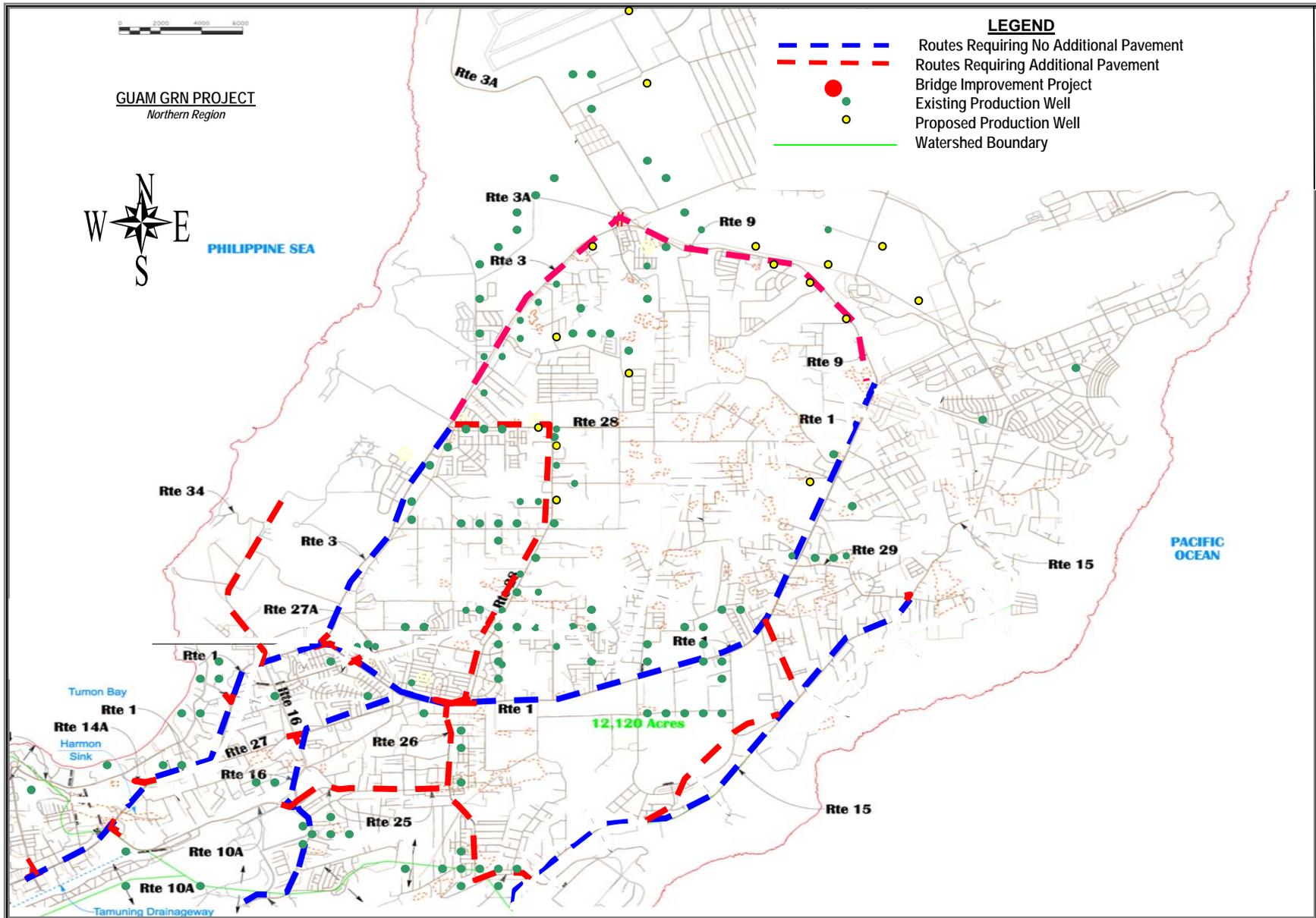


Figure 2 North Guam Road Network

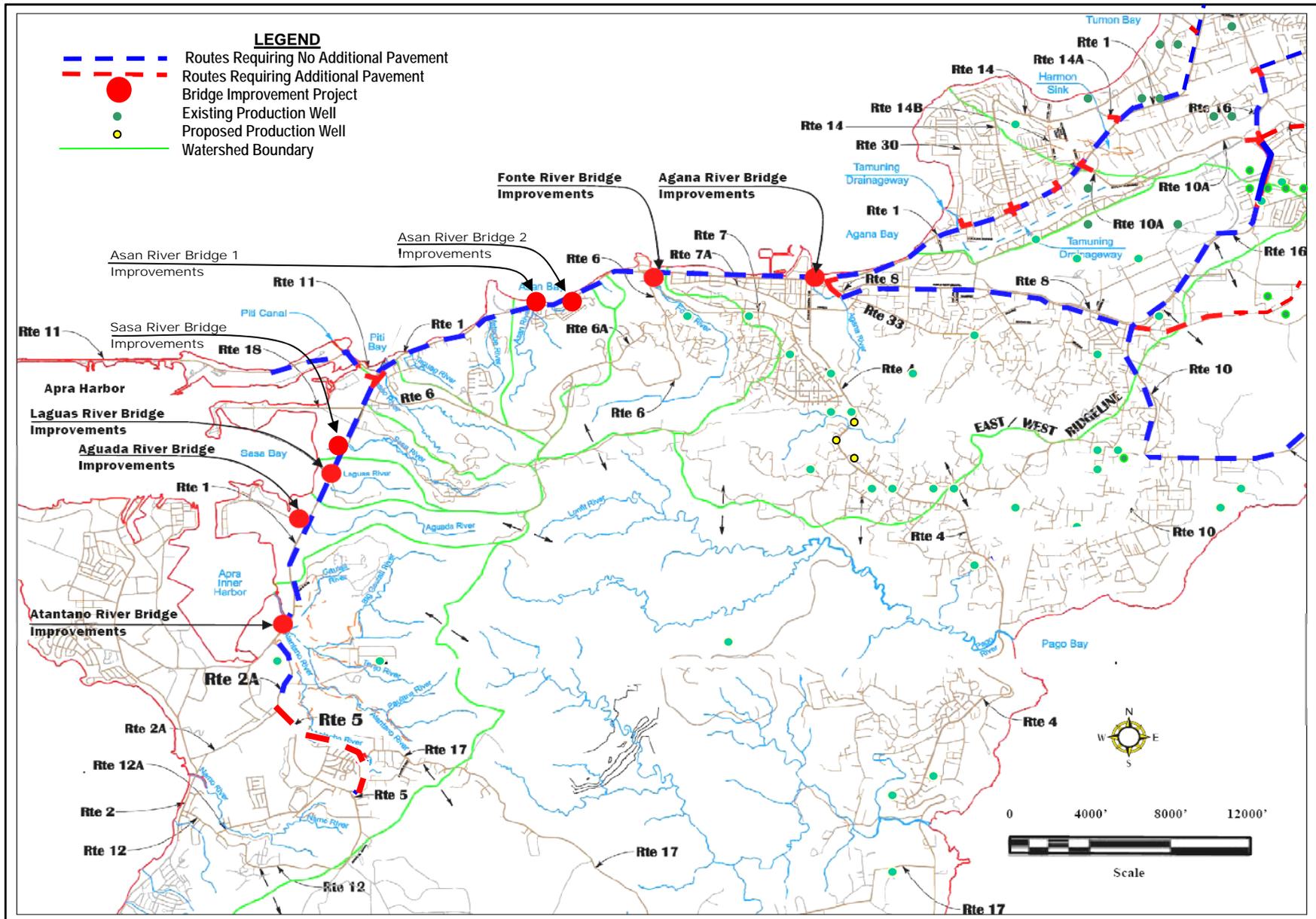


Figure 3 South Guam Road Network

## 1.2 REPORT OBJECTIVES

This report presents the stormwater management strategy for the GRN. In general, it includes descriptions of the proposed runoff interception and conveyance systems, the water pollution source control elements, and the water pollution treatment and recharge control facilities to be used to mitigate potential water resource impacts. The objective of the report is to:

- Develop an understanding of the appropriate storm water management practices for the GRN projects;
- Develop an understanding of the existing water quality control elements and the impact of the GRN projects on these existing elements;
- Develop an understanding of construction practices, construction monitoring, and construction permitting for activities required for the GRN projects;
- Develop a permitting and project schedule for the GRN projects;
- Develop a strategy for achieving early agreement among jurisdictional agencies on the storm water management approach through design and construction; and
- Provide a plan to be used in developing storm runoff drainage system design elements for the GRN projects.

## 1.3 REPORT ORGANIZATION

The report is divided into eight sections along with supplemental information provided in the appendices. The report organization is indicated in Table 3.

**Table 3 - Report Organization**

Section	Description
Introduction	GRN background information and report objectives.
Hydrologic Setting	Watershed characteristics along with surface water and groundwater information.
Storm Water Regulatory Mandates, Coordination and Implementation	Project implementation process and permitting requirements.
Water Pollution Control Strategy	General information on construction and post-construction BMPs.
Pollution Source Control	Source control BMPs for GRN projects.
Pollution Treatment Control	Treatment control BMPs for GRN projects.
GRN Stormwater Management Concepts	Strategies for on-site and off-site runoff interception, conveyance and treatment For GRN Projects.
References	Document citations for reports and information cited within the document.
Appendices	Provides supporting information on GRN projects including maps, design guidelines and bridge project details.

## SECTION 2 HYDROLOGIC SETTING

### 2.1 WATERSHED CHARACTERISTICS

Guam is the largest and southernmost island in the Mariana Islands chain. It is approximately 30 miles long and nine miles wide and is divided into two distinct geological formations by a central fault line. The northern half is mainly a broad sloping limestone plateau which is bordered by steep seaward cliffs and fringed by narrow coral reefs. The southern half is mountainous and composed of eroded volcanic formations. The bordering fringing reefs in the south are broader than in the north. Two large barrier reef systems occur at Cocos Lagoon and at Apra Harbor. Guam has a total of 116.5 miles of shoreline. Based on storm intensity, existing soils and the porosity of its coralline rock formation, the northern half of Guam has no estuaries or deep bays and only a limited number of perennial streams. The southern half of Guam has its volcanic slopes deeply channeled by 97 streams in numerous watersheds with varying sizes of bays breaching the shallow fringing coral reefs at the mouths of the streams. Western slope streams are short with steep gradients and drainage areas of less than three square miles each. The eastern slopes are steep in their upper reaches with long gently-sloping stream beds that terminate in wide flat valleys.

### 2.2 SURFACE WATER IN NORTH GUAM

**Surface Drainage:** 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. Typical roadway drainage throughout the north area is shown on



*Figure 4 North Guam Typical Roadway Cross-Section*

Figure 4. Roadway runoff generally sheet flows through grass strips located along the edge of pavement. In some of the more urban locations (such as along Route 1 on the western side of the island), the road cross-section is 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 Guam Department of Public Works (see Appendix B) which are currently being used as outlets for the routed roadways in North Guam. Table 4 provides a summary of the routed roads to be improved as part of the GRN and the respective infiltration basins currently being used as outlets for the roadway drainage systems.

**Table 4** – Summary of Infiltration Basins along GRN (North Guam)

Route	Location
1	Tamuning – S-20 Harmon Park Subdivision
1, 3	Dededo – Rte 1 Near M. Mall Northgate/ Rte 3
1	Dededo – Between Route 27a and Kayan R. Agustin
1	Dededo – Route 1 at Santa Barbara
1	Dededo – Route 1 at Calamendo
1, 28	Dededo – Route 1 at Cr. Y-Sengsong Rd.
1	Yigo – Mapola Loop. Ghura 505
1	Yigo - Milalak Dr. at St. Pacific Memorial Park
1	Yigo – Abanbang Loop @ Q Ponderosa Acres
1	Yigo – SS-29 Nissho Subdivision
1, Chalan Lujana	Yigo – Baki Court @ Perez Acres
3	Dededo – Kamute Lane, Astumbo
3, 28	Dededo – Chalan Sibukao, Astumbo
3	Dededo – Mabelo Drive @ Fern Terrace
3, 9	Dededo – Snowball St. - Santa Ana Sub
3, 9	Dededo – Ch Santa Maria - Santa Ana Sub
16	Dededo - Route 16 Near Iglesia Ni Kristo Church
16, 27	Mangilao – Hegao Loop, Harmon Gardens (E of Route 16)
26	Mangilao – Gardenia and Rte 26 – Latte Heights
26	Mangilao – Daisy Lane and Rte 26 – Latte Heights
26	Mangilao – Mil. Flores and Rte 26 - Latte Heights
26	Dededo – Magof Dr & SS-17 (East of 26)
26, 25	Dededo – Ch Gafo, PGD Subd. (E of Rte 26)
27	Dededo - Route 27 at Kayen Cascado
28	Dededo - Route 27a at Rte 28

**Flood Zones:** The Federal Emergency Management Agency (FEMA) has mapped flood hazard areas throughout the island for the National Flood Insurance Program (NFIP) and has designated the areas on Flood Insurance Rate Maps (FIRMs). These maps are provided in Appendix D. As shown in FIRM Map 6600010125D, various depressions are located throughout the area and have been designated as Flood Hazard Zone X (areas of less than 1 ft depth or areas with less than 1 sq mile of contributing drainage area). The largest depression within the north area is referred to as the Harmon Sink.

*Figure 5 Harmon Sink at Rte 1*

This sink has been mapped as a Flood Hazard Zone AE by FEMA and crosses under Route 1 with a high water elevation of 93 feet above mean sea level. In general, the sink acts as an outlet for much of the local storm water runoff in the area including street drainage (see

Figure 5 where the sink is located adjacent to Route 1). South of Route 3, the drainage along Route 1 is conveyed to the Harmon Sink via a storm drain network.

### 2.3 SURFACE WATER IN SOUTH GUAM

**Surface Drainage:** 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 about 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. Also located in this area is the Apra Harbor which is a large Barrier Reef System. Apra Harbor covers over three square miles, with the Navy's Inner Apra Harbor encompassing approximately 650 acres. For south Guam, surface drainage from the roadway in the rural areas generally sheet flows through grass strips located along the edge of pavement. In the more urban locations, the road cross-section is curbed with roadway runoff conveyed through storm drain systems. Several infiltration basins are located along Route 10 in the southern area (see Appendix B) and are used as outlets for the drainage systems.

**Flood Zones:** GRN Projects located within the south area are primarily on the west side of the island where the area is traversed by streams that are short with steep gradients and drainage areas of less than three 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. These include: 1) the Tamuning Drainageway, Agana River and Fonte River outleting to Agana Bay, 2) the Asan River with two tributaries, each of which outlet to Asan Bay, 3) the Matgue, Taguag and Masso Rivers, each outleting into Piti Bay, 4) the Sasa, Laguas and Aguada Rivers, each outleting into the Sasa Bay Marine Preserve and 5) the Atantano River that outlets into the Apra Inner Harbor. The Tamuning Drainageway and the Agana, Fonte, Asan and Masso Rivers are designated as floodways by FEMA (see Appendix D). Other rivers are designated as Flood Hazard Zone X areas with minimal flooding potential. Route 1 parallels the coastline from Apra Harbor, northward to Agana Bay. Along this section of roadway, several locations 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. The Sasa Bay Marine Preserve which is the outlet for the Sasa, Laguas and Aguada Rivers is located along the shoreline of Apra Harbor. The Atantano River flows into the Inner Harbor. FEMA Floodplain Mapping indicates that much of the Harbor is within FEMA Flood Zone A. Route 11 is the main entry to Apra Harbor which is also shown to be within the flood zone.



*Figure 6 Tamuning Drainageway Outlet*

## SECTION 3

### STORM WATER REGULATORY MANDATES, COORDINATION AND IMPLEMENTATION

This section provides a summary of the regulatory context for the GRN projects, the regulatory agency coordination process as well as required permits and clearances.

#### 3.1 STORM WATER REGULATIONS

**Executive Order 11988 (Floodplain Management)** directs all federal agencies to refrain from conducting, supporting, or allowing actions in floodplains unless it is the only practicable alternative. A Floodplain Evaluation is required under the National Flood Insurance Program (23 CFR 650, Subpart A Section 650). Section 650.111 of the regulation calls for location hydraulic studies to be performed to avoid and/or minimize hydrologic and floodplain impacts.

**Coastal Zone Management Act (16 CFR 1451 et seq.)** The Coastal Zone Management Act establishes a federal-state partnership to provide for the comprehensive management of coastal resources. The Bureau of Statistics and Plans (BSP), formerly the Bureau of Planning (BOP), is the lead agency of the Federally approved Guam Coastal Management Program (GCMP), mandated for enforcing this law. The GCMP guides the use, protection and development of land and ocean resources within Guam's coastal zone. In accordance with the Coastal Zone Management Act of 1972 (P.L. 92-583), as amended (P.L. 94-370), the BSP is responsible for conducting a review to determine a project's consistency with GCMP policies, as stated in E.O. 78-37, conducted as specified in 15 CFR Part 930.

**Federal Clean Water Act.** The primary federal law governing water quality is the Clean Water Act (CWA) of 1972. This Act provides for the restoration and maintenance of the chemical, physical, and biological integrity of the Nation's waters. Three sections of the CWA, in particular, are the focus of construction-phase compliance. **Section 401**, water quality certification, regulates impacts of all discharges of pollutants including the placement of dredged or fill material on water quality. All federal permits for work in marine waters, rivers, streams and wetlands require Section 401 water quality certification from Guam EPA (GEPA). **Section 402**, the National Pollutant Discharge Elimination System (NPDES) permit program, controls water pollution by regulating point sources that discharge pollutants into waters of the U.S. Projects that disturb greater than one acre of soil are required to file a Notice of Intent with US EPA, develop a construction site Storm Water Pollution Prevention Plan and file a Notice of Termination upon project stabilization. Under **Section 404** of the CWA, the U.S. Army Corps of Engineers (ACOE) authorizes discharges of dredged or fill material into waters of the U.S. through a permit program.

**Guam Soil Erosion and Sedimentation Control Regulations.** In 1975, the Guam EPA first developed the Guam Soil Erosion and Sedimentation Control Regulations under the authority of 10 Guam Code Annotated (GCA), Chapter 47. These were then updated and revised in 1985 and again in 1997. The regulations address important provisions that: 1) control nonpoint source pollution from runoff within Guam's waters such as runoff containing fertilizers, pesticides and other polluting substances carried by sediment, 2) protect property and 3) promote public health, safety and welfare by regulating grading, clearing, grubbing and stockpiling and by setting specific requirements for erosion and sedimentation control within the island of Guam.

**Draft Guam Erosion Control and Stormwater Management Regulations.** GEPA has prepared a draft regulation for erosion control and stormwater management which updates the existing regulations described above. The regulations set limits for erosion, sedimentation and nonpoint source runoff and establish administrative procedures for the issuance of clearing, grading and stockpiling permits. Requirements for grading plans, cut and fill slopes, Soil Reports, Erosion and Sediment Control Plans, Storm Water Pollution Prevention Plans (SWPPPs) and post-construction storm water management are provided. The requirements are consistent with those set forth in the 2006 Commonwealth of Northern Mariana Islands (CNMI) and Guam Storm Water Management Manual (2006 Stormwater Manual).

**Effluent Limitations Guidelines & Standards for the Construction & Development Point Source Category (40 CFR, Part 450), Dated December 1, 2009 – Final Rule.** According to the Final Rule on Effluent Limitations Guidelines and Standards for Construction and Development Point Source (40 CFR Part 450), dated December 1, 2009, construction sites that disturb 10 or more acres of land at one time will be required to monitor discharges from the site and comply with the numeric effluent limitation (turbidity). Note – According to US EPA, this new requirement and other non-numeric effluent limitations to limit discharges of pollutants will be included in the next Construction General Permit (CGP) tentatively scheduled to be issued after July 2011 upon expiration of the existing 2008 CGP in June 2011. The Final Rule indicates that discharges associated with construction activity are required to obtain NPDES permit coverage; as such, the contractors are required to comply with these requirements.

**Numeric Effluent Limitations requirement attainable by application of Best Available Technology Economically Achievable (BAT).** Beginning no later than August 2, 2010 for a construction activity that disturbs 20 or more acres of land at one time, including non-contiguous land disturbances that take place at the same time and are part of a larger common plan of development or sales; and no later than February 2, 2014 for a construction activity that disturbs 10 or more acres of land area at one time including non-contiguous land disturbances that take place at the same time and are part of a larger common plan of development or sale, the following shall apply:

- The average turbidity of any discharge for any day must not exceed a daily maximum value of 280 nephelometric turbidity units (NTUs).

**US EPA Sole Source Aquifer Program.** The Sole Source Aquifer (SSA) Program is authorized by Section 1424(e) of the Safe Drinking Water Act (SDWA) of 1974. Since 1977, it has been used by communities to help prevent contamination of groundwater from

federally-funded projects. Designation of an aquifer as a sole source aquifer provides US EPA with the authority to review federal financially assisted projects planned for the area to determine their potential for contaminating the aquifer. All projects proposed over the Northern Guam Sole Source Aquifer or Northern Guam Lens (NGL) are subject to review by GEPA as well as by the US EPA. Projects are scrutinized for potential direct or indirect impacts to groundwater.

**Wellhead Protection for Public Water Supply Well.** GEPA's wellhead protection program authorized by 22 Guam Administrative Rules (GAR) 7130 (d)(1) indicate that written Administrator approval is required prior to construction on, utilization of, operation on, or occupation of land, served or to be served by septic tank and leached field, sanitary sewer, stormwater disposal method, or liquid waste storage, disposal or treatment method, that is within the groundwater management protection zone and within a 1,000-foot radius of any public utility potable water supply well. Under 22GAR 7130(b) a wellhead protection area means the surface and subsurface area surrounding a water well or wellfield supplying a public water system through which contaminants are reasonably likely to move toward and reach such water well or wellfield, or a minimum of 1,000 feet radius of any potable water supply well.

**Underground Injection Control Program:** GEPA's Underground Injection Control (UIC) program (22 GAR Division II Chapter 9) includes underground injection wells and underground injection systems for use as drainage systems for storm water runoff. These permits are issued only after all other methods of storm water disposal have been thoroughly investigated and exhausted. This disposal method requires a higher burden of justification and typically is issued with very strict pretreatment and/or monitoring requirements for the life of the injection well.

### 3.2 REGULATORY AGENCY COORDINATION PROCESS

Implementation of any GRN project will require coordination with local and federal agencies prior to project advertisement (i.e. the design phase) and prior to construction (i.e. build phase).

The design approval process should be initiated at the beginning of the design phase of any project. The approval process should include a scoping meeting with agencies that would be considered stakeholders to the particular project. Such agencies include Guam DPW, GEPA, US EPA Region 9, BSP, and ACOE (if needed for 404 permitting requirements). With respect to overall stormwater management, plans shall be submitted and coordination meetings will be arranged during the design process with various agencies.

Both federal and local agencies require permits and clearances for activities that have or may potentially have an impact on Guam's ground or surface water. Table 5 displays agency-specific permits and clearances that are required prior to construction of any GRN project. A brief description regarding submittal and timing of each permit or clearance is also discussed.

**Table 5 - Agency Required Permits and Clearances**

Local/ Federal	Agency	Permit or Clearance	Implementation	
			Design <sup>1</sup>	Construction <sup>2</sup>
Local	Guam Department of Public Works	Building Permit		X
		Clearing and Grading Permit		X
	Guam EPA	Underground Injection Control Permit	X	
		Aquifer Protection Review	X	
		Section 401 Water Quality Certification	X	
		Environmental Protection Plan (EPP)		X
		Erosion Control Plan (ECP)		X
		Storm Water Pollution Prevention Plan (SWPPP)		X
	Bureau of Statistics and Plans	Federal Consistency Certification	X	
Federal	US EPA, Region 9	Sole Source Aquifer Protection	X	
		Wellhead Protection Program		X
		Section 402 National Pollutant Discharge and Elimination System (NPDES) Permit / Storm Water Pollution Prevention Plan (SWPPP)		X
		Storm Water Runoff Requirements – Section 438 of the Energy Independence and Security Act of 2007 (EISA)	X	
	US Army Corps of Engineers	Section 404 Discharge of Dredged or Fill Material into Waters of the United States	X	

1) Design phase, prior to advertisement for construction bids.

2) Construction phase, prior to Notice to Proceed.

**Sole Source Aquifer Protection Review/Clearance:** The GRN is within the boundaries of the NGL which has been designated as a Sole Source Aquifer by US EPA Region 9. Design reviews for consistency with the Sole Source Aquifer Program will be subject to an Aquifer Protection Review by GEPA as well as review by US EPA Region 9 for all projects. GEPA will forward the design plans provided during design to US EPA Region 9 for this effort. To comply with the US EPA Sole Source Aquifer Program and to prevent potential contamination from roadway runoff, runoff will be pre-treated (through devices such as bio-strips, bio-swales or retrofitted catch basins) and/or routed to infiltration facilities that are a minimum separation distance of 1000-ft from any water supply wells which provide a direct conduit into the drinking water aquifer. Existing production wells are shown as green points in Figures 2 and 3.

**Coastal Management Program Federal Consistency Review:** The GRN is within the boundaries of the Coastal Zone Management Area. All GRN projects requiring a federal permit or license or any other type of authorization are subject to the requirements of CZMA § 307(c)(3)(A)(16 U.S.C. § 1456(c)(3)(A)) and 15 C.F.R. part 930, subparts A, B and D. Please refer to CZMA Federal Consistency regulations, 15 CFR Part 930.31(a). A state agency or local government applying for federal financial assistance follows the

requirements of CZMA §307(d)(16 U.S.C. § 1456(d) and 15 C.F.R. part 930, subparts A, B and F. If a local agency is applying for funds under any of the applicable federal programs that are likely to affect land, water or natural resource uses in the coastal zone, materials must be submitted to the Guam State Clearinghouse. The notice of application must be reviewed by the BSP, normally conducted through procedures established by Guam pursuant to Executive Order 12372 – intergovernmental review of federal programs, or through State Clearinghouse procedures, P.L. 26-169. Should any inconsistencies with the GCMP be identified and the BSP formally objects to the application, the Federal agency is prohibited from approving the proposed project (Section 307(d), National CZMA).

**Building Permit:** The DPW, through the One-Stop Permit Center is responsible for issuing Building Permits. The review process involves routing the Construction Contract and the Plans and Specifications to a number of individual agencies, including GEPA, to ensure compliance with applicable law, regulatory standards, procedures, policies and rules within their respective mandated area of concern.

**Clearing and Grading Permit (CGP):** DPW is authorized to issue a Clearing and Grading Permit (CGP). The CGP issued by GEPA is the Erosion Control Permit which includes GEPA’s approval of an Erosion Control Plan (ECP) and an Environmental Protection Plan (EPP). GEPA assumes the lead review and approval responsibility to ensure the Construction Contracts (plans and specifications) are in compliance with the Guam Soil Erosion and Sedimentation Control Regulations. To receive a CGP, an EPP and an ECP to protect water quality of the closest body of water, fresh or marine (from Guam EPA Environmental Guidebook), must be submitted with the CGP application. Therefore, it is recommended that the EPP and the ECP be submitted to GEPA during the design process.

**Underground Injection Control (UIC) Permit:** This control permit is utilized to ensure that pollutants are not migrating into the groundwater through the UIC wells or systems. Operating permits may be issued in approximately 60 days for existing wells or in approximately 90 days for new wells, depending on the complexity of the injection proposal. Operating permits are renewable every two years (from 10 GCA Chapter 46 Water Resources Conservation Act, Section 46105 and Guam EPA Environmental Guidebook).

**Section 401 Water Quality Certification:** All federal permits for work in marine waters, rivers, streams or wetlands require GEPA Section 401 Water Quality Certification. Section 401 Water Quality Certification issuance identifies that construction or operation of a proposed project or facility will be conducted in a manner consistent with Guam Water Quality Standards. Submission of a completed 401 Water Quality Certification form is required. GEPA may also require submittal of the following additional plans and documentation prior to Section 401 issuance or as a condition of issuance:

- Construction Drawing Plans
- Construction Specifications
- Wetland Delineation Map
- Specifications

- Environmental Baseline Survey (marine, freshwater aquatic or adjacent upland)
- Environmental Protection Plan
- Water Quality Monitoring Plan
- Environmental Impact Assessment/Statement (EIA/EIS)
- Mitigation/Restoration Plans

**Section 402 National Pollutant Discharge and Elimination System 2008 General Permit for Stormwater Discharges from Construction Activities (NPDES Permit No. GUR100000):** The US EPA Construction General Permit is a NPDES permit issued under the authority of the CWA and associated regulations. Permit coverage for stormwater discharges from construction activity occurring within Guam is provided by a legally separate and distinctly numbered permit (NPDES Permit No. GUR100000). This permit regulates the discharge of storm water from construction sites that disturb one (1) acre or more of land, and from smaller sites that are part of a larger, common plan of development. This permit requires operators of construction sites to implement storm water controls and to develop SWPPPs to prevent sediment and other pollutants associated with construction sites from being discharged in storm water runoff. The following water pollution control activities to be used during construction will be identified as part of the SWPPP:

- Source identification and control (through covering and containing) of potential pollutants
- Erosion control techniques for temporary, permanent and wind conditions (types of erosion control to be considered include rolled erosion control products and hydraulically applied mulches)
- Sediment control techniques with the specific objective of maintaining sediment loads consistent with pre-construction levels (types of sediment control BMPs to be considered include fiber rolls, silt fence, drainage inlet protection and sediment traps and basins)
- Control of non-stormwater through elimination of sources

In addition, specific BMPs for construction work upstream, adjacent and within waterways are particularly important since many of the waterways (especially in the South portion of the island) discharge to marine waters that harbor coral reef habitat. Sedimentation is the most significant threat to the coral reefs around Guam. Therefore, pollutant source control BMPs for work upstream, adjacent and within waterways will be identified in the SWPPP and will include such items as:

- Minimizing demolition and construction activities over streams during the wet season
- Use of non-shattering demolition methods that would normally scatter debris
- Securing all materials adjacent to streams to prevent discharges into receiving waters via wind
- Using attachments on equipment to catch debris from small demolition operations
- Stockpiling accumulated debris and waste generated from demolition away from streams
- Isolating work areas within streams from flow using sheet piling, k-rails, or other methods of isolation

- Using drip pans during equipment operation, maintenance, cleaning, fueling, and storage for spill prevention
- Conducting all vehicle maintenance and mobile fueling operations at least 50 feet away from operational inlets and drainage facilities and on a level graded area.
- Keeping equipment used in streams leak-free
- Directing water from concrete curing and finishing operations away from inlets and water courses to collection areas for removal and/or proper disposal

The SWPPP will also include a stormwater runoff sampling and analysis plan consistent with the requirements indicated in the Construction General Permit. These requirements are applicable to:

- Attainment of Water Quality Standards After Authorization
- Compliance with Numeric Effluent Limitations for Turbidity<sup>3</sup>

The SWPPP must be prepared (generally by the Contractor) and must be available for review by US EPA, Region 9 and/or GEPA prior to construction.

An operator is authorized to discharge stormwater from construction activities under the terms and conditions of the Construction General Permit seven (7) calendar days after acknowledgment of receipt of a completed Notice of Intent (NOI) filed with US EPA<sup>4</sup>. The exception to this 7-day timeframe is if US EPA delays authorization based on eligibility considerations such as:

- Request to review SWPPP
- Endangered species documentation
- Consultation with US Fish and Wildlife Service
- Request to revise SWPPP
- Request to file for an individual permit

Thirty (30) days after cessation of construction activities and final stabilization of the site has been established, a Notice of Termination (NOT) must also be filed with US EPA Region 9. Authorization to discharge terminates at midnight of the day the NOT is signed.

**Section 404 Dredge/Fill Permitting:** This permit regulates the discharge of dredged or fill material into waters of the U.S. The program's scope also includes the regulation of discharges of dredged or fill material into wetlands adjacent to national waters. Although this permit program is administered by the Secretary of the Army through the ACOE, Sections 401 and 404 are related and result in coordinated permitting with GEPA and ACOE. The ACOE will not issue a 404 permit without satisfaction of Section 401 requirements. Permits for dredging or fill (including hardscape) can only be issued by the ACOE once the applicant

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<sup>3</sup> According to US EPA, this new requirement and other non-numeric effluent limitations to limit discharges of pollutants will be included in the next Construction General Permit (CGP) tentatively scheduled to be issued after July 2011 upon expiration of the existing 2008 CGP in June 2011.

<sup>4</sup> For GRN projects both DPW and the Contractor need to submit a NOI using US EPA's online system (i.e., eNOI).

has adequately demonstrated that the least environmentally damaging practicable alternative has been identified. The analysis must demonstrate that impacts to waters of the U.S. have been avoided to the maximum extent practicable and that unavoidable impacts will be minimized and compensated through mitigation consistent with the 2008 ACOE/EPA Compensatory Mitigation Rule.

**Section 438 Energy Independence and Security Act of 2007:** In December 2007, Congress enacted the Energy Independence and Security Act of 2007 (EISA). Section 438 of EISA establishes strict stormwater runoff requirements for federal development and redevelopment projects. Specifically, Section 438 requires federal agencies to develop and redevelop facilities with a footprint that exceeds 5,000 square feet in a manner that maintains or restores the pre-development site hydrology to the maximum extent technically feasible. Two options are provided to demonstrate that projects are maintaining pre-development hydrology: managing on-site the total volume of rainfall from the 95<sup>th</sup> percentile storm or managing on-site the total volume of rainfall based on a site-specific hydrologic analysis. Compliance with Section 438 can be demonstrated by using a variety of stormwater management practices referred to as green infrastructure or low impact development. The practices include, for example, reducing impervious surfaces, using vegetative BMPs and porous pavements<sup>5</sup>.

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<sup>5</sup> <http://www.epa.gov/owow/nps/lid/section438/>

## SECTION 4 WATER POLLUTION CONTROL STRATEGY

### 4.1 CONSTRUCTION

Construction site BMPs are to be used during construction to minimize the impacts of construction and construction-related activities on the watershed. They include, but are not limited to, temporary soil stabilization, temporary sediment control, waste management, material pollution controls and other non-storm water BMPs. Temporary soil stabilization and sediment controls provide the first line of defense in preventing off-site sedimentation and are designed to remove sediment from runoff before the runoff is discharged from the site. These control measures can be further divided into two major classes of controls: stabilization practices and structural practices. Typically, a combination of both (as well as non-stormwater management and waste management and material pollution controls) is necessary throughout the site to provide adequate water quality protection (see Section 3.2). Areas used for the maintenance of construction equipment are considered “Hot Spots” in accordance with the 2006 Storm Water Manual and must include BMPs specific to equipment operation, maintenance, cleaning, fueling, and storage. A more thorough description of these practices is given in the “Draft Transportation Storm Water Drainage Manual” (TSDM), Parsons 2010.

In the event groundwater dewatering is proposed or anticipated during construction, and an alternative method of disposal (e.g., discharge to sanitary sewer, retention on site) is not feasible, then the Contractor would coordinate with the DPW and GEPA prior to discharging waste. A SWPPP will be prepared by the Contractor after final design documents are available. This is required for compliance with the NPDES Construction General Permit and is regulated by US EPA, Region 9. The selection of construction BMPs will be determined as part of the development for the SWPPP.

### 4.2 POST-CONSTRUCTION

The post-construction stormwater program was developed based on guidelines set forth in the 2006 Manual and the TSDM. BMPs for controlling post-construction pollution are broken down into:

- Source Control – BMPs used to prevent contaminants from entering the runoff stream at the source of pollution (e.g. along unlined ditches or non-vegetated side slopes that could contribute sediment to the runoff stream),
- Treatment Control – BMPs used to treat the runoff by removing the contaminants that have already entered the runoff stream (e.g. removal of sediment through filtration, infiltration or detention), and
- Maintenance Control - BMPs used for the long-term maintenance of the roadway project area and the associated BMPs to keep them operating at proper efficiencies. (e.g. street sweeping and mowing to remove pollutants at the source and keeping ponds and storm sewers clean of debris and sediments).

The specific maintenance control BMPs are not listed in detail in this report, because they are the subject of separate DPW guidelines. There are, however, several design reviews that should be completed with DPW's maintenance staff which will help to define locations, types, and features of the selected stormwater facilities. These are discussed in greater detail in the TSDM. Discussions regarding Source and Treatment Control BMPs are provided below.

#### **4.2.1 SOURCE CONTROL**

The overall surface water quality program was designed to incorporate pollution prevention mechanisms through the use of source control BMPs. These include the following items to be incorporated into the design documents:

- Minimize impervious surfaces
- Stabilize disturbed soil areas and existing erodible surfaces
- Maximize vegetated surfaces
- Preserve existing vegetation
- Construct concentrated flow conveyance systems
- Provide outlet protection (energy dissipation)

#### **4.2.2 TREATMENT CONTROL**

Pollutant removal will be accomplished using treatment BMPs which are measures designed to remove pollutants from stormwater runoff prior to discharging (directly or indirectly) to receiving waters. GEPA requires that permanent treatment BMPs are considered for all new construction and major reconstruction projects that do not have exemption status (GEPA 2010)<sup>6</sup>.

##### **4.2.2.1 POLLUTANTS OF CONCERN**

Table 6 displays storm water monitoring results from recent discharge characterization studies conducted by the California Department of Transportation (2003). These studies have shown that pollutants of concern generated from roadways within an environment similar to what is found in Guam (with land use designated as open space, residential or commercial) include suspended solids and metals (the latter generally found in particulate form). Trash and debris are also considered pollutants of concern within urban areas. Hydrocarbons are of concern mainly at locations where vehicles idle for extended periods of time such as toll stations, or at fueling areas and vehicle maintenance facilities. None of these types of facilities (referred to as "Hot Spots" in the 2006 Manual) are included in the GRN. When the GRN projects become operational (i.e., during the post-construction phase), any added pavement would likely contain sediment, metals and other particulates that accumulate on roadway surfaces. Of these pollutants, sediment is the most significant threat to the coral reefs around Guam. Implementation of the post-construction source control BMPs and the treatment control BMPs listed in Table 7 and discussed in the following sections will minimize sediment impacts to Guam's coral reef systems.

**Table 6 - Storm Water Characterization Study Results**

Pollutant Category	Parameter	Unit	Highway Facilities Mean
Physical Properties	Dissolved Organic Carbon (DOC)	mg/L	18.7
	Hardness	mg/L	36.5
	Total Dissolved Solids (TDS)	mg/L	87.3
	Total Organic Carbon (TOC)	mg/L	21.8
	Total Suspended Solids (TSS)	mg/L	113
Hydrocarbons	TPH: Diesel	mg/L	3.72
Metals	Arsenic, Dissolved	ug/L	1
	Arsenic, Total	ug/L	2.7
	Copper, Dissolved	ug/L	14.9
	Copper, Total	ug/L	33.5
	Lead, Dissolved	ug/L	7.6
	Lead, Total	ug/L	47.8
	Nickel, Dissolved	ug/L	4.9
	Nickel, Total	ug/L	11.2
	Zinc, Dissolved	ug/L	68.8
	Zinc, Total	ug/L	187
Nutrients	Nitrate-Nitrogen	mg/L	1.07
	Total Kjeldahl Nitrogen	mg/L	2.06
	Total Phosphorus	ug/L	0.29

Source: California Department of Transportation (2003).

#### 4.2.2.2 TREATMENT BMP SELECTION

Treatment BMPs are selected for projects based on those best suited for: 1) the pollutants of concern (namely suspended solids, particulate metals and trash), 2) for the hydrologic, geologic and physical roadway characteristics on Guam, and 3) those considered easy to maintain to ensure proper operation once the network is completed.

These treatment BMPs generally include infiltration devices, biofiltration swales, biofiltration strips, media filters, detention devices and gross solids removal devices. Where necessary, recharge augmentation BMPs (infiltration basins, underground infiltration galleries, dry wells and if designed properly, vegetated swales and strips), should be considered where new impervious surfaces would diminish the overall recharge to the groundwater basins (specifically to the US EPA designated sole source aquifer in North Guam). Note that in order to protect the groundwater from contamination, treatment of storm water via vegetated swales or other water pollution control devices are generally located upstream of these wells. Where flows are already directed to existing depressions and infiltration basins, additional recharge augmentation is considered unnecessary since runoff would be retained within the basins and subsequently be allowed to infiltrate into the groundwater regime.

<sup>6</sup> Guam Environmental Protection Agency. 2010. Guam Erosion Control and Stormwater Management Draft Regulations, Section 10101 D. January 2010.

### 4.2.3 TREATMENT BMP DESIGN

BMP design depends on the amount of runoff expected, which is affected by:

- Location,
- Land use,
- Drainage area,
- Storm intensity,
- Topography,
- Soil characteristics,
- Quantity of impervious area,
- Constituents of concern to be removed,
- Storm volume, and
- Peak flow conditions.

The Water Quality Design Storm is the particular event that generates runoff rates or volumes that the drainage facilities are designed to handle. Treatment BMPs are designed to treat the flow of smaller, more frequent storm events. The volume of flows associated with these more frequent events are commonly referred to as the water quality volume or WQV (as defined in the 2006 Manual and the TSDM) for BMP designs based on volume, and the water quality flow (WQF) for BMP designs based on flow. BMP Design Guidelines for Infiltration Devices, Detention Devices, and Media Filters can be found in the 2006 Manual and the TSDM after its finalization. Design guidelines for biofiltration swales and strips are included in Appendix E. The parameter used for these designs is described as the water quality flow rather than the water quality volume as described below.

**Water Quality Volume:** The water quality volume (WQV) corresponds to the active storage capacity for stormwater treatment BMPs and is required for sizing volume-based BMP treatment systems such as infiltration basins, infiltration trenches, media filters or detention basins. The WQV for treatment BMPs is intended to provide the level of protection specified in the 2006 Manual for the Water Quality Classification indicated in Figure 10. As shown on this figure, the GRN projects are within areas with a moderate water quality classification. As per the 2006 Manual and the TSDM, areas with this type of classification should have associated treatment BMPs that treat runoff from the 80<sup>th</sup> percentile storm. Areas designated as having a high water quality classification have associated treatment BMPs that treat runoff from the 90<sup>th</sup> percentile storm. Both the 80<sup>th</sup> and 90<sup>th</sup> percentile storms correspond to storm events between 1 and 2 years (statistically approximated at 56% and 72%, respectively, of a 2 yr – 1 hr storm per the TSDM). The WQV is estimated using the precipitation depth equal to 56% of the 2 year storm (for moderate water quality classification areas) and 72% of the 2 year storm (for high water quality classification areas) times the individual tributary areas and the percent imperviousness.

**Water Quality Flow:** The water quality flow (WQF) corresponds to the design flow used for flow-based stormwater treatment BMPs that are usually filtration type BMPs such as grass swales and buffer strips. For the project area, the WQF is calculated using the Rational Method and a precipitation intensity equal to 56% and 72% of the 2 yr - 1 hr storm intensity for moderate and high water quality classification areas, respectively. See Figure 7 which shows that the 2 yr – 1 hr storm intensity equate to 1.1 inches per hour.

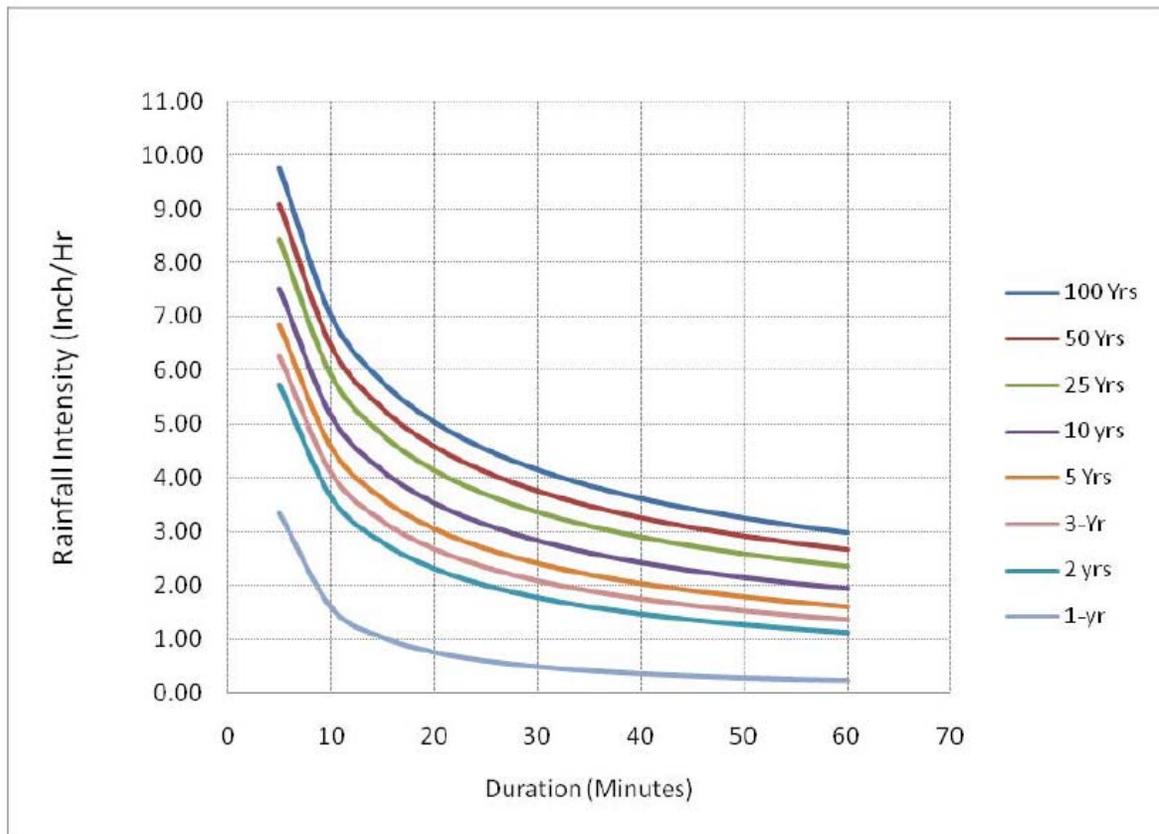


Figure 7 – Guam TSDM Intensity Duration Frequency Curves

### 4.3 TYPES OF TREATMENT BEST MANAGEMENT PRACTICES

**Biofiltration Swales/Strips:** Biofiltration swales (bioswales) are vegetated channels that receive directed flow and convey stormwater. Biofiltration strips (biostrips) are vegetated sections of land over which stormwater flows as overland sheet flow. Pollutants are removed by straining through the grass, sedimentation, adsorption to soil particles, and infiltration into the soil. Biostrips and bioswales are mainly effective at removing debris, solid particles (suspended solids) and associated pollutants absorbed to these solids and particulate metals. These BMPs are most applicable in areas where site conditions and climate allow for the establishment of vegetation (very good on the island of Guam), where flow velocities are low, and where the length of flow through the bioswales or across the biostrips can be maximized. In accordance with the *Caltrans Treatment BMP Technology Report, April 2007*, bioswales have good removal efficiencies for the pollutants of concern, namely metals and total suspended solids. When designed appropriately, these BMPs have been found to remove over 80% of these pollutants.

Bioswales should be considered at locations along the alignments where longitudinal slopes are consistent with design criteria and where right-of-way is available (generally within the less urbanized areas). A key consideration in the design of bioswales is to have peak flow

velocities (for higher storm event flows) of less than 4 feet/second through the channel to avoid erosion and water quality flow velocities low enough to maintain a hydraulic residence time greater than 5 minutes within the swale (at a maximum depth of 0.5 feet). Generally, this requires slopes to be less than 3.0 percent.

Biostrips are sloped vegetated land areas located adjacent to impervious areas, over which storm water runoff flows as sheet flow. Pollutants are removed by filtration through the vegetation, uptake by plant biomass, sedimentation, adsorption to soil particles, and infiltration through the soil. Biostrips are effective at trapping litter, Total Suspended Solids (soil particles), and particulate metals (Caltrans, 2008). The slope of the biostrip should be designed as flat as possible (1:4 or flatter). The minimum recommended slope length for biostrips is 15 ft for any side slope ratio as long as the site supports a minimum 70 percent vegetation coverage without rills or gullies. Biostrips can be used in lieu of shoulders in rural areas (referred to as grass shoulders).

**Infiltration Devices:** An infiltration basin is a device designed to remove pollutants from surface discharges by capturing stormwater runoff and infiltrating it directly into the soil rather than discharging to receiving waters. The feasibility criteria for infiltration basins require: 1) sufficient area to accommodate a basin with side slopes of 3:1, maintenance access, and fencing at the top of embankment, 2) sufficient soil infiltration and permeability rates, 3) sufficiently low water table, and 3) no threat to local groundwater quality<sup>7</sup>. Infiltration basins are a good choice for surface water protection where soils exist that support their use. They are considered the best form of treatment for stormwater runoff.

**Detention Devices:** A detention basin is a permanent device that temporarily detains stormwater runoff under quiescent conditions such that sediment and particulates are able to settle before the runoff is discharged. A portion of the detained water is also lost due to infiltration and evaporation. Detention basins remove litter, settleable solids (debris), TSS (total suspended solids), and pollutants that are attached (adsorbed) to the settled particulate matter. Detention basins are primarily suited for sites where: 1) the seasonal high groundwater is below the bottom of the basin, and 2) where sufficient head is available so that water stored in the basin does not cause objectionable backwater conditions in the storm drain systems. In accordance with the *Caltrans Treatment BMP Technology Report, April 2007*, detention basins have good removal efficiencies for pollutants of concern – total metals (mainly those in particulate form) and suspended solids, though they are generally used as a method of pre-treatment prior to conveyance to an infiltration basin or as a means of flow control. The detention basins are generally equipped with outlets that meter out the flow at a low rate and are mainly considered as a suitable BMP for flow control where existing flows are being increased due to increased impervious area.

**Media Filters:** Media filters primarily remove particulates from runoff by sedimentation and filtration (through a porous media such as a sand bed generally equipped with a drainage system under the media) and are also effective at removing dissolved metals and litter. The

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<sup>7</sup> According to 22 GAR 002-7, Section 7130(b) Wellhead Protection Area shall mean the surface and subsurface area surrounding a water well or wellfield supplying a public water system through which contaminants are reasonably likely to move toward and reach such water well or wellfield, or a minimum of 1,000 feet radius of any potable water supply well. Thus wellhead protection applies to UIC wells as well as infiltration basins.

filters can be designed at grade, with an open top, or designed below grade within a closed chamber. At grade filters may be configured with earthen sides or concrete while below grade filters are designed as concrete chambers. Runoff is initially routed through a sediment chamber which allows settleable solids to settle out prior to filtering the runoff through the bed of media. The filters require sufficient hydraulic head to operate by gravity (a minimum of 3 feet). Closed chamber media filters are suitable for relatively small drainage areas and are usually only recommended where surface use over the filter is required. At grade earthen media filters require a fairly large footprint, though are the least expensive alternative. Maintenance is usually easier for at-grade filters since the facility is not considered a confined space. However, the filter beds are more susceptible to vegetative growth which may require more frequent maintenance activities than underground filters.

**Catch Basin Retrofits:** Within urban areas where the on-site roadway drainage systems include catch basins connected to conveyance pipelines, there are often no areas available for

downstream treatment BMPs. In these areas, it is recommended that the catch basins be retrofitted to accommodate removal of litter and debris (commonly referred to as gross solids). The retrofit can be accomplished in various ways. A simple retrofit option of catch basins is to ensure that all catch basins have a hooded outlet to prevent floatable materials, such as trash and debris, from entering the storm drain system. An opening filled with pervious material placed in the bottom of the catch basin will enable a small amount of runoff to infiltrate, preventing standing water in the bottom of the structure (see Figure 8). A second option is to incorporate a reverse 90 degree bend in the outlet structure. The outlet can also be equipped with a filtering plate such as a plastic or metal wire mesh with 0.5 mm openings in order to filter out some of the larger suspended solids. Note that both of these options will require continued maintenance for trash and debris removal as specified in separate DPW guidelines.

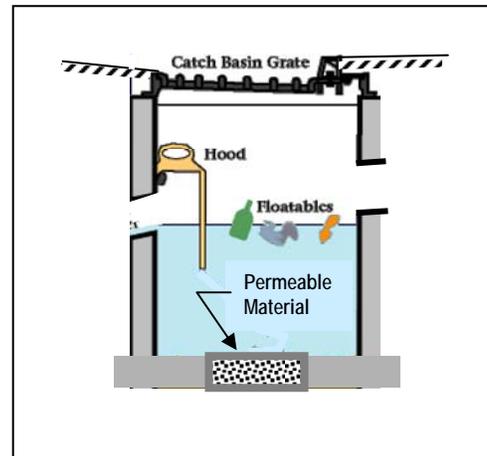


Figure 8: Sample Catch Basin Retrofit

downstream treatment BMPs. Note that both of these options will require continued maintenance for trash and debris removal as specified in separate DPW guidelines.

**Flow Splitters:** The purpose of the flow splitter is to direct water quality flows (WQF) to the BMPs for stormwater treatment, while allowing peak flows to remain in their original watershed/discharge location (mimicking pre-project conditions). The splitter design shown in Figure 9 represents a typical vaulted flow splitter. Alternative designs may be evaluated in the final design phase for projects requiring these devices.

**Other BMP Options:** There are many other BMP options available for both water pollution control and recharge augmentation such as dry wells, underground infiltration galleries, infiltration trenches, wetlands, and others. The BMPs provided in this report are those which are most likely to be used throughout the GRN Network, though other BMPs may be prudent for use at certain site specific areas. Descriptions and design criteria for these BMPs are provided in the 2006 Manual and the TSDM.

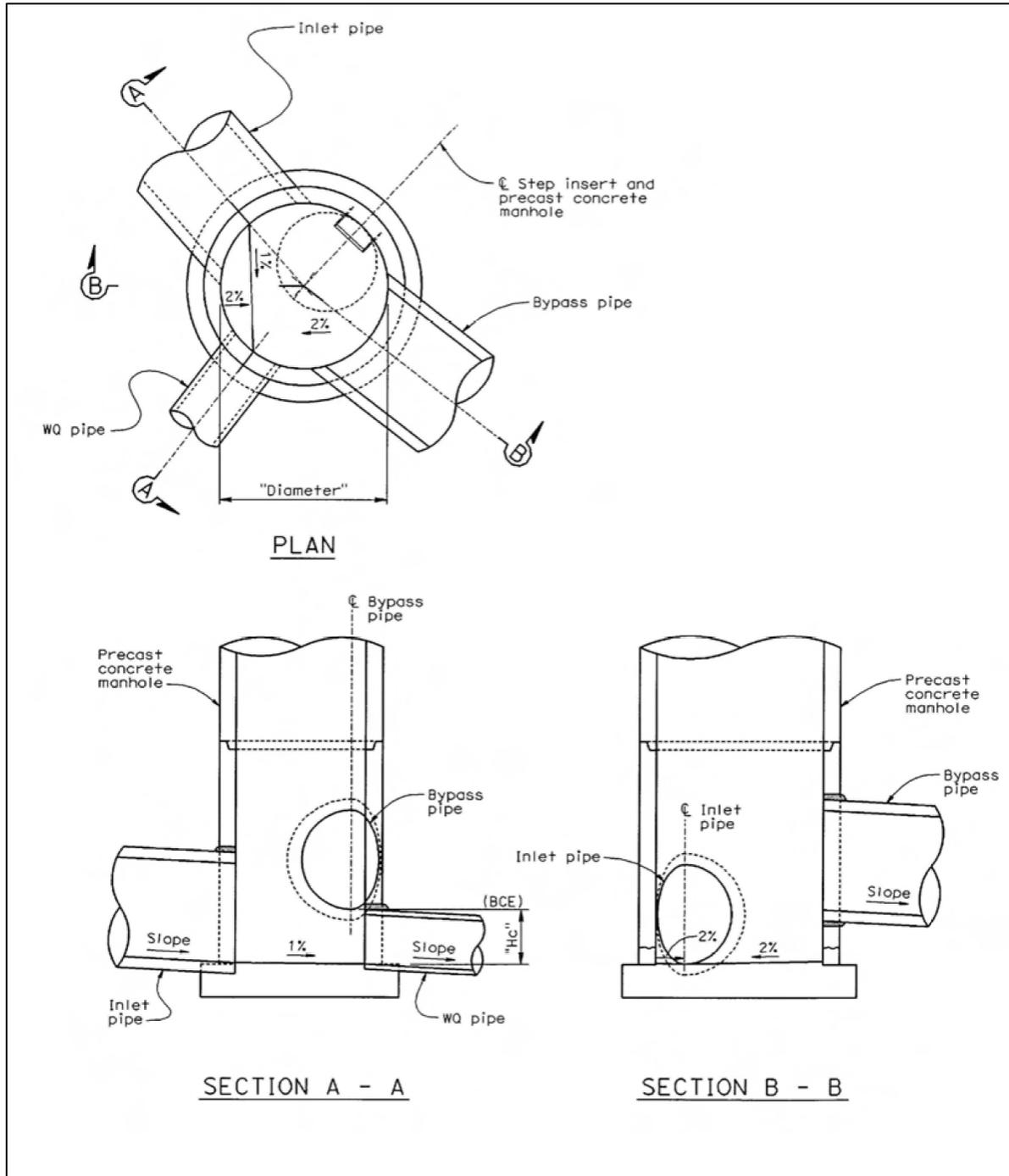


Figure 9: Sample Flow Splitter Design

## SECTION 5

### POLLUTION SOURCE CONTROL

Source control BMPs are practices used to prevent contaminants from entering the runoff stream at the source of pollution. These include such practices as lining unlined ditches or vegetating side slopes that could contribute sediment to the runoff stream or preventing increases in offsite flow velocities that could result in downstream erosion. This section describes typical post-construction source control BMPs that can be used for the GRN projects.

#### 5.1 REDUCTION OF IMPACTS FROM FLOW CHANGES

**North Guam:** In the north area of Guam, the porosity of its coralline rock formation facilitates rapid rainfall percolation through the limestone into the freshwater lens below. Although the surface in this area is relatively flat, and precipitation generally flows by sheets into swales, then into depressions/retention basins, where it percolates into the ground, during heavy rainfall, seasonal streams do exist in some areas. For instance, due to the presence of clayey soils in the Mount Santa Rosa area, heavy rainfall produces streams. However, water in these streams eventually percolates through the highly permeable limestone. Therefore, there are a very limited number of permanent streams for surface drainage from the north area of Guam.

Planned roadway improvements in North Guam are generally pavement strengthening projects that will create no increase in impervious surfaces. Where possible, the pavement strengthening projects will include biostrips and/or swales which will generally decrease existing flow rates prior to flow conveyance to existing infiltration basins and surface depressions. Existing conveyance facilities and outlets may be adequate to accommodate the future widening. The facilities must be evaluated for the roadway design storm events specified in the TSDM.

**South Guam:** With the exception of a few intersections, increases in impervious surfaces are not anticipated in South Guam and drainage flow patterns are generally to remain unchanged. Bioswales/ strips will also be used wherever possible in South Guam to both treat and potentially reduce existing flow rates entering the various surface waters (including streams, surface depressions/ infiltration basins and bays/estuaries).

#### 5.2 PRESERVATION OF EXISTING VEGETATION

Existing desirable vegetation and landscaping will be protected in place, where possible, and will be shown on the plans. The plans should include demarcation of the limit of disturbed soil area to ensure that adjacent vegetation is preserved during construction to the extent possible.

### **5.3 CONCENTRATED FLOW CONVEYANCE SYSTEMS**

Risks due to erosion or washout may be minimized through the use of rock slope protection, hydroseeding, ground cover, mulch, longitudinal ditches, and down drains. Velocity dissipation devices, flared end outlets, headwalls, transition structures, and splash walls may be incorporated into the design, where necessary, at culvert inlets and outlets to prevent erosion. Grass or concrete lined longitudinal ditches may be incorporated to intercept sheet flow, where necessary, and to convey it to culverts or bridges that cross under the roadway. Culvert outlets may be equipped with appropriate energy dissipating devices.

### **5.4 SLOPE AND SURFACE PROTECTION SYSTEMS**

Various slope and surface protection measures may be used to address site soil stabilization and reduce deposition of sediments in the adjacent surface waters. Typical measures include installation of appropriate vegetation for permanent erosion control, application of soil stabilizers such as hydroseed, rock slope protection, gabions, velocity dissipation devices, flared end sections for culverts, and others. The project may be constructed to minimize erosion, including use of retaining walls to reduce the steepness of slopes or to shorten slopes; providing cut and fill slopes flat enough to allow re-vegetation and limit erosion to pre-construction rates; and collection of concentrated flows in stabilized drains and channels. Energy dissipaters in the form of riprap or impact basins may be provided at storm drain outlets as necessary to control erosion. Riprap sizes and thicknesses may be shown on the plans, and stone gradation/placement methods may be defined in the project specifications.

At the bridge improvement sites, the use of hardscape for bank or channel bed protection should be minimized to the extent practicable. Where natural bed and banks occur, soft-bottomed channel crossings as well as softer bank and channel protection techniques may be considered. In instances where an existing bridge crossing has localized hardscape, opportunities to reconstruct the bridge crossing with vegetation, in lieu of hardscape, that is suitable to the site conditions and seasonal requirements in accordance with Guam Division of Aquatic and Wildlife Resources' recommendations may be considered along with specific design recommendations provided by the US Fish and Wildlife Service and the National Marine Fisheries Service. Slope and surface protection measures may be incorporated in the channels immediately upstream and downstream of the bridge sites. These include measures to prevent scour and embankment erosion and include such items as vegetation stabilization techniques, channel widening, channel lining with either natural (i.e. vegetation) or manufactured materials, pier placement/ reconfiguration, utility line relocation where utilities cause obstructions to flow, debris removal and landscaping with appropriate vegetation. At bridge crossings, where the use of hardscape is the only option, incorporation of debris noses upstream of piers, wingwalls, channel recontouring, and embankment stabilization using lining such as gabions, concrete or rip rap may be considered.

## SECTION 6

### POLLUTION TREATMENT CONTROL

Treatment control BMPs are practices used to treat the runoff by removing the contaminants that have already entered the runoff stream (e.g. removal of sediment through filtration, infiltration or detention). Such BMPs will be designed and implemented to reduce the discharge of pollutants from the onsite storm drainage systems for the GRN projects. This section describes sizing criteria and constraints that must be evaluated prior to BMP selection/ implementation. Typical treatment BMPs are described in detail in Section 4.

**Constraints to be Evaluated for Implementation** - Constraints evaluated during BMP design should include:

- Storm drain conveyance viability,
- Right-of-way constraints,
- Topographic constraints,
- Sensitive Habitat
- Soil infiltration characteristics,
- Water quality classifications (see Figure 10),
- Pollutants of concern (mainly TSS and associated particulate metals),
- Recharge requirements (see Figure 10),
- Maintainability,
- Existing on-site drainage systems,
- Proximity to existing production wells, infiltration facilities, streams and sinks (see Section 7),
- Roadway cross-sections which may or may not concentrate flows,
- Type of roadway project (pavement widening or pavement strengthening), and
- Location of the storm drain/treatment system outlet.

**Sizing Criteria** - Water quality volumes used for volume-based treatment facility sizing and recharge augmentation facility sizing will be calculated using procedures described in the 2006 Manual and the TSDM. Water quality flows used for flow-based treatment facilities (e.g. for bioswales and biostrips) will be calculated using rainfall intensities for the 80<sup>th</sup> and 90<sup>th</sup> percentile storms for areas designated with moderate and high water quality classifications, respectively. These intensities have been statistically approximated at 56% and 72% of a 2-year storm event (1 hour duration), per the TSDM (see Figure 7).

**Treatment BMP Selection** –The selection of treatment BMPs for the projects were based on the 2006 Manual, supplemented with recent BMP design guidelines prepared by the California Department of Transportation for biofiltration devices (grass swales and filter strips) to maximize efficiencies.

For much of the GRN, the NGL groundwater basin will be the receiving water since the runoff in the Northern Guam area generally flows to natural depressions or manmade percolation basins that allow the surface waters to infiltrate to the aquifer below. As shown in



**Treatment BMPs for Guam Projects-** Each of the water quality and recharge augmentation BMPs was evaluated individually for implementation on GRN projects. A description of the evaluation performed for most of the BMPs that will be implemented as part of the GRN projects and the associated design criteria is discussed below.

**Biofiltration Strips/Swales:** Recent pilot testing of these facilities have shown that they can be very effective at treating the pollutants of concern and for use as recharge augmentation devices (if designed properly, these facilities have been shown to allow up to 50% of the flows to infiltrate prior to conveyance to the receiving water bodies). Since this is from recent testing of said facilities (Caltrans 2009), the documentation was not provided in the 2006 Manual. This documentation serves to supplement the information provided in that manual. In addition, these facilities are generally considered flow-based BMPs and are designed given rainfall intensities for the 80<sup>th</sup> to 90<sup>th</sup> percentile storms (of only 1 hour duration) rather than rainfall depths as provided for volume based BMPs described in the previous manuals.

**Infiltration Basins:** Most of the proposed roadway improvements in North Guam are located in areas characterized by soils with good infiltration characteristics and sufficiently low groundwater. As shown in Table 4, there are many existing infiltration basins (approximately 25) and natural depressions within this area that act as infiltration basins. It is assumed that these areas can be used for the future improvements as they are already being maintained by Guam DPW. An analysis to determine the capacity of existing infiltration devices to accommodate any changes in runoff volume due to the increase in impervious surfaces should be evaluated at the time of design and must satisfy the guiding principles of the regulatory agencies required at the time of the design (see Table 5). Requirements for any rehabilitation of the existing infiltration facilities must also be assessed at this time. Studies have shown that with the inclusion of adequately designed biostrips and bioswales, up to 50% of the runoff should infiltrate prior to entering the infiltration basins (Caltrans 2009). This figure may be higher in areas of North Guam where the permeability of underlying soils is high. The soil material underlying most of the alignment in this area is limestone, with associated high permeability that supports the use of infiltration basins. The corridors located within the South Guam Region, however, are generally located where: 1) soils (generally volcanic in origin) exhibit poor infiltration/permeability characteristics, and/or 2) groundwater levels are high such as near the coastline. In these locations, infiltration basins are generally not considered feasible and some other means of water quality treatment is recommended (see Table 7 for treatment BMPs). Note that the impervious areas along the GRN corridors within South Guam are generally not being widened, eliminating the need for recharge augmentation in this area. Secondly, since the natural drainage flow paths will be maintained along with existing flow rates, BMPs for flow reduction are considered unnecessary in this area (though flow rates will likely be reduced with the inclusion of treatment BMPs).

**Detention Basins:** A detention basin is currently being proposed to collect runoff for the Harmon Sink along Rte 10a. This same basin, located adjacent to Route 1, could be used as an outlet to the drainage systems along Route 1 in that vicinity. The detention basin is proposed as a pre-treatment facility for runoff prior to conveyance to the Harmon Sink.

**Flow Splitters:** Flow splitters can be used to divert the poor quality low flows to a BMP, while higher flows remain in the existing flow path. This minimizes the need for large scale BMPs since they will only be required to accommodate the lower water quality flows.

**Catch Basin Retrofits:** In some of the more urbanized areas, catch basin retrofits may be the best solution for treatment. Retrofitting a catch basin is generally proposed for removal of gross solids which may be accomplished by modifying the outlet structure as described in Section 4.

## SECTION 7

### GRN STORMWATER MANAGEMENT CONCEPTS

#### 7.1 OVERALL CONCEPT

Major runoff interception, conveyance and water pollution control elements of the GRN projects are described in this section. Where feasible, the overall drainage concepts should maintain existing drainage flow patterns and incorporate existing drainage systems and water quality control features as much as possible, given existing physical constraints. While this section provides overall concepts, each GRN project will need to have the drainage evaluated at a more detailed level during the design phase with proper drainage systems installed and existing problems corrected in accordance with guidelines provided in the Transportation Storm Water Manual and the 2006 Manual.

#### 7.2 PROJECT CATEGORIES

The following sub-sections describe drainage conditions along the GRN corridors for onsite systems and offsite systems. In general, there are four categories of projects that require different storm water management strategies. These can be broken down into: 1) pavement widening which includes projects that will increase the impervious surface such as capacity improvements (i.e. addition of new lanes), pavement strengthening with shoulder widening, and new roadways; 2) pavement strengthening without shoulder widening; 3) intersection improvement projects that include signaling, striping, and possibly additional lanes that may result in minor increases of onsite impervious surfaces and 4) bridge crossing replacement projects which may affect conveyance of offsite flows under the roadway. Figures 11 and 12 depict the alignments of the combined GRN projects and show the limits of those projects requiring pavement widening along with the bridge replacement project locations. Table 7 summarizes the GRN project storm water management strategies for the four categories of projects. Table 8 at the end of this section provides a synopsis of the drainage conditions and potential BMPs to be used for the GRN Corridor Segments shown in these figures. General guidelines for water pollution control are described below for the various project categories:

**Pavement Widening Projects** – These involve pavement strengthening projects that include shoulder widening, capacity improvement projects that include construction of additional lanes, and new roadways, all of which result in an increase in onsite impervious surfaces. Construction site BMPs as described in Section 4.1 will be employed during construction for each project falling under this category (see Table 7). The Scope of Work for these projects will implement appropriate pollution source control and pollution treatment controls based on the drainage characteristics in Section 7.3 and 7.4.

**Pavement Strengthening Projects (Without Shoulder Widening)** – These projects involve replacement of the existing structural segment of the roadway and do not involve increases in the pavement area. Without additional impervious surface, the existing drainage flow rates, patterns as well as the existing drainage system will generally be maintained. Each project, however, will need to have the drainage evaluated at a more detailed level during the design phase with proper drainage systems installed and existing problems corrected in accordance

with guidelines provided in the Transportation Storm Water Manual and the 2006 Manual. Construction BMPs as described in Section 4.1 will be employed during construction for each project falling under this category (see Table 7). In rural areas where curbs are not present, existing grass shoulders should be graded to drain away from the road to prevent concentrated flow along the pavement and subsequently improve drainage conditions (see Section 7.4). In doing so, the elevation of the pavement should be at grade or higher than the adjacent grass shoulder to ensure sheet flow through the grass. The grass shoulders and swales will both promote infiltration and provide treatment for the pollutants of concern. As shown in Figures 11 and 12, approximately 70% of the Guam projects fall within this category. Tables 7 and 8 display the Guam corridors and related projects which require strengthening.

**Intersection Improvement Projects** - Intersection projects include improvements at roadway intersections and military access points and involve such items as signaling, striping, and in some instances additional lanes that may result in minor increases of onsite impervious surfaces. Construction BMPs as described in Section 4.1 will be employed during construction for intersection improvement projects which result in disturbed soils such as those requiring pavement widening for additional lanes (see Table 7). The intersections requiring pavement widening are shown in Figures 13 and 14. The Scope of Work for these projects will implement appropriate pollution source control and pollution treatment controls based on the drainage characteristics discussed in Section 7.3 and 7.4. Treatment related to pavement widening for these intersections should be accomplished at the outlet of the pipeline network if sufficient room is available for BMP placement at the outlet. This is recommended along Route 1 at the Tamuning Drainageway as described further in this section. Otherwise, catch basins at the intersections may be retrofitted for gross solids removal as described in Section 4.4.

**Bridge Crossing Replacement Projects** - Several bridge crossings are to be replaced along the rural portion of Route 1 (see Figure 12 and Appendix F). Bridges and associated approach slabs within all areas generally concentrate flow since they are curbed. On-site runoff from the bridges must not be allowed to flow directly to the stream below through openings in the bridge. Instead, the runoff from the bridges should be directed to asphalt concrete (AC) spillways where the curbs beyond the bridge approach slabs generally end. Some form of energy dissipation such as rip rap will be required at the downstream end of the AC spillway to prevent erosion of the road embankment. The bridges also provide conveyance of off-site flows under the roadway. Off-site runoff design requirements are generally limited to source control BMPs such as streambank stabilization. Embankment stabilization in the vicinity of the bridges is important since embankment erosion is evident at all bridge sites. In order to control the erosion, simple source control improvements are recommended. These include improvements such as the placement of rip rap or gabions along the river's embankment immediately upstream and downstream of the bridges, concrete channel lining along the river's embankment, and/or wing wall replacement where necessary. The extent of the proposed improvements will be provided on a per-project basis during the design phase. Tables 7 and 8 show the GRN corridors and related projects which require bridge crossing replacement.

Table 7 – Summary of GRN Projects<sup>10</sup>

Project Type	GRN Project	Corridor Segment	Project Limits	Existing Drainage System	Post-Construction Source Control	Post-Construction Treatment Control	Proposed Onsite Drainage Improvements	North		South	
								Urban	Rural	Urban	Rural
Pavement Strengthening (Without Shoulder Widening)	6	Rte 1, Area 7	Rte 27 to Ch Lujana	Sheet Flow Off Pavement	Exist Veg Embankment	Runoff Routed to Exist Infiltration Basins, Biofiltration Pre-Treatment	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	7	Rte 1, Area 6	Rte 3 to Rte 27	Inlets & Storm Drain	Exist Hardscape <sup>9</sup>	Runoff Routed to Exist Infiltration Basins	Retrofit Catch Basins	x			
	13	Rte 1, Area 2	Rte 11 to Asan River	Sheet Flow Off Pavement	Exist Veg Sides	Runoff to flow through exist grass shoulders	Grade Biostrips to Drain				x
	14	Rte 1, Area 2	Asan River to Rte 6	Sheet Flow Off Pavement	Exist Veg Sides		Eliminate Localized Onsite Ponding				x
	15	Rte 1, Area 2	Rte 6 to Rte 4	Sheet Flow Off Pavement	Exist Veg Sides		Eliminate Localized Onsite Ponding				x
	23	Rte 1, Area 7	Ch Lujana to Rte 9	Sheet Flow Off Pavement	Exist Veg Embankment	Runoff Routed to Exist Infiltration Basins, Biofiltration Pre-Treatment	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	24	Rte 1, Area 1	Rte 11 to Rte 2A	Sheet Flow Off Pavement	Exist Veg Embankment	Runoff to flow through exist grass shoulders	Grade Biostrips to Drain or Add Bioswales				x
	33	Rte 1, Areas 3, 4, 5	Rte 8 to Rte 3	Inlets & Storm Drain	Exist Hardscape	Catch Basin Retrofits Recommended for Area 3, Media Filter or Bio-Swale at Tamuning Drainageway for Area 4, Existing Detention Pre-Treatment at Harmon Sink for Area 5	Add Flow Splitter at Tamuning Drainageway, Route Drainage to Detention Basin at Harmon Sink	x		x	
	8	Rte 3, Area 1	Rte 28 to Rte 1	Sheet Flow Off Pavement	Exist Veg Embankment	Runoff Routed to Exist Infiltration Basins	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	17	Rte 8, Area 2	Rte 10 to Tiyan Pk/ Rte 33	Inlets & Storm Drain	Exist Hardscape & Veg Embankment	Runoff Routed to Exist Infiltration Basins	Eliminate Localized Onsite Ponding			x	
	30	Rte 10	Rte 15 to Rte 8/16	Inlets & Storm Drain	Exist Hardscape & Veg Embankment	Runoff Routed to Exist Infiltration Basins	Eliminate Localized Onsite Ponding			x	
	4	Rte 11	Port to Rte 1	Inlets & Storm Drain	Exist Veg Embankment		Eliminate Localized Onsite Ponding				x
	12	Rte 15	Smith Quarry to Ch Lujana	Sheet Flow Off Pavement	Exist Veg Embankment	Runoff to flow through exist grass shoulders	Grade Biostrips to Drain		x		
	18	Rte 16, Areas 2, 3	Rte 27 to Rte 10A	Inlets & Storm Drain	Exist Hardscape & Veg Embankment	Runoff Routed to Exist Infiltration Basins	Eliminate Localized Onsite Ponding	x			
	63	Rte 16, Area 1	Rte 10A to Sabana Barrigada	Sheet Flow Off Pavement	Exist Veg Embankment	Runoff to flow through exist grass shoulders	Eliminate Localized Onsite Ponding			x	
21	Rte 27	Rte 1 to Rte 16	Inlets & Storm Drain	Exist Hardscape & Veg Embankment	Runoff Routed to Exist Infiltration Basins	Not Anticipated	x				

<sup>9</sup> Hardscape includes concrete-based, concentrated flow structures such as sidewalks, curb and gutter, etc.

Table 7 – Summary of GRN Projects<sup>10</sup>

Project Type	GRN Project	Corridor Segment	Project Limits	Existing Drainage System	Post-Construction Source Control	Post-Construction Treatment Control	Proposed Onsite Drainage Improvements	North		South	
								Urban	Rural	Urban	Rural
Pavement Widening (Capacity Improvement, Shoulder Widening, New Roads)	9	Rte 3, Area 2	NCTS Finegayan to Rte 28	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Infiltration Basins & Thru Biostrips	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	10	Rte 3, Area 2	NCTS Finegayan to Route 9	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Infiltration Basins & Thru Biostrips	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	31	Rte 8A	Route 16 to NAVCAMS Barrigada	Sheet Flow Off Pavement	Veg Embankments	Place New Infiltration Basins on South Side	Grade Biostrips/ Swales to Drain to Infiltration Basins				x
	16	Rte 8	Tiyan Pkwy/Route 33 (east) to Route 1	Inlets & Storm Drain	Hardscape	Retrofit Catch Basins or Route Flow to Infiltration	Inlet Relocation, Storm Drain Improvements at Rte 33			x	
	22	Rte 9	Route 3 to AAFB (North Gate)	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Infiltration Basins & Thru Biostrips	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	22a	Rte 9	AAFB North Gate to Route 1	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Infiltration Basins & Thru Biostrips	Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	26	Rte 2A	Rte 1 to Rte 5	Sheet Flow Off Pavement	Veg Embankments	Runoff to flow through grass shoulders	Grade Biostrips to Drain		x		
	25	Rte 5	Rte 2A to Rte 17	Sheet Flow Off Pavement	Veg Embankments	Runoff to flow through grass shoulders	Grade Biostrips to Drain		x		
	27	Rte 5	Rte 17 to Naval Ordnance	Sheet Flow Off Pavement	Veg Embankments	Runoff to flow through grass shoulders	Grade Biostrips to Drain		x		
	29	Rte 25	Route 16 to Route 26	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	28	Rte 26	Route 1 to Route 15	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	New Swales, Conveyance Systems Required along Each Side	x			
	36	Rte 15	Realignment onto DoD Property South of Ch Lujana	N/A (new road)	Veg Sides	Route runoff to flow through grass shoulders and to infiltration basins	Biostrips each side, convey flow to infiltration basin		x		
	57	Rte 28	Route 1 to Route 3	Sheet Flow Off Pavement	Veg Sides	Runoff Routed to Infiltration Basins & Thru Bioswales	Inlet Relocation, Grade Biostrips/ Swales to Drain to Infiltration Basins		x		
	124	Finegayan Connection	Route 1 and Route 16	N/A (new road)	Veg Sides	Route runoff to flow through grass shoulders and to infiltration basins	Biostrips each side, convey flow to infiltration basin		x		
	11	Ch Lujana	Route 1 to Route 15	Sheet Flow Off Pavement	Veg Embankments	Runoff to flow through grass shoulders	Grade Biostrips to Drain		x		

Table 7 – Summary of GRN Projects<sup>10</sup>

Project Type	GRN Project	Corridor Segment	Project Limits	Existing Drainage System	Post-Construction Source Control	Post-Construction Treatment Control	Proposed Onsite Drainage Improvements	North		South	
								Urban	Rural	Urban	Rural
Intersection Improvements	1	Rte 1, Area 3	Route 1 / Route 8 Intersection	Inlets & Storm Drain	Veg Embankments	Retrofit Catch Basins	Inlet Relocation			x	
	2	Rte 1, Area 5	Route 1 / Route 3 Intersection	Inlets & Storm Drain	Veg Embankments	Route SD to Detention at Harmon Sink	Inlet Relocation	x			
	6	Rte 1, Area 6	Route 1 / Route 28 Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	6	Rte 1, Area 6	Route 1 / Route 26 Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	7	Rte 1, Area 6	Route 1 / Route 27 Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	7	Rte 1, Area 6	Route 1 / Route 27A Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	33	Rte 1, Area 5	Route 1 / Route 14 (NSV) Intersection	Inlets & Storm Drain	Veg Embankments	Route SD to Detention at Harmon Sink	Inlet Relocation	x			
	33	Rte 1, Area 5	Route 1 / Route 14A Intersection	Inlets & Storm Drain	Veg Embankments	Route SD to Detention at Harmon Sink	Inlet Relocation	x			
	33	Rte 1, Area 5	Route 1 / Route 10A Intersection	Inlets & Storm Drain	Veg Embankments	Route SD to Detention at Harmon Sink	Inlet Relocation	x			
	33	Rte 1, Area 4	Route 1 / Route 14B Intersection	Inlets & Storm Drain	Veg Embankments	Place Treatment BMP at Tamuning Drainageway	Inlet Relocation			x	
	33	Rte 1, Area 4	Route 1 / Route 14 (ITC) Intersection	Inlets & Storm Drain	Hardscape	Place Treatment BMP at Tamuning Drainageway	Inlet Relocation			x	
	33	Rte 1, Area 4	Route 1 / Route 30 Intersection	Inlets & Storm Drain	Hardscape	Place Treatment BMP at Tamuning Drainageway	Inlet Relocation			x	
	50	Rte 1, Area 7	Navy Main Base, Rte 1 @ Turner	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Infiltration Basins & Thru Biostrips	Grade Biostrips to Drain		x		
	124	Rte 1, Area 5	Route 1 / Route 16 Intersection	Inlets & Storm Drain	Veg Embankments	Route SD to Detention at Harmon Sink	Inlet Relocation	x			
	44	Rte 1, Area 7	Anderson South (Main Gate)	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Infiltration Basins & Thru Biostrips	Grade Biostrips to Drain		x		
9	Rte 3, Area 2	Route 3 / Route 28 Intersection	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Biostrips & Infiltration Basins	Eliminate Localized Onsite Ponding		x			

Table 7 – Summary of GRN Projects<sup>10</sup>

Project Type	GRN Project	Corridor Segment	Project Limits	Existing Drainage System	Post-Construction Source Control	Post-Construction Treatment Control	Proposed Onsite Drainage Improvements	North		South	
								Urban	Rural	Urban	Rural
Intersection Improvements	10	Rte 3, Area 2	Route 3 / Route 3A Intersection	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Biostrrips & Infiltration Basins	Grade Biostrrips/ Swales to Drain to Infiltration Basins		x		
	41	Rte 3, Area 2	South Finegayan (Residential Gate)	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Biostrrips & Infiltration Basins	Grade Biostrrips/ Swales to Drain to Infiltration Basins		x		
	42	Rte 9	AAFB (North Gate)	Sheet Flow Off Pavement	Veg Embankments	Runoff Routed to Biostrrips & Infiltration Basins	Grade Biostrrips/ Swales to Drain to Infiltration Basins		x		
	5	Rte 11	Route 1 / Route 11 Intersection	Inlets & Storm Drain	Veg Embankments	Add Bioswales	Route SD to Bioswales				x
	52	Rte 5	Naval Munitions Site @ Route 5/ Route 12	Sheet Flow Off Pavement	Veg Embankments	Existing Biostrrips	Grade Biostrrips to Drain				x
	32	Rte 15	Route 15 / Route 26 Intersection	Sheet Flow Off Pavement	Veg Embankments	Existing Biostrrips	Grade Biostrrips/ Swales to Drain		x		
	117	Rte 15	Route 15 / Route 29 Intersection	Sheet Flow Off Pavement	Veg Embankments	Existing Biostrrips	Grade Biostrrips/ Swales to Drain		x		
	46	Rte 15	Anderson South (Secondary Gate)	Sheet Flow Off Pavement	Veg Embankments	Existing Biostrrips	Grade Biostrrips/ Swales to Drain		x		
	18	Rte 16	Route 16 / Route 27 Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	19	Rte 16	Route 16/ Route 10A Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	25	Rte 5	Route 5 / Route 17 Intersection	Sheet Flow Off Pavement	Veg Embankments	Existing Biostrrips	Grade Biostrrips to Drain				x
	28	Rte 26	Route 26 / Route 25 Intersection	Inlets & Storm Drain	Veg Embankments	Runoff Routed to Exist Infiltration Basins	Inlet Relocation	x			
	57	Rte 28	Route 28 / Route 27A Intersection	Sheet Flow Off Pavement to Swales	Veg Embankments	Runoff Routed to Exist Infiltration Basins	New Swales or Conveyance Systems Required along Each Side		x		

Table 7 – Summary of GRN Projects<sup>10</sup>

Project Type	GRN Project	Corridor Segment	Project Limits	Existing Drainage System	Post-Construction Source Control	Post-Construction Treatment Control	Proposed Onsite Drainage Improvements	North		South	
								Urban	Rural	Urban	Rural
Bridge Replacement Projects	3	Rte 1, Area 3	Agana Bridge Replacement	Inlets & Storm Drain	Rip rap or embankment channel lining, wing walls	Retrofit Catch Basins	Retrofit Catch Basins at Downstream Side of Bridge				x
	35	Rte 1, Area 1	Fonte Bridge Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x
	35	Rte 1, Area 1	Asan Bridge 2 Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x
	35	Rte 1, Area 1	Asan Bridge 1 Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x
	35	Rte 1, Area 1	Sasa Bridge Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x
	35	Rte 1, Area 1	Laguas Bridge Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x
	35	Rte 1, Area 1	Aguada Bridge Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x
	35	Rte 1, Area 1	Atantano Bridge Replacement	Sheet Flow Off Pavement	Rip rap or embankment channel lining, wing walls	Onsite runoff beyond bridge to flow through exist grass shoulders or swales at bottom of embankment	AC Spillway Downstream Side of Bridge. Rip Rap at Base of Spillway.				x

<sup>10</sup> The proposed improvements discussed in this table are conceptual. The extent of the proposed improvements will be provided on a per-project basis during the design phase.

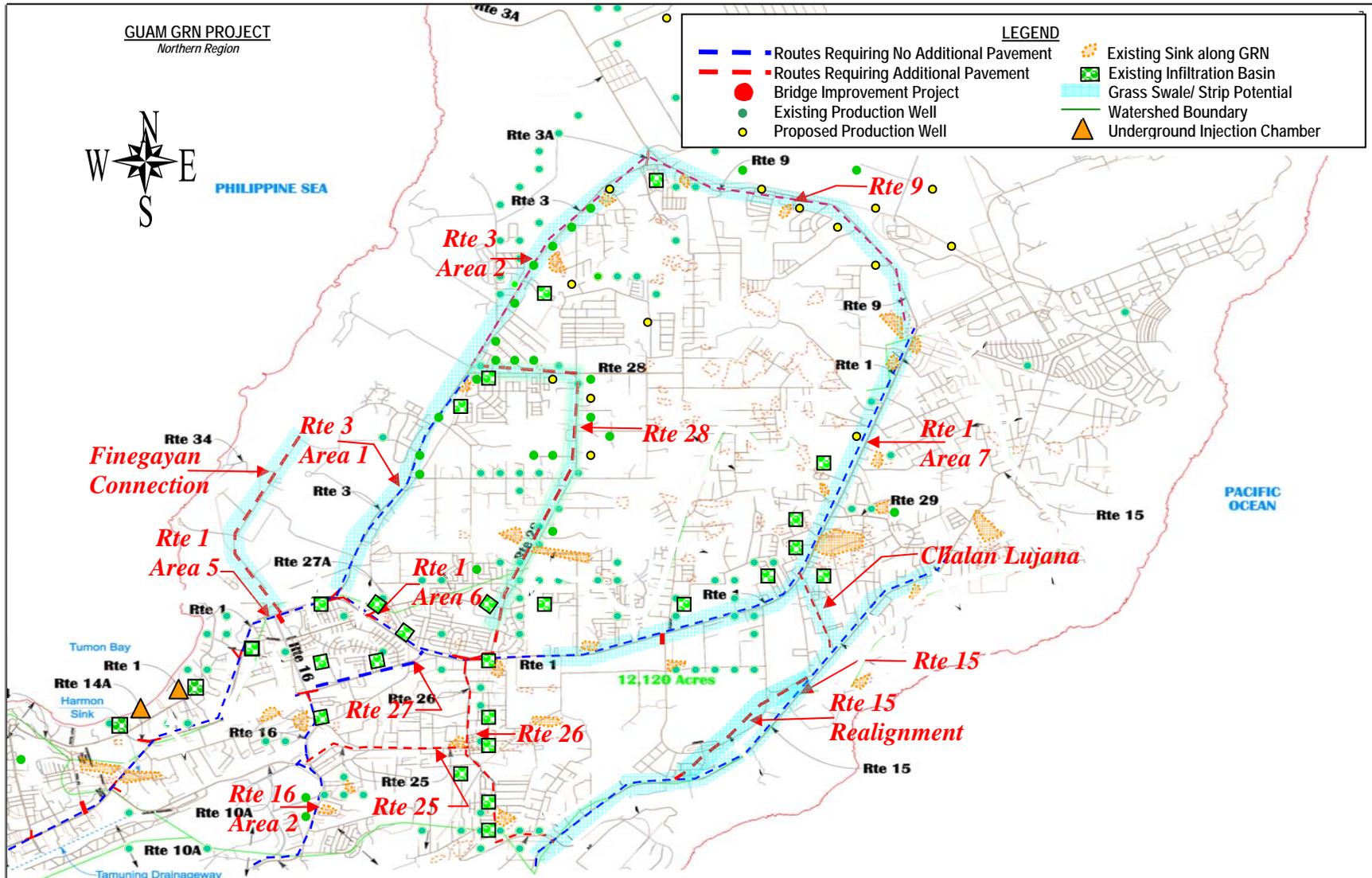


Figure11 North Guam Road Network Corridor Identification

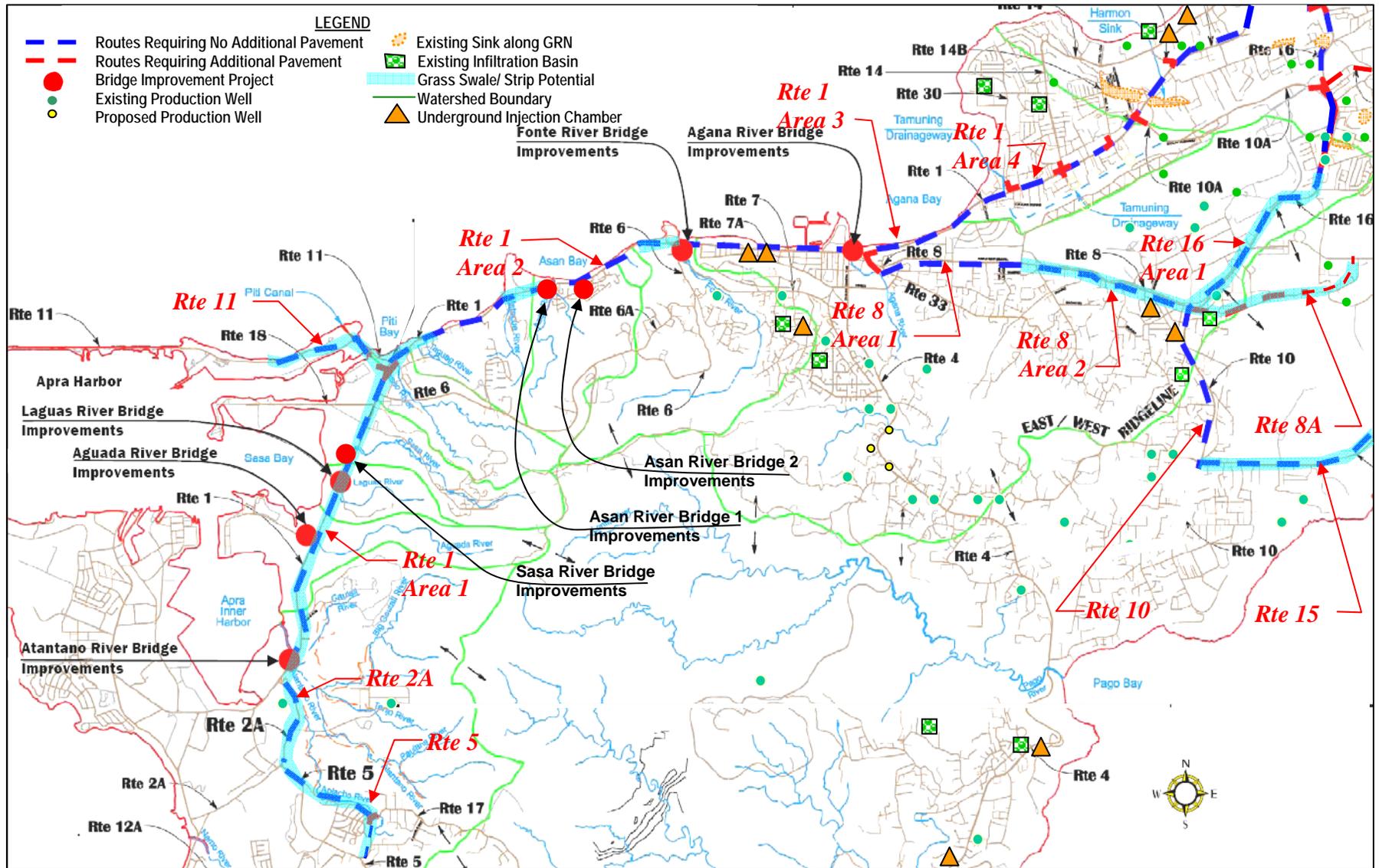


Figure 12 South Guam Road Network Corridor Identification

### 7.3 GRN ONSITE DRAINAGE CHARACTERISTICS

Onsite drainage characteristics of the GRN projects are described in this section. Projects have been broken down into those located in rural and urbanized areas. Roadway cross-sections in rural areas are generally not curbed and allow onsite runoff to sheet flow from the roadway onto grass shoulders. Roadway cross-sections within urbanized areas are generally curbed due to right-of-way constraints. The latter generally possess concentrated flow conveyance systems consisting of inlets and storm drains conveying flow to a single point. Onsite storm water management strategies for these two types of drainage systems can vary substantially and are described separately in the following sections.

#### 7.3.1 NORTH GUAM

Road surfaces in this area are relatively flat and runoff generally flows by sheets onto grass shoulders and/or swales, then into existing depressions (sinks) or manmade infiltration devices where it percolates into the ground. In this way, the runoff from the road is generally filtered prior to its conveyance to the sinks or infiltration devices. Figure 11 depicts the proposed GRN within North Guam. Section 4.3 provides general information on biofiltration swales and strips. The discussion below provides an overview of the drainage patterns in the area. There may be minor localized ponding issues that should be addressed during design that may not be described in this section. Therefore, each project will require a specific drainage review that addresses localized ponding/flooding issues.

**Rural Areas** - The corridors highlighted in blue in Figure 11 display road sections generally located in the more rural areas that have existing grass shoulders and/or swales generally of sufficient size to act as treatment BMPs for water pollution control of on-site drainage. GRN project designs for these areas should include road cross-sections that incorporate these existing features with grass shoulders designed to accommodate sheet flow (not concentrated flow) from the pavement as described in Section 4.4 (Biofiltration Strips). The existing sinks will act as outlets for the drainage systems. Capacity of existing infiltration devices to accommodate any changes in runoff volume due to the increase in impervious surfaces should be evaluated at the time of design and must satisfy the guiding principles of the regulatory agencies required at the time of the design (see Table 5). If infiltration capacity is insufficient to accommodate the widened roads, additional infiltration devices or increases in existing infiltration basin capacity may be required. Any new infiltration devices should be placed within government right-of-way and should be located as far as possible from any existing production wells (with a minimum separation distance of 1000 ft).

**Urbanized Areas** - Corridors located in the more urban areas of North Guam convey flow directly to manmade infiltration devices or natural sinks generally through a storm drain network consisting of catch basins, pipelines and outfalls. The lowest and largest sink within this area is the Harmon Sink located along Route 1, immediately north of Route 10A. A detention basin is currently being proposed to collect runoff for the Harmon Sink along Route 10A. This same basin, which will be located adjacent to Route 1, could potentially be used as an outlet to the drainage systems along Route 1 in that vicinity. Proposed GRN roadway projects that entail pavement widening in the urbanized corridors include Rtes 25 and 26. Improvements are underway for these routes including storm drain interception and

conveyance systems to infiltration basins, underground recharge systems and existing sinks. Future widening along these roads is anticipated, though since these routes are not considered high priority, the widening will occur much further in the future in order to accommodate traffic concerns in the 2020 time frame. At that time, the existing facilities should be evaluated to see if any retrofit to the storm drain system would be required to accommodate the future widening.

### 7.3.2 SOUTH GUAM

In Southern Guam, surface drainage generally flows to one of the numerous rivers that traverse the area (with the exception of portions of Route 8 and Route 10 where runoff enters existing manmade infiltration devices or natural sinks and infiltrates into the ground). Figure 12 displays the proposed GRN roadway projects within South Guam. The corridors highlighted in blue display roadway sections that have existing grass shoulders and/or swales generally of sufficient size to act as treatment BMPs for water pollution control of on-site drainage. Projects for the GRN within the south area of Guam mainly involve pavement strengthening with the exception of several intersection improvement projects and 8 bridge replacement projects. The discussion below provides an overview of the drainage patterns within the area though there may be localized ponding issues that need to be addressed during the design phase that may not be described in this section. Therefore, each project will require a specific drainage review that addresses localized ponding/flooding issues.

**Rural Areas** - Grass shoulders and/or swales exist in the more rural areas. Under existing conditions, many of the grass shoulders exhibit concentrated flow due to growth above the pavement. In order for the grass shoulders to properly drain and also treat the runoff, the grass must be maintained in such a way that will allow the runoff to sheet flow onto the grass. The design for these areas should therefore include roadway cross-sections that incorporate these existing features though with grass shoulders designed to accommodate sheet flow from the pavement as described in Section 4.4 (Biofiltration Strips). Several bridges are to be replaced along the rural portion of Route 1. Bridges and associated approach slabs within all areas generally concentrate flow since they are curbed. As such, the on-site runoff from the bridges for this area should be directed to asphalt concrete (AC) spillways where curbs beyond the bridge approach slabs end (see Section 7.2).

**Urbanized Areas** - Interception and conveyance of drainage flow in the more urbanized areas of



Figure 13 BMP Concept Tamuning Drainageway - 1

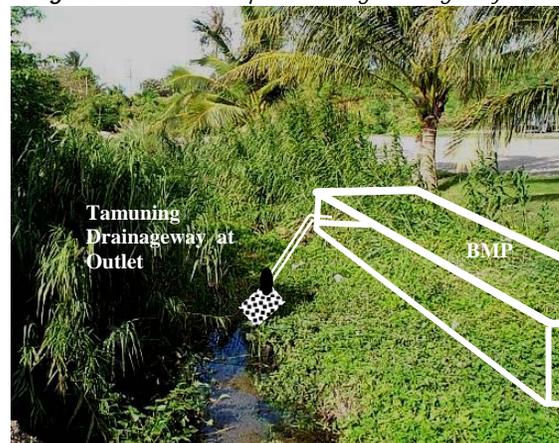


Figure 14 BMP Concept Tamuning Drainageway - 2

the GRN in South Guam is accomplished with existing catch basins and storm drains. These include storm drain networks along Route 1 and Route 8 within the village of Agana and along Route 1 within the village of Tamuning. In Agana, Route 1 drainage systems outlet directly to Agana Bay and Route 8 drainage systems outlet directly to the Agana River. Here, water pollution control may be accomplished through catch basin retrofits (right of way and groundwater constraints seemingly prevent effective use of other BMP options). As described in Section 4.4, catch basins would be retrofitted to accommodate gross solids removal with some percolation through the bottom of the structure.

The drainage system for Route 1 in the vicinity of Tamuning is a large storm drain system that conveys flow to a single point of concentration, the Tamuning Drainageway. Strategic placement of a BMP at this location would enable treatment for several upstream projects. During design, the feasibility of a flow splitter placed in the on-site storm drain system at the Tamuning Drainageway should be evaluated. This could allow low flow roadway runoff to be directed to a treatment BMP located off-site, preferably on public property (see Figures 13 and 14). This may require a right of way easement for the incorporation of a low flow pipeline to the BMP location. Potential treatment for this location includes construction of a bioswale or media filter at the outlet.

## 7.4 GRN OFFSITE DRAINAGE CHARACTERISTICS

### 7.4.1 NORTH GUAM

Since North Guam has no perennial streams and rainfall percolates rapidly through the surficial soils, there are very few drainage concerns regarding offsite runoff in this area. One area of concern is along Route 27, south of Route 16 where inadequate drainage conveyance causes offsite and onsite flow to intermingle and pond along the roadway. While this area is not within the purview of the GRN, it is being identified as a project of importance to be addressed in the overall Guam Transportation Improvement Program (GTIP).

### 7.4.2 SOUTH GUAM

Proposed GRN projects within South Guam are generally on the west side of the island where the streams are channeled within the volcanic slopes which outlet into shallow fringing coral reefs. This section provides additional information regarding off-site drainage issues that should be addressed during the design phase of the GRN projects. Appendix F provides additional information regarding off-site conditions at each of the bridge replacement project sites.

Off-Site Coastal Issues: Route 1 parallels the coastline from Apra Harbor, northward to Agana Bay. Along this section of roadway, several locations are designated within FEMA



Figure 15: Coastal Erosion Protection along Rte 1

Flood Hazard Zone V or VE which is defined as a coastal flood zone with velocity hazard due to wave action. Currently, these areas are protected from erosion by gabion walls or rip rap slope protection. Figure 15 shows a typical area along Route 1 within the coastal flood zone and where coastal erosion control has been used along the embankment in the form of riprap revetment. Field investigations indicate that several sections of the coastline within the limits of Route 1, Area 2 (see Figure 12) have little to no protection. Coastal erosion appears to encroach into the roadway right-of-way at one or two locations within this area.

Offsite Flooding Issues:

Flooding is prevalent along Route 1 in the vicinity of Apra Harbor from the Sasa River Bridge to the Atantano River Bridge (designated as Route 1, Area 1 in Figure 12). Here, the roadway is located above the tidal zone of the various rivers that flow to Apra Harbor. It has been noted that at periods of high tide and high flow in the river, the river's water surface is elevated above the outer pavement for Route 1 (which is generally crowned in this area). This has been observed



*Figure 16: Route 1 Flood Prone Area – Apra Harbor*

to occur at a frequency of approximately once every two years. Figure 16 displays a cross-culvert in this area during normal high tide condition. The only way to remedy this situation is to raise the road surface which is beyond the scope of the GRN projects since the only work to be done in this area is with respect to pavement strengthening. In order to improve the drainage in this area (i.e. the area designated as Route 1, Area 1 in Figure 12), it is recommended that the grass shoulders be graded to drain (currently the grass shoulder is allowed to grow onto the pavement causing flow to concentrate along the edge of pavement, rendering sheet flow ineffective). The level of the adjacent ground surface should be at the elevation of the edge of pavement and the grass shoulders should slope away from the pavement. This will: 1) improve the drainage characteristics for this area, 2) enable use of the grass shoulders as treatment devices, 3) promote infiltration of the roadway runoff prior to entering the offsite receiving waters, and 4) improve flooding characteristics from offsite flows.

## **7.5 GRN STORM WATER MANAGEMENT SUMMARY**

Table 8 below provides a synopsis of the various elements used in determining the appropriate on-site storm water management facilities for the various GRN corridors. The corridors have been segmented, where necessary, to separate areas exhibiting different drainage system characteristics and/or different water quality control requirements. Overall, the stormwater management components include potential source control BMPs for on-site and off-site storm drainage systems and treatment control BMPs for on-site systems (where applicable). This is to be used to integrate site design practices and procedures for the GRN projects with the design and layout of stormwater infrastructure to attain stormwater quality and quantity management goals set forth in the 2006 Manual and TSDM. In turn, this will mitigate any impact that may occur to the beneficial uses for the various water bodies receiving runoff from the proposed facilities (e.g. marine waters and associated coral reefs, surface waters and groundwater).

Table 8 – Summary of GRN Storm Water Management Components

GRN Location (Figures 11 and 12)	Added Paved Area?	Water Quality Classification	General Location	Length (ft)	Total New Impervious Area (ac)	Total Disturbed Area (ac)	Is Onsite Flow Concentrated ?	Is There Adequate Area for Biofiltration Devices?	Are Soils and Groundwater Depths Adequate for Infiltration?	Is Area Tributary to NGL Aquifer?	Potential BMPs	Remarks
Rte 1, Area 1	No	Moderate	South Guam, Apra Harbor Area	16,247	0.0	17.9	No	Yes	No	No	Bioswales/ strips	See Section 7 for exist flooding issues.
Rte 1, Area 2	No	Moderate	South Guam, Piti Bay Area	24,009	0.0	31.5	No	Some Locations	No	No	Bioswales/ strips	
Rte 1, Area 3	No	Moderate	South Guam, Agana Bay Area	9,042	0.0	14.9	Yes	No	No	No	CB Retrofits	
Rte 1, Area 4	At Intersect'ns	Moderate	South Guam, Tamuning	9,042	1.0	15.9	Yes	No	No	Yes	Flow Splitter, Media Filter or Bioswale	See Section 7 for BMP location.
Rte 1, Area 5	At Intersect'ns	Moderate	North Guam, Harmon Sink	13,563	0.0	22.4	Yes	No	Yes	Yes	Existing Detention, Exist Infiltration	See Figure 11 for exist infiltration basins
Rte 1, Area 6	At Intersect'ns	Moderate	North Guam, Rte 3 to Rte 28	6,867	0.0	11.4	Yes	No	Yes	Yes	Exist Infiltration, Catch Basin Retrofits	See Figure 11 for exist infiltration basins
Rte 1, Area 7	No	Moderate	North Guam, Rte 28 to Rte 9	30,450	0.0	33.6	No	Yes	Yes	Yes	Exist Infiltration, Bioswales/ Strips	See Figure 11 for exist infiltration basins
Rte 2A	No	Moderate	South Guam, Atantano Watershed	4,577	0.0	5.0	No	Yes	Yes	No	Bioswales/ strips	
Rte 3, Area 1	No	Moderate	North Guam, Rte 1 to Rte 28	13,500	0.0	14.9	No	Yes	Yes	Yes	Exist Infiltration, Bioswales/ Strips	See Figure 11 for exist infiltration basins
Rte 3, Area 2	Yes	Moderate	North Guam, Rte 28 to Rte 9	16,050	14.7	23.6	No	Yes	Yes	Yes	Bioswales/ strips, Exist Infiltration	See Figure 11 for exist infiltration basins
Rte 5	Yes	Moderate	South Guam, Atantano Watershed	10,333	3.8	9.5	No	Yes	Yes	No	Bioswales/ strips	
Rte 8, Area 1	Yes	Moderate	South Guam, Rte 1 to Airport	8,290	0.0	13.7	Yes	No	Yes	Yes	CB Retrofits, Media Filters, Infiltration	
Rte 8, Area 2	No	Moderate	South Guam, Airport Area	7,904	0.0	8.7	No	Yes	Yes	Yes	Bioswales/ strips, Existing Injection Wells w/ Infiltration	See Figure 12 for exist injection wells
Rte 8A	Yes	Moderate	South Guam, East of Rte 10	8,865	3.3	8.2	No	Yes	Yes	Yes	Bioswales/ strips, Infiltration	
Rte 9	Yes	Moderate	North Guam, Rte 3 to Rte 1	15,500	8.5	17.1	No	Yes	Yes	Yes	Bioswales/ strips, Infiltration	See Figure 11 for exist infiltration basins
Rte 10	No	Moderate	South Guam, Rte 8 to Rte 15	7,847	0.0	8.6	Yes	No	Yes	Yes	Infiltration	See Figure 12 for exist infiltration basins
Rte 11	No	Moderate	South Guam, Apra Harbor Area	10,630	0.0	5.9	Yes	Yes	No	No	Bioswales/ strips	
Rte 15	No	Moderate	North/ South Guam, Rte 10 to Quarry North of Chalan Lujana	47,600	0.0	26.2	No	Yes	Yes	Yes	Infiltration, Bioswales/ strips	
Rte 15 Realignment	Yes	Moderate	North Guam, Rte 15 South of Ch Lujana	11,200	7.7	15.4	No	Yes	Yes	Yes	Infiltration, Bioswales/ strips	
Rte 16, Area 1	No	Moderate	South Guam, Rte 8 to Rte 10A	8,691	0.0	9.6	No	Yes	Yes	Yes	Infiltration, Bioswales/ strips	
Rte 16, Area 2	Yes	Moderate	North Guam at Rte 10A	5,448	3.0	9.0	Yes	No	Yes	Yes	Exist Infiltration	See Figure 11 for exist infiltration basins
Rte 16, Area 3	No	Moderate	North Guam, Rte 10A to Rte 27	4,505	0.0	7.4	Yes	No	Yes	Yes	Exist Infiltration	See Figure 11 for exist infiltration basins
Rte 25	Yes	Moderate	North Guam, Rte 16 to Rte 26	8,050	2.2	8.9	Yes	No	Yes	Yes	Exist Infiltration	See Figure 11 for exist infiltration basins
Rte 26	Yes	Moderate	North Guam, Rte 15 to Rte 1	12,900	3.6	14.2	Yes	No	Yes	Yes	Exist Infiltration, Bioswales/ Strips	See Figure 11 for exist infiltration basins
Rte 27	No	Moderate	North Guam, Rte 16 to Rte 1	5,448	0.0	9.0	Yes	No	Yes	Yes	Exist Infiltration	See Figure 11 for exist infiltration basins
Rte 28	Yes	Moderate	North Guam, Rte 1 to Rte 3	21,000	13.5	25.1	No	Yes	Yes	Yes	Exist Infiltration, Bioswales/ Strips	See Figure 11 for exist infiltration basins
Chalan Lujana	Yes	Moderate	North Guam, Rte 15 to Rte 1	4,350	1.2	3.6	No	Yes	Yes	Yes	Infiltration, Bioswales/ strips	See Figure 11 for exist infiltration basins
Finegayan Conn	Yes	Moderate	North Guam, Rte 1 & Rte 16	18,910	17.4	30.4	No	Yes	Yes	Yes	Infiltration, Bioswales/ strips	

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**APPENDIX A**  
**GRN PROJECT SPREADSHEET**

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Rte	Segment Limits	Type of Work	Requirements/Description	GRN #	Length (ft)	Construction Year
1	Route 1 / Route 8 Intersection	Intersection Improvements	Intersection Improvements (.15 mi on Rte 1 & .09 mi on Rte 8) to provide two left-turn lanes and two right-turn lanes for northbound Route 8 approaching Route 1.	1	940	2010
1	Route 1 / Route 3 Intersection	Intersection Improvements	Intersection Improvements (.24 mi on Rte 1 & .04 mi on Rte 3) to provide southbound left, combined left/right, and free right with accel lane; east to north double left-turn lane.	2	2,400	2010
1	Agana Bridge	Bridge Improvement	Agana Bridge Replacement	3	85	2010
1	Route 27 to Chalan Lujana	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	6	18,200	Not Scheduled
1	Route 1 / Route 28 Intersection	Intersection Improvements	Intersection improvements to provide additional eastbound left-turn lane; southbound Route 28 approach to include two right-turn lanes and combined left/through lane.			
1	Route 1 / Route 26 Intersection	Intersection Improvements	Intersection improvements to provide additional westbound left-turn lane, eastbound right-turn lane; northbound Route 26 approach to include left-turn, combined left-turn/right-turn, and right-turn lane.			
1	Route 3 to Route 27	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (six lanes)	7	4,600	Not Scheduled
1	Route 1 / Route 27 Intersection	Intersection Improvements	Intersection improvements to provide double eastbound left-turn lanes, eastbound right-turn lane, and triple westbound left-turn lanes. Northbound Route 27 approach to include left-turn, combined left-turn/through and two right-turn lanes.			
1	Route 1 / Route 27A Intersection	Intersection Improvements	Intersection improvements to provide additional eastbound left-turn lane, additional northbound Route 27A right-turn lane.			
1	Route 11 to Asan River	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	13	8,472	Not Scheduled
1	Asan River to Route 6 (Adelup)	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	14	6,437	Not Scheduled
1	Route 6 (Adelup) to Route 4	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (six lanes)	15	9,100	Not Scheduled
1	Chalan Lujana to Route 9 (AAFB)	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	23	14,250	Not Scheduled
1	Route 11 to Route 2A	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	24	16,247	Not Scheduled
1	Route 8 to Route 3	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (six lanes)	33	31,647	Not Scheduled
1	Route 1 / Route 14 (NSV)	Intersection Improvements	Intersection improvements to add southbound right-turn lane.			
1	Route 1 / Route 14A	Intersection Improvements	Intersection improvements to add northbound and southbound left-turn lanes, southbound right-turn lane.			
1	Route 1 / Route 10A	Intersection Improvements	Intersection improvements to add southbound left-turn lane, northbound right-turn lane.			
1	Route 1 / Route 14B	Intersection Improvements	Intersection improvements to change eastbound right-turn lane to combined right-turn/left-turn lane.			
1	Route 1 / Route 14 (ITC)	Intersection Improvements	Intersection improvements to include southbound right-turn lane.			
1	Route 1 / Route 30	Intersection Improvements	Intersection improvements to provide additional northbound left-turn lane, change existing lanes on eastbound approach to combined left-turn/through, and two right-turn lanes.			

Rte	Segment Limits	Type of Work	Requirements/Description	GRN #	Length (ft)	Construction Year
1	7 Bridge Improvements	Bridge Improvements	Replace Bridges (Atantano, Aguada, Laguas, Sasa, Fonte, Asan 1, Asan 2)	35	364	Not Scheduled
1	Navy Main Base	Intersection Improvements	Military Access Point 14, at existing signalized intersection of Routes 1 and 2a. Intersection improvements to provide additional westbound left-turn lane.	50	N/A	Not Scheduled
1	Route 1 / Route 16 Intersection	Intersection Improvements	Intersection improvements to provide northbound two left-turn lanes, three through lanes and right-turn lane (500'); southbound, two left-turn lanes, two through lanes, and one combined through/right lane; eastbound, two left-turn lanes (250'), two through lanes, and right-turn lane (500'); westbound, two left-turn lanes, two through lanes, and right-turn lane.	124	N/A	Not Scheduled
1	Anderson South (Main Gate)	Intersection Improvements	Military Access Point 8, at Turner Street. Would be signalized; westbound Route 1 left-turn lane (500', restripe existing 2WLT); eastbound Route 1 right-turn lane (1,000'); and northbound two left-turn lanes (300') and right-turn lane.	44	N/A	Not Scheduled
2A	Route 1 to Route 5	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	26	4,577	Not Scheduled
3	Route 28 to Route 1	Pavement Strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	8	13,500	Not Scheduled
3	NCTS Finegayan to Route 28	Road Widening for Capacity Increase	Pavement strengthening, widen from 2 lanes to 4 lanes, add median and shoulders	9	11,900	Not Scheduled
3	Route 3 / Route 28 Intersection	Intersection Improvements	Intersection improvements add southbound left-turn lane and northbound right-turn lane.			
3	NCTS Finegayan to Route 9	Road Widening for Capacity Increase	Pavement strengthening, widen from 2 lanes to 4 lanes, add median and shoulders	10	4,150	Not Scheduled
3	Route 3 / Route 3A Intersection	Intersection Improvements	Eliminate Y-intersection, provide four-legged intersection with one left-turn and one right-turn lane on Route 3A, a northbound left-turn lane on Route 3.			
3	South Finegayan (Residential Gate)	Intersection Improvements	Military Access Point 5, located 680 feet south of Hahasu Dr. Would be signalized; eastbound, two left-turn lanes (200'), free right-turn with acceleration lane on Route 3; northbound, two left-turns (700'), two through lanes, southbound, through and combined through/right-turn.	41	N/A	Not Scheduled
5	Route 2A to Route 17	Pavement strengthening, no Shoulder Widening	Pavement strengthening (two lanes)	25	6,379	Not Scheduled
5	Route 17 to Naval Ordnance	Pavement strengthening, no Shoulder Widening	Pavement strengthening (two lanes)	27	3,954	Not Scheduled
8	Tiyan Pkwy/Route 33 (east) to Route 1	Road Widening for Capacity Increase	Pavement strengthening, widening from 4/6 lanes to 6 lanes, with median.	16	8,290	Not Scheduled
8	Route 10 to Tiyan Pkwy/Route 33(east)	Pavement strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	17	7,904	Not Scheduled
8A	Route 16 to NAVCAMS Barrigada	Pavement strengthening, no Shoulder Widening	Pavement strengthening (two lanes)	31	8,865	Not Scheduled
9	Route 3 to AAFB (North Gate)	Road Widening for Capacity Increase	Pavement strengthening, widen from 2 lanes to 4 lanes, with median.	22	6,300	Not Scheduled
9	AAFB North Gate to Route 1	Road Widening for Capacity Increase	Pavement strengthening (two lanes), widen to add median and shoulders	22a	9,200	Not Scheduled
9	AAFB (North Gate)	Intersection Improvements	Military Access Point 6, proposed between Routes 3 and 9. Would be STOP-controlled with STOP for access from base; eastbound, left turn lane (600'), two through lanes;	42	N/A	Not Scheduled

Rte	Segment Limits	Type of Work	Requirements/Description	GRN #	Length (ft)	Construction Year
			westbound, one through lane and one right-turn lane (320'); southbound, left-turn lane, free right-turn lane with accel lane (becomes second westbound through lane).			
10	Route 15 to Route 8 & 16	Pavement strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	30	7,847	Not Scheduled
11	Port to Intersection with Route 1	Pavement strengthening, no Shoulder Widening	Pavement strengthening (two lanes)	4	9,150	2010
11	Route 1 / Route 11 Intersection	Intersection Improvements	Intersection Improvements (.12 mi on Rte 1) to provide additional eastbound left-turn lane.	5	1,480	2010
12 & 5	Naval Munitions Site	Intersection Improvements	Military Access Point 16, proposed relocation of existing access point to Harmon Road for safety/operational improvements.	52		Not Scheduled
15	Smith Quarry to Chalan Lujana	Pavement strengthening, no Shoulder Widening	Pavement strengthening (two lanes), Safety/ Operational Improvements	12	6,100	Not Scheduled
15	Route 10 to Connector (Ch Lujana to end)	Pavement strengthening, no Shoulder Widening	Pavement strengthening (two lanes)	32	41,500	Not Scheduled
15	Route 15 / Route 26 Intersection	Intersection Improvements	Signalize intersection.			
15	Route 15 / Route 29 Intersection	Intersection Improvements	Intersection improvements to signalize, provide additional northbound, southbound left-turn lanes, southbound right-turn lane	117	N/A	Not Scheduled
15	Anderson South (Secondary Gate)	Intersection Improvements	Military Access Point 10 at Unnamed road, 1.16 miles east of Route 26. Would be STOP controlled with STOP for access from base; eastbound Route 15 left-turn lane (250'); southbound, left-turn lane (150') and right-turn lane.	46	N/A	Not Scheduled
16	Route 27 to Route 10A	Pavement strengthening, no Shoulder Widening	Pavement strengthening (six lanes)	18	4,505	Not Scheduled
16	Route 16 / Route 27 Intersection	Intersection Improvements	Intersection improvements to provide additional northbound, southbound left-turn lanes, change westbound right-turn to combined through/right-turn lane.			
16	Route 10A to Sabana Barrigada Drive	Pavement strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	19	5,448	Not Scheduled
16	Route 16/ Route 10A Intersection	Intersection Improvements	Intersection improvements to provide one additional lane on northbound and southbound off-ramps to provide one left-turn, combined left/through/right-turn and right-turn lane. Restripe to provide additional westbound left-turn lane.			
16	Sabana Barrigada Drive to Route 8/10	Pavement strengthening, no Shoulder Widening	Pavement strengthening (four lanes)	20	8,691	Not Scheduled
17 & 5	Route 5 / Route 17 Intersection	Intersection Improvements	Intersection improvements to add right-turn lane on Route 17 approaching Route 5.	25	N/A	Not Scheduled
25	Route 16 to Route 26	Road Widening for Capacity Increase	Pavement strengthening, widen from 2 lanes to 4 lanes	29	8,050	Not Scheduled
26	Route 1 to Route 15	Road Widening for Capacity Increase	Pavement strengthening, widen from 2 lanes to 4 lanes	28	12,900	Not Scheduled
26	Route 26 / Route 25 Intersection	Intersection Improvements	Intersection improvements to provide northbound left-turn, through, combined through/right, southbound left-turn, two throughs, and right-turn, eastbound left-turn, left-through, and right-turn lane. Southbound right-turn should have raised island and free right to westbound Route 25 curb lane.			
27	Route 1 to Route 16	Pavement strengthening,	Pavement strengthening (six lanes)	21	5,448	Not Scheduled

Rte	Segment Limits	Type of Work	Requirements/Description	GRN #	Length (ft)	Construction Year
		no Shoulder Widening				
28	Route 1 to Route 3	Road Widening for Capacity Increase	Pavement strengthening, widen from 2 to 3 lanes, with shoulders	57	21,000	Not Scheduled
28	Route 28 / Route 27A Intersection	Intersection Improvements	Intersection improvements to provide northbound left-turn, through, combined through/right-turn, southbound left-turn, through, and combined through/right-turn, eastbound left-turn, through, and right-turn lane.			
Ch Lujana	Route 1 to Route 15	Road Widening for Capacity Increase	Pavement strengthening (two lanes), Turning lane & intersection improvements for trucks	11	4,350	Not Scheduled

**APPENDIX B**  
**EXISTING INFILTRATION BASIN SITE MAPS**

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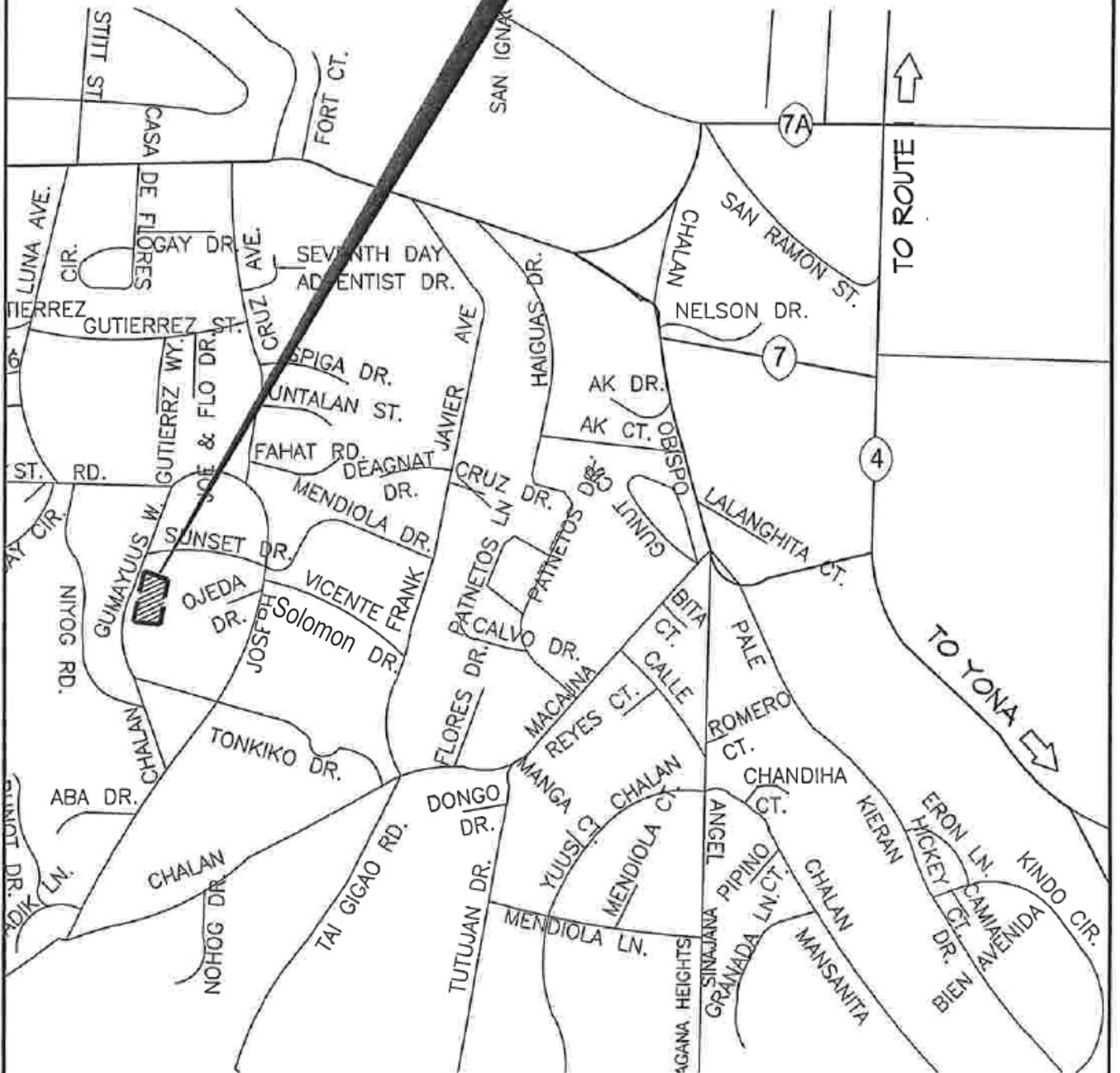
ISLAND-WIDE  
REHABILITATION  
OF  
PONDING BASINS

PROJECT NUMBER: GU-NH-REHB(001)

# LOCATION MAP

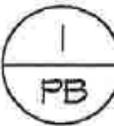


**PROJECT LOCATION**



**VILLAGE OF AGANA HEIGHTS**

**PONDING BASIN- CHALAN GUMA YU'US**

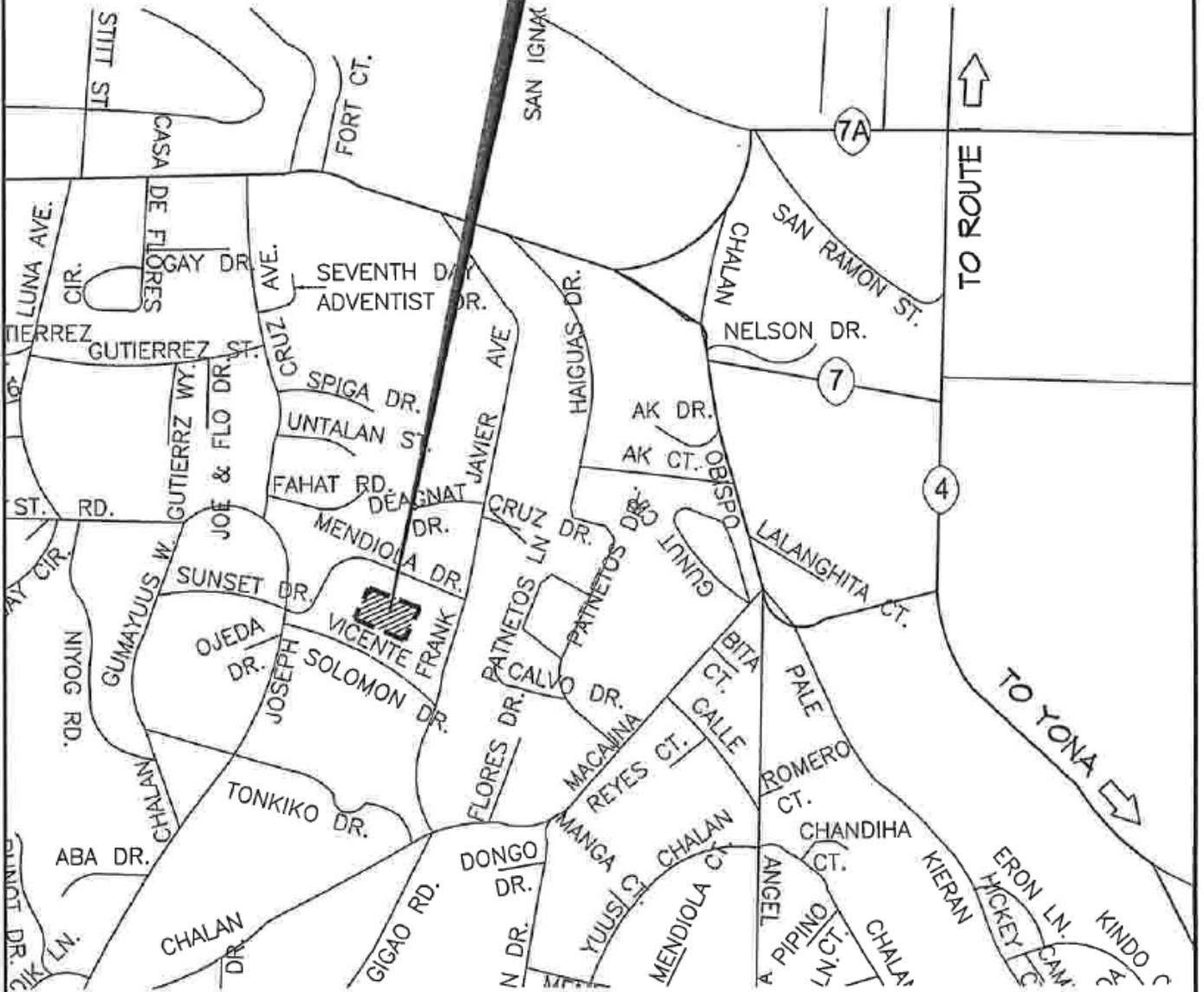


NOT TO SCALE

# LOCATION MAP



## PROJECT LOCATION



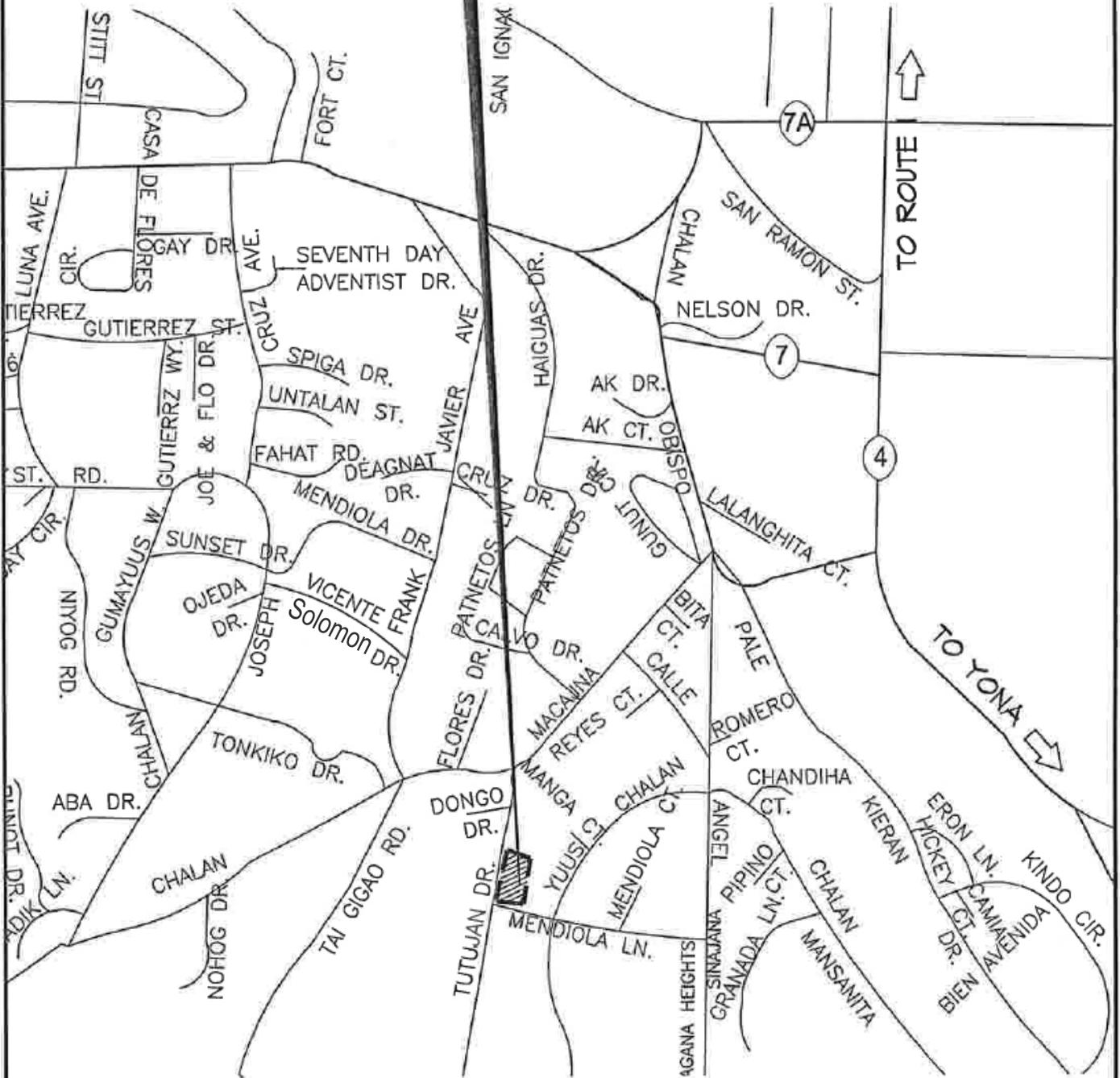
## VILLAGE OF AGANA HEIGHTS

2 PONDING BASIN- VICENTE SOLOMON DRIVE  
PB NOT TO SCALE

# LOCATION MAP



## PROJECT LOCATION



**3**  
**PONDING BASIN- TUTUJAN DRIVE**  
**PB** NOT TO SCALE

# LOCATION MAP



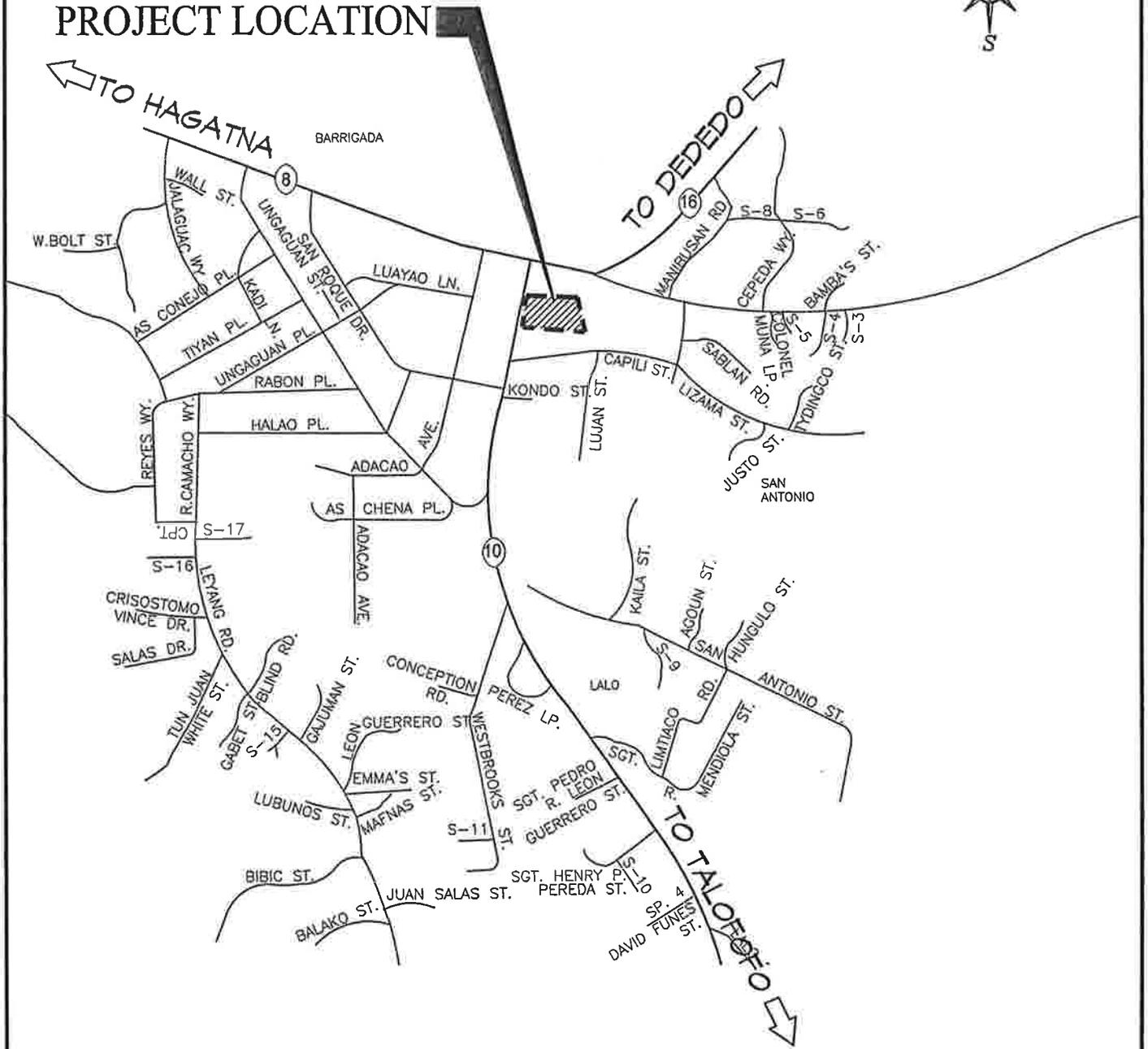
## VILLAGE OF BARRIGADA

4 PONDING BASIN- LEON GUERRERO ST.  
PB NOT TO SCALE

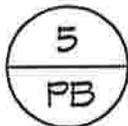
# LOCATION MAP



PROJECT LOCATION



VILLAGE OF BARRIGADA  
PONDING BASIN- ROUTE 16 / ROUTE 10  
BEHIND 76 GAS STATION



NOT TO SCALE

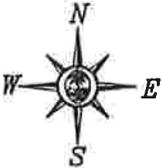
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VILLAGE OF DEDEDO  
PONDING BASIN -ROUTE 16 NEAR IGLESIA  
NI KRISTO CHURCH

6  
PB NOT TO SCALE

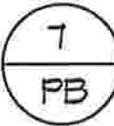
# LOCATION MAP



PROJECT LOCATION



VILLAGE OF DEDEDO  
PONDING BASIN- CHN. GAFO, PGD SUBD.  
MACHECHE

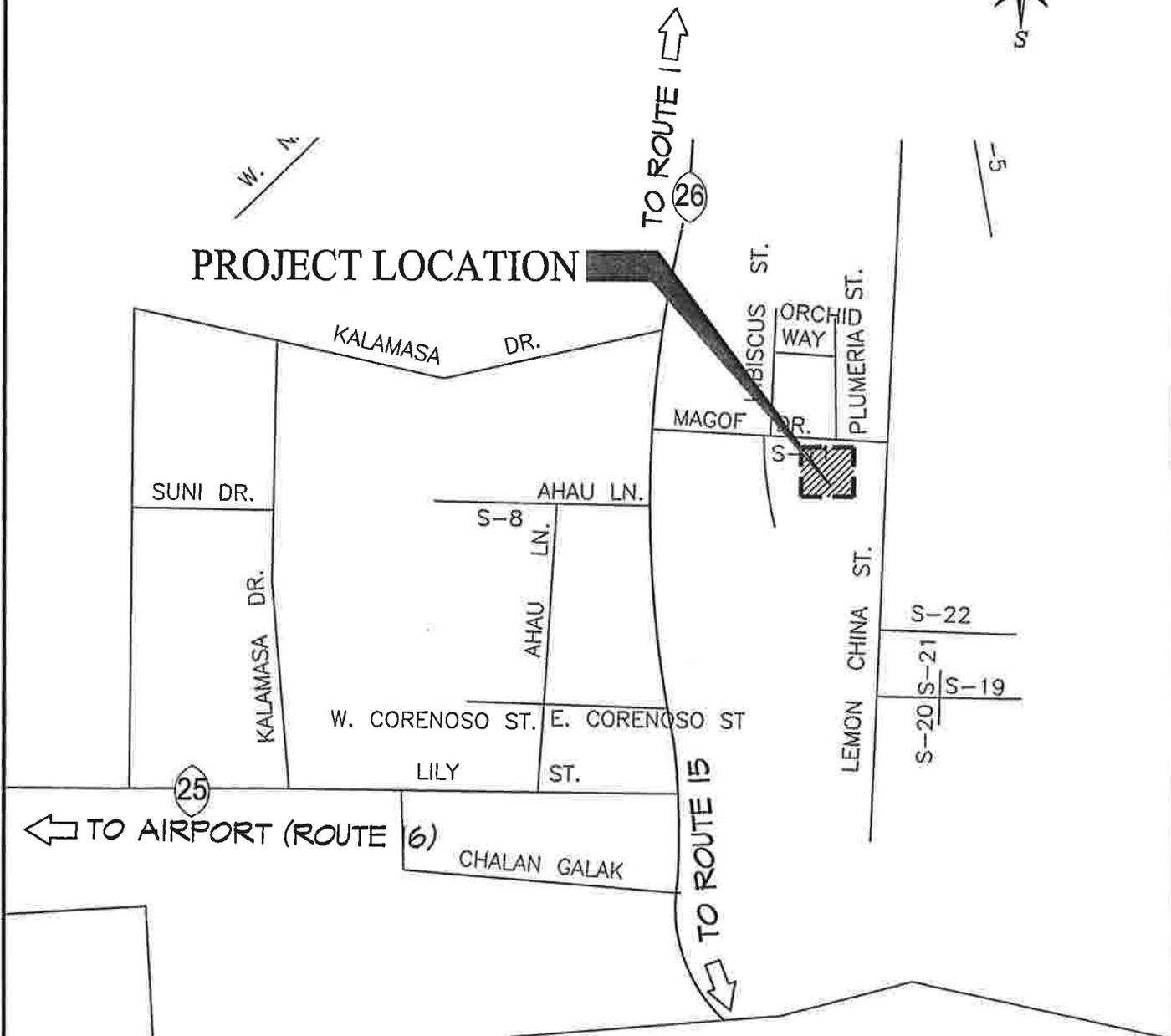


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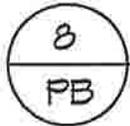
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PROJECT LOCATION

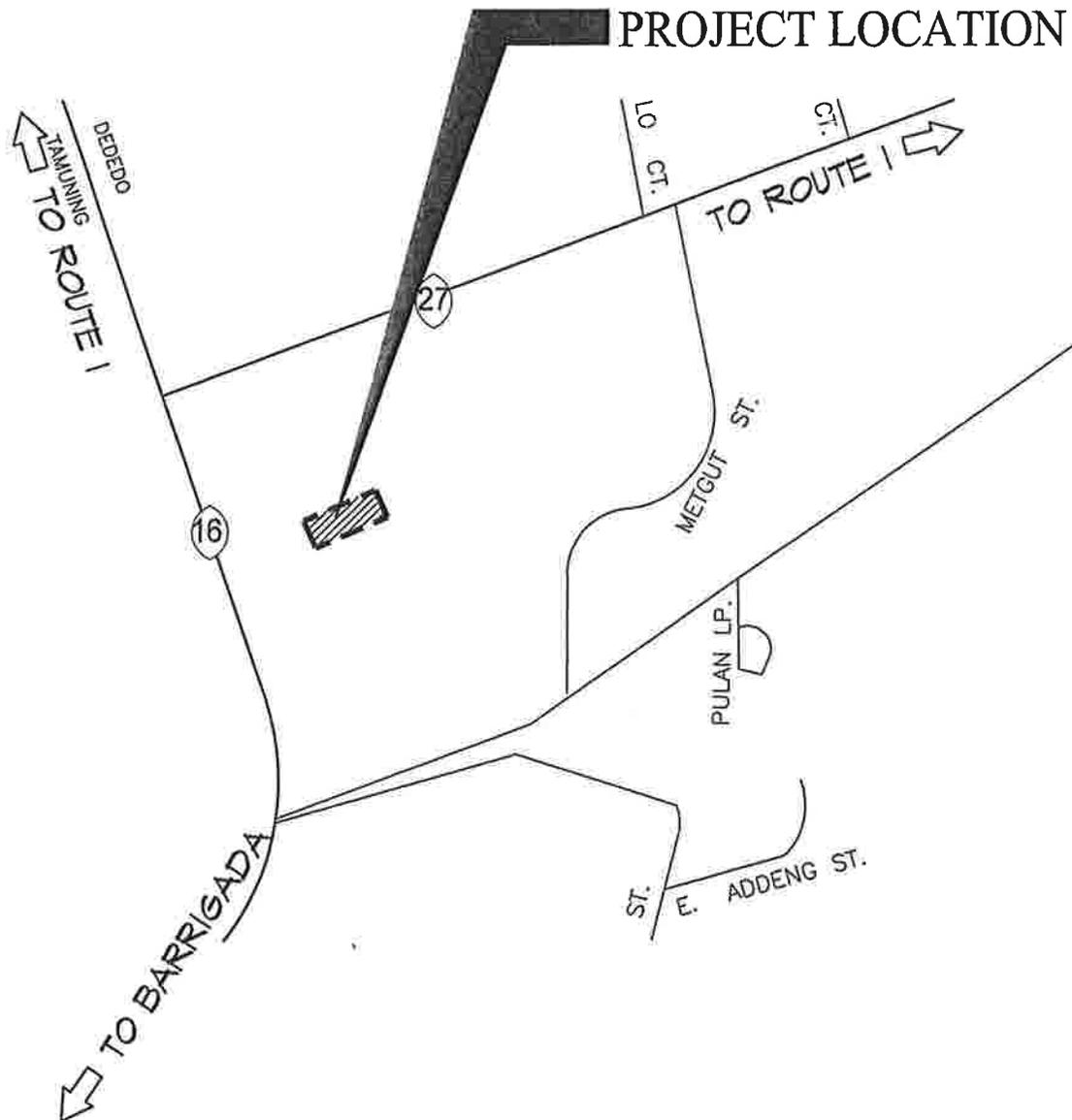


VILLAGE OF DEDEDO  
PONDING BASIN- CORNER SS-17 & MAGOF DR.  
MACHECHE

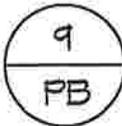


NOT TO SCALE

# LOCATION MAP



VILLAGE OF MANGILAO



PONDING BASIN- HEGAO LOOP, HARMON GARDENS

NOT TO SCALE

# LOCATION MAP

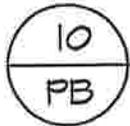


**PROJECT LOCATION**

BIRADAN AN RITA

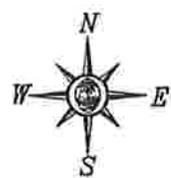
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**VILLAGE OF DEDEDO  
PONDING BASIN- KAYEN CASCAO &  
HARMON LOOP RD.**

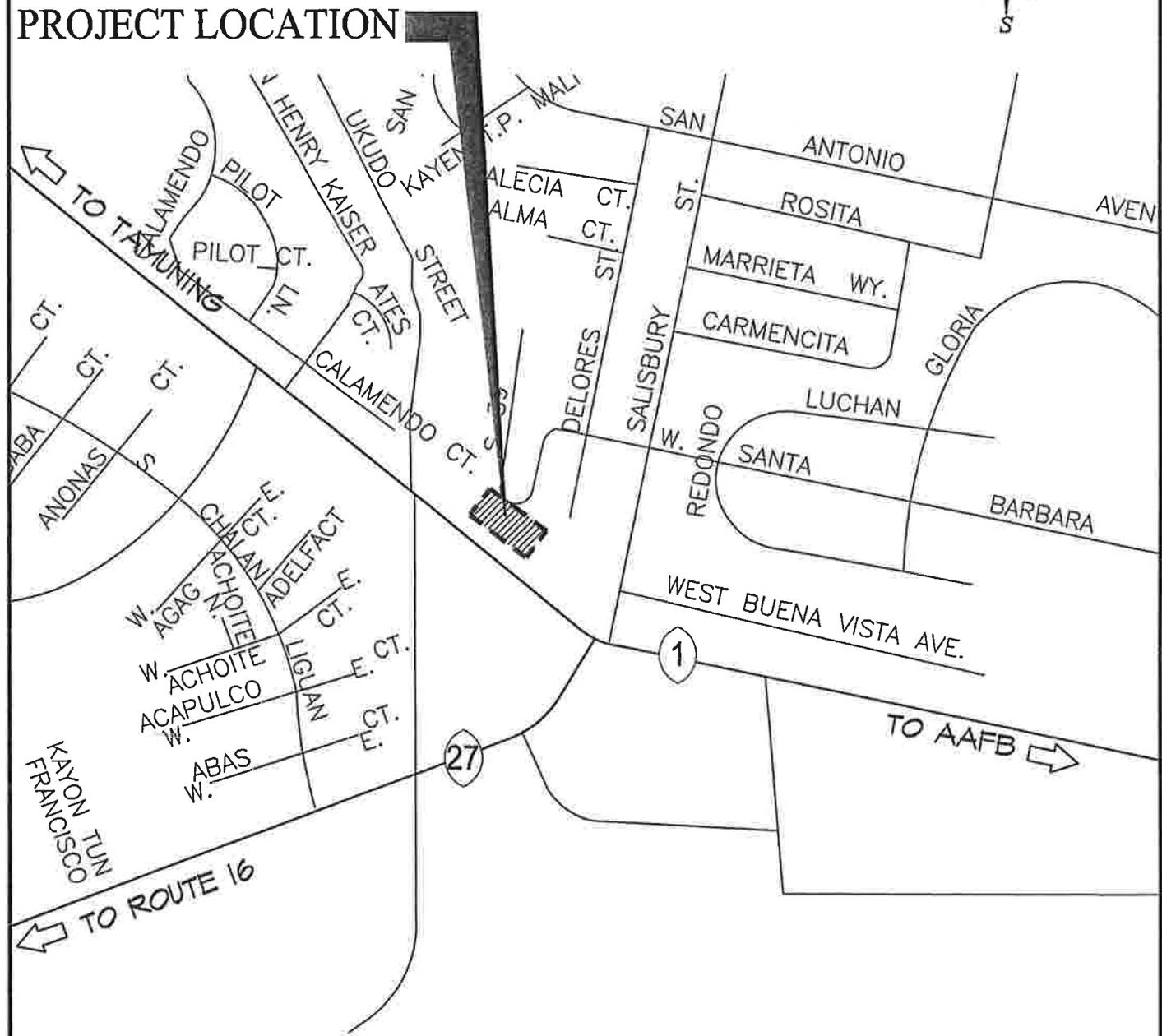


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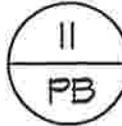
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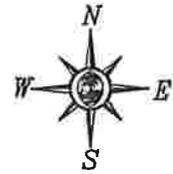
## VILLAGE OF DEDEDO



PONDING BASIN - ROUTE 1 / W. STA. BARBARA AVE.

NOT TO SCALE

# LOCATION MAP



PROJECT LOCATION



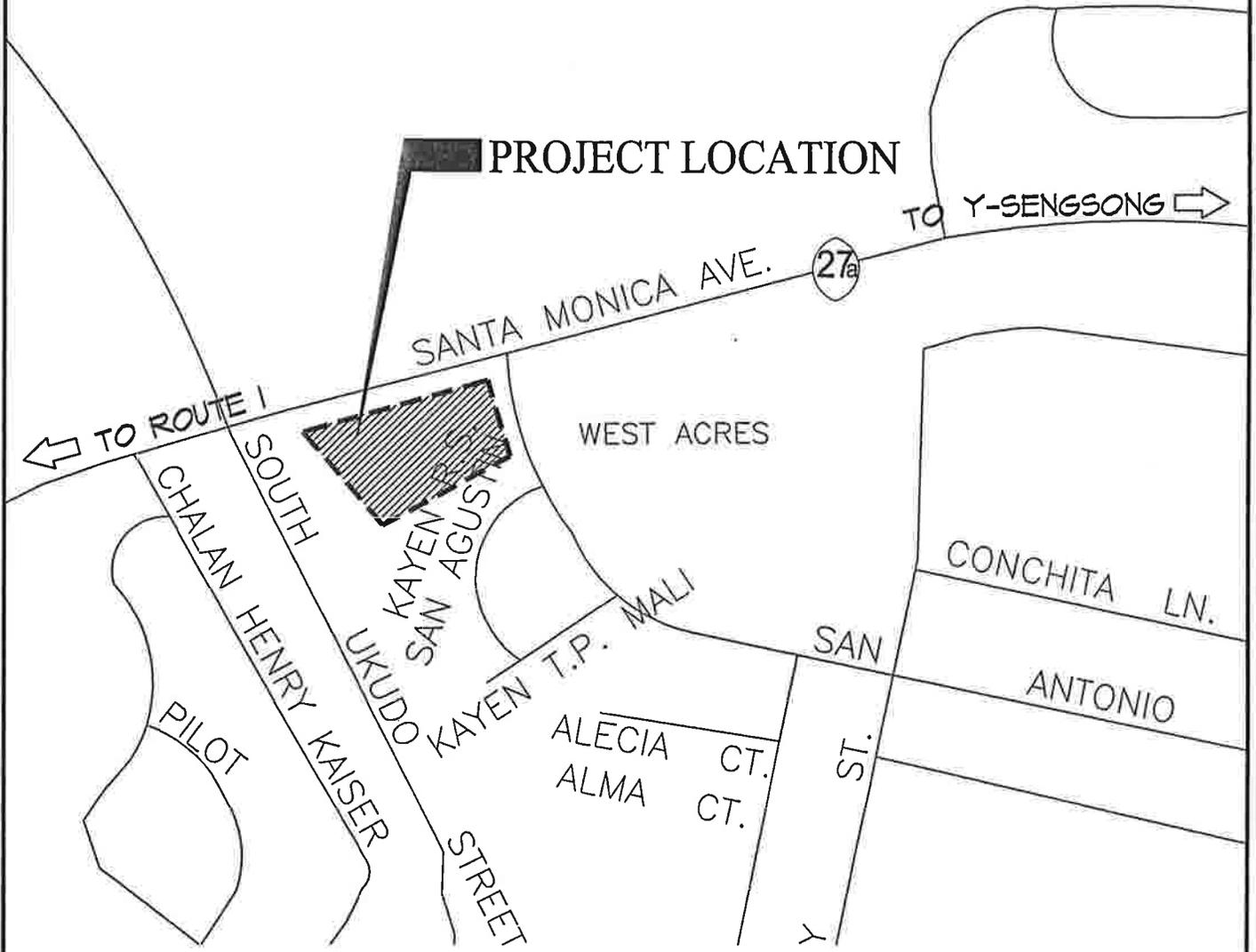
VILLAGE OF DEDEDO

PONDING BASIN-ROUTE 1/ CALAMENDO LN.

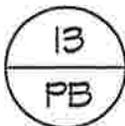
12  
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# LOCATION MAP

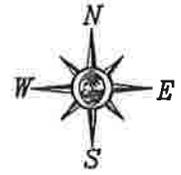


VILLAGE OF DEDEDO  
PONDING BASIN - STA. MONICA AVE. / KAYEN  
R. AGUSTIN / GHURA 35

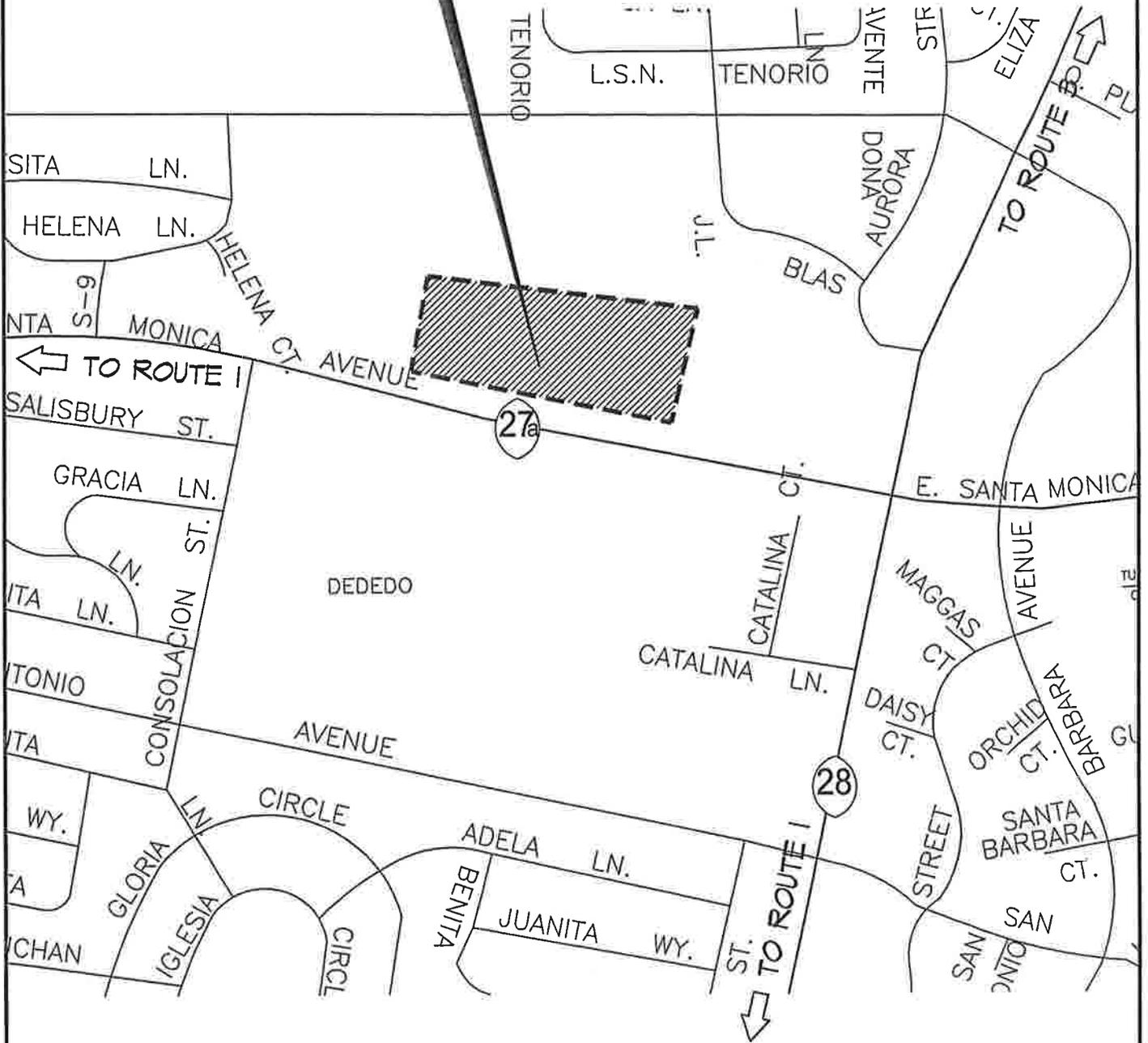


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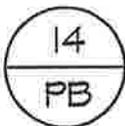
# LOCATION MAP



PROJECT LOCATION

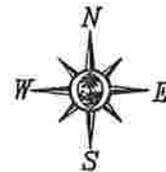


VILLAGE OF DEDEDO  
PONDING BASIN - STA. MONICA ACROSS DEDEDO  
MIDDLE SCHOOL

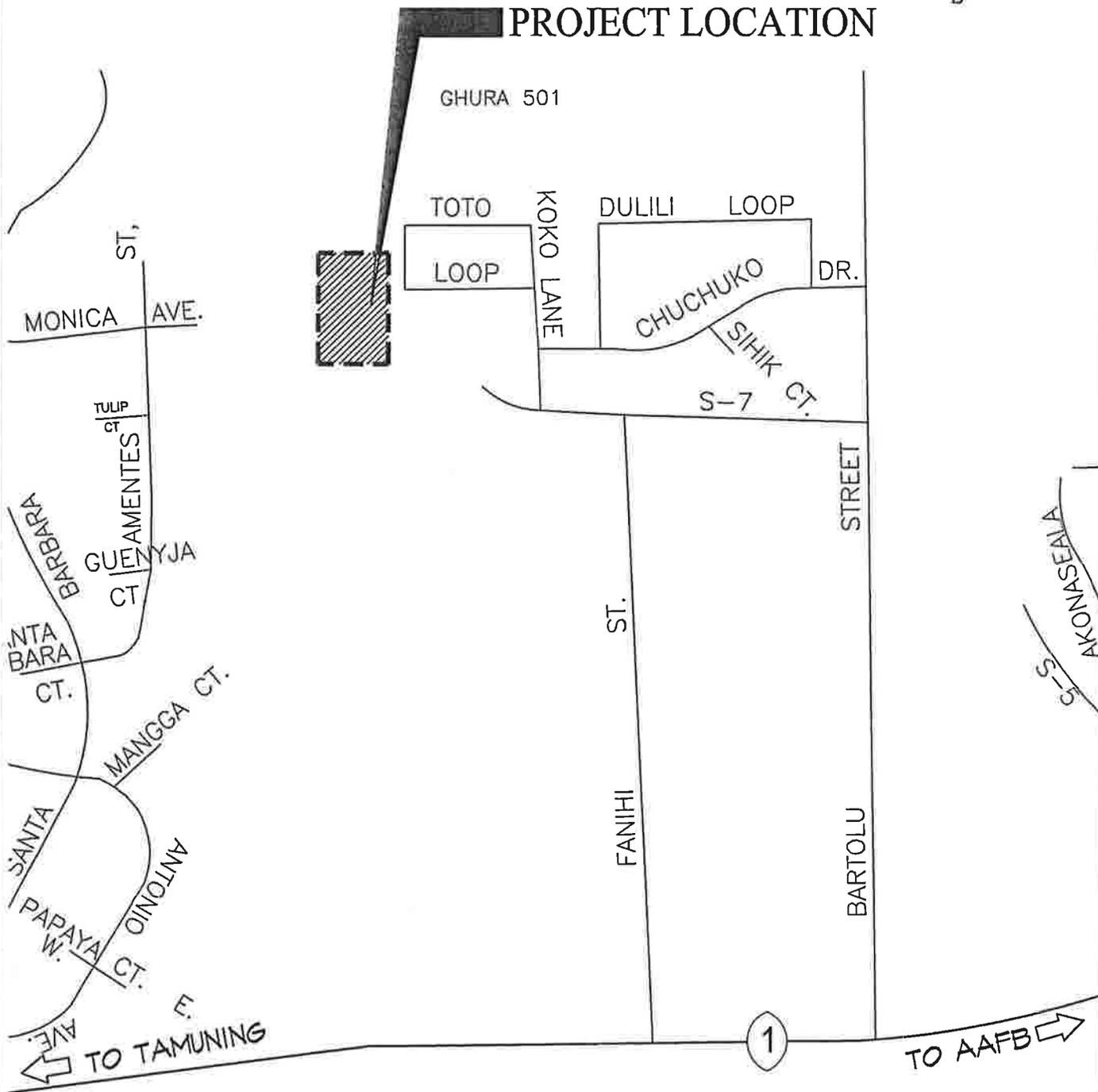


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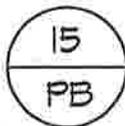
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## PROJECT LOCATION



## VILLAGE OF DEDEDO



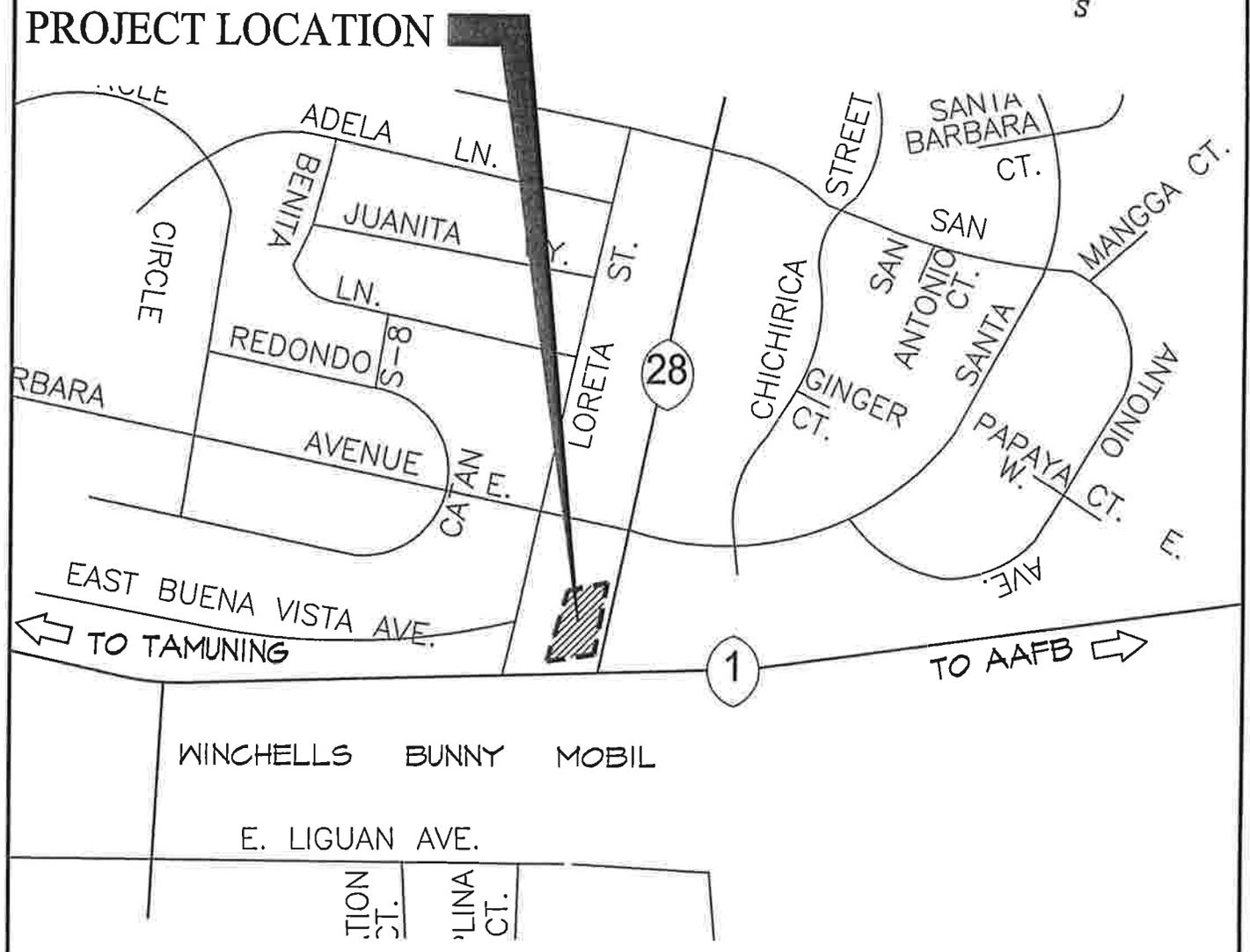
15 PONDING BASIN - TOTO LOOP, GHURA 501

NOT TO SCALE

# LOCATION MAP



PROJECT LOCATION



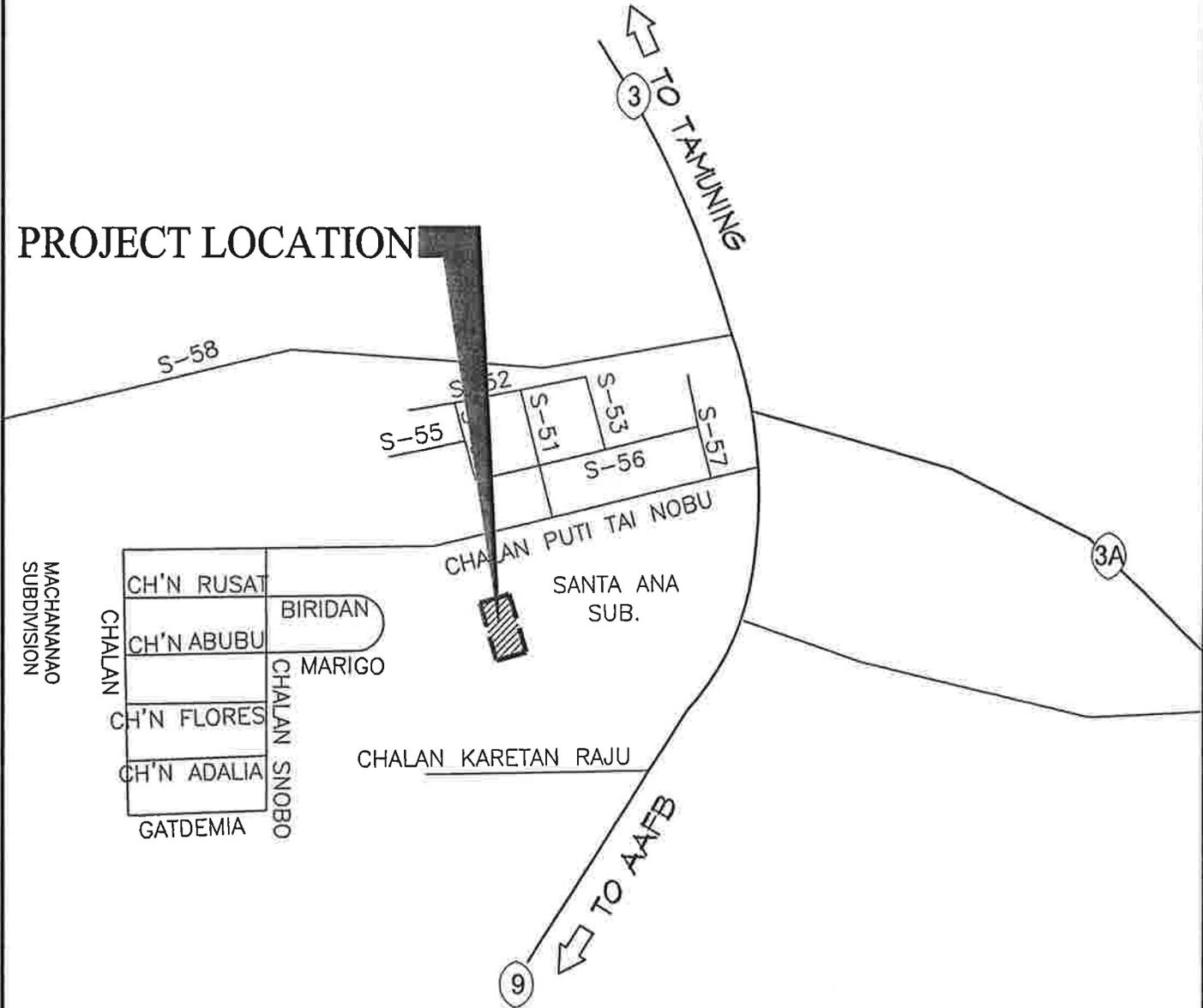
## VILLAGE OF DEDEDO

16 PONDING BASIN - CR. Y-SENGSONG RD. & ROUTE 1  
PB NOT TO SCALE

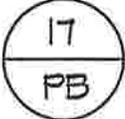
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**PROJECT LOCATION**

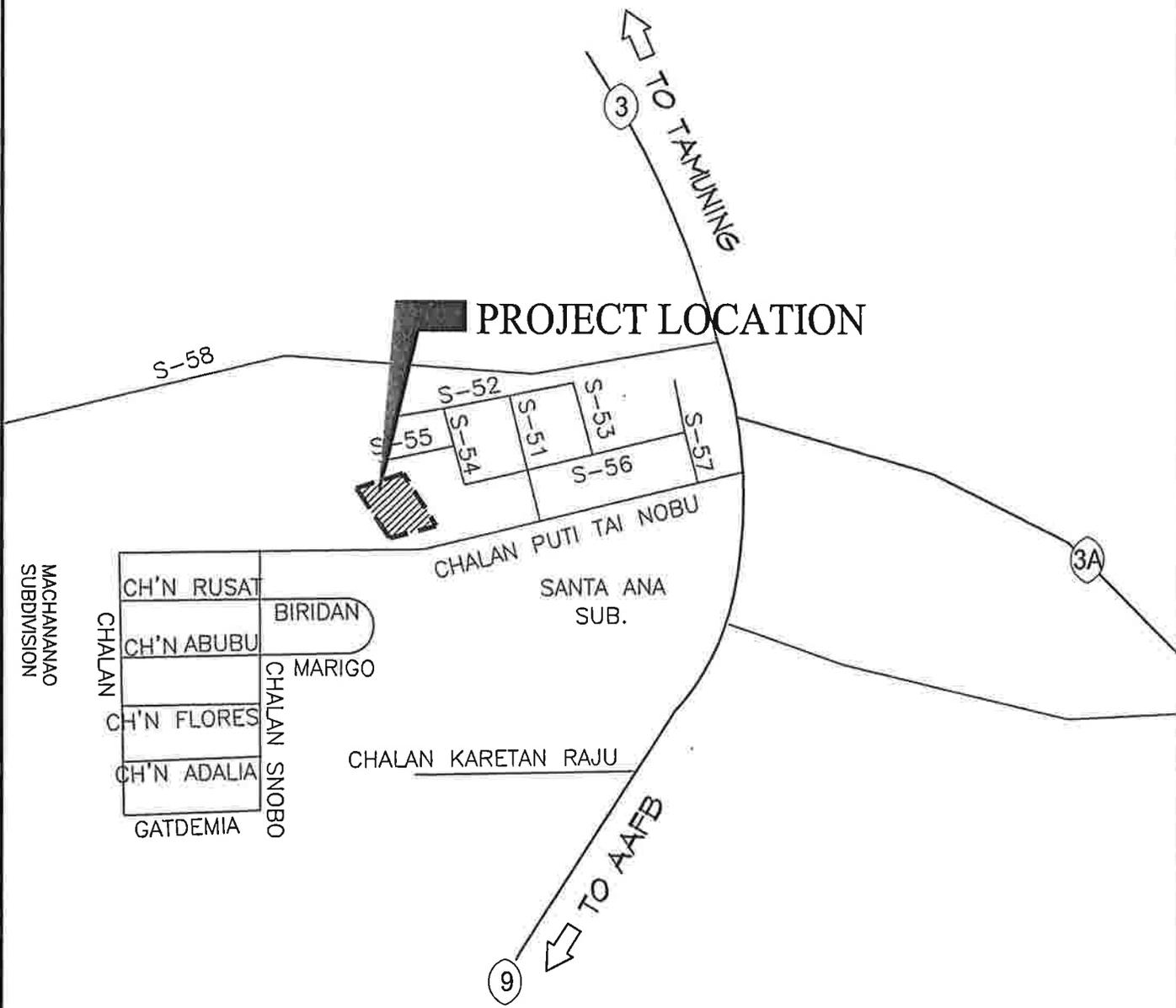
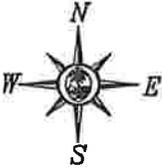


VILLAGE OF DEDEDO  
 PONDING BASIN - SNOWBALL ST. STA. ANA  
 SUBD., MACHANANAO

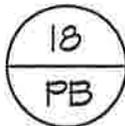


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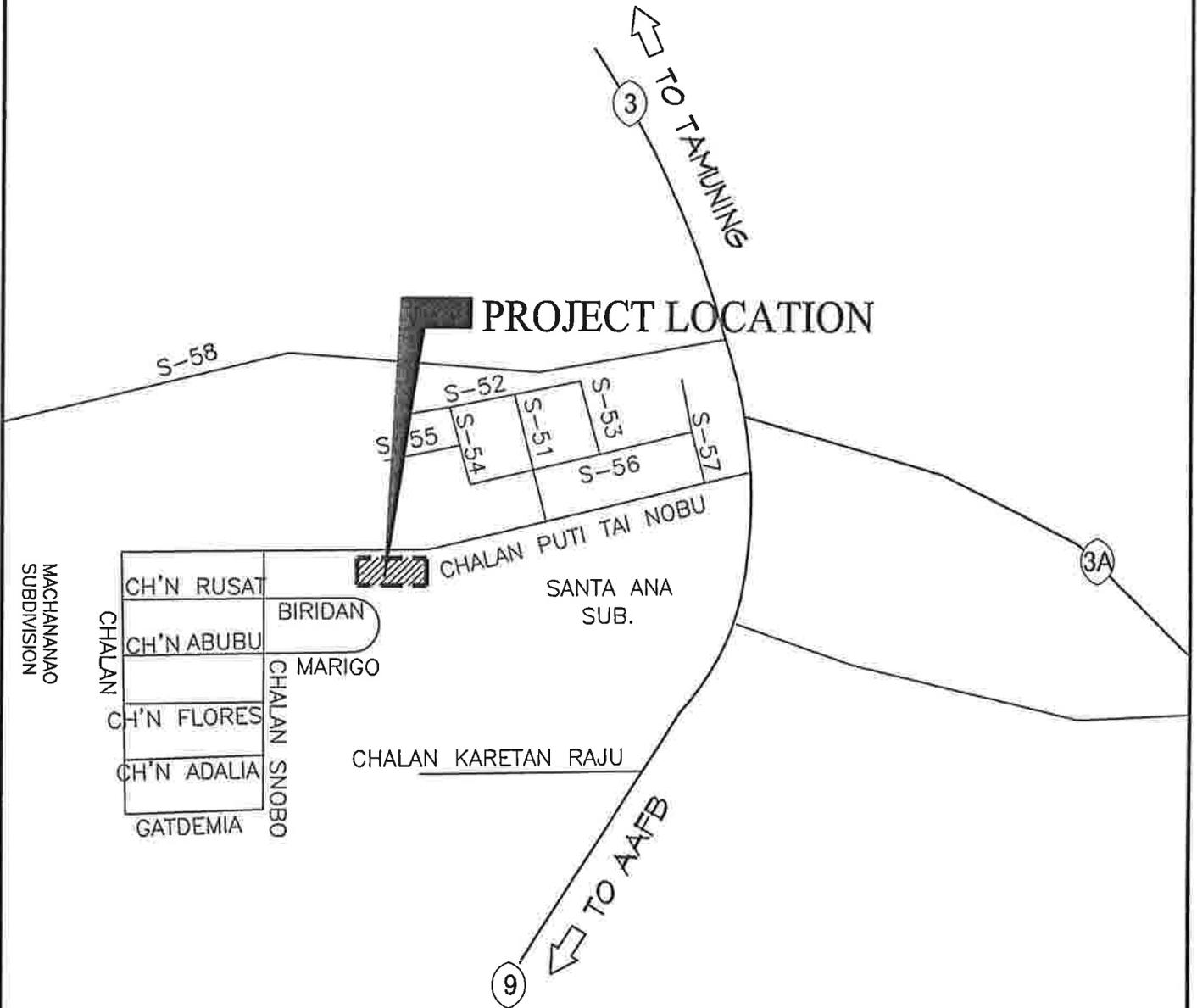
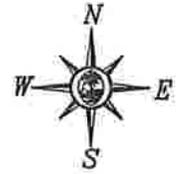


VILLAGE OF DEDEDO  
PONDING BASIN - CHN. STA. MARIA, STA. ANA  
SUBD., MACHANANAO

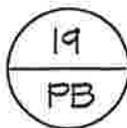


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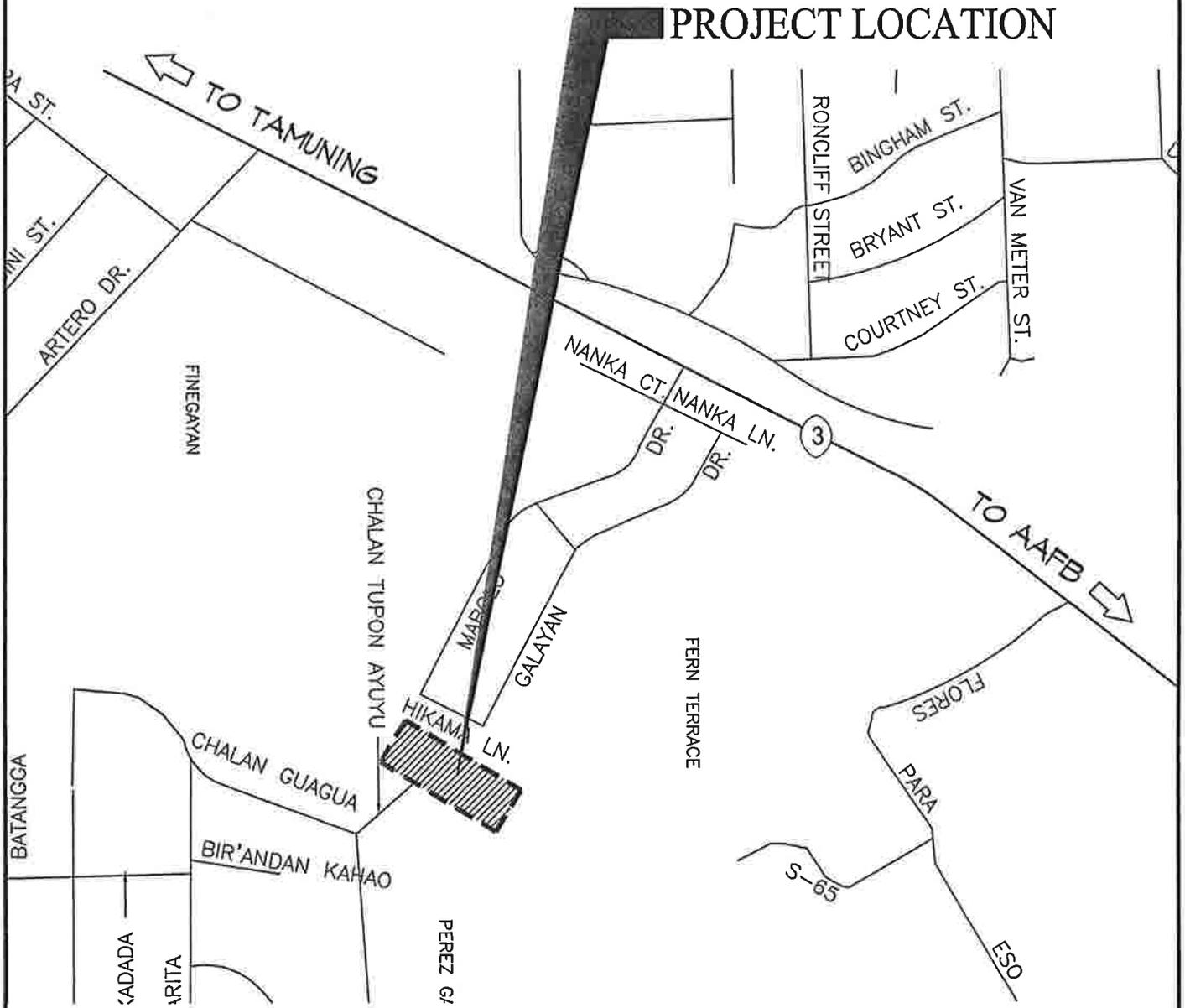


VILLAGE OF DEDEDO  
 PONDING BASIN - BONGAVILLA ST, STA. ANA  
 SUBD., MACHANANAO



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# LOCATION MAP

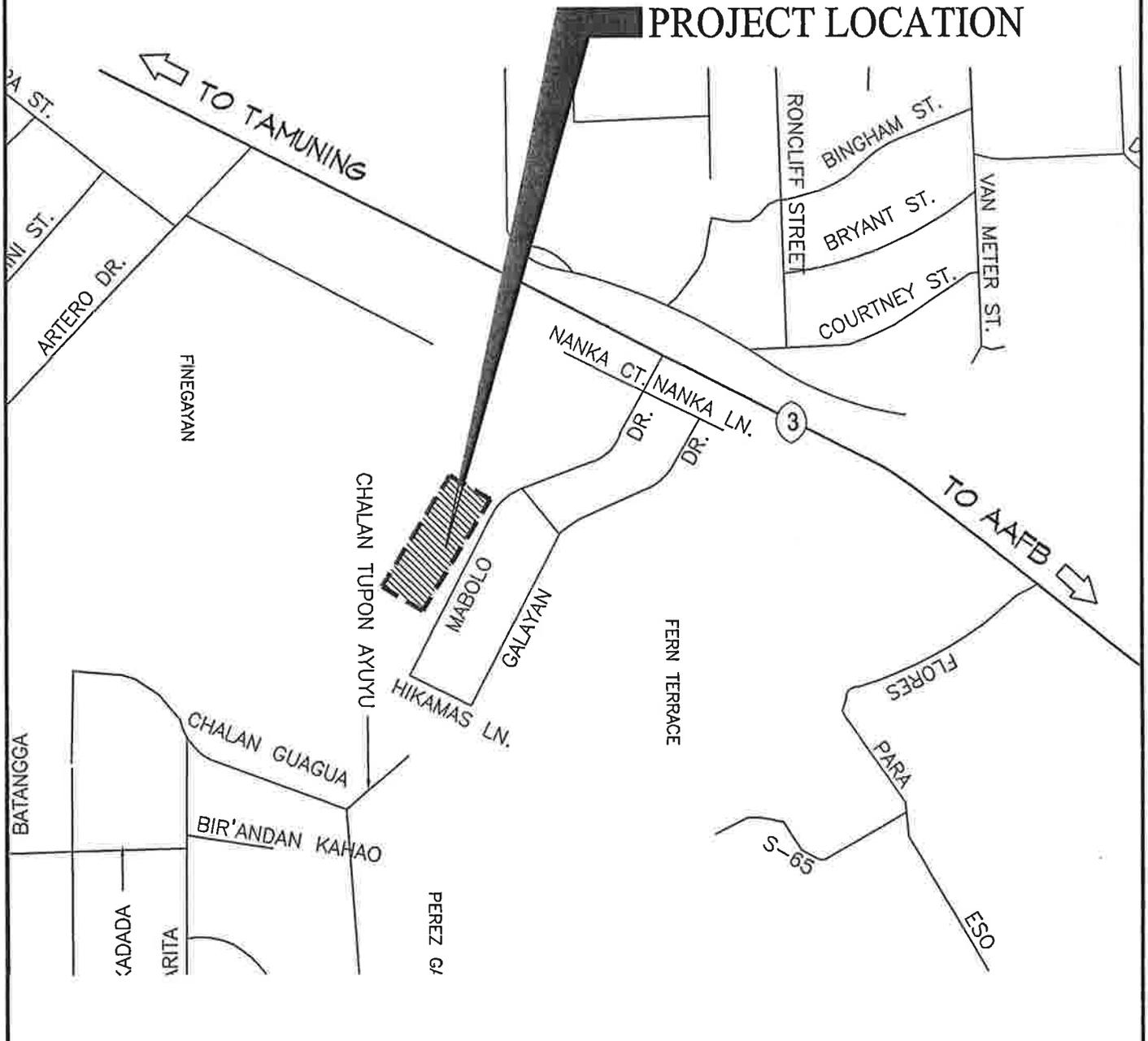


**PROJECT LOCATION**

## VILLAGE OF DEDEDO

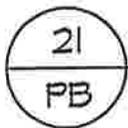
**20 PONDING BASIN - HIKAMA AVE. FERN TERRACE**  
**PB NOT TO SCALE**

# LOCATION MAP



PROJECT LOCATION

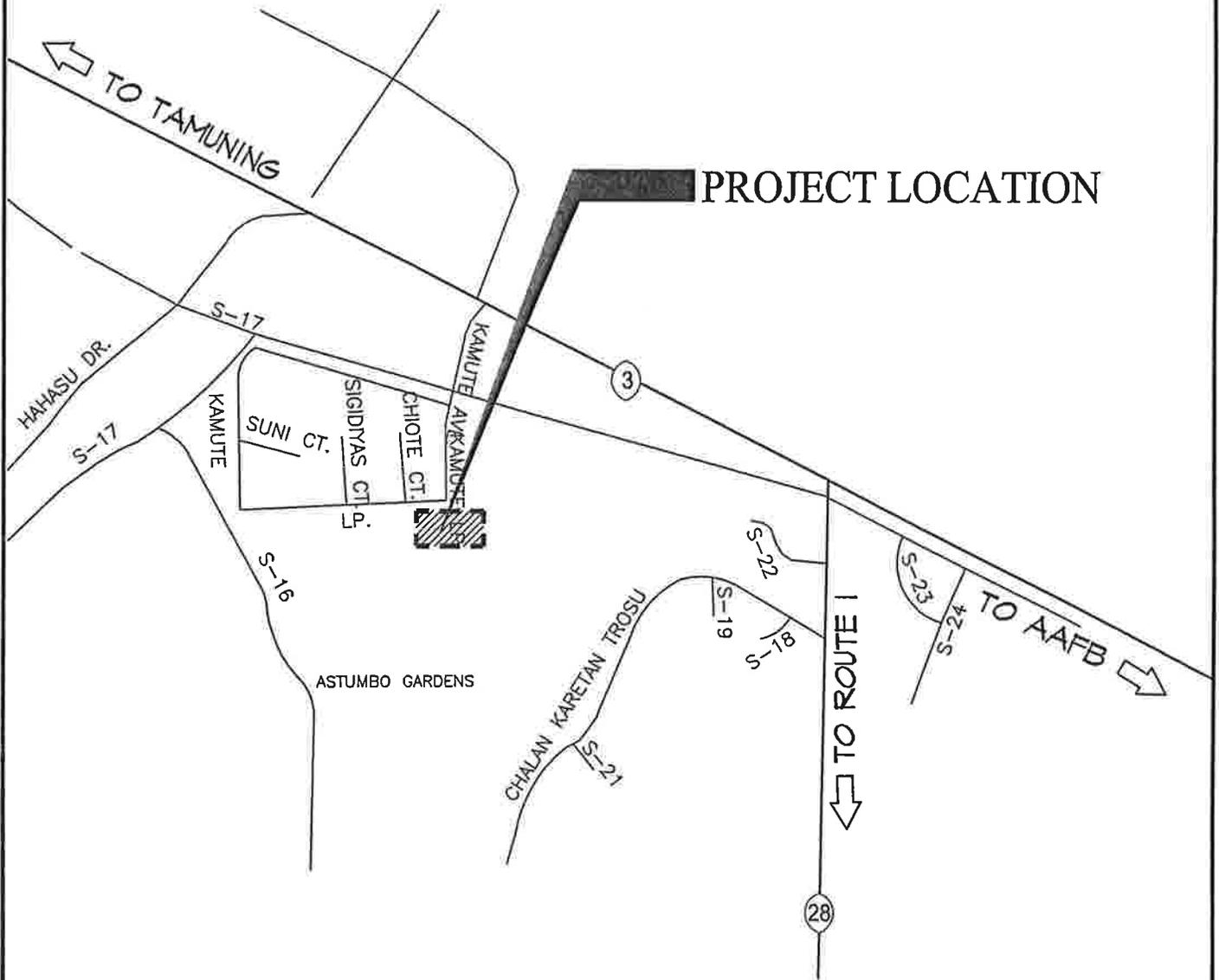
## VILLAGE OF DEDEDO



PONDING BASIN - MABOLO LN. FERN TERRACE

NOT TO SCALE

# LOCATION MAP



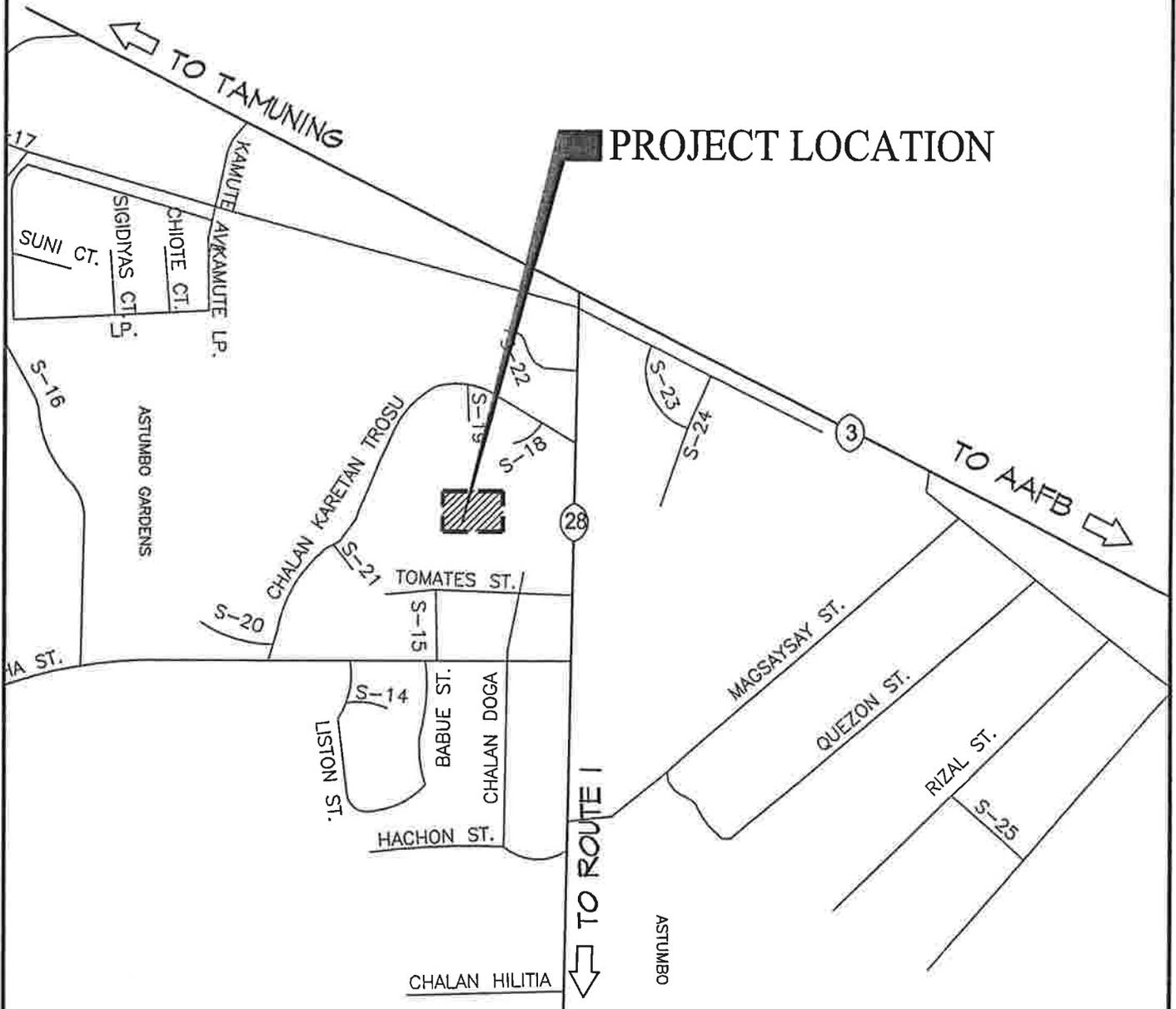
VILLAGE OF DEDEDO

22 PONDING BASIN - KAMUTE LN. ASTUMBO

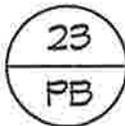


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# LOCATION MAP



## VILLAGE OF DEDEDO



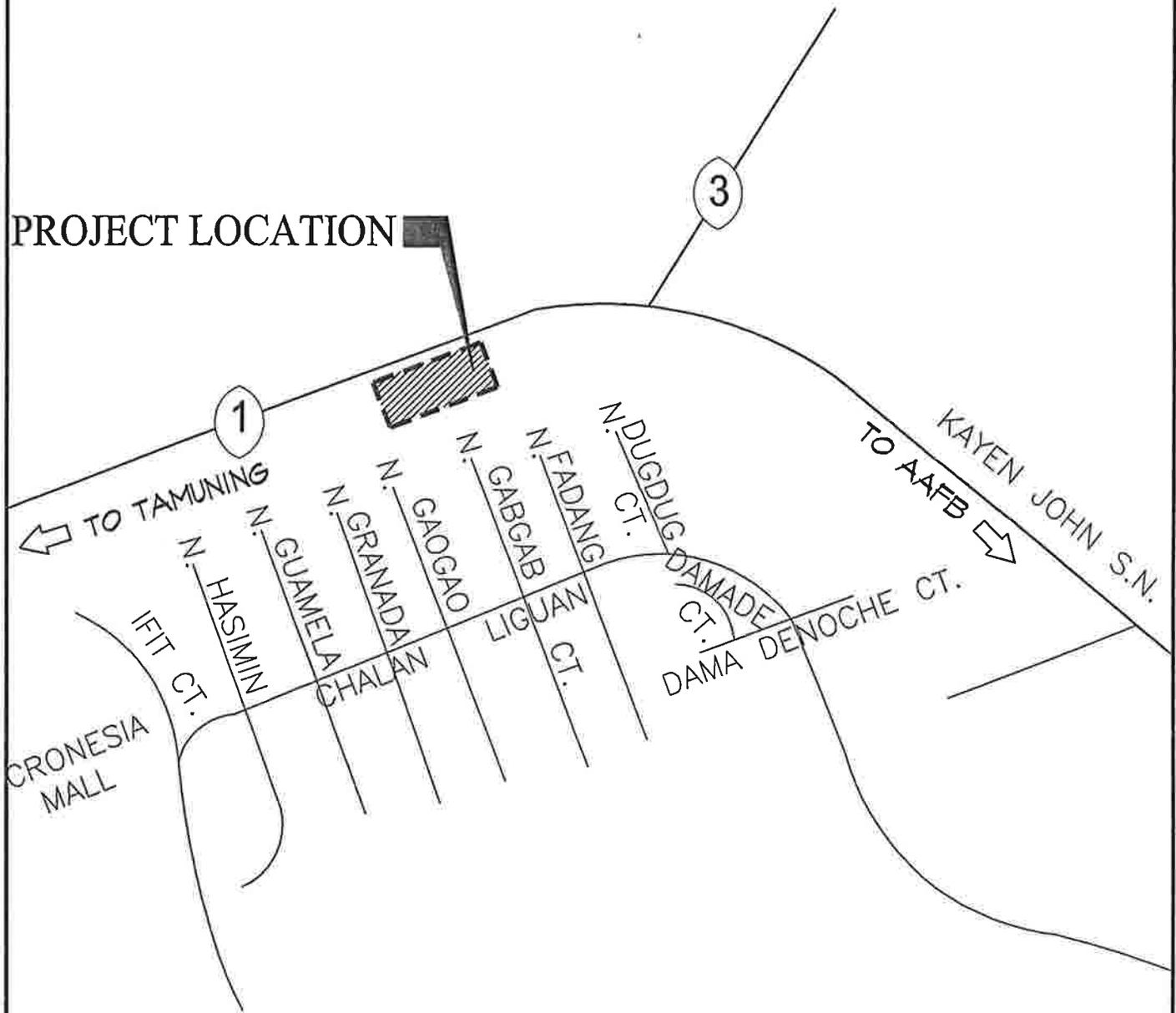
PONDING BASIN - CHALAN SIBUKAO, ASTUMBO

NOT TO SCALE

# LOCATION MAP



PROJECT LOCATION

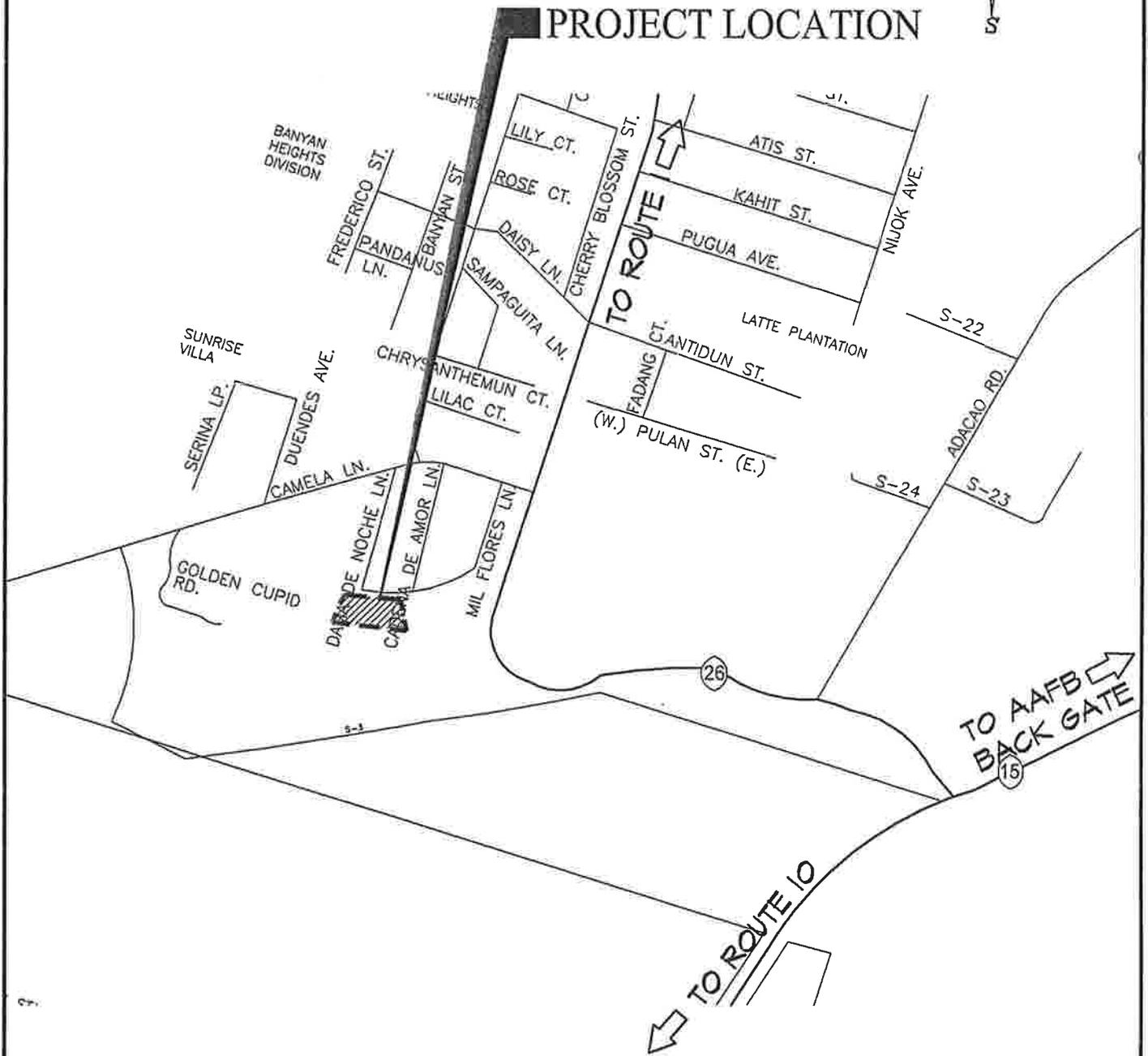


VILLAGE OF DEDEDO  
PONDING BASIN- ROUTE 1, NEAR M. MALL  
NORTHGATE AND ROUTE 3

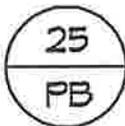
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NOT TO SCALE

# LOCATION MAP



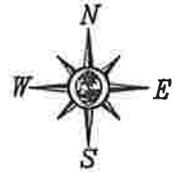
## VILLAGE OF MANGILAO



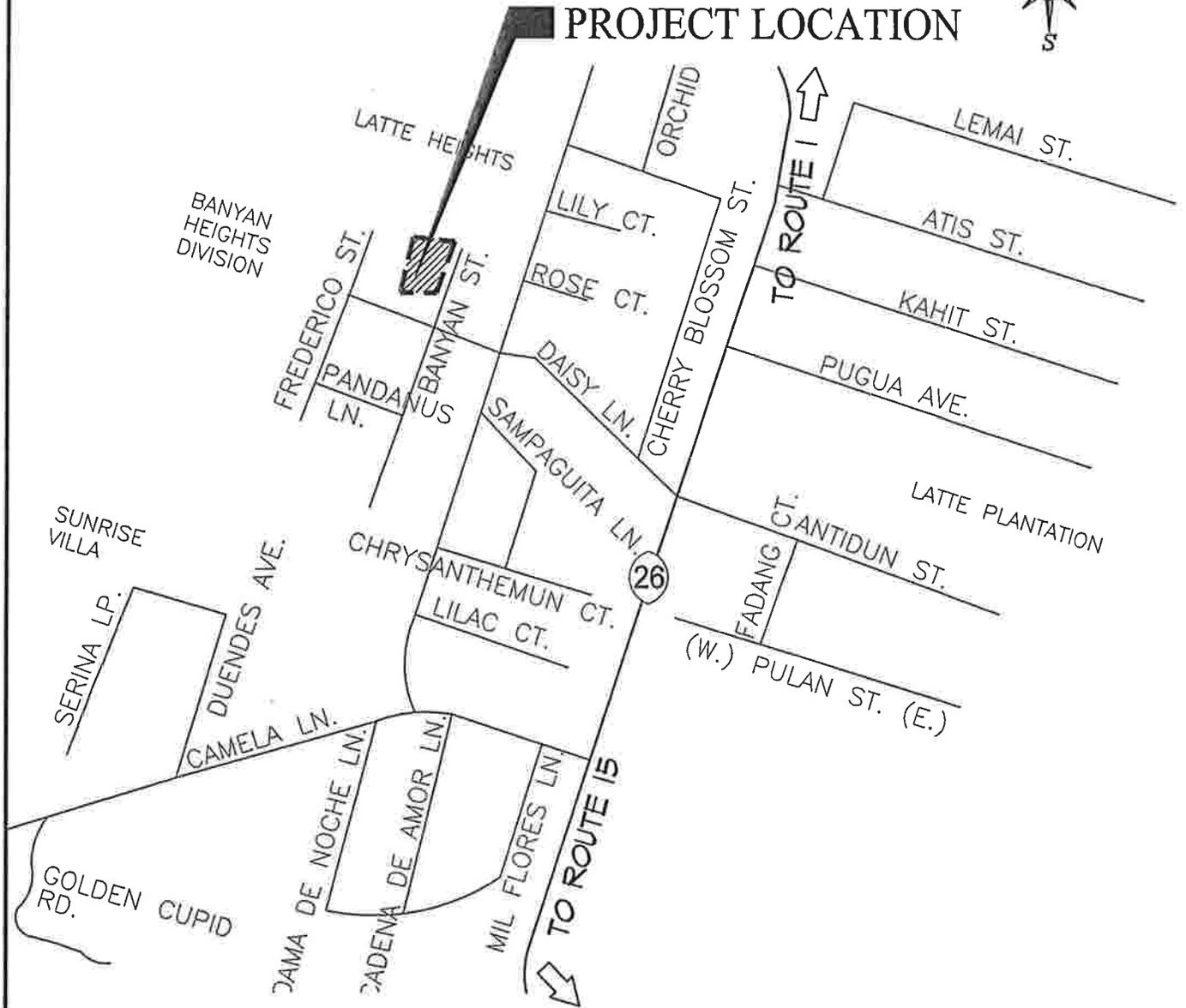
25 PONDING BASIN- DAMA DE NOCHE LATTE HEIGHTS

PB NOT TO SCALE

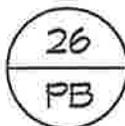
# LOCATION MAP



## PROJECT LOCATION



## VILLAGE OF MANGILAO



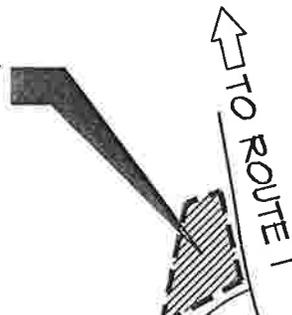
PONDING BASIN - BANYAN ST., BANYAN HEIGHTS

NOT TO SCALE

# LOCATION MAP

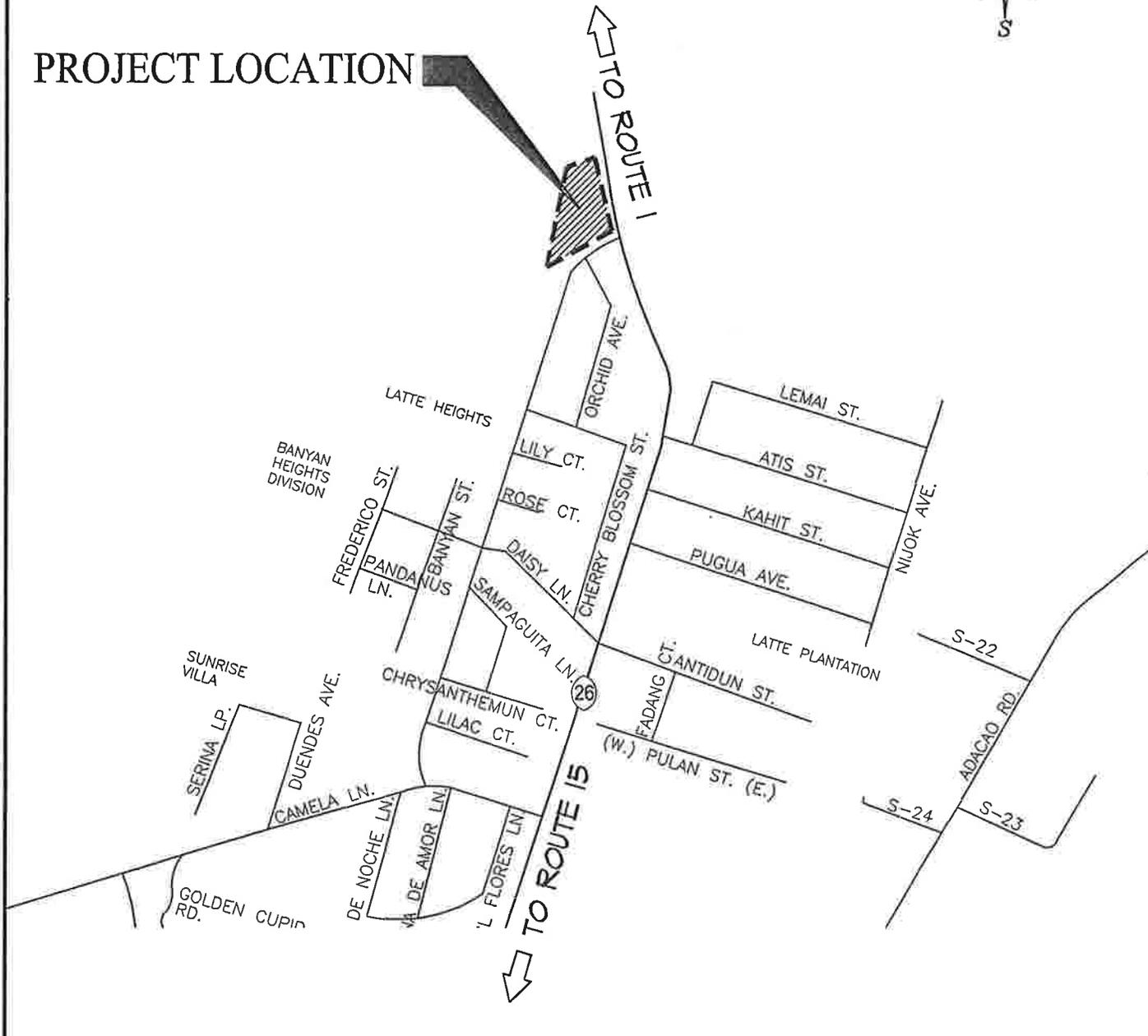


PROJECT LOCATION



TO ROUTE 1

TO ROUTE 15

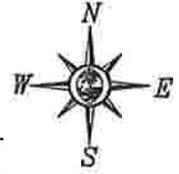


VILLAGE OF MANGILAO  
PONDING BASIN- COR. GARDENIA & CARNATION AVE.,  
LATTE HEIGHTS

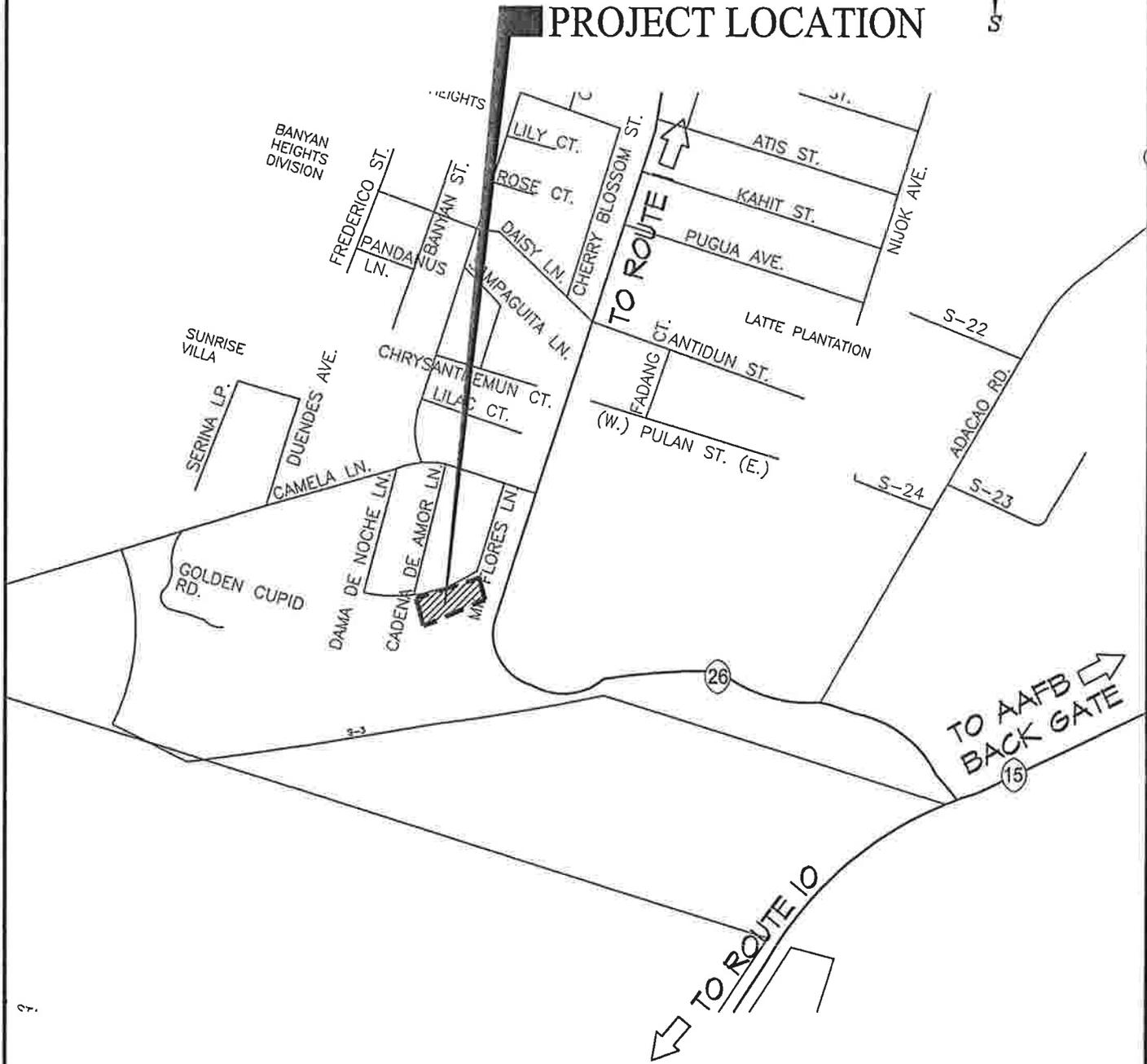
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NOT TO SCALE

# LOCATION MAP



## PROJECT LOCATION



VILLAGE OF MANGILAO  
PONDING BASIN- COR. MIL FLORES LN. & CARNATION  
AVE., LATTE HEIGHTS

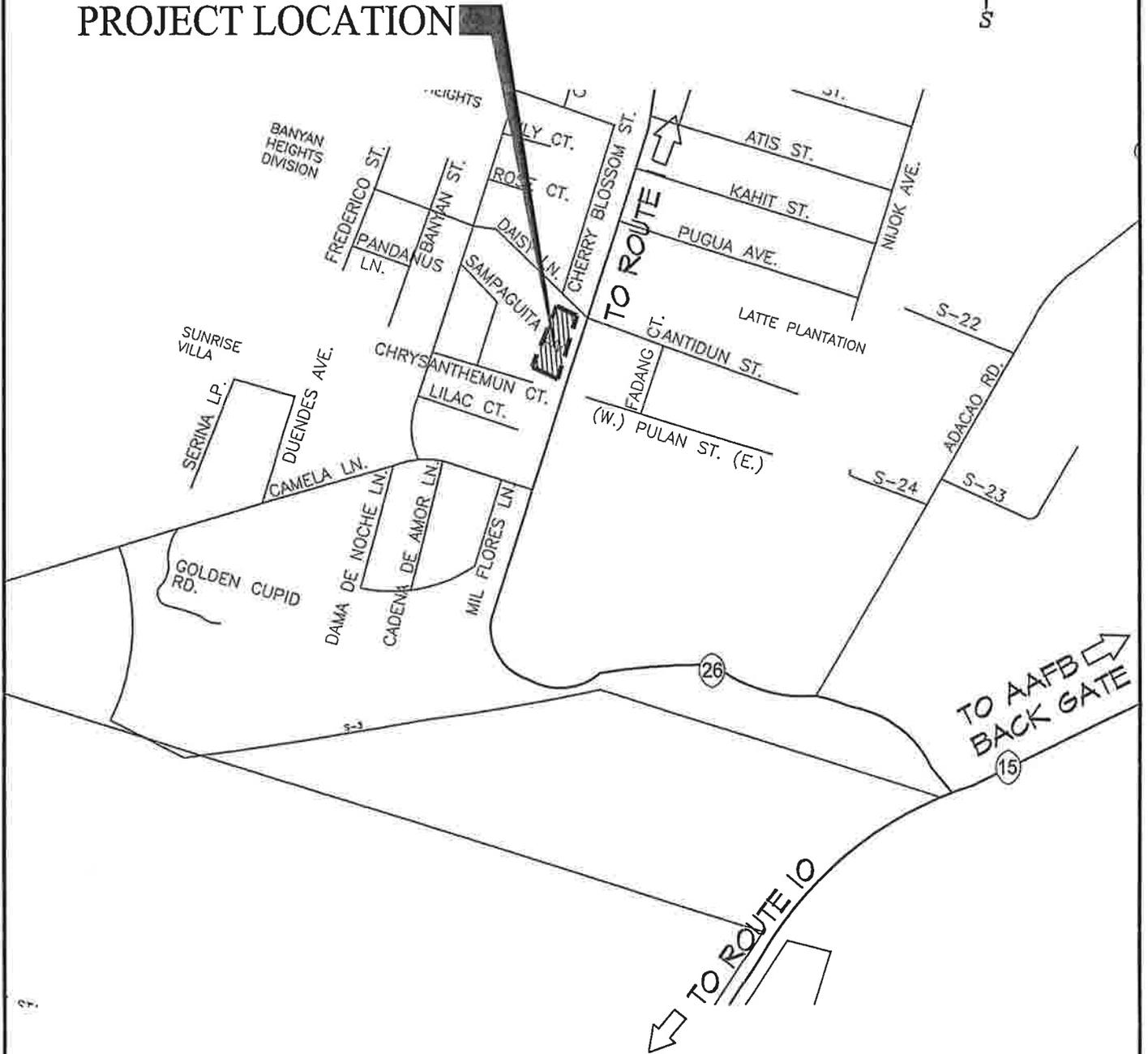
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PB

NOT TO SCALE

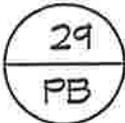
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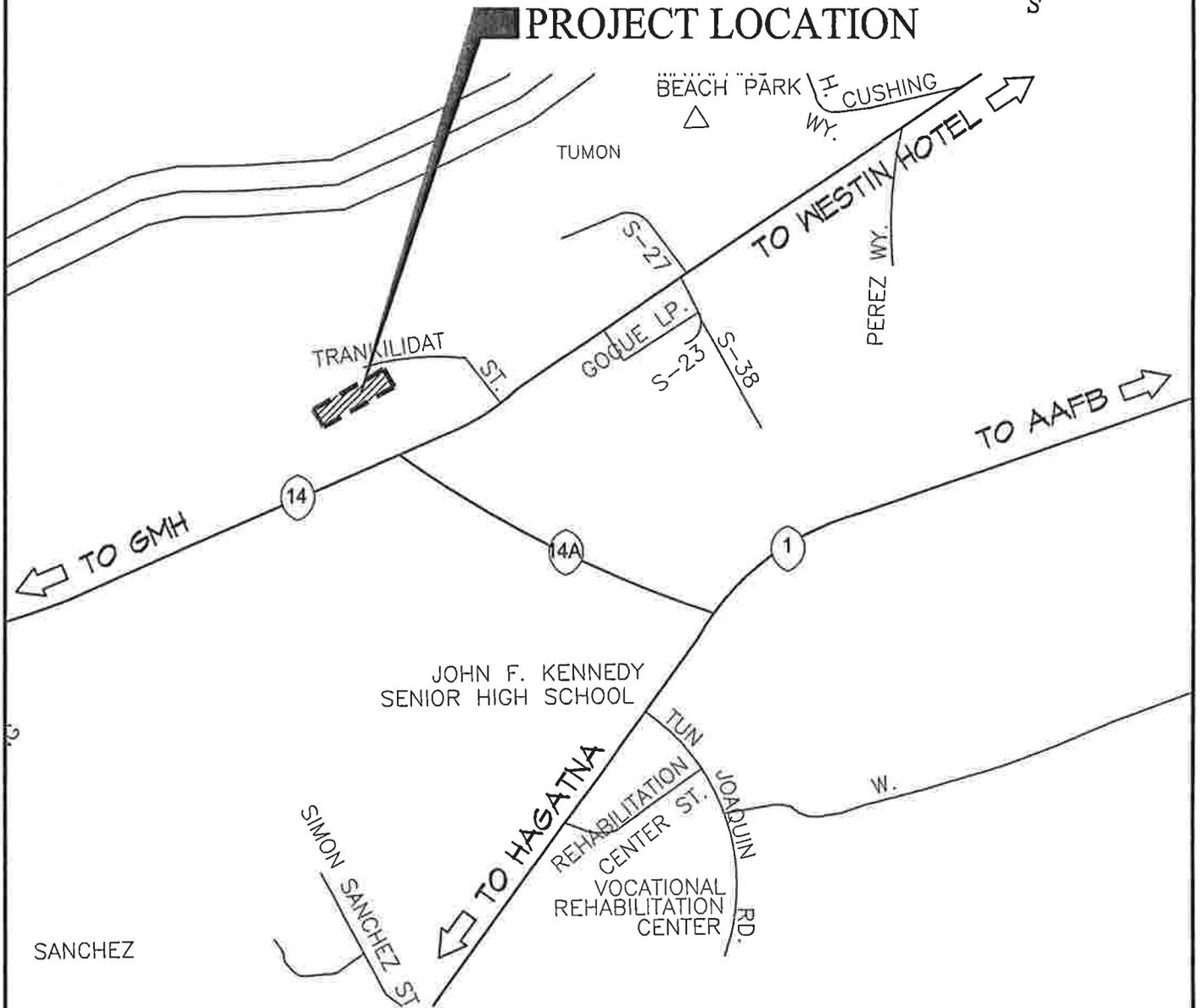
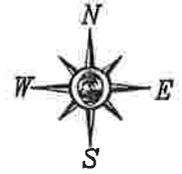


VILLAGE OF MANGILAO  
PONDING BASIN- COR. DAISY LN., & CARNATION  
AVENUE

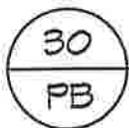


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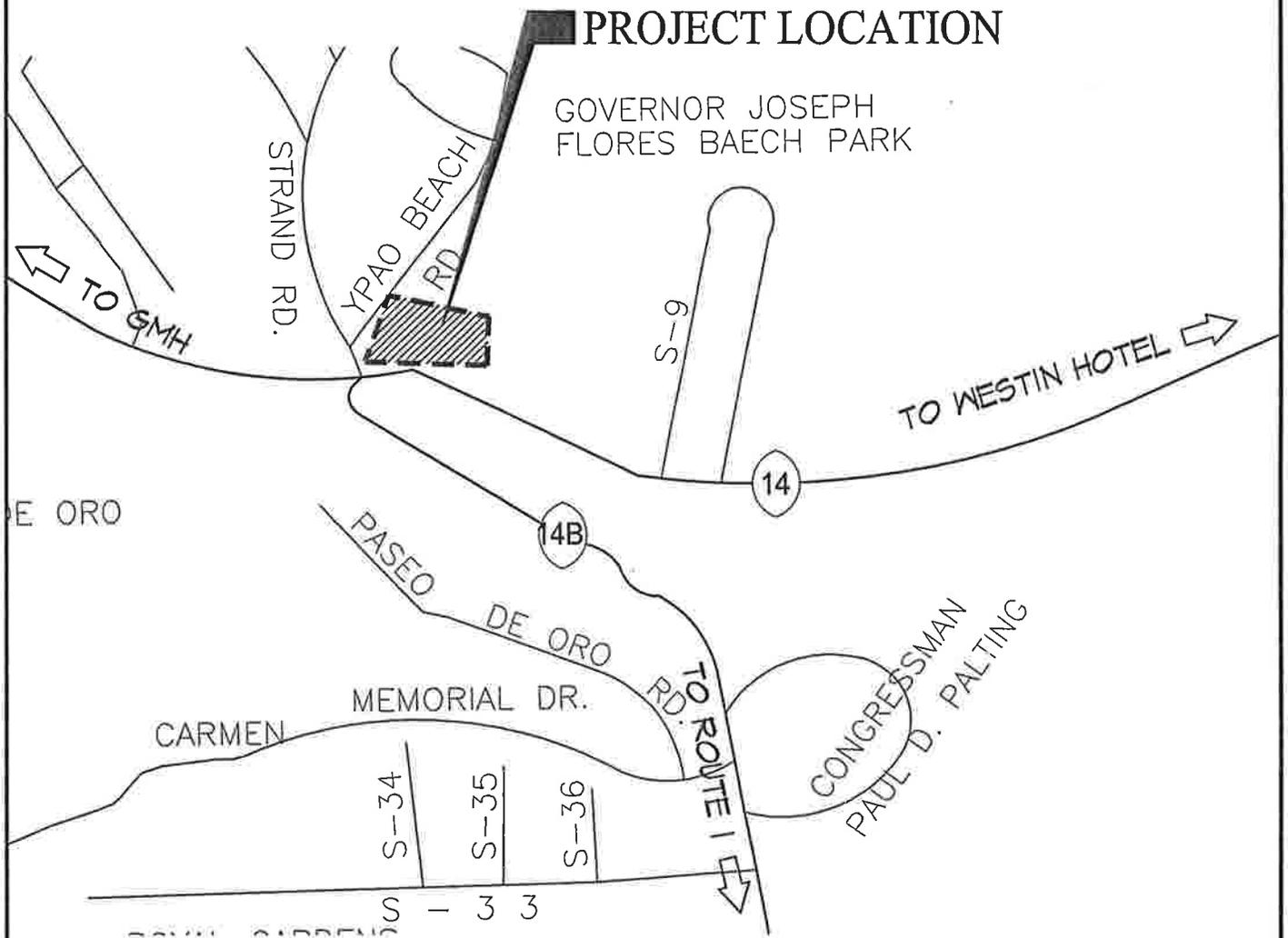


VILLAGE OF TAMUNING  
PONDING BASIN - GUMA TRANKILIDAT,  
PALE SAN VITORES, TUMON



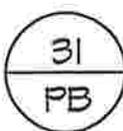
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# LOCATION MAP



## VILLAGE OF TAMUNING

PONDING BASIN - PALE SAN VITORES, TUMON

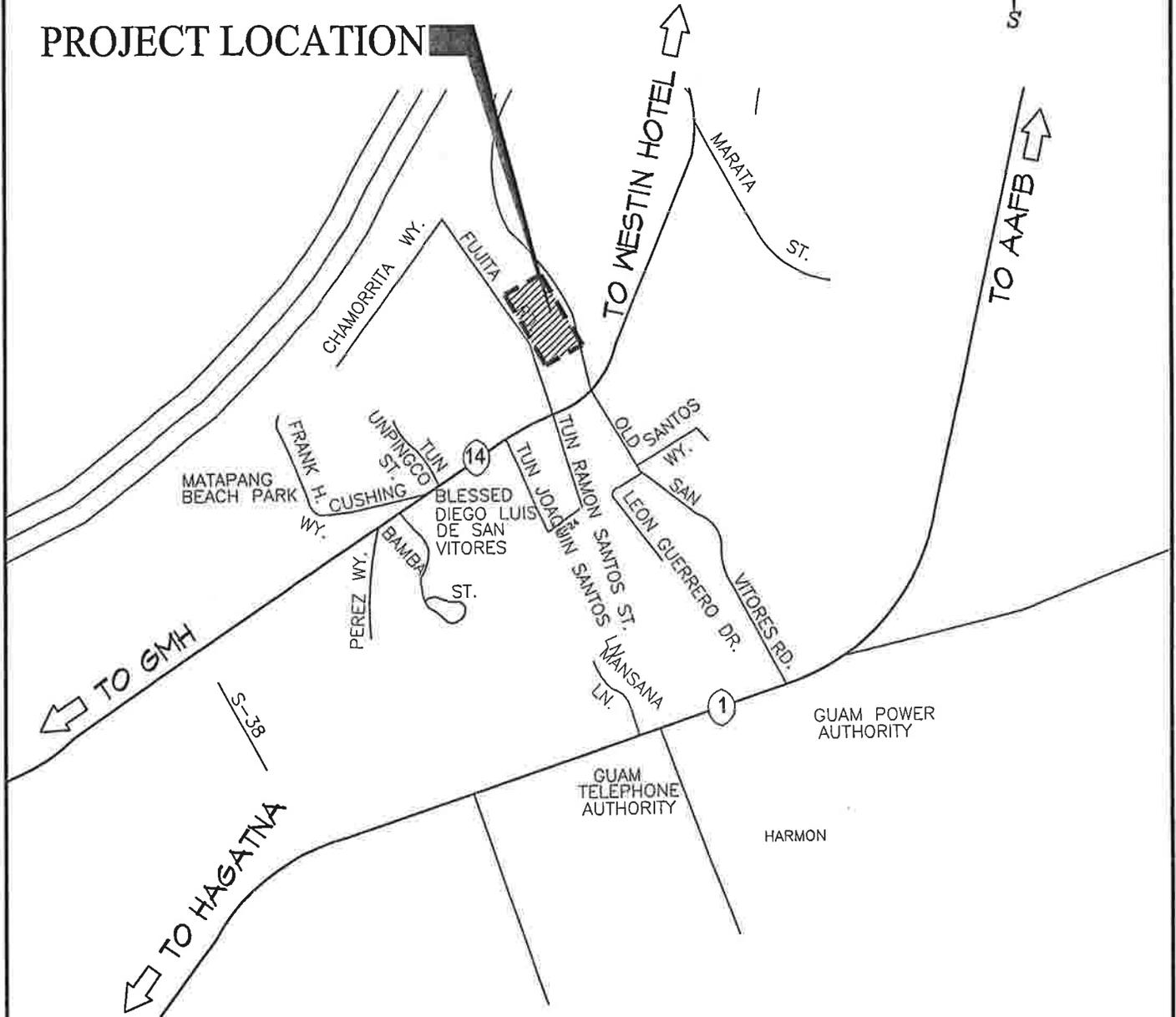


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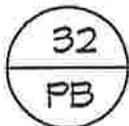
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PROJECT LOCATION



VILLAGE OF TAMUNING  
PONDING BASIN - COR. FUJITA RD. & PALE  
SAN VITORES, TUMON

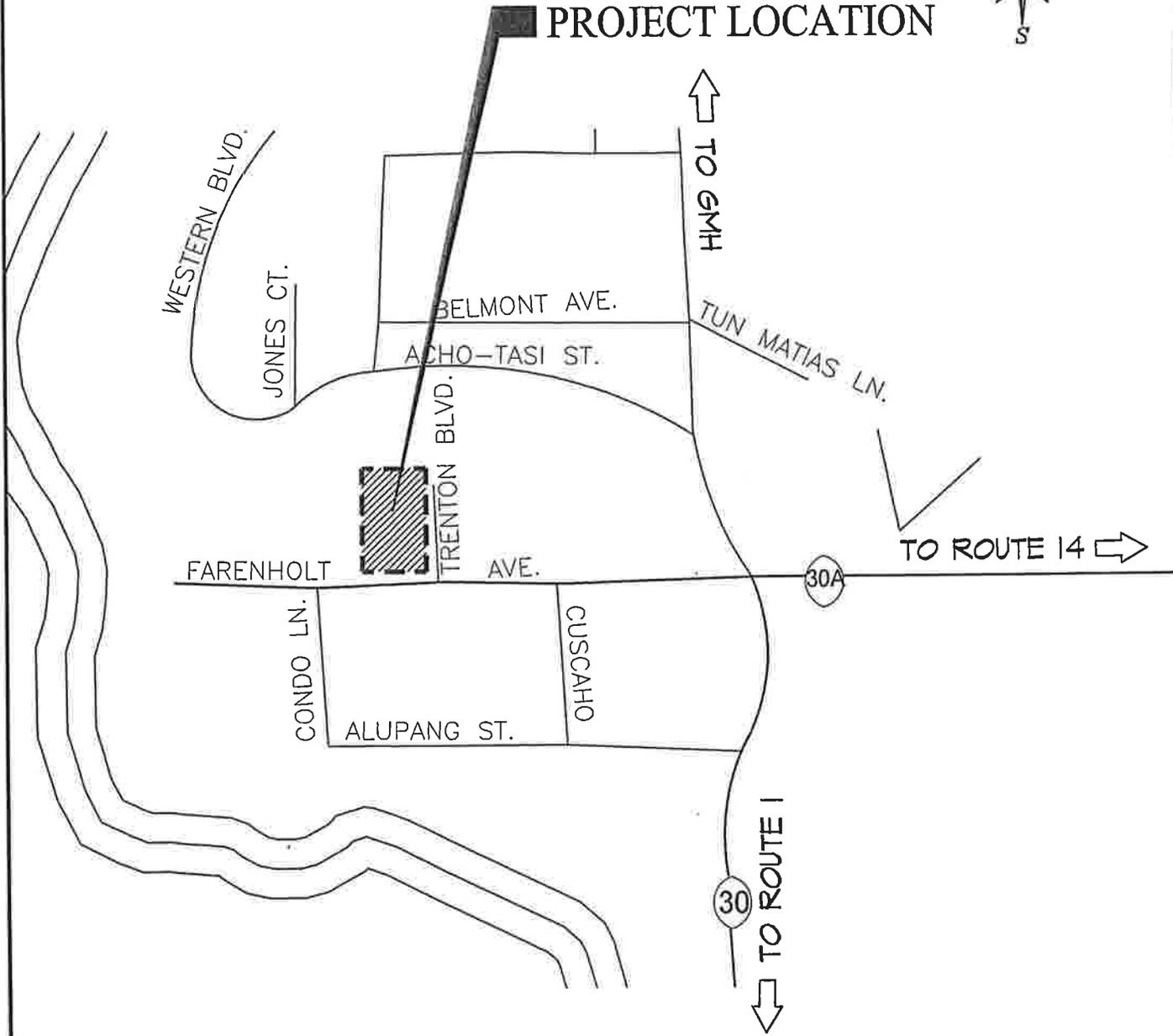


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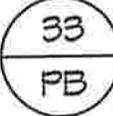
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PROJECT LOCATION



## VILLAGE OF TAMUNING



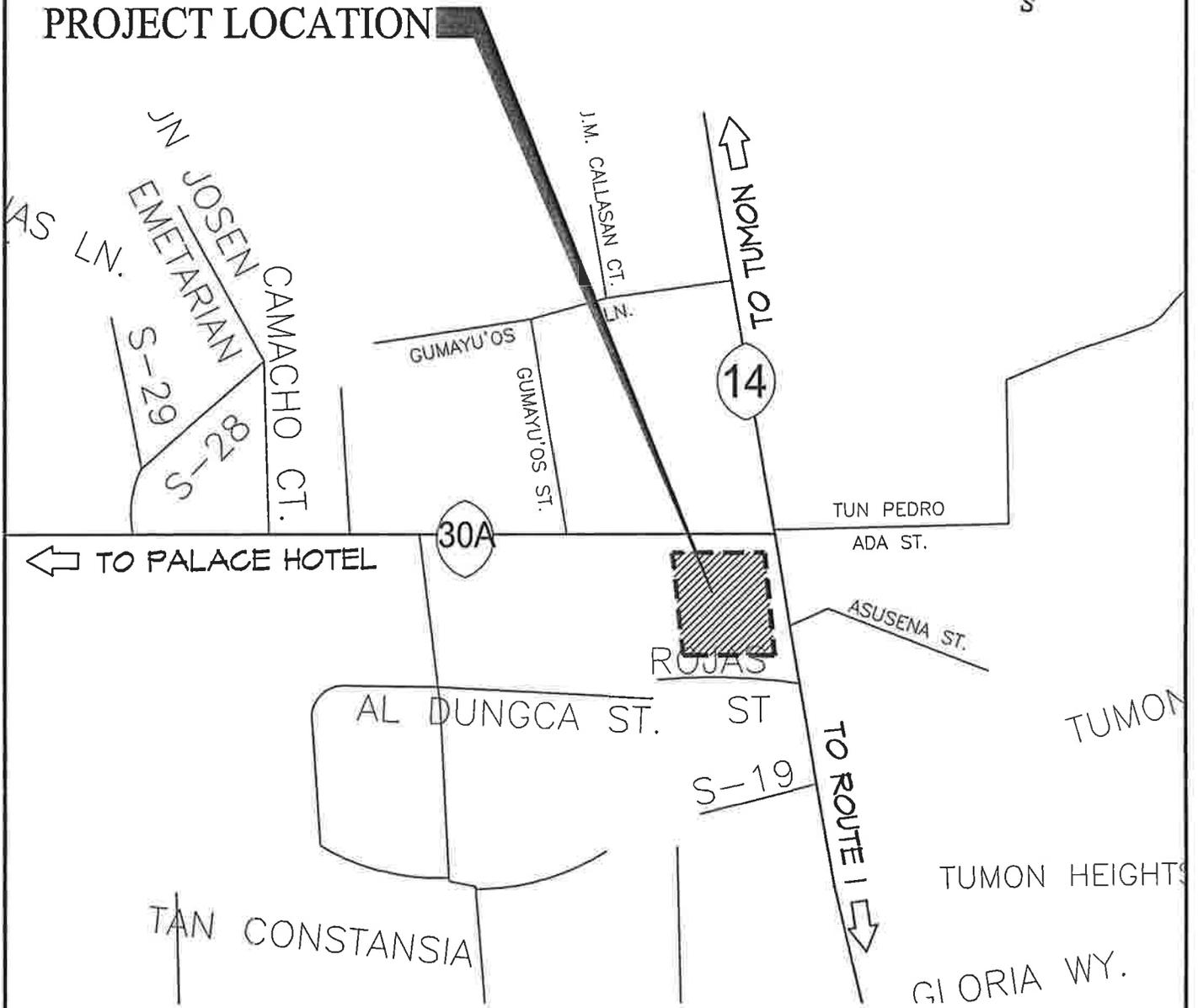
PONDING BASIN - BY POLICE KOBAN, FARENHOLT

NOT TO SCALE

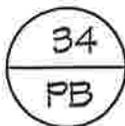
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PROJECT LOCATION



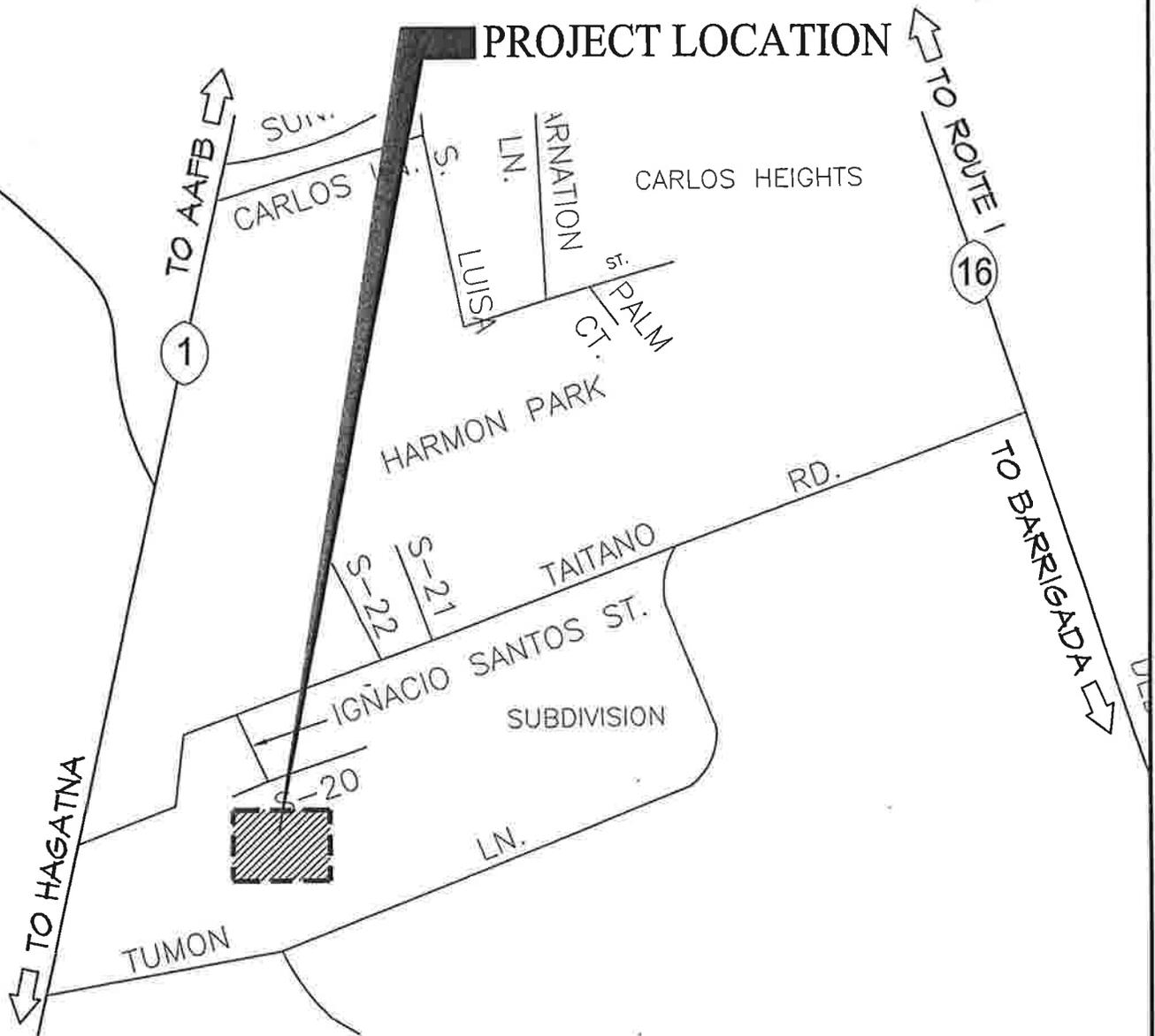
VILLAGE OF TAMUNING



PONDING BASIN - COR. RTE. 14 & FARENHOLT AVE.

NOT TO SCALE

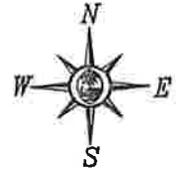
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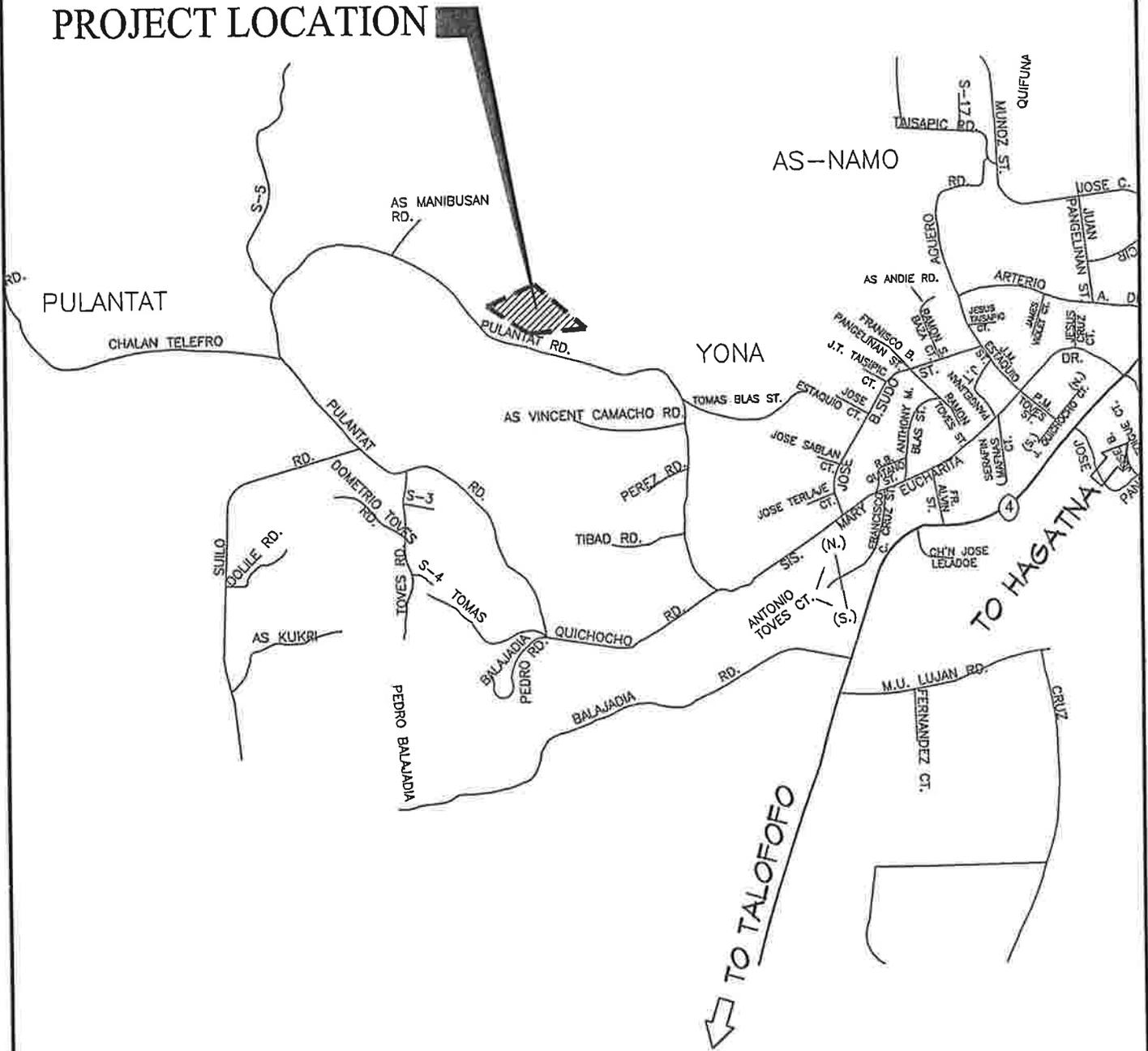
## VILLAGE OF TAMUNING

**35** PONDING BASIN - S-20 HARMON PARK SUBDIVISION  
**PB** NOT TO SCALE

# LOCATION MAP

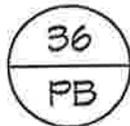


## PROJECT LOCATION



VILLAGE OF YONA

PONDING BASIN- PULANTAT

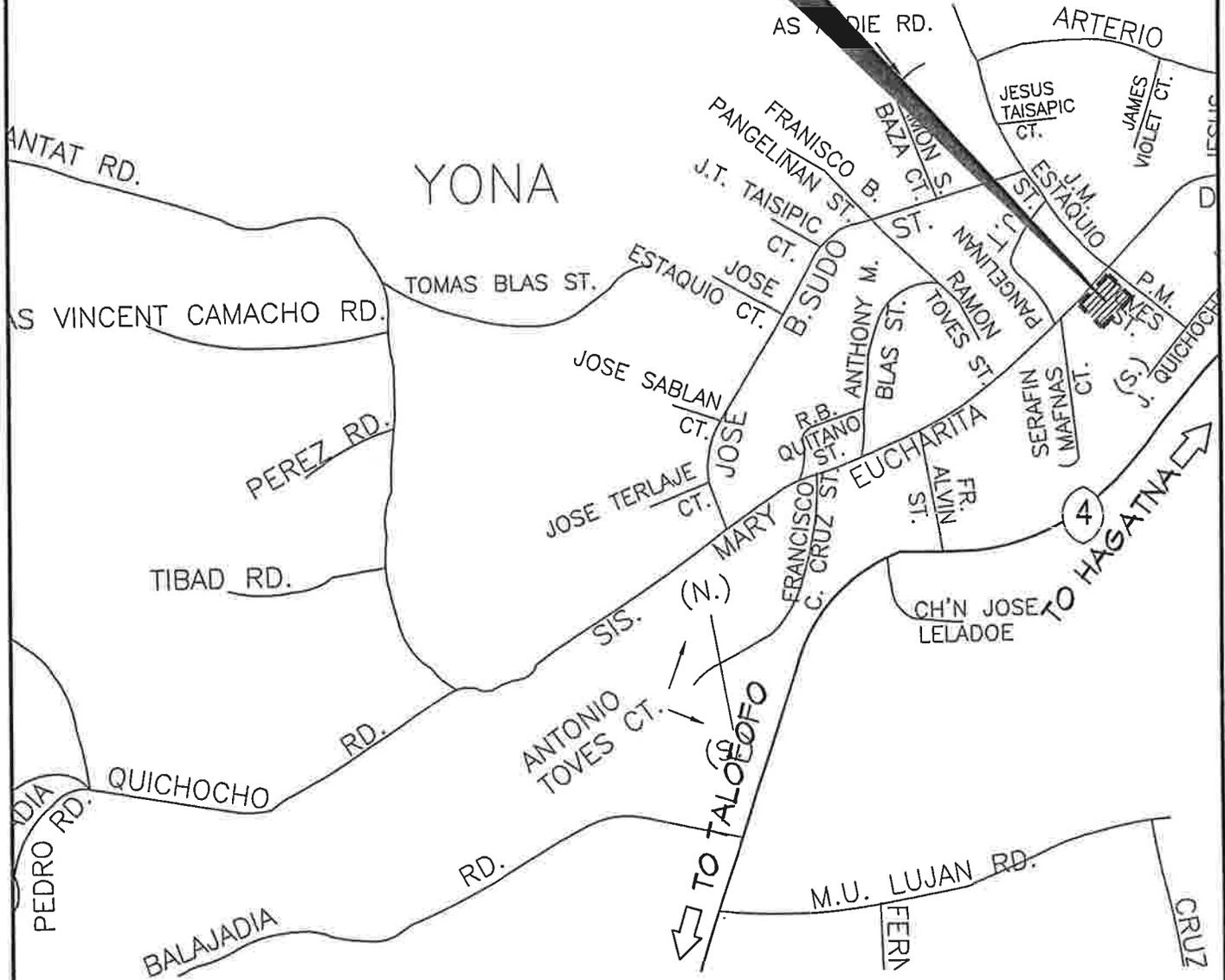


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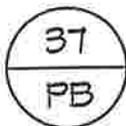
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## PROJECT LOCATION



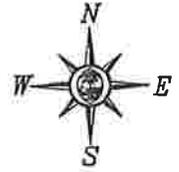
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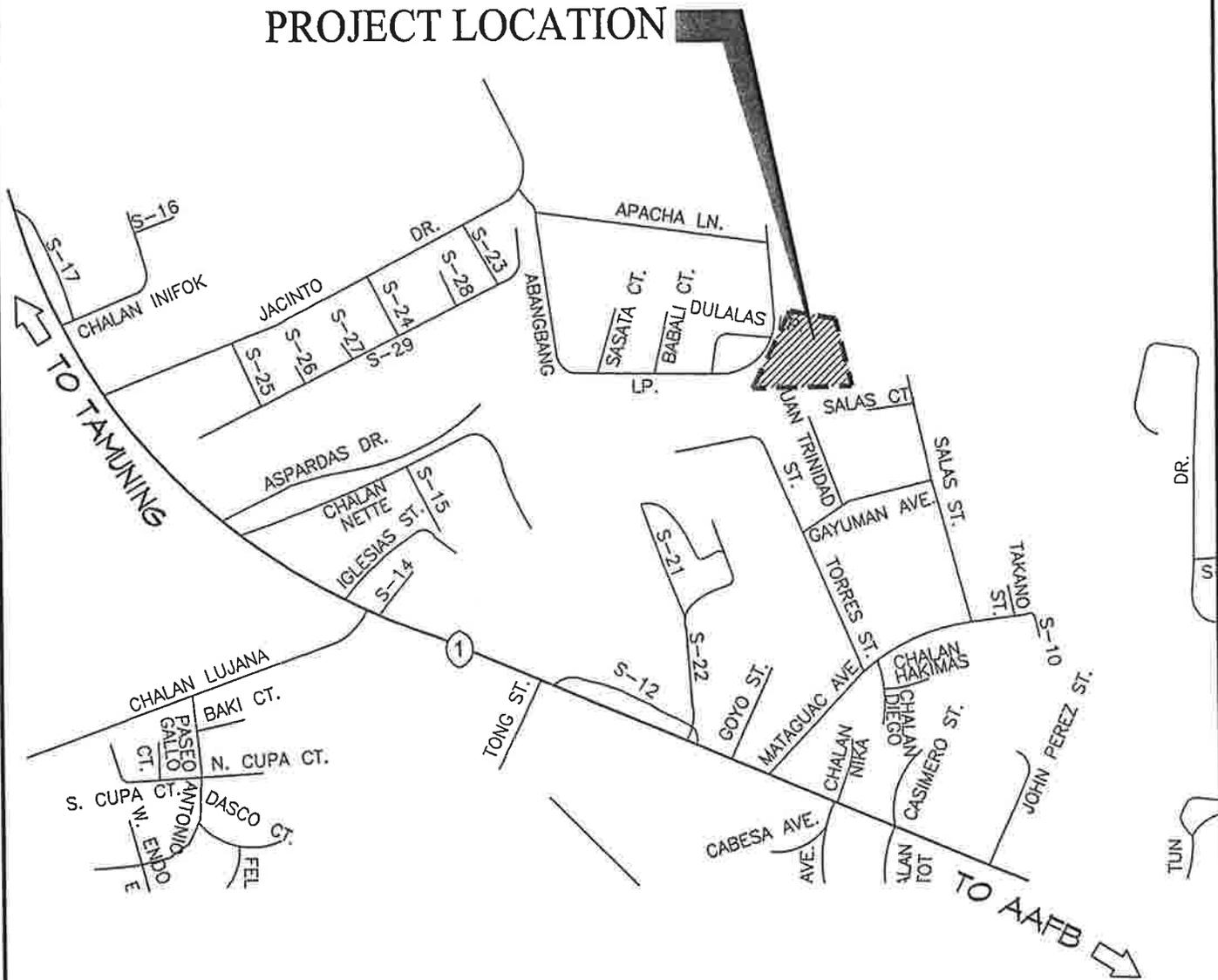
**PONDING BASIN- SISTER MARY EUCHARITA DRIVE**

NOT TO SCALE

# LOCATION MAP



## PROJECT LOCATION



VILLAGE OF YIGO  
38 PONDING BASIN - GHURA 506  
PB NOT TO SCALE

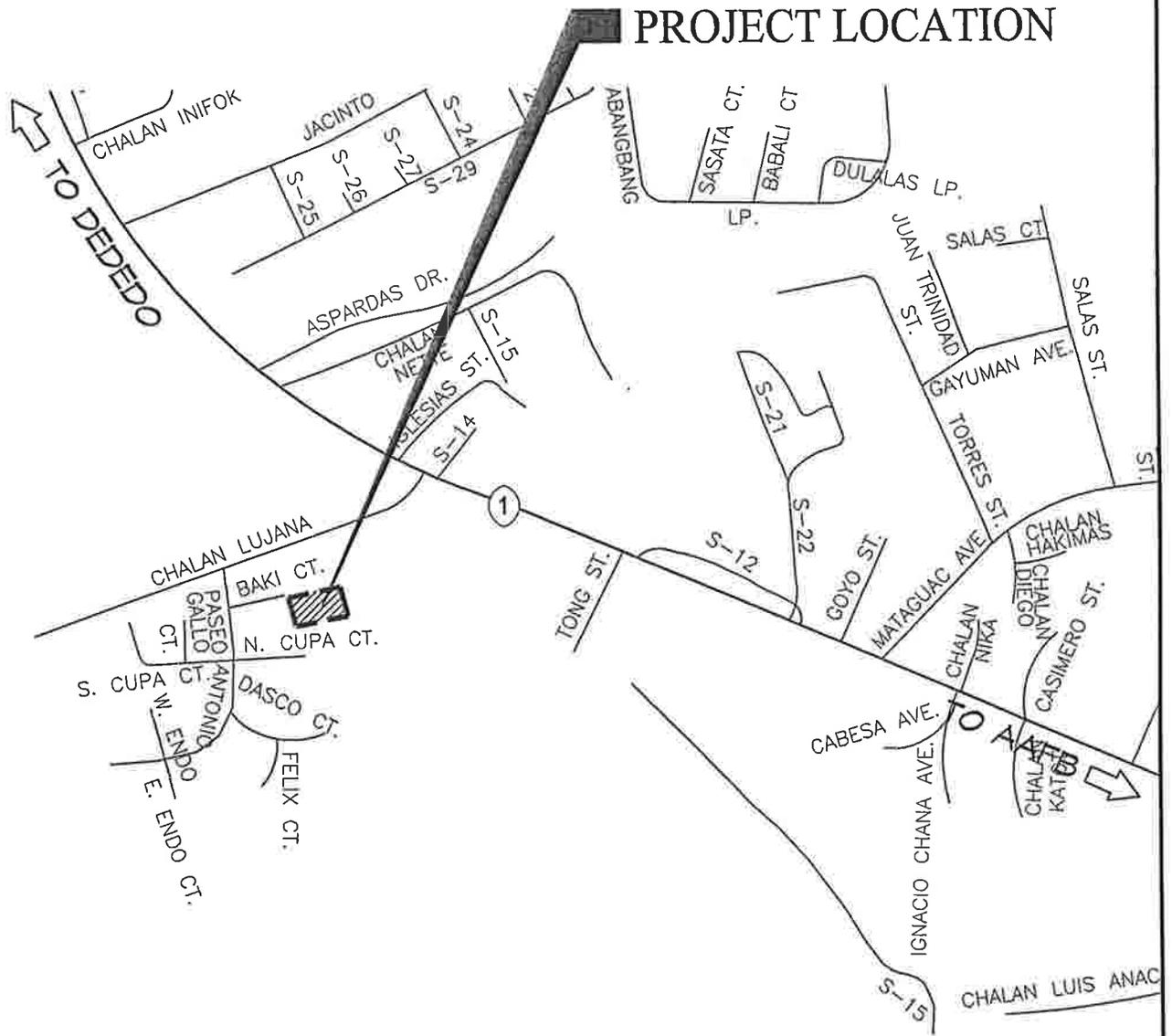
# LOCATION MAP



## PROJECT LOCATION



# LOCATION MAP



## VILLAGE OF YIGO

**40** PONDING BASIN - BAKI CT. / PEREZ ACRES  
**PB** NOT TO SCALE

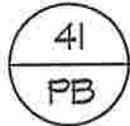
# LOCATION MAP



## PROJECT LOCATION



VILLAGE OF YIGO  
PONDING BASIN - MILALAK DR., ST. PACIFIC  
MEMORIAL PARK

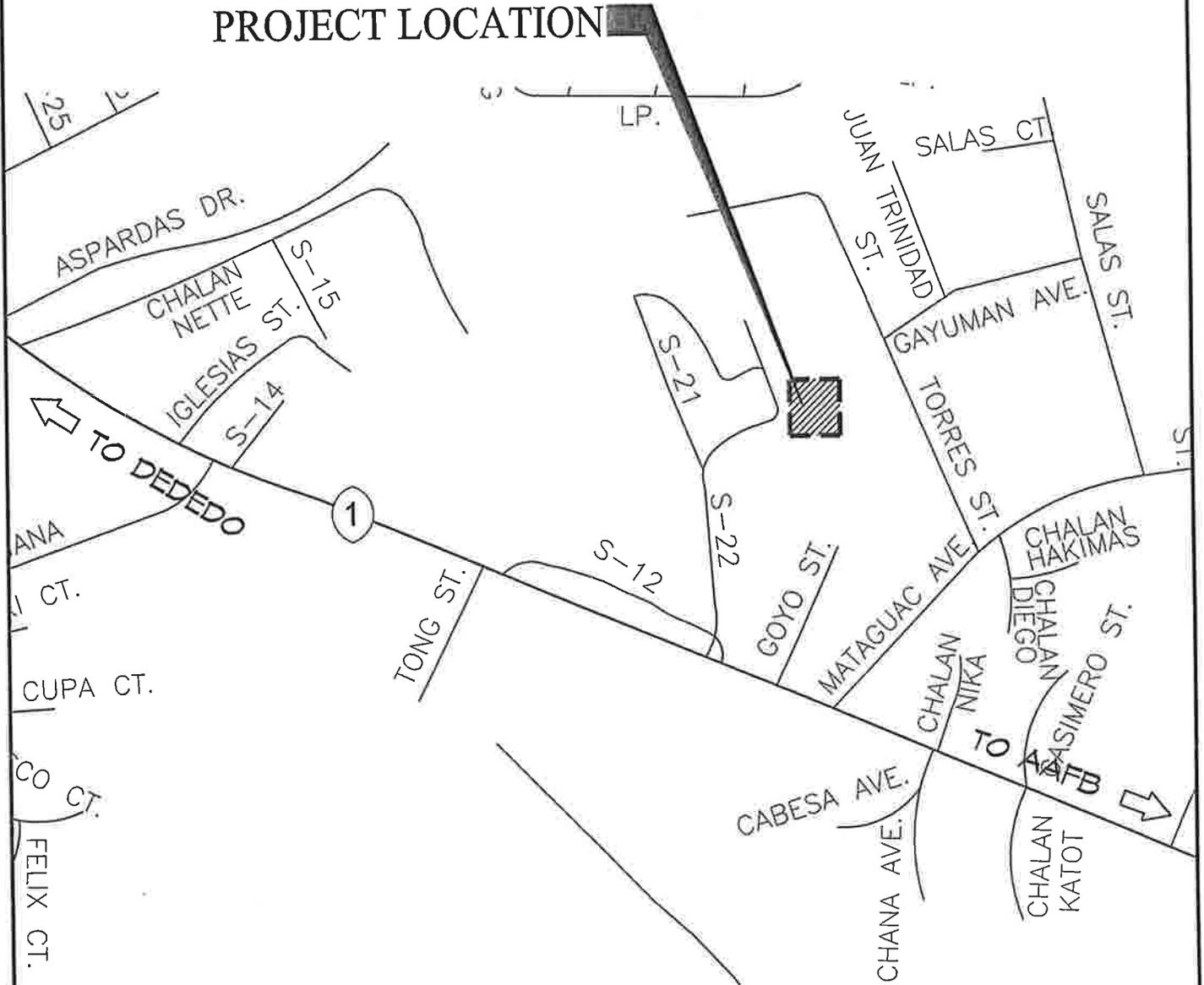


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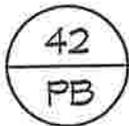
# LOCATION MAP



PROJECT LOCATION

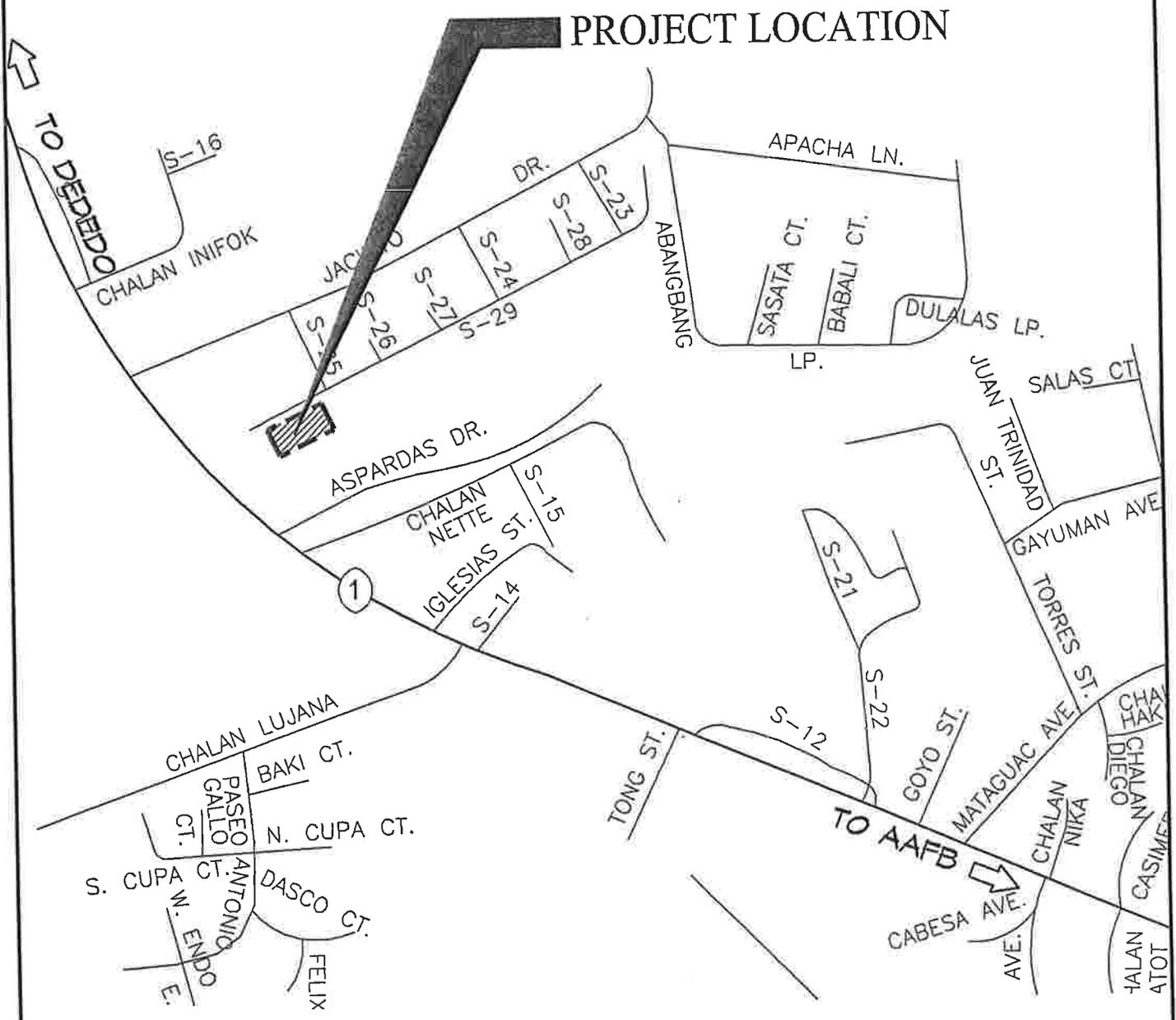
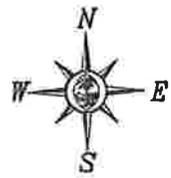


VILLAGE OF YIGO  
PONDING BASIN - ABANBANG LP., Q PONDEROSA  
GARDENS

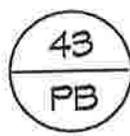


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# LOCATION MAP



## VILLAGE OF YIGO



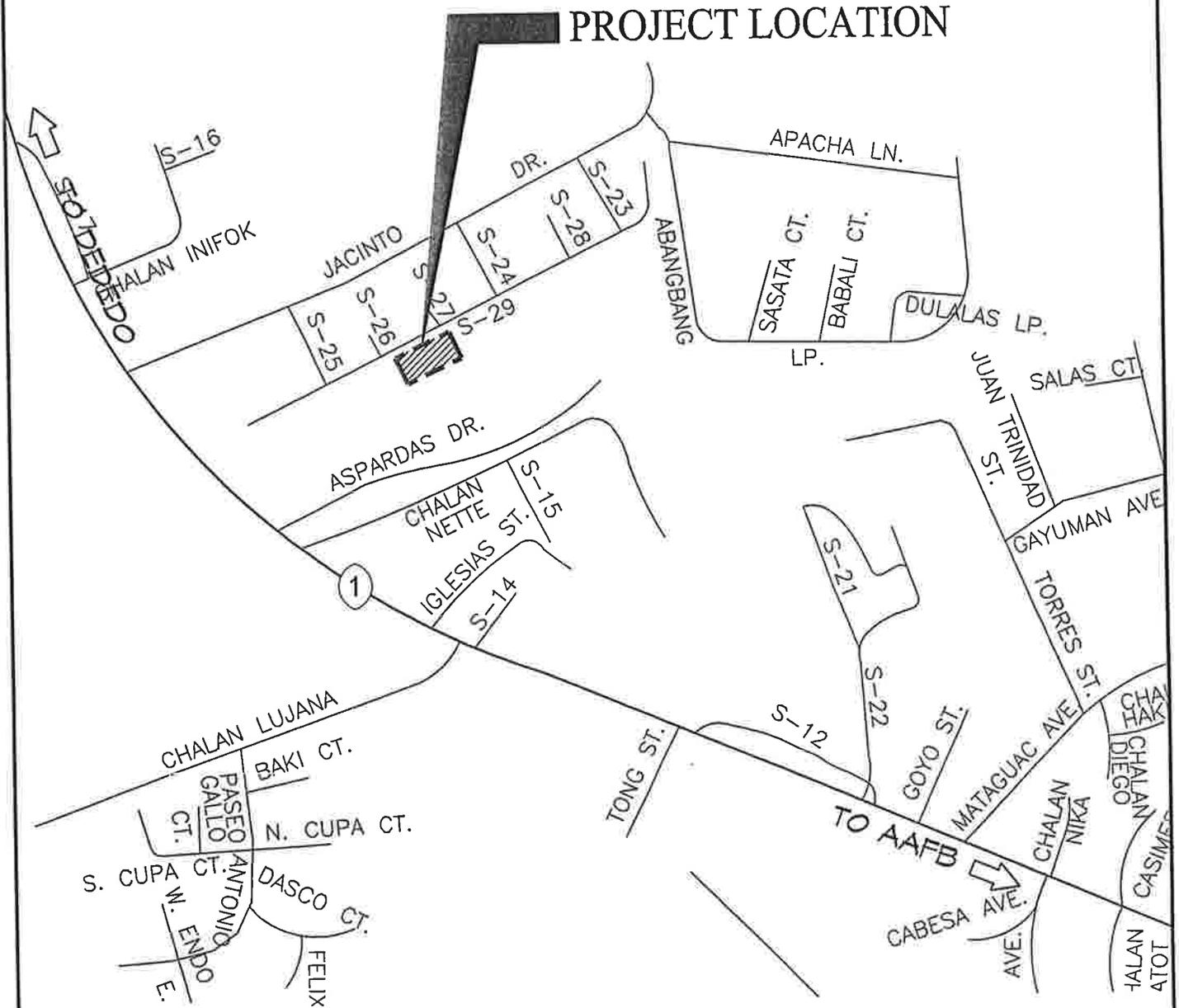
PONDING BASIN - 1 SS-29 NISSHO SUBDIVISION

NOT TO SCALE

# LOCATION MAP

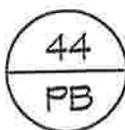


PROJECT LOCATION



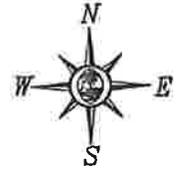
VILLAGE OF YIGO

PONDING BASIN - 2 SS-29 NISSHO SUBDIVISION

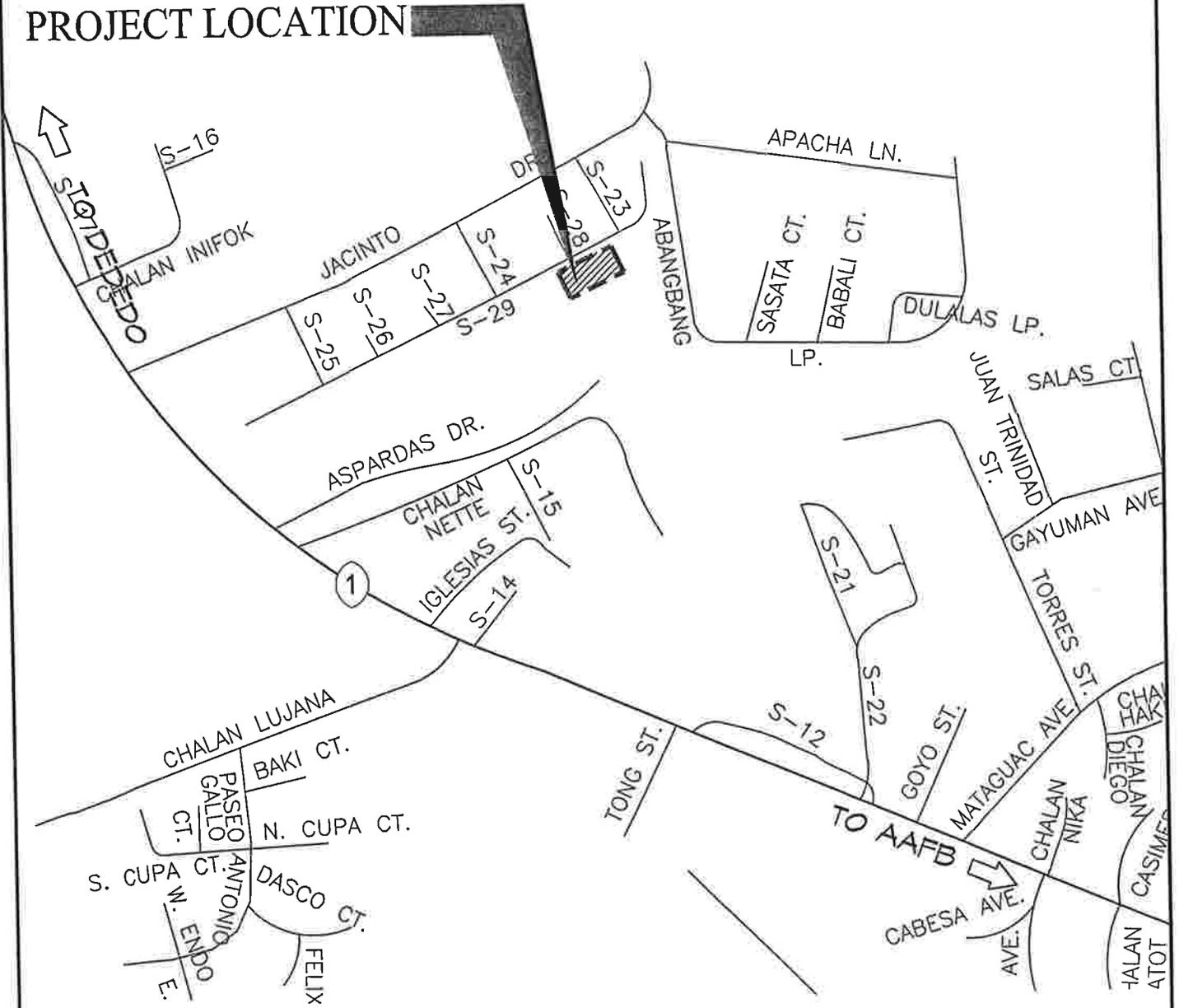


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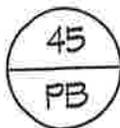
# LOCATION MAP



PROJECT LOCATION



## VILLAGE OF YIGO

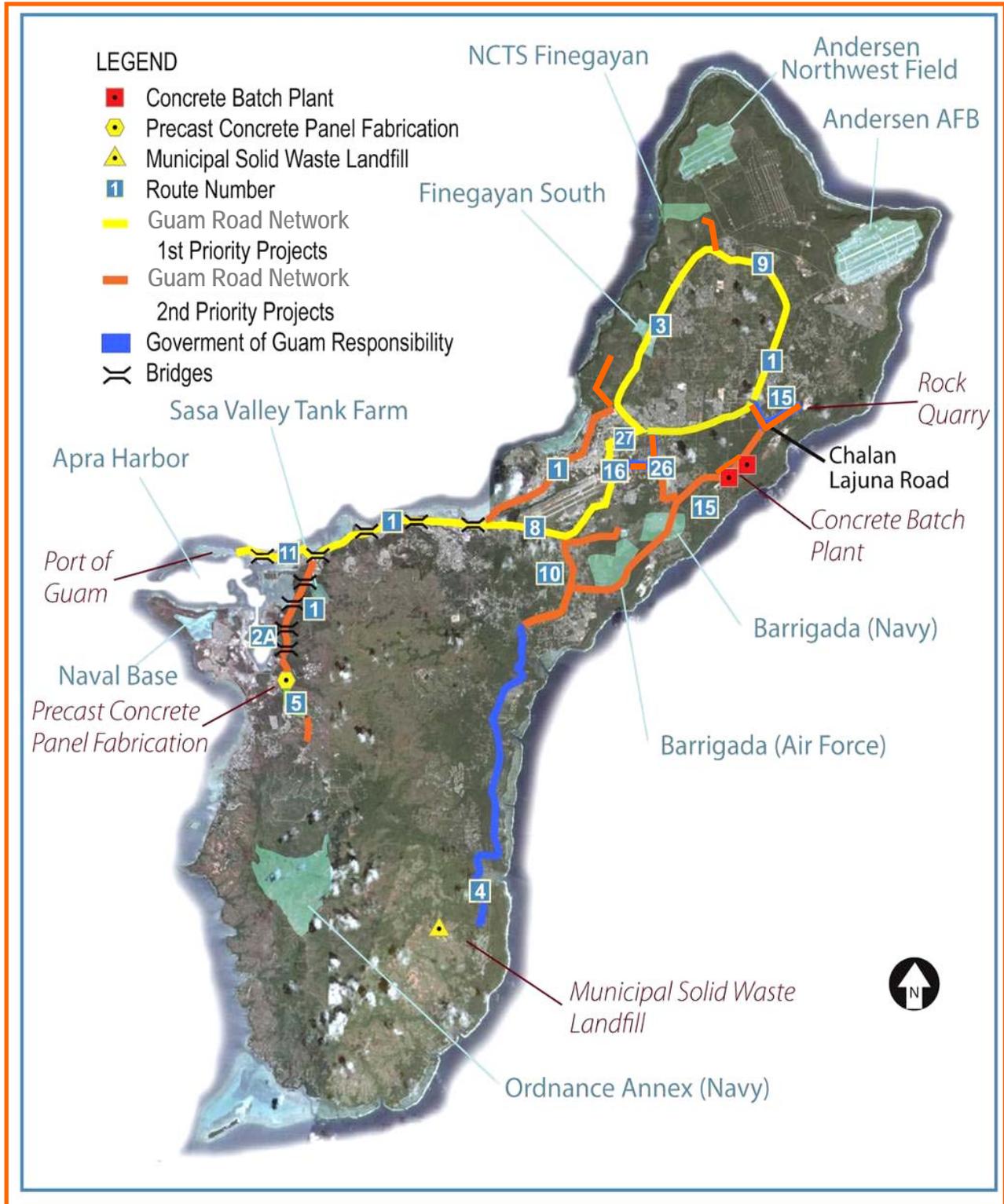


PONDING BASIN - 3 SS-29 NISSHO SUBDIVISION

NOT TO SCALE

**APPENDIX C**  
**GRN OVERVIEW MAP**

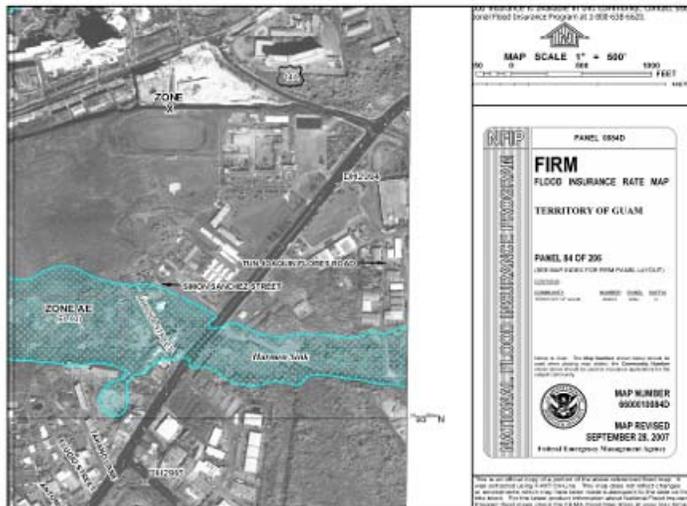
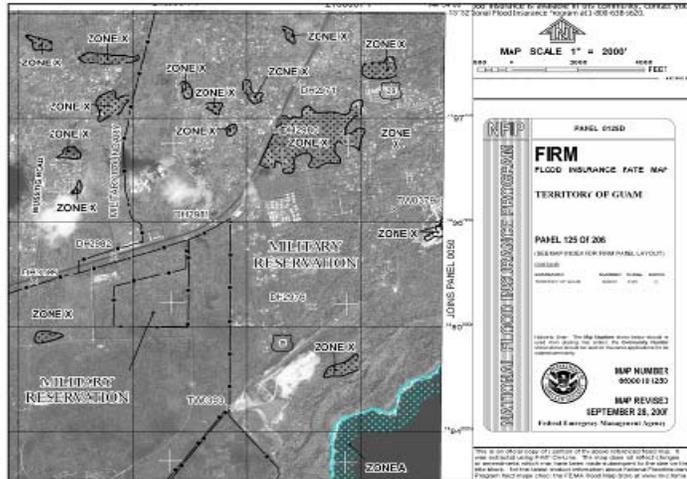
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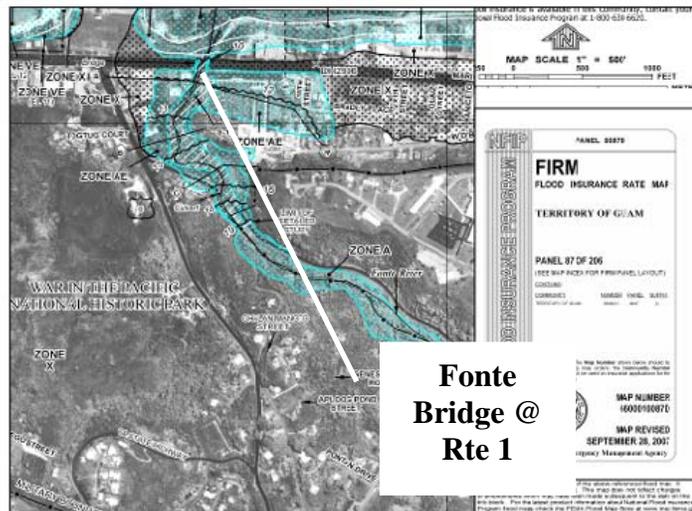
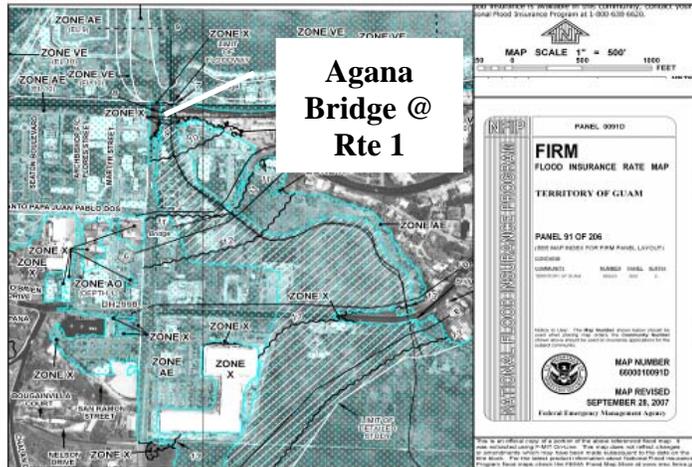
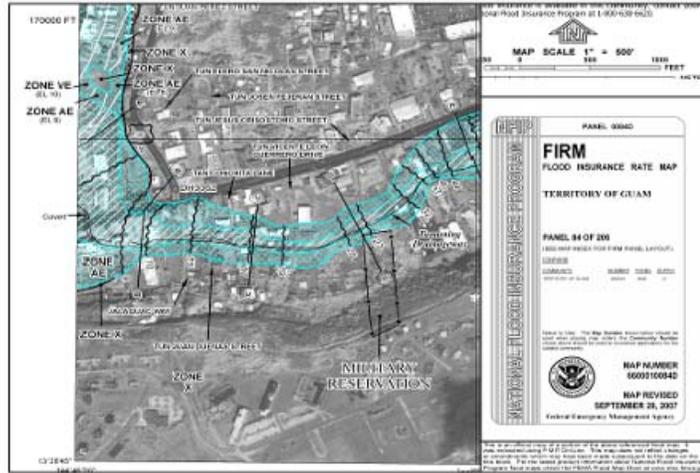
**APPENDIX D**  
**FEMA MAPS**

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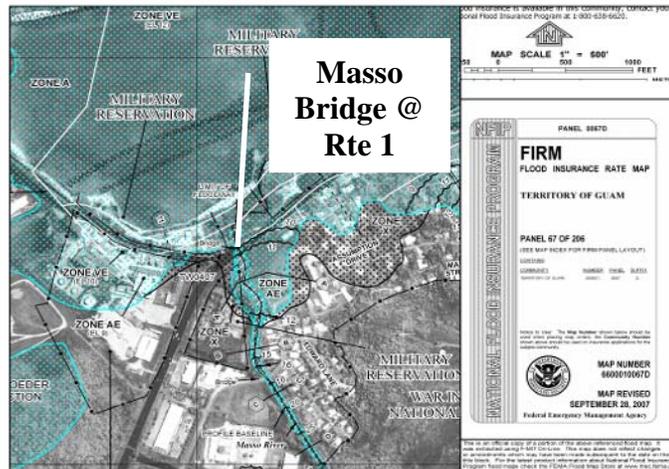
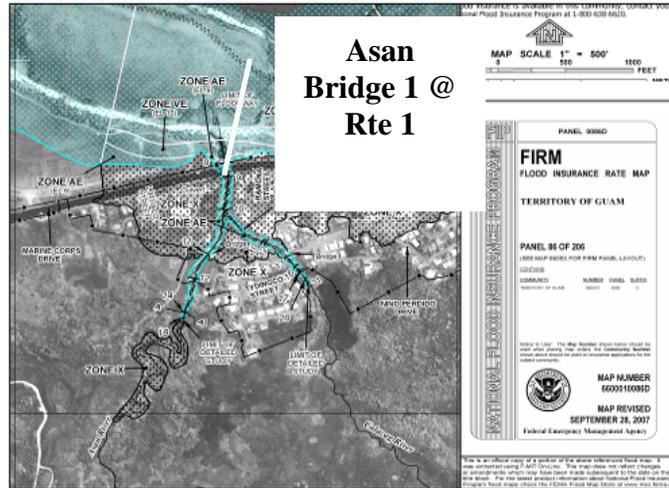
# NORTH GUAM



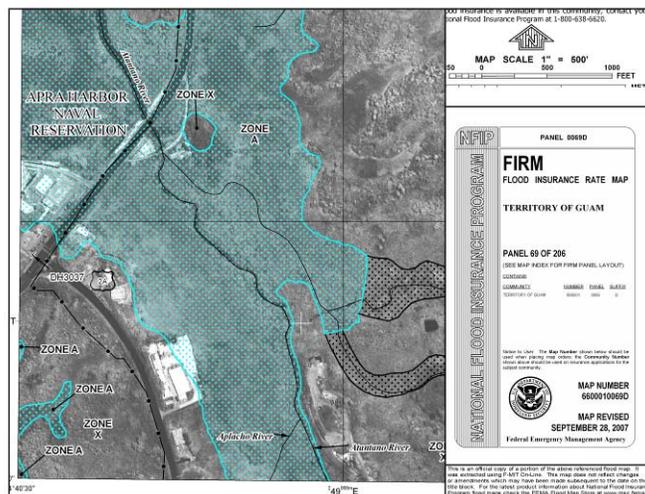
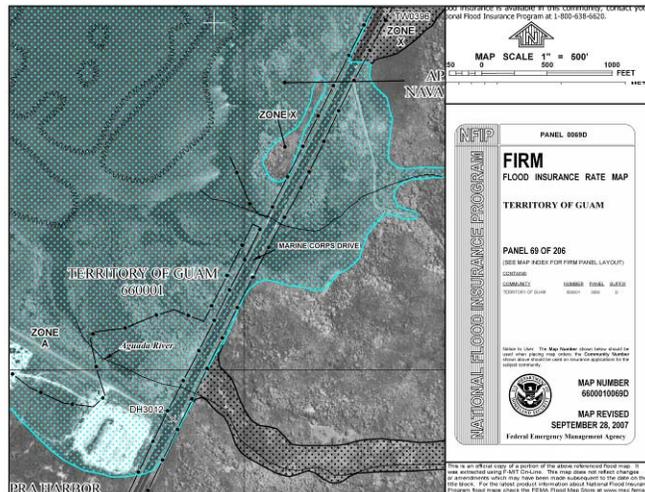
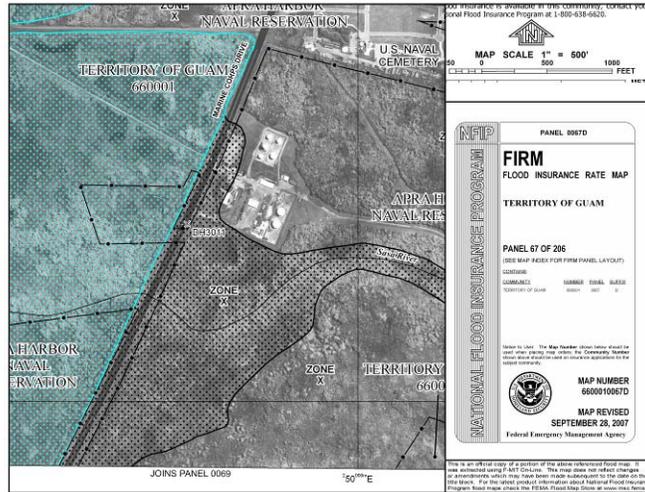
# SOUTH GUAM ALONG GRN



### SOUTH GUAM ALONG GRN (CONT'D)



# SOUTH GUAM ALONG GRN (CONT'D)



**APPENDIX E**  
**DESIGN GUIDELINES – BIOFILTRATION STRIPS AND SWALES**

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## **Biofiltration Strips**

This section provides guidance for incorporating Biofiltration Strip Treatment Best Management Practices (BMPs) into projects during the planning and design phases of transportation related facilities. The primary functions of this document are to:

- Assist with determining the applicability of a Biofiltration Strip (“BioStrip”);
- Provide the design guidance;
- Cover the required elements for implementing a Biofiltration Strip in a PS&E package (Plans, Specifications, and Estimates) for a given project; and
- Provide information about vegetation for BioStrips.

### ***Biofiltration Strips – A Brief Description***

Biofiltration Strips are one of several BMPs for treatment of stormwater runoff from project areas that are anticipated to produce pollutants of concern such as roadways or parking lots. BioStrips are sloped vegetated land areas located adjacent to impervious areas, over which storm water runoff flows as sheet flow. Pollutants are removed by filtration through the vegetation, uptake by plant biomass, sedimentation, adsorption to soil particles, and infiltration through the soil. BioStrips are effective at trapping litter, Total Suspended Solids (soil particles), and particulate metals. The following list demonstrates some advantages of utilizing a BioStrip as a Treatment Control BMP.

- When properly implemented, Biostrips are aesthetically pleasing. Due to the presence of its vegetation, the public views Biostrips as a “landscaped roadside” which would make placement more acceptable than other Treatment BMPs using concrete vaults;
- Biostrips were determined to be an effective Treatment BMP in reducing sediment and heavy metals, as described in the *BMP Retrofit Pilot Program Final Report* (Caltrans, 2004); and
- Biostrips were determined to be cost effective and, together with Bioswales, were among the least expensive Treatment BMP per volume of runoff treated (Caltrans, 2004).

### ***Design Criteria***

To perform as an effective Treatment BMP, the Biofiltration Strip must meet certain design criteria as follows:

- Side Slope Ratio - Must grade to drain, but no minimum limit (4H:1V or flatter preferred);
- Tributary Area – Maximum 150 ft width (length of sheet flow path);
- Biofiltration Strip Length (Direction of Flow) - 15 ft minimum;
- Manning's *n* value during WQF - 0.24 (infrequently mowed) recommended;
- WQF Velocity - No minimum value, Maximum = 1.0 fps (seldom controls design);
- Flow Depth (WQF) - No minimum value, Maximum = 1.0 inch (seldom controls design); and
- Vegetative Coverage - 70 % minimum coverage.

### ***Minimum Biofiltration Strip Length***

Treatment is obtained by BioStrips through filtration through the vegetation, uptake by plant biomass, sedimentation, adsorption to soil particles, and infiltration through the soil. Of these mechanisms, probably the two most important are sedimentation and infiltration. The relative proportion of total treatment done by the sedimentation and infiltration can vary by site, but in terms of total pollutant load reduction (as opposed to concentration reductions) the role played by infiltration can be much more than 50%. Using TSS (total suspended solids) as the key pollutant for this discussion indicated a

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reduction in the TSS concentration of 50% or more can occur after as little as 12 feet of travel for a variety of side slope ratios, including slopes as steep as 2H:1V. The minimum recommended slope length for BioStrips is 15 ft for any side slope ratio as long as the site supports the required 70 percent vegetation coverage without rills or gullies.

### ***Site Specific Design Elements***

**Use of Level Spreaders** – Due to various difficulties, use of concrete level spreaders is not recommended to distribute runoff.

**Concentrated runoff at the end of a bridge** - Runoff at the end of a bridge will usually be in the form of concentrated flow, rather than sheet flow. Since the use of level spreaders is discouraged, this runoff should be considered for capture in a drainage inlet, from which it ideally would be brought to the base of the embankment and directed into a Biofiltration Swale. The remaining portion of the bridge approach would then be allowed to convey runoff as sheet flow onto BioStrips. Runoff from the end of a bridge should not be allowed to cause erosion.

**Use of Curbs and Dikes within the roadway cross section** - Curbs are used when needed to improve channelization, delineation, or improving traffic flow and safety, and their use will likely not be waived due to water quality issues. However, dikes are used when deemed needed for drainage control, and can be considered in the context both of water quality and highway drainage. Use of dikes should be discouraged as much as possible on embankment sections that would otherwise meet BioStrip criteria.

### ***Design Drawings***

**Layout Sheets** - Show location(s) of BioStrips. This will aid in the recognition within and outside the Department that BioStrips were placed within the project limits.

**Contour Grading Sheets** - As BioStrips are primarily earthwork features they may be shown on Contour Grading sheets. Any other associated grading surrounding the BioStrip should be shown on these sheet(s).

**Construction Details** - There will not typically be any construction details associated with BioStrips, but if there are, these sheets may be used to show these items.

**Landscape Plans** - These sheets, and the Contour Grading sheets, will be the primary sheets used to show the placement of the landscape contract items of work for BioStrips.

**Other Sheets** - Drainage Plans, Water Pollution Control, Erosion Control Plans, Construction Staging, Utility Plans, Irrigation Plans, and other sheets should be considered as appropriate for the construction of BioStrips on a project-specific basis. If BioStrips will be constructed at multiple locations, a “Locations of Construction” table should be considered. This table could present the stationing and other location information. WQF could also be considered. This table may be incorporated into an existing drawing if there is room (such as a Title, Layout or Construction Detail), or may be developed as a separate drawing if necessary.

### ***Soil and Planting Bed Preparation***

The soils in areas designated for biofiltration should be ripped and cultivated to a minimum depth of 12-inches to relieve surface compaction. Compost should be incorporated at a minimum rate of 400 cu yd/acre (3-inch layer) to a minimum depth of 12-inches in all areas designated for biofiltration to restore soil organics, rooting depth, porosity and nutrients (carbon and nitrogen). Compost incorporation is typically recommended for slopes less than or equal to 4:1 H:V. Compost incorporation is not suggested for areas where harvested topsoil will be placed. Designate topsoil harvest and stockpile locations on the plans. Include details for re-application and placement of topsoil.

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## ***Planting Strategies***

The following criteria should be used as a general measure of successful Biofiltration BMP installation:

- Within the first year, a minimum of 70 percent vegetative cover is achieved.
  - Within three years, 75 to 85 percent vegetative cover is achieved.
  - The Biofiltration BMP does not exhibit rills, gullies, or visible erosion that is contributing to the export of sediment.
  - Temporary cover with sufficient longevity should be provided until the desired percentage cover of vegetation is achieved.
  - Temporary cover is usually provided through the use of short-term, degradable erosion control products such as rolled erosion control products (RECPs), wood chips and compost, straw, and hydromulch. These products vary in how long they will last. For example, straw can be expected to last through a single rainy season while a woven coconut fiber netting will usually persist for 3 years.
  - Strive for cost effective solutions. In most cases, the temporary cover product with the greatest longevity will also be the most expensive. While plant performance, slope steepness, slope inclination, slope aspect, and soil characteristics must be considered, avoid over-design. Specify different materials when warranted by diverse project conditions. For example, a cost-effective project design may include the use of blown straw and hydroseed on areas of good soil and gentle slopes whereas compost and coir netting are reserved for steep, cut slopes.
  - Combine hydroseeding and direct planting. Some plant species favor particular planting methods, so allowances have to be made if these species are to be used. Many plant species can be applied by hydroseeding. Other plants are better established as liner, container, or plug plant material and can be installed in previously seeded areas, following germination. This method can be effective for bioswales when the upland zone on the banks is hydroseeded and the hydrophilic zone in the bed is planted with sedge, grass, and rush liners.
  - Specify pre-germination or include mulch for weed control. Pre-germination is a very effective method for killing weeds that germinate from an existing seed bank. Planting by hydroseeding or other methods should be done after one or more pregermination cycles.
  - Specify erosion control blankets or other RECPs in areas that will receive concentrated flow. Although hydroseeding may be appropriate for planting portions of bioswales, it should not be used in locations that will receive concentrated runoff. Liner, container or plug plant material is a better choice in these areas.
  - Specify “stepped-slope” construction for grading cut slopes. Cut slopes are difficult to vegetate for different reasons such as rocky subsoil, compaction, removal of topsoil and organic material, and steepness. Using a “stepped-slope” method can enhance vegetation establishment. This method involves making a series of cuts, or small benches, starting at the top of the proposed cut slope and working down. The final slope has a “stair step” appearance rather than a smooth, scraped slope. Each step should be between 2 to 6 feet wide. By allowing approximately 50 percent of the loose, excavated material to remain on each step, a planting bed is created. This planting bed can be further enhanced by adding compost.
-

### ***Restrictions for Plant Selection***

Nearly half of the bulk solids collected in the structural treatment BMPs consists of plant litter such as leaves and twigs. To maintain the efficiency of these BMPs trees and large shrubs selected for banks of biofiltration swales should contribute minimal plant litter to the BMP. Deciduous trees and other species that contribute large amounts of bark, leaf, flower, or seed litter should be avoided.

### ***Plant Establishment Period (PEP)***

PEP ensures project success by maintaining plants during a period when mortality rates tend to be high. This is true for Highway Planting, as well as for revegetation planting that includes grasses and forbs, and especially native grasses. The following should be considered when requiring PEP for biofiltration BMPs:

- Biofiltration BMPs that are graded, constructed and planted as part of a roadway construction contract should have a 1-year PEP. Depending upon the type of construction and order of work, the PEP may run concurrently with other work.
- Work to be performed during the PEP should include the following when applicable for the project:
  - a) Weed control and removal of inappropriate plant species,
  - b) Mowing and other vegetation management,
  - c) Repair of rills, gullies, and other damage caused by erosion and scour,
  - d) Reseeding of bare or repaired areas,
  - g) Removal of accumulated sediment and debris.

## **Biofiltration Swales**

This document provides guidance for incorporating Biofiltration Swale Treatment Best Management Practices (BMPs) into projects during the planning and design phases of transportation facilities. The primary functions of this document are to:

- Describe the design criteria of Biofiltration Swales (“Bioswales”);
- Present detailing standards and siting limitations;
- Present the formulas used to design Bioswales; and
- Review the required elements for implementing Bioswales into PS&E packages.

### ***Biofiltration Swales – A Brief Description***

Biofiltration Swales are one of several BMPs for treatment of stormwater runoff from project areas that are anticipated to produce pollutants of concern (e.g., roadways, parking lots). Bioswales are vegetated, typically trapezoidal channels, which receive and convey storm water flows while meeting water quality criteria and other flow criteria. Pollutants are removed by filtration through the vegetation, uptake by plant biomass, sedimentation, adsorption to soil particles, and infiltration through the soil. Pollutant removal capability is related to channel dimensions, longitudinal slope, and type of vegetation. Bioswales are effective at trapping litter, Total Suspended Solids (soil particles), and particulate metals (Caltrans, 2007). The following list demonstrates some advantages of utilizing a Bioswale as a Treatment Control BMP.

- When properly implemented, Bioswales are aesthetically pleasing. Due to the presence of its vegetation, the public views Bioswales as a “landscaped roadside” which would make placement more acceptable than other Treatment BMPs using concrete vaults.
- Bioswales were determined to be an effective Treatment BMP in reducing sediment and heavy metals, as described in the *BMP Retrofit Pilot Program Final Report* (Caltrans, 2004).
- In that same report, Bioswales were determined to be cost effective and, together with Biofiltration Strips, were among the least expensive Treatment BMP per volume of runoff treated.

### ***Design Criteria***

To perform as an effective Treatment BMP, the Biofiltration Swale must meet certain design criteria; the primary factors to be incorporated into the design are found in the table below.

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**Biofiltration Swale Design Criteria**

<b>Parameter</b>	<b>Min. Value</b>	<b>Max. Value</b>
Flow Rate (See Note 1)	For water quality treatment: WQF	For roadway drainage ("Design Event")
Bottom Width (See Note 1)	0 ft, as v-ditch 2 ft, as trapezoid	See Note 2
Side Slope (sides of the Bioswale, in cross section)	4H:1V	3H:1V
Longitudinal Slope	0.25%	1% to 2% preferred but no theoretical maximum, but the resulting depth, velocity and HRT must meet the Interrelationship formula
Hydraulic Residence Time (HRT) at WQF	5 minutes	No maximum
Length of flow path	Based on minimum HRT	No maximum
Flow Depth during WQF	No minimum	6 inches (See Note 3)
Velocity	No minimum	During WQF: 1.0 ft/sec (See Note 3) During Design flow: 4.0 ft/sec
Interrelationship Formula for HRT, depth, and velocity	1300 sec <sup>2</sup> /ft <sup>2</sup>	No maximum
Manning's <i>n</i> value	During WQF: 0.20 to 0.30 but 0.24 recommended During Design flow: 0.05	
Hydraulic conductivity of the soils in the Biofiltration Swale	There is no minimum set of this parameter at this time set for water treatment purposes.	

## Notes:

1. Bioswale should be designed based on both the WQF and peak flow of the design storm, unless bypass of the larger flows are made.
2. For large flows, consideration should be given to using a minimum bottom width of 12 feet for construction and maintenance purposes, but depths of flow less than one foot are not recommended." However, smaller bottom widths are preferred for water quality purposes, in order to limit the tendency at low flows to concentrate into smaller rivulets.
3. Maximum value may be limited if HRT less than 10 minutes, using the Interrelationship Formula. Higher if protected from erosion.

**Flow in the Bioswale under the WQF intensity:**

The Biofiltration Swale is a flow-based Treatment BMP that is designed to convey and treat the runoff during WQF intensity events, as long as the flow depth, velocity, HRT, and the Interrelationship Formula all met. The Rational Formula should be used to calculate the runoff, as shown below:

$$WQF = C \times I \times A \text{ See Footnote 1}$$

Where:

WQF = Water Quality Flow rate (cfs)

C = runoff coefficient

I = WQF rainfall intensity (in/hr)

A = tributary area to the Bioswale (acres)

### Flow in the Bioswale during the Design Event:

The Bioswale must be designed to convey larger during rainfall intensities greater than the WQF, and in fact must handle the peak drainage from the roadway unless an upstream bypass for the larger events is provided. Absent such diversion, the “Design Event” for the Bioswale must be consistent with the intensity, duration and frequency of the rainfall event used in the roadway drainage design for that tributary area contributing runoff to the Treatment BMP.

### Flow depths and velocities at WQF and during Design Event

The flow depth during WQF and the Design Event can be calculated using Manning’s Equation, as shown below.

$$Q = (1.486/n) \times A \times R^{2/3} \times S^{1/2}$$

Where

Q = flow at defined event (WQF or Q25)

n = Manning’s coefficient; recommend using “n” = 0.24 for WQF and 0.05 for the Design Event Q25

A = Cross-sectional area of the flow in the channel

R = Hydraulic Radius = “A” / Wetted Perimeter (“P”)

S = longitudinal slope

### Hydraulic Residence Time

There is a minimum travel time within the Bioswale, termed the Hydraulic Residence Time [HRT]) set at 5 minutes. This can be checked after the proposed Bioswale site is analyzed using Manning’s Equation, as discussion above. After the velocity associated with the WQF is determined, the HRT is calculated using the proposed length of the Bioswale:

$$HRT = L / (60 \times VWQF)$$

where

L = proposed length of the Bioswale (ft)

HRT = Hydraulic Residence Time (minutes)

VWQF = velocity at WQF (ft/sec)

60 = conversion from seconds to minutes

A minimum Hydraulic Residence Time of 5 minutes has been assigned to Bioswales. If the HRT is less than 5 minutes, then the length of the Bioswale should be increased, or the velocity at the WQF should be decreased by increasing the width of the Bioswale or by decreasing the slope.

### Interrelationship Formula during WQF

Upon determining that the HRT,  $d_{WQF}$ , and  $V_{WQF}$  meet their respective design criteria, the Interrelationship Formula shown below also must be satisfied, as the maximum allowed depth of flow and velocity may be restricted if the HRT is less than 10 minutes.

$$(HRT \times 60) / (d_{WQF} \times V_{WQF}) \geq C$$

where:

HRT = Hydraulic Residence Time during WQF

60 = conversion factor from minutes to seconds

$d_{WQF}$  = depth of flow at WQF (ft)

$V_{WQF}$  = velocity of flow at WQF (fps)

C = constant: 1,300 (sec<sup>2</sup>/ft<sup>2</sup>)

## ***Other Comments***

- The Bioswale should be designed with the maximum length (in direction of flow) as allowed by the site. In general, the flatter the slope, the shorter the Bioswale length required to meet Treatment BMP requirements.
- The width of the Bioswale is often the most easily changed site variable if the original proposed dimensions do not satisfy depth, velocity and Hydraulic Residence Time (HRT) criteria at WQF, but sometimes the slope may be reduced.
- The tributary area upstream of Bioswales is usually not as large as the tributary areas for volume-based Treatment BMPs.
- Calculations for the Bioswale, especially the HRT, are easier if most or all of the WQF enters at a discrete location at the upstream, rather than at distributed locations along the length of the Bioswale. However, if the flow enters the Biofiltration Swale continuously along the length of the swale or at multiple discrete locations, other rational methods should be employed; for example: the analysis could calculate the depths and velocities at selected points along the Bioswale, using the Q at that location, with the remaining downstream length of the Bioswale, to verify that all criteria have been met.
- Use of check dams within the Bioswale: If the HRT, velocity, or length requirements are not met (and they are all interrelated) due to the steepness of the proposed Bioswale, but the *HDM* criteria are met, the use of check dams within the Bioswale can be considered and the check dam should be constructed of soil, placed a maximum of 20 ft apart, using 4H:1V slopes, maximum height of 9 inches, placement should not impede the flow of the Design Event and should be vegetated.

## **Location**

Biofiltration Swales, and the related Biofiltration Strips, are probably the least expensive Treatment BMPs for an area, if the proposed location is otherwise suitable. However, to provide effective treatment of runoff, the proposed location must be able to support the chosen vegetation; locations should be sought that have sufficient open space, adequate sunlight for vegetation growth, and topography to meet the hydraulic requirements. Entry of runoff into a Bioswale may enter as sheet flow along its length, and/or from a concentrated conveyance. If the latter, it may require energy dissipation to prevent erosion. One location that should receive special consideration is at the end of a bridge structure.

## **Erosion Control**

When the flow velocity exceeds 4 ft/sec for the largest design storm, a geotextile, such as turf reinforcement mat (TRM), may be used to prevent scour within the swale. The use of a TRM within the swale for velocities higher than 4 ft/sec during design storm events does not negate the need to meet all the design criteria during Water Quality events. If the flow characteristics do not require a TRM, a temporary erosion control blanket or RECP (Rolled Erosion Control Product) may still be needed to protect the soil from concentrated flow that may occur the first winter before vegetation can be established. For example, hydroseeding is not recommended for areas that will receive concentrated flows. The runoff entering at the upstream end of the Bioswale, if entering as concentrated flow from a drainage conveyance (e.g., from a lined channel or at the end of a bridge), should not cause erosion, and detailing such as flared end sections should be considered.

## ***Design Drawings***

**Layout Sheets** - Show location(s) of Bioswales. This will aid in the recognition within and outside the Department that Bioswales were placed within the project limits.

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**Contour Grading Sheets** - As Bioswales are primarily earthwork features they may be shown on Contour Grading sheets. Any other associated grading surrounding the Bioswale should be shown on these sheet(s).

**Construction Details** - There will not typically be any construction details associated with Bioswales, but if there are, these sheets may be used to show these items.

**Landscape Plans** - These sheets, and the Contour Grading sheets, will be the primary sheets used to show the placement of the landscape contract items of work for Bioswales.

**Other Sheets** - Drainage Plans, Water Pollution Control, Erosion Control Plans, Construction Staging, Utility Plans, Irrigation Plans, and other sheets should be considered as appropriate for the construction of Bioswales on a project-specific basis. If Bioswales will be constructed at multiple locations, a "Locations of Construction" table should be considered. This table could present the stationing and other location information. WQF could also be considered. This table may be incorporated into an existing drawing if there is room (such as a Title, Layout or Construction Detail), or may be developed as a separate drawing if necessary.

### ***Soil and Planting Bed Preparation***

See Biostrip Section

### ***Planting Strategies***

See Biostrip Section

### ***Restrictions for Plant Selection***

See Biostrip Section

### ***Plant Establishment Period (PEP)***

See Biostrip Section

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**APPENDIX F**  
**BRIDGE IMPROVEMENT PROJECT DATA**

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Several of the Route 1 bridge crossings will be replaced as part of the GRN project. These include bridges over the Agana River, the Fonte River, the Laguas River, the Agueda River and the Atantano Bridge. On-site and off-site design requirements for these bridges are described in Section 7.2. Additional information for these offsite channels is provided below.

- Agana Bridge - This concrete structure spans 42 ft over the Agana (Hagatna) River for a length of 87 ft under Route 1 and shows signs of decay through severe cracking, delamination and spalling of concrete. Erosion along the abutments was apparent on the upstream side of the bridge (see Figure F-1).



*Figure F-1 Agana Bridge Upstream Embankment*

- Fonte Bridge - This five span, concrete frame structure spans 78 ft over the Fonte River for a length of 100 ft under Route 1. Hairline vertical cracks are located on the pier walls with some delamination, spalling and exposed rebar shown in some of the piers on the downstream side.

- Laguas Bridge - This single span box girder bridge spans 46 ft over Laguas River for a length of 81 ft under Route 1. The bridge exhibits moderate cracking and spalling in the beams and scour in the north abutment. The bottom of the channel upstream of the bridge had been removed of vegetation, increasing erosion potential along the channel bottom (see Figure F-2).



*Figure F-2 Laguas Bridge Upstream Section*

- Agueda Bridge - This 3-barrel concrete box culvert spans 27 ft over the Agueda River for a length of 81 ft under Route 1. Downstream obstructions have produced backwater effects upstream of the culvert (see Figure F-3), since at the time of inspection, the culvert openings were inundated. Erosion was apparent at the upstream wingwalls.



*Figure F-3 Agueda Bridge Downstream Obstructions*

- Atantano Bridge - This 3-span cast-in-place concrete T-beam structure spans 46 ft over the Atantano River for a length of 81 feet under Route 1. Abutment settlement, cracking of the pier walls and deck and spalling at the deck corners is apparent. Vegetation along the channel embankment is thick with some apparent erosion under the high water mark, leaving the embankments unlined at several locations (see Figure F-4). Here, the embankment exhibits relatively steep slopes which could lead to additional erosion along the upstream segment.



*Figure F-4: Rte 1 at Atantano Bridge*

- Asan Bridge #1 - This 4-barrel concrete box culvert spans 48 ft over the Asan River for a length of 68 ft under Route 1. Spalling of concrete is apparent with exposed rebar at several locations. The downstream channel is unlined and shows little erosion along the vegetated embankments.
  - Asan Bridge #2 - This 2-barrel concrete box culvert spans 30 feet over the Asan River for a length of 106 ft under Route 1. Erosion is evident at the corners of the upstream and downstream headwalls.
  - Sasa Bridge - This single span box-girder bridge spans 46 ft over Sasa River for a length of 82 ft under Route 1. While the bridge is in good condition, significant debris was witnessed throughout and upstream of the structure most likely due to utility lines crossing underneath the bridge.
-





## CHAPTER 6.

### NOISE

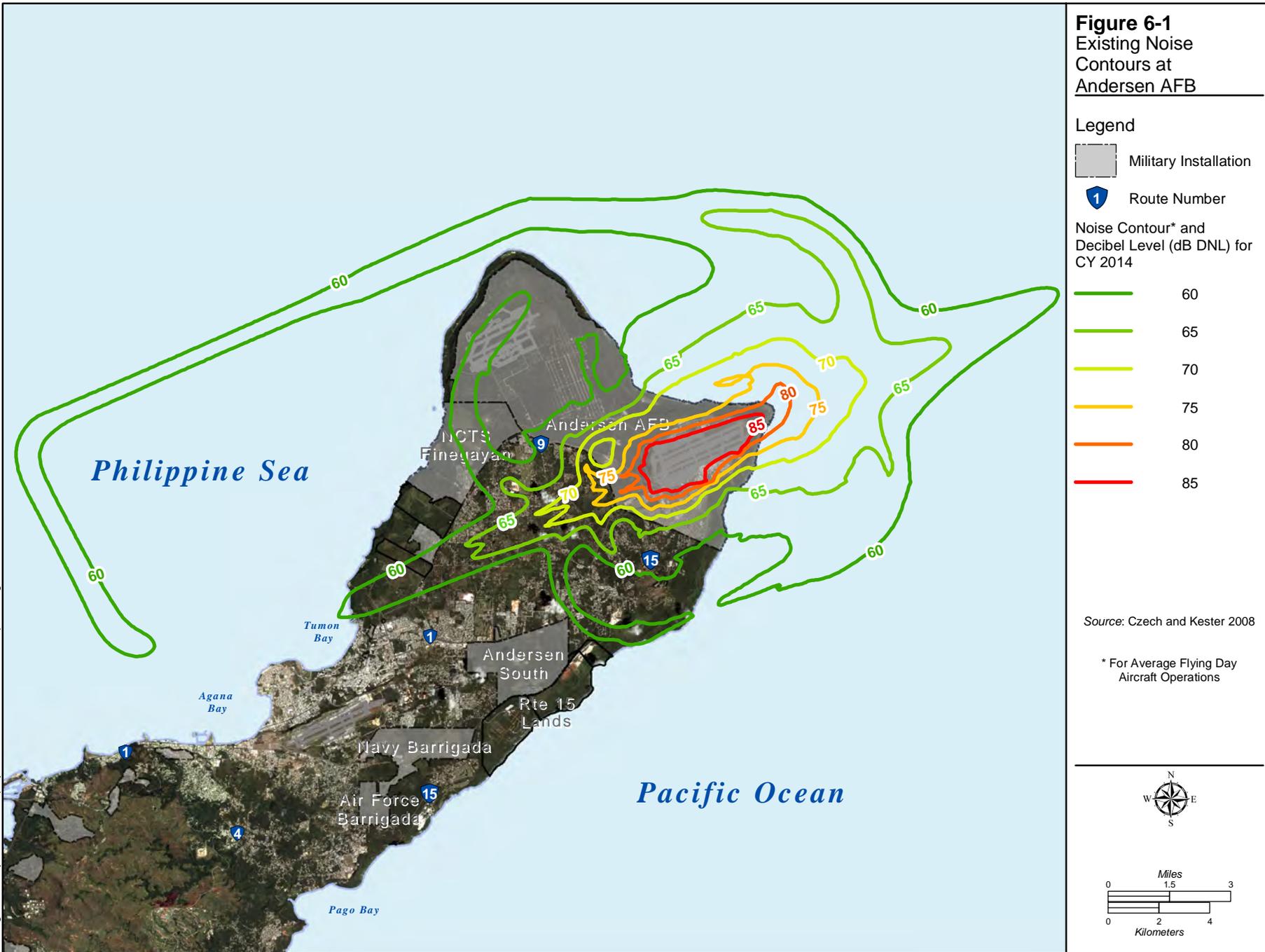
#### 6.1 INTRODUCTION

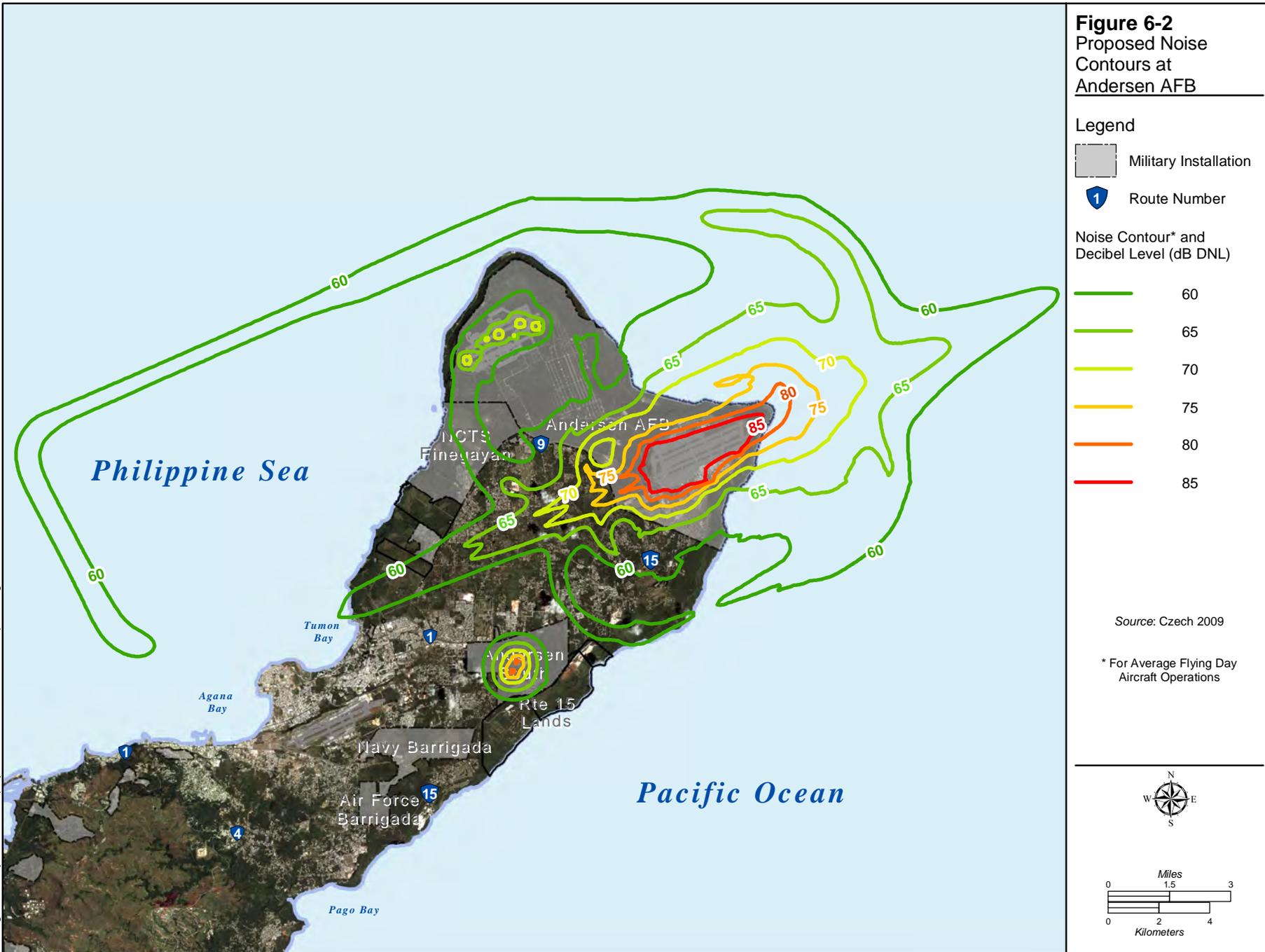
This appendix provides noise contour maps to show the noise contours overlain on aerial photographs. The noise contours are identical to those depicted in Volume 2, Chapter 6, but these figures show a different perspective showing how the contours relate visually to features on the ground. Table 6.1-1 correlates the figures in this appendix to those in Volume 2, Chapter 6 of this EIS. Figures 6.2-6 and 6.3-7 in Volume 2 are not presented here because the noise contours do not extend over populated areas.

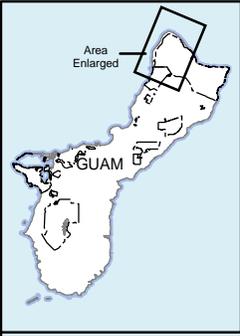
**Table 6.1-1. Figure Reference to Volume 2, Chapter 6**

<b>Appendix Figure</b>	<b>EIS Figure</b>
6-1: Existing Noise Contours at Andersen AFB	6.1-2: Existing Noise Contours at Andersen AFB
6-2: Proposed Noise Contours at Andersen AFB	6.2-1: Proposed Noise Contours at Andersen AFB
6-3: Existing Demolition Operational Noise Contours at Northwest Field	6.1-3: Existing Demolition Operational Noise Contours at Northwest Field
6-4: Projected Demolition Operational Noise Contours	6.2-2: Projected Demolition Operational Noise Contours
6-5: Aviation Training Noise Contours at Andersen South	6.2-3: Aviation Training Noise Contours at Andersen South
6-6a: Noise Contours and Complaint Risk Contours for the Breacher House and Hand Grenade Range - Alternative A	6.2-4: Noise Contours and Complaint Risk Contours for the Breacher Houses and Hand Grenade Range
6-6b: Noise Contours and Complaint Risk Contours for the Breacher House and Hand Grenade Range - Alternative B	6.2-4: Noise Contours and Complaint Risk Contours for the Breacher Houses and Hand Grenade Range
6-7a: Noise Contours for Route 15 Small Arms Ranges - Alternative A	6.2-5: Noise Contours for Route 15 Small Arms Ranges
6-7b: Noise Contours for Route 15 Small Arms Ranges - Alternative B	6.2-5: Noise Contours for Route 15 Small Arms Ranges
6-8a: Projected Small Caliber Operational Noise Contours with Foliage Attenuation - Alternative A	6.2-8: Peak Noise levels with Foliage Attenuation
6-8b: Projected Small Caliber Operational Noise Contours with Foliage Attenuation - Alternative A	6.2-8: Peak Noise levels with Foliage Attenuation
6-9a: Projected Small Caliber Operational Noise Contours with Barrier Attenuation - Alternative A	6.2-9: Peak and ADNL Noise Contours with Barrier Attenuation
6-9b: Projected Small Caliber Operational Noise Contours with Barrier Attenuation - Alternative A	6.2-9: Peak and ADNL Noise Contours with Barrier Attenuation
6-10a: Projected Small Caliber ADNL Noise Contours without Barrier Attenuation - Alternative A	6.2-10: ADNL Noise Contours - Options A and B
6-10b: Projected Small Caliber ADNL Noise Contours without Barrier Attenuation - Alternative B	6.2-10: ADNL Noise Contours - Options A and B

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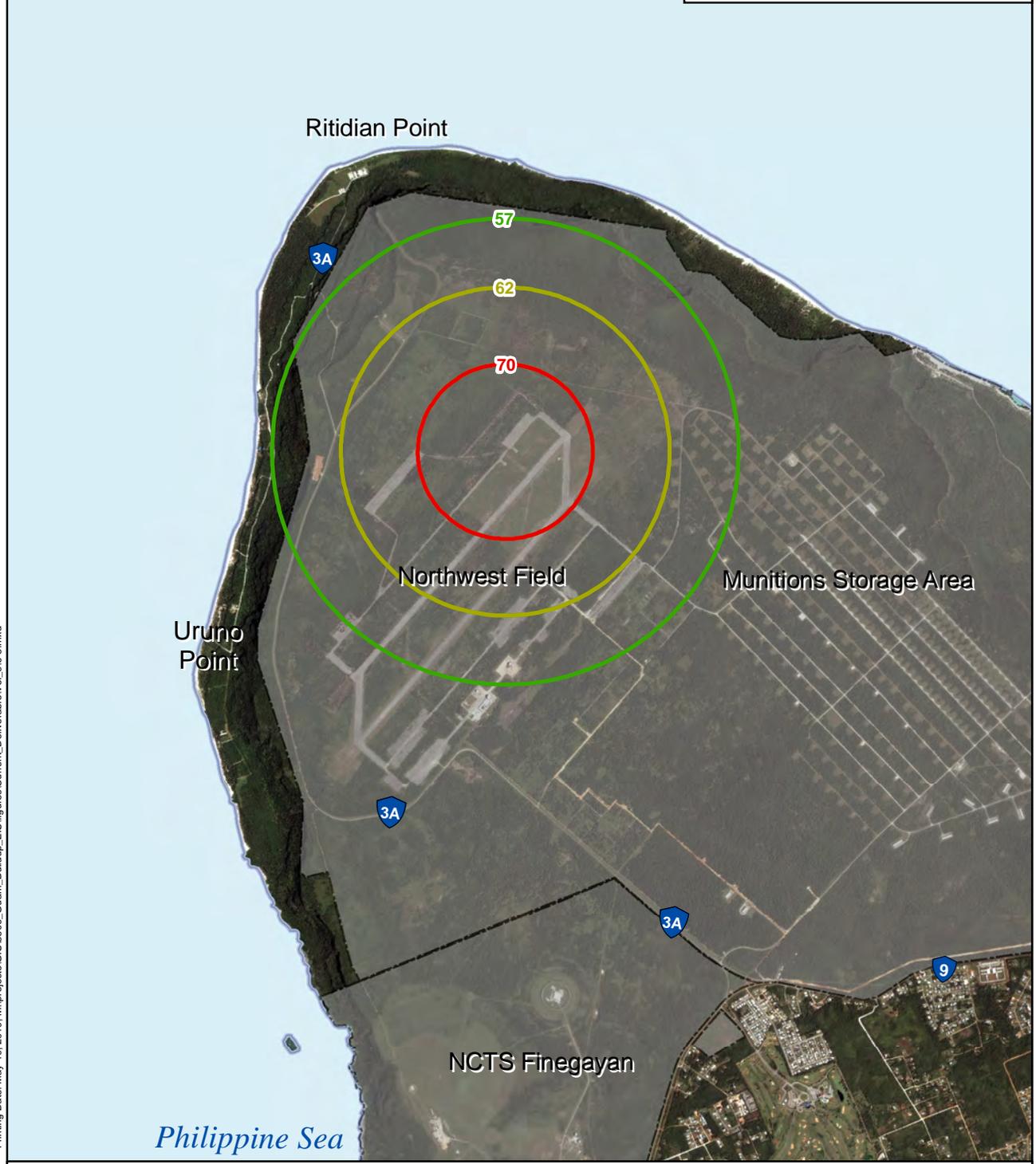




**Legend**

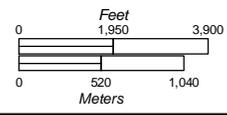
-  Military Installation
-  Route Number
- Noise Contour and Decibel Level (dB CDNL)
-  57
-  62
-  70

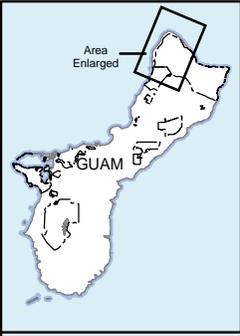
Source: USCHPPM 2009



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**Figure 6-3**  
Existing Demolition Operational Noise Contours at Northwest Field





**Legend**

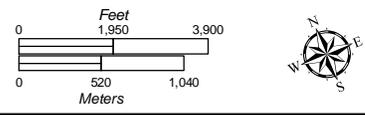
-  Military Installation
-  Route Number
- Noise Contour and Decibel Level (dB CDNL)
-  57
-  62
-  70

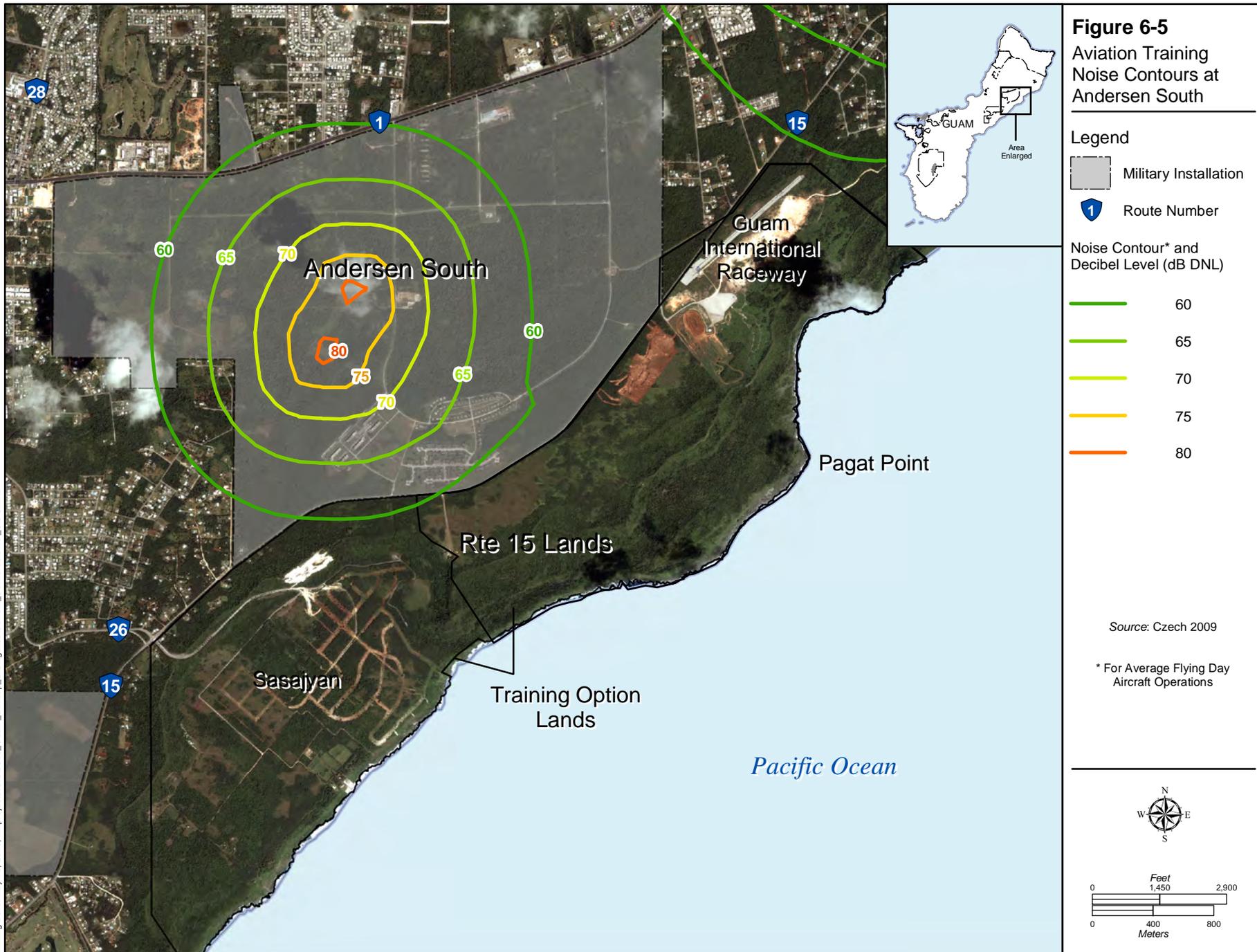
Source: USCHPPM 2009



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**Figure 6-4**  
**Projected Demolition Operational Noise Contours**





**Figure 6-5**  
 Aviation Training  
 Noise Contours at  
 Andersen South

**Legend**

Military Installation

Route Number

Noise Contour\* and  
 Decibel Level (dB DNL)

60

65

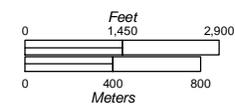
70

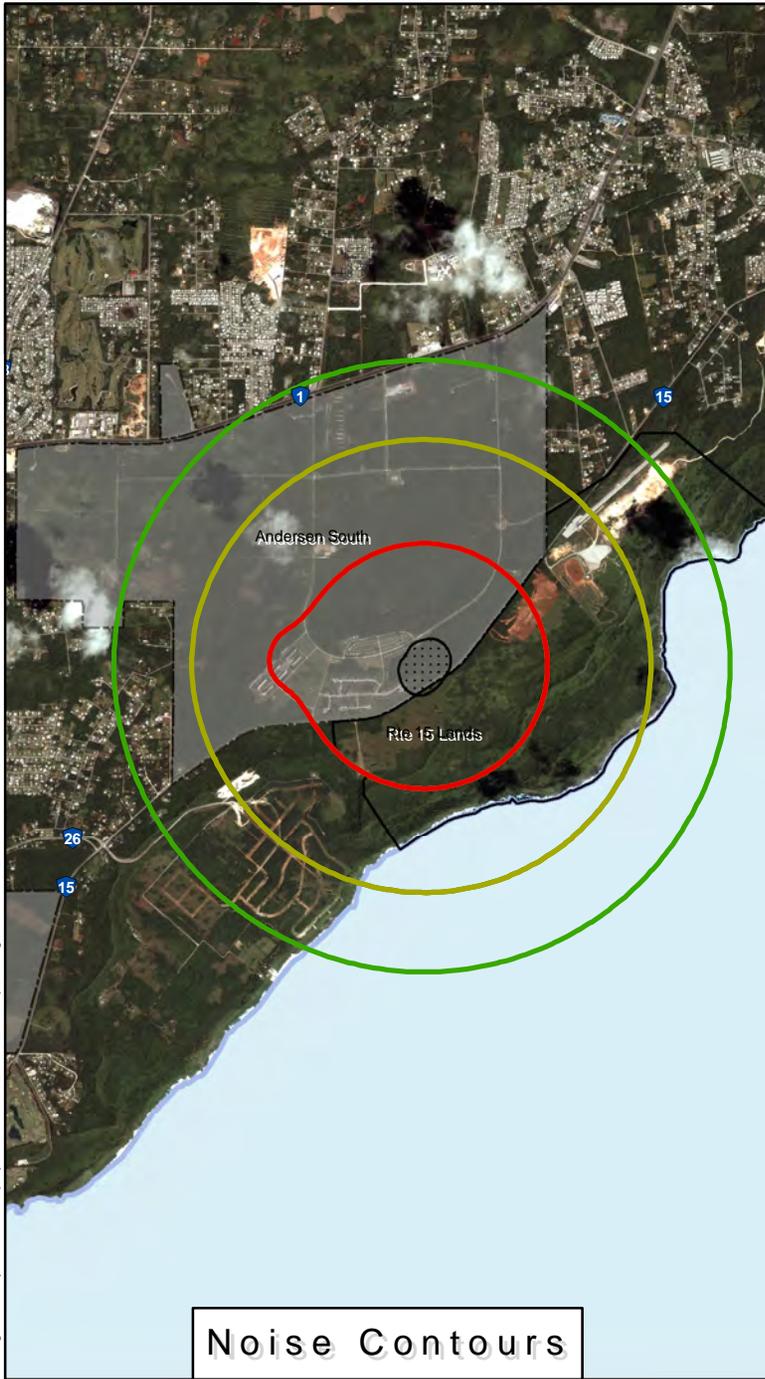
75

80

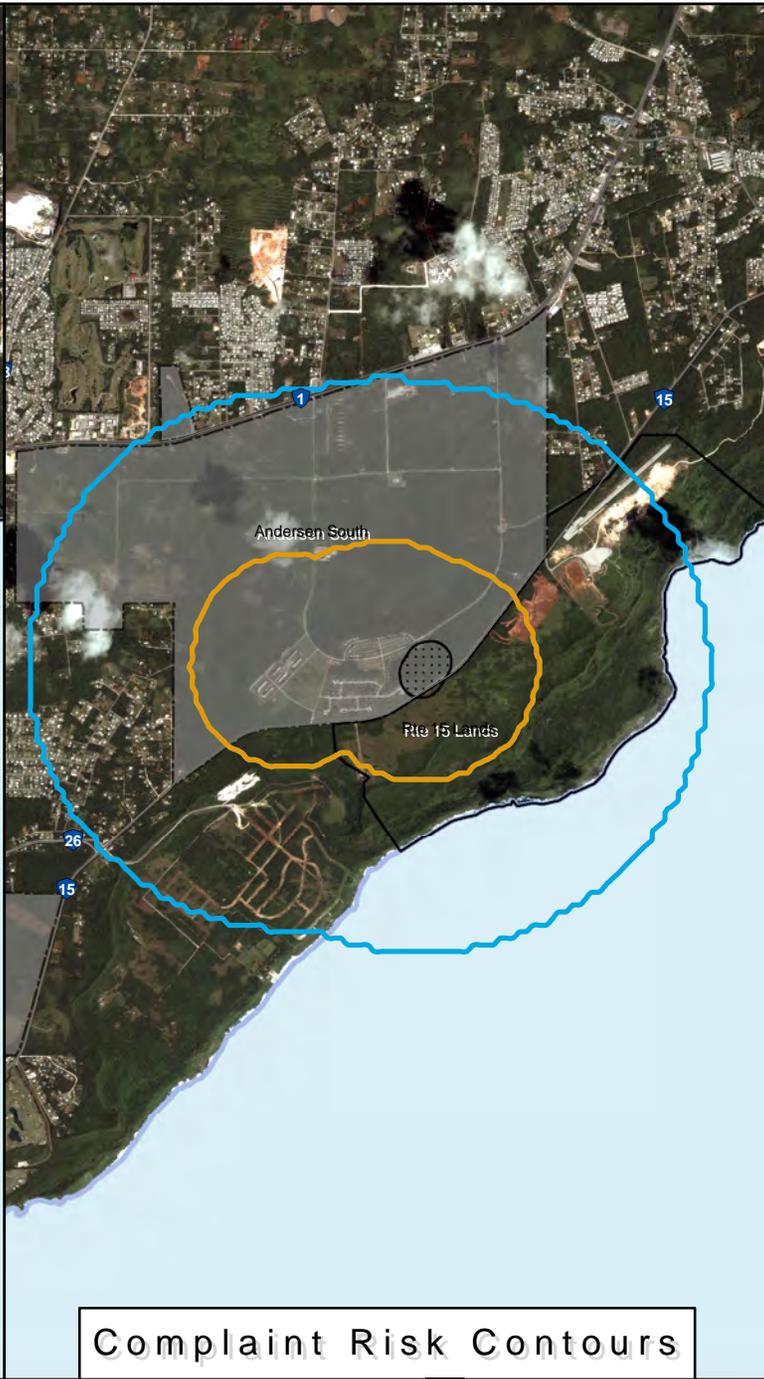
Source: Czech 2009

\* For Average Flying Day  
 Aircraft Operations





Noise Contours



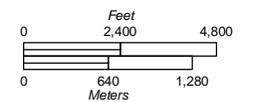
Complaint Risk Contours

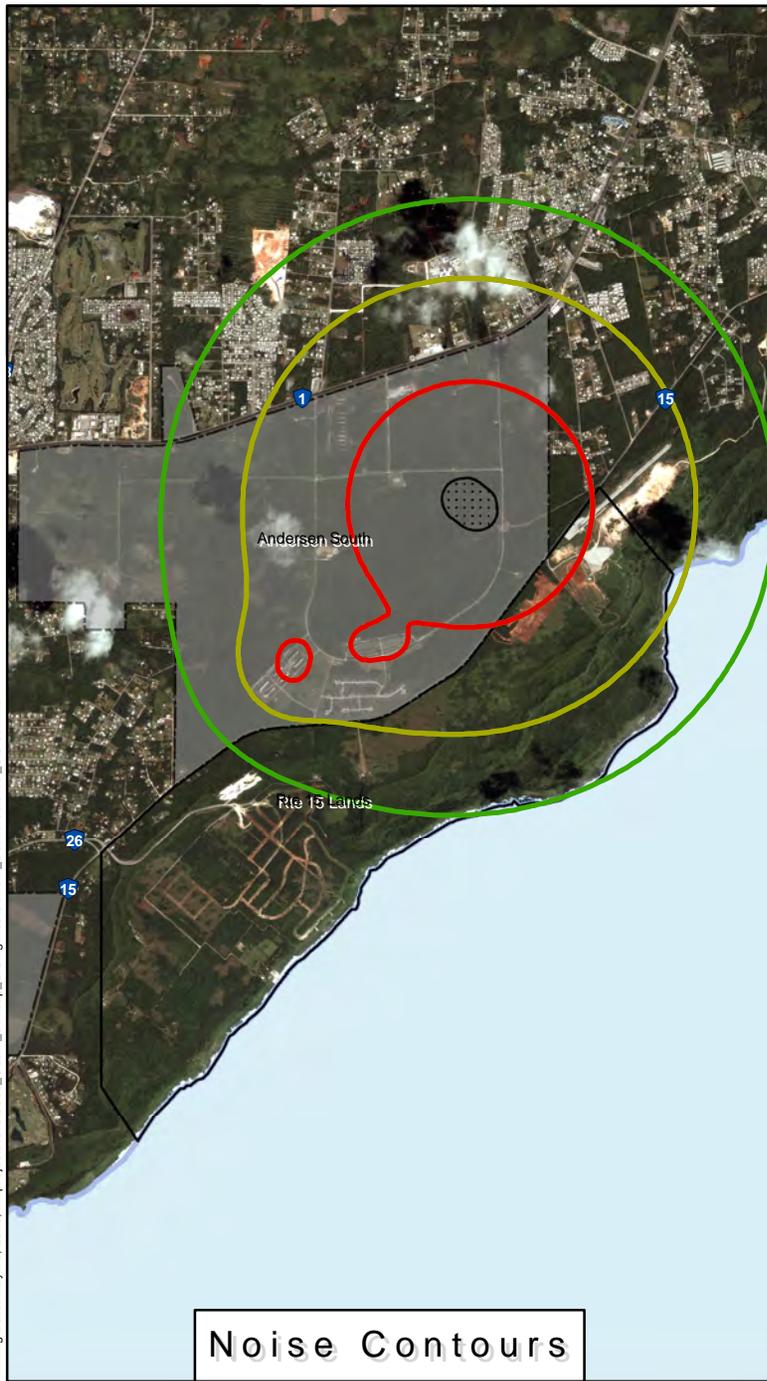
**Figure 6-6a**  
Noise Contours and  
Complaint Risk  
Contours for the  
Breacher House  
and Hand Grenade  
Range - Alternative A

Legend

-  Military Installation
-  Project Footprint
-  Route Number
- Noise Contours (dB CDNL)
  -  57
  -  62
  -  70
- Complaint Risk Contours (dB PK15[met])
  -  115
  -  130

Source: USCHPPM 2009

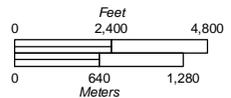


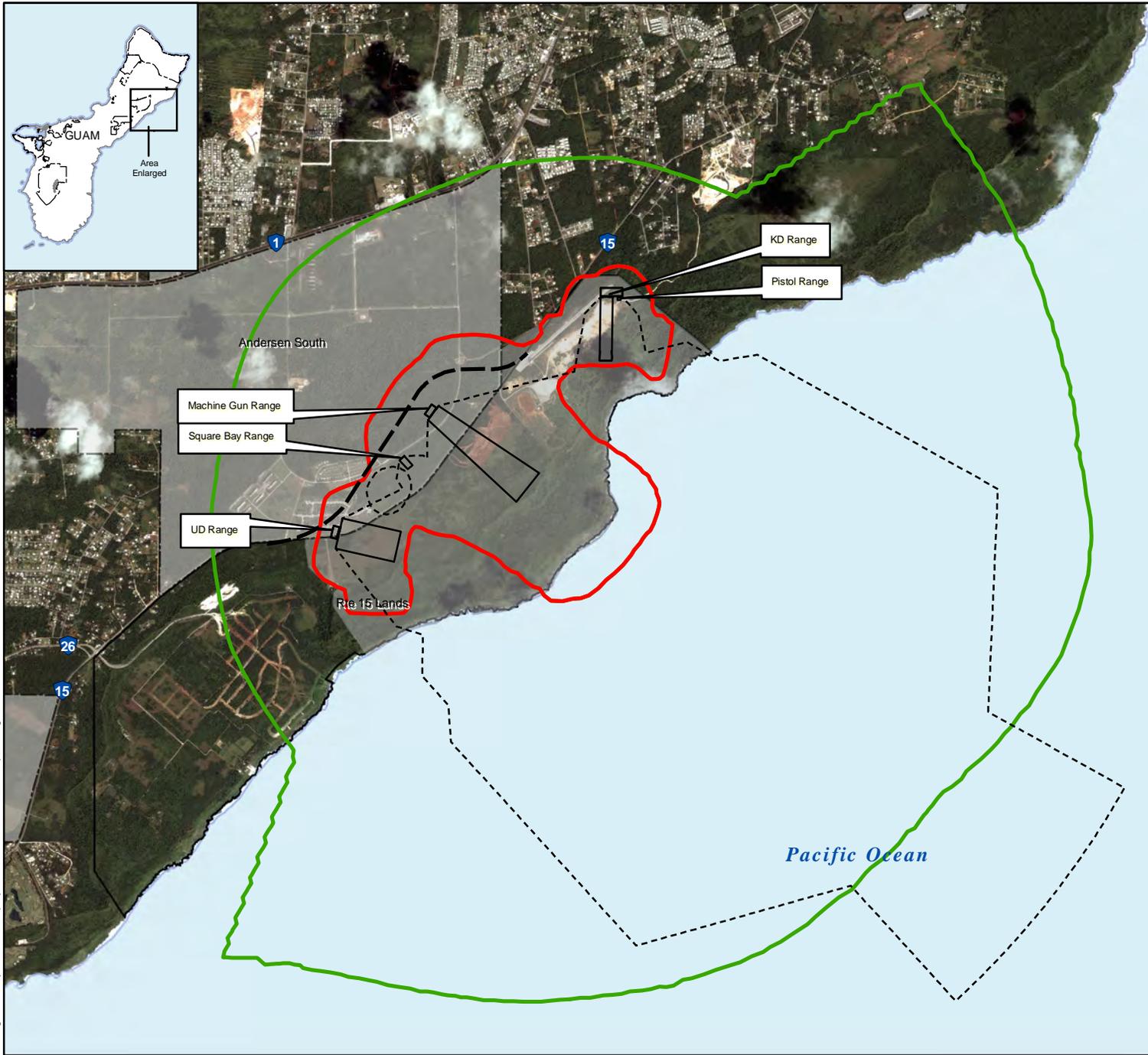


**Figure 6-6b**  
Noise Contours and  
Complaint Risk  
Contours for the  
Breacher House  
and Hand Grenade  
Range - Alternative B

- Legend**
-  Military Installation
  -  Project Footprint
  -  Route Number
  - Noise Contours (dB CDNL)**
    -  57
    -  62
    -  70
  - Complaint Risk Contours (dB PK15[met])**
    -  115
    -  130

Source: USCHPPM 2009





**Figure 6-7a**  
Noise Contours for  
Route 15 Small  
Arms Ranges -  
Alternative A

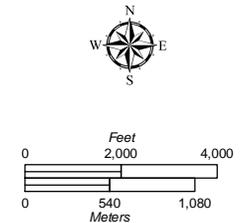
**Legend**

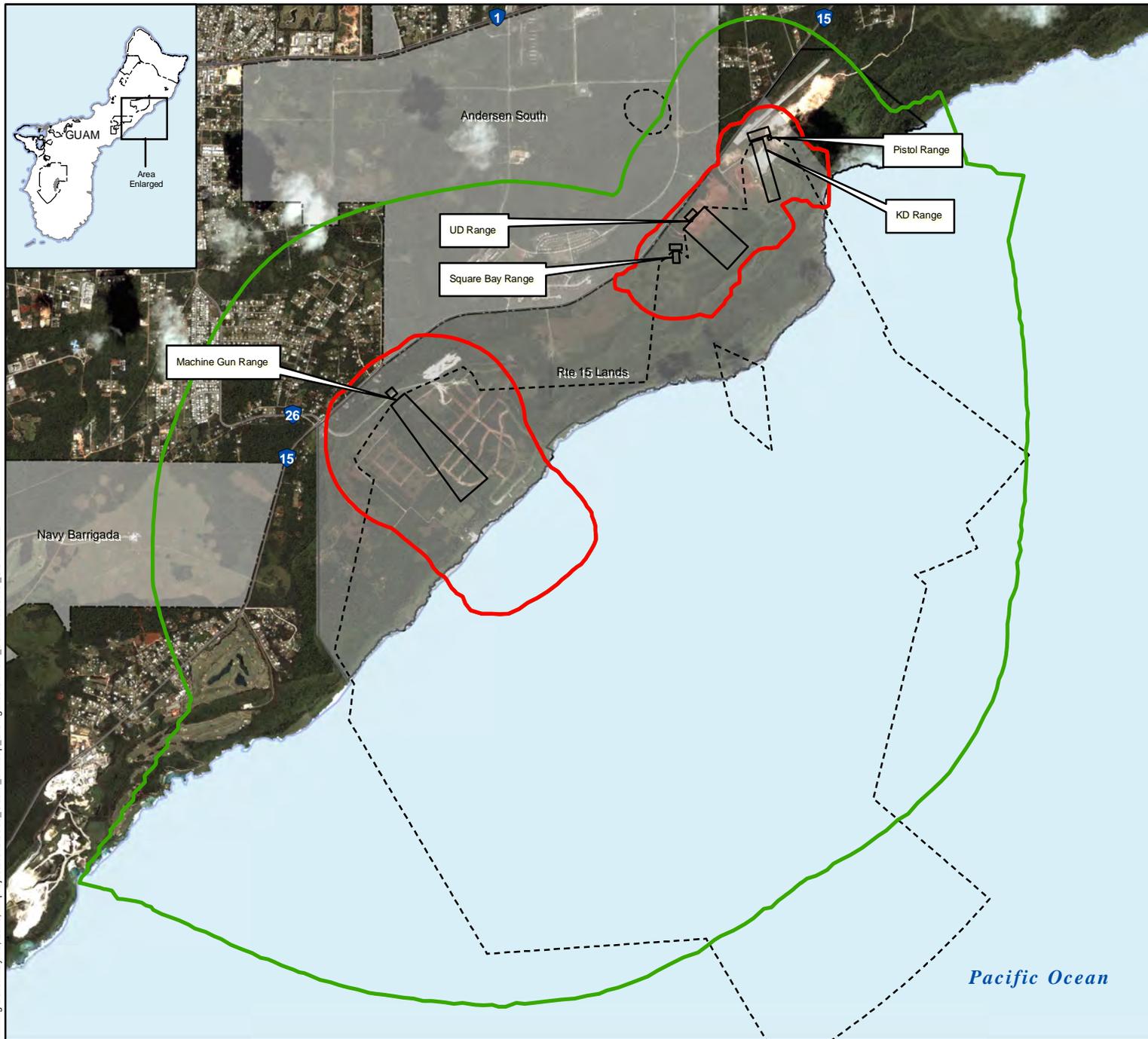
- Military Installation
- Proposed Land Acquisition
- Route Number
- Firing Range
- Notional SDZ
- Rte 15 Realignment

**Noise Contours  
(dB PK15[met])**

- 87
- 104

Source: USCHPPM 2009



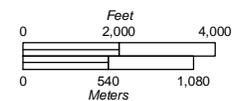


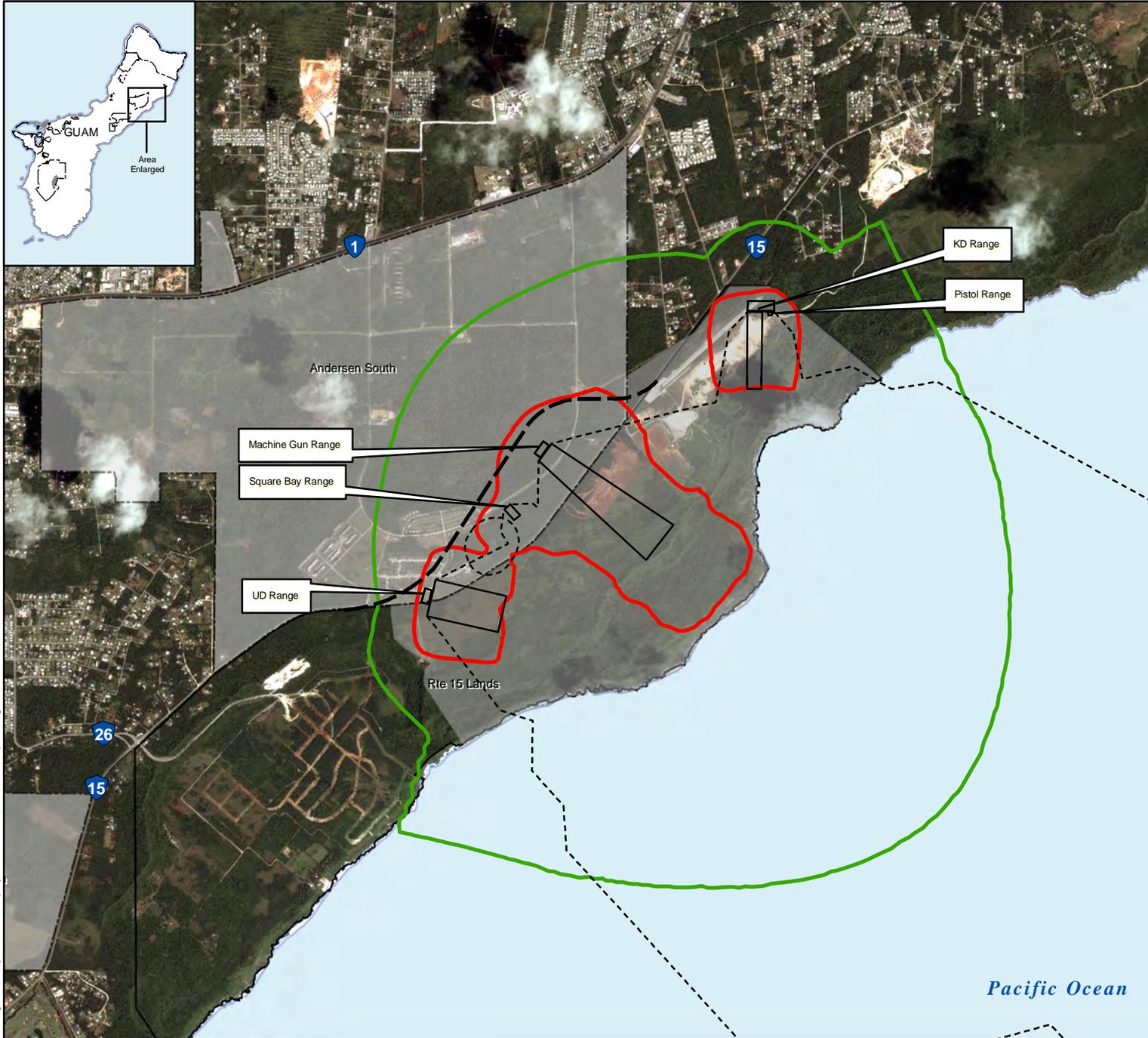
**Figure 6-7b**  
Noise Contours for  
Route 15 Small  
Arms Ranges -  
Alternative B

**Legend**

-  Military Installation
-  Proposed Land Acquisition
-  Route Number
-  Firing Range
-  Notional SDZ
-  Rte 15 Realignment
- Noise Contours (dB PK15[met])**
-  87
-  104

Source: USCHPPM 2009



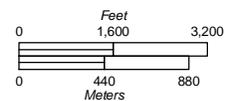


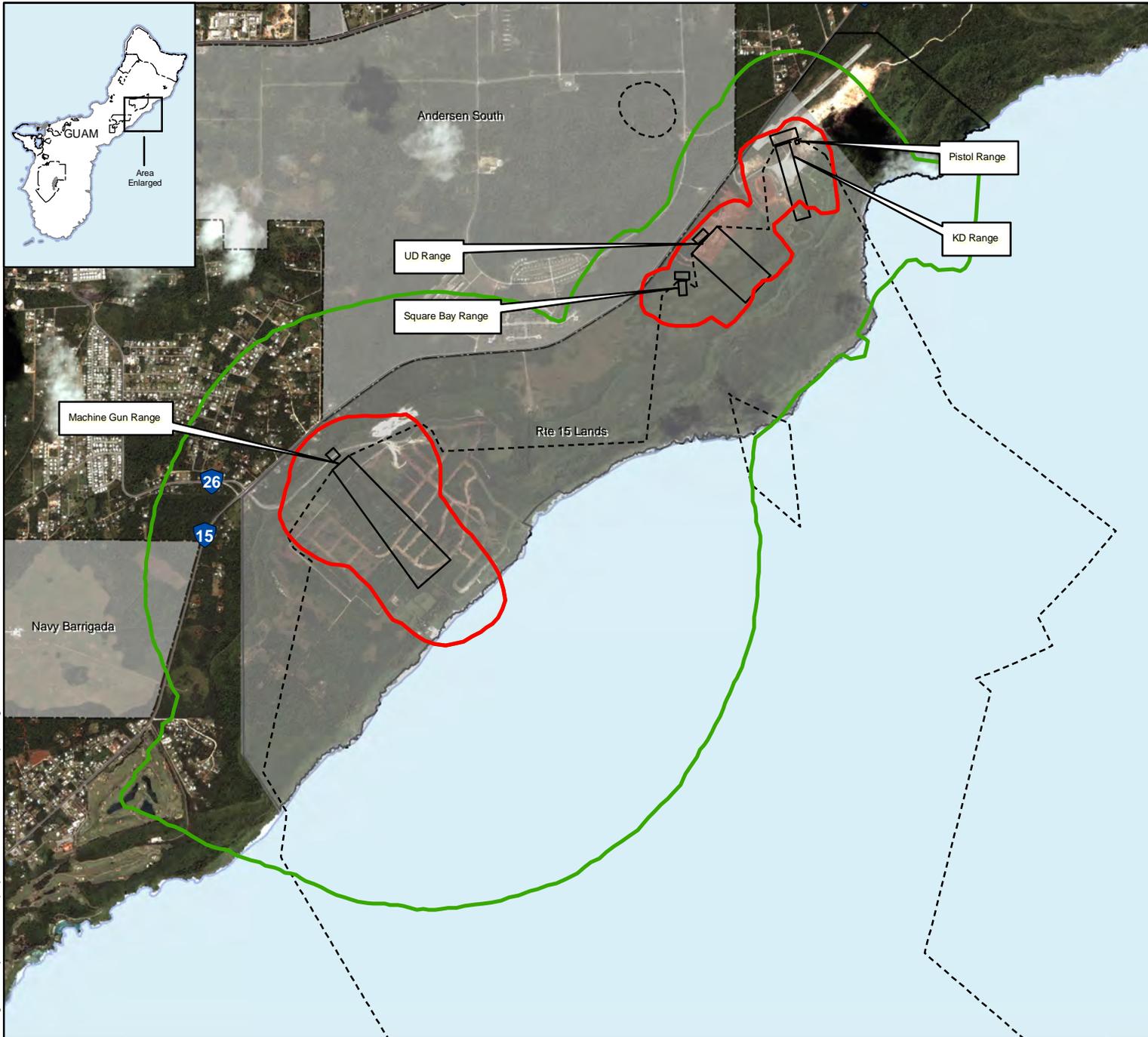
**Figure 6-8a**  
Projected Small  
Caliber Operational  
Noise Contours  
with Foliage  
Attenuation -  
Alternative A

**Legend**

-  Military Installation
-  Proposed Land Acquisition
-  Route Number
-  Firing Range
-  Notional SDZ
-  Rte 15 Realignment
- Noise Contours  
(dB PK15[met])**
-  87
-  104

Source: USCHPPM 2010



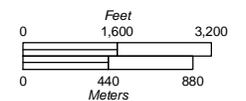


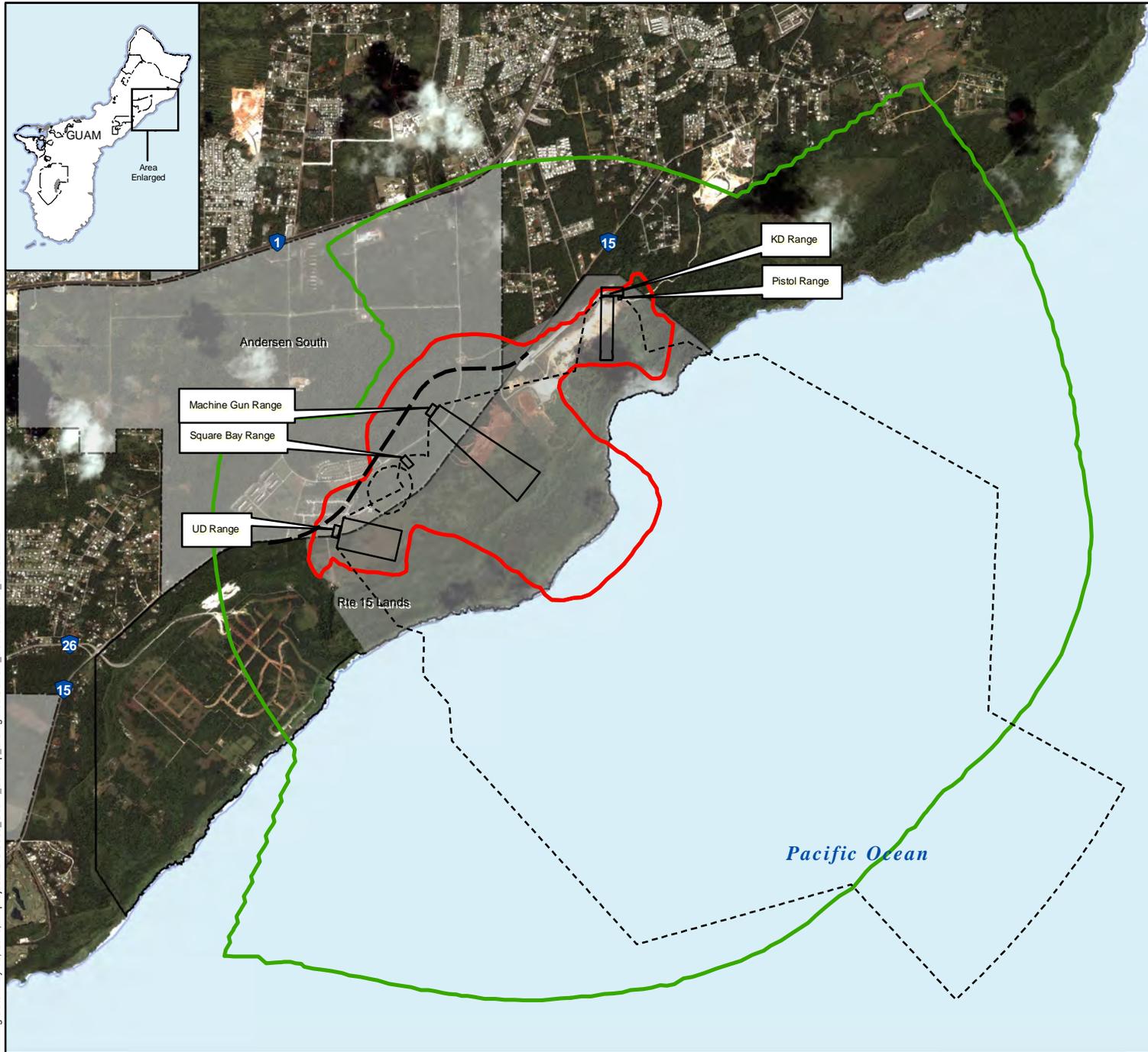
**Figure 6-8b**  
Projected Small  
Caliber Operational  
Noise Contours  
with Foliage  
Attenuation -  
Alternative B

**Legend**

- Military Installation
- Proposed Land Acquisition
- Route Number
- Firing Range
- Notional SDZ
- Rte 15 Realignment
- Noise Contours (dB PK15[met])**
- 87
- 104

Source: USCHPPM 2010

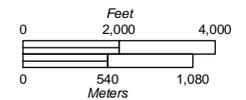


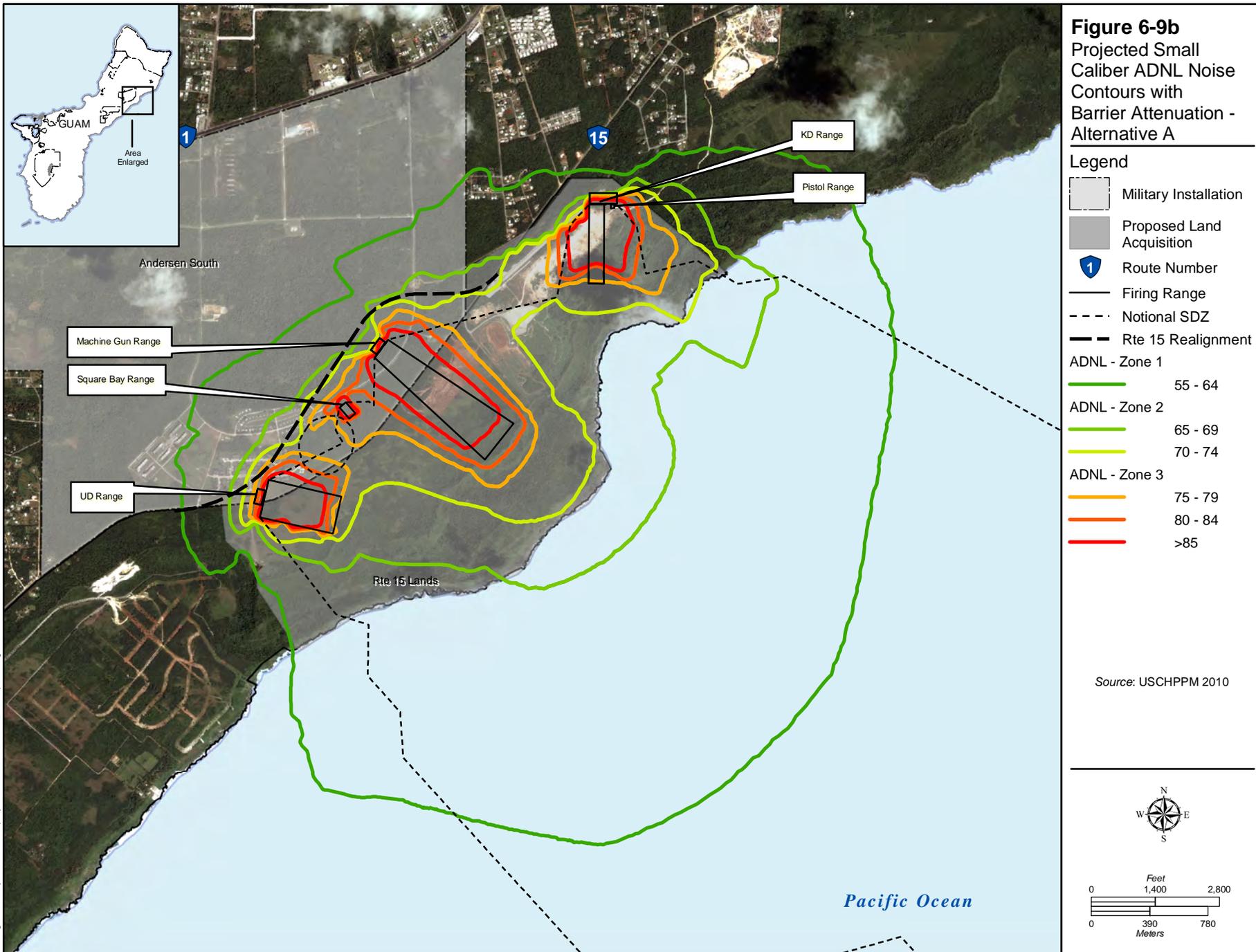


**Figure 6-9a**  
Projected Small  
Caliber Operational  
Noise Contours with  
Barrier Attenuation -  
Alternative A

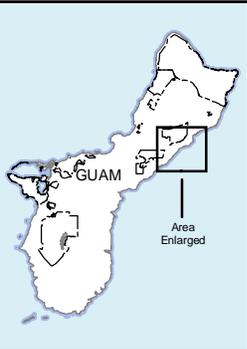
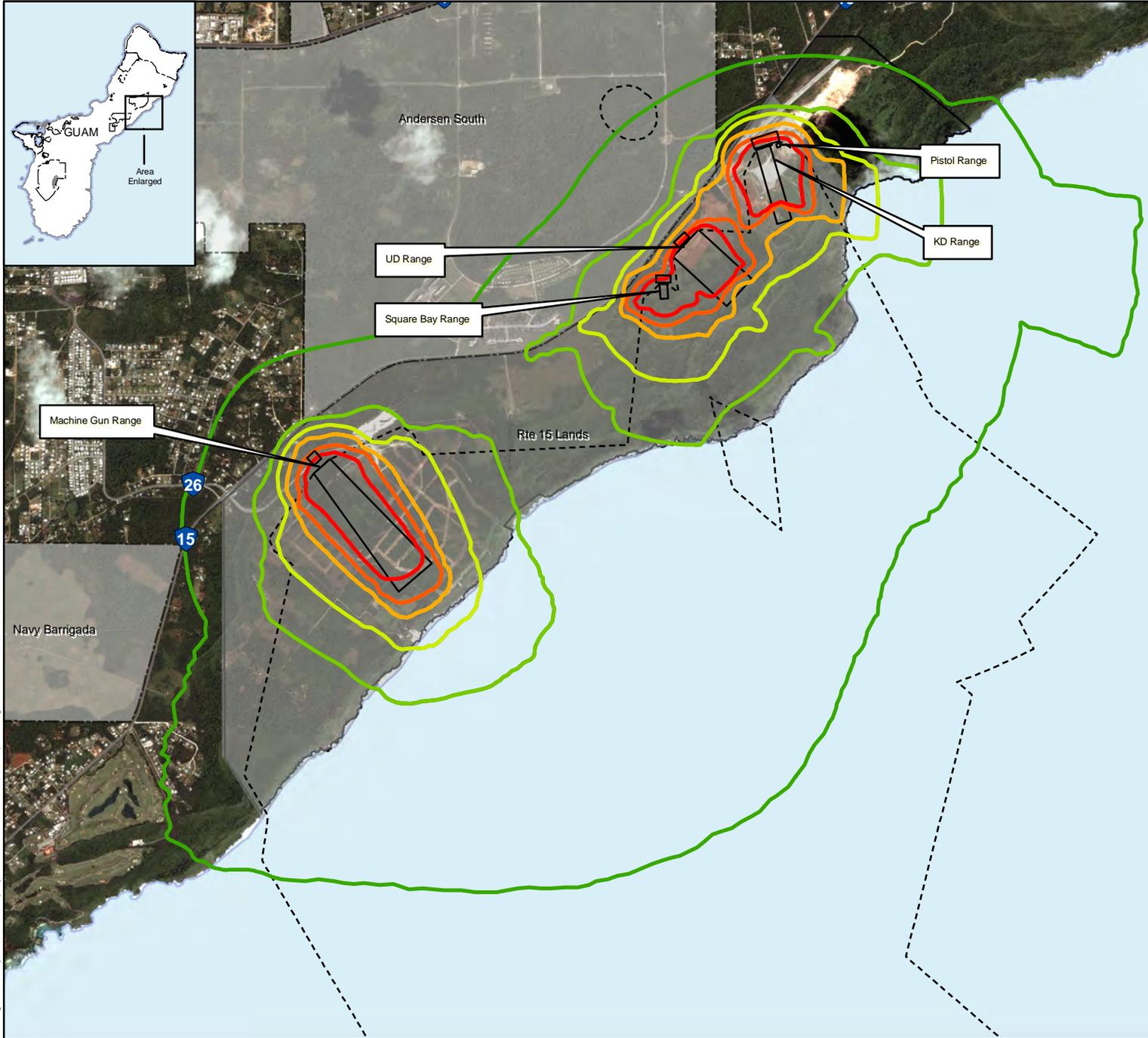
- Legend**
- Military Installation
  - Proposed Land Acquisition
  - Route Number
  - Firing Range
  - Notional SDZ
  - Rte 15 Realignment
  - Noise Contours (dB PK15[met])**
  - 87
  - 104

Source: USCHPPM 2010







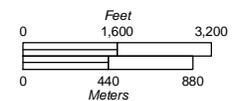


**Figure 6-10b**  
 Projected Small Caliber ADNL Noise Contours without Barrier Attenuation - Alternative B

**Legend**

- Military Installation
- Proposed Land Acquisition
- Route Number
- Firing Range
- Notional SDZ
- Rte 15 Realignment
- ADNL - Zone 1**
- 55 - 64
- ADNL - Zone 2**
- 65 - 69
- 70 - 74
- ADNL - Zone 3**
- 75 - 79
- 80 - 84
- >85

Source: USCHPPM 2010



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MATCH LINE SEE HRN02

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed blue)	- 66 dBA LINE FOR NON ABATEMENT
—○— (solid with circles)	- SOUNDWALL
- - - (dashed black)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' | Drawing HRN008 | Sheet 1 of 69



MATCH LINE SEE HRN02

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—○—	- SOUNDWALL
- - - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**

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PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' | Drawing HRN008 | Sheet 1B of 69

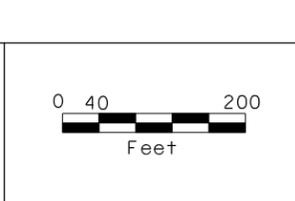


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- EXISTING RIGHT-OF-WAY
---	- 66 dBA LINE FOR NON ABATEMENT
○	- SOUNDWALL
---	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 2 of 69



MATCH LINE SEE HRN01

MATCH LINE SEE HRN03

EXISTING RIGHT-OF-WAY

ROUTE 3

**AREA-1**

CHURCH

CHEDO

DRIVEWAY

S-96

LOBO

NDA

8' RT

R2

LT3/R3

8'

EXISTING RIGHT-OF-WAY

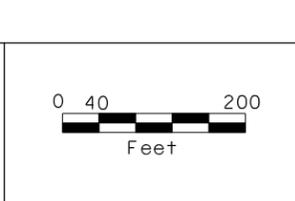
SFR

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 2B of 69

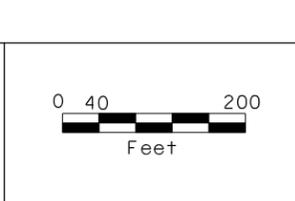


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed line)	- EXISTING WALL
--- (dotted line)	- 66 dBA LINE FOR NON ABATEMENT
—○— (line with circles)	- SOUNDWALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' | Drawing HRN008 | Sheet 3 of 69

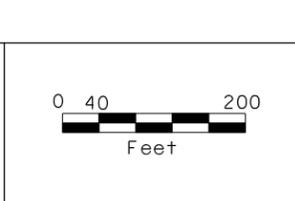


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 3B of 69



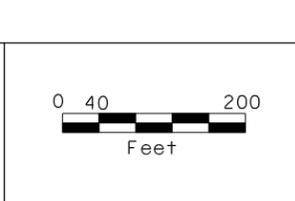
**LEGEND**

⊕ LT	- LONG TERM MEASUREMENT	--- (dashed blue)	- 66 dBA LINE FOR NON ABATEMENT
⊕ ST	- SHORT TERM MEASUREMENT	— (solid black)	- SOUNDWALL
SFR	- SINGLE FAMILY RESIDENCE	- - - (dashed black)	- EXISTING WALL
MFR	- MULTI - FAMILY RESIDENCE		
COMM	- COMMERCIAL		

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**  
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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 4 of 69



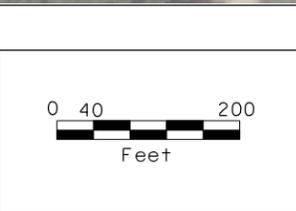
**LEGEND**

⊕ LT	- LONG TERM MEASUREMENT	---	- 66 dBA LINE FOR NON ABATEMENT
⊕ ST	- SHORT TERM MEASUREMENT	—○—	- SOUNDWALL
SFR	- SINGLE FAMILY RESIDENCE	---	- EXISTING WALL
MFR	- MULTI - FAMILY RESIDENCE		
COMM	- COMMERCIAL		

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
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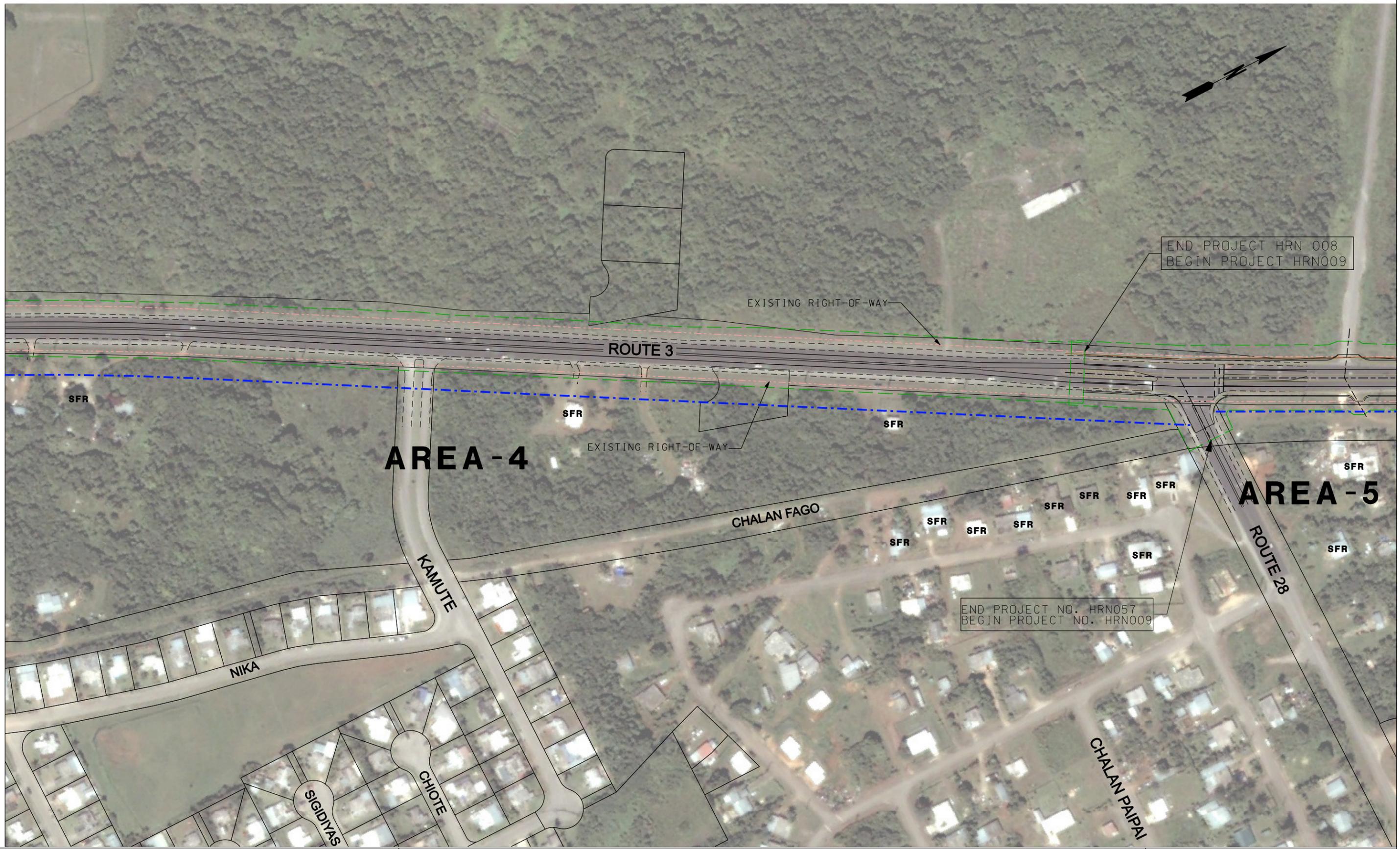
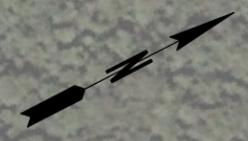
**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 4B of 69

MATCH LINE SHT5

MATCH LINE SEE HN03

MATCH LINE SEE HRN04

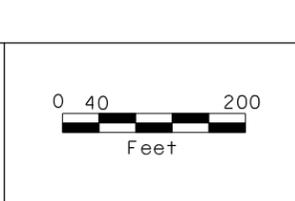


LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

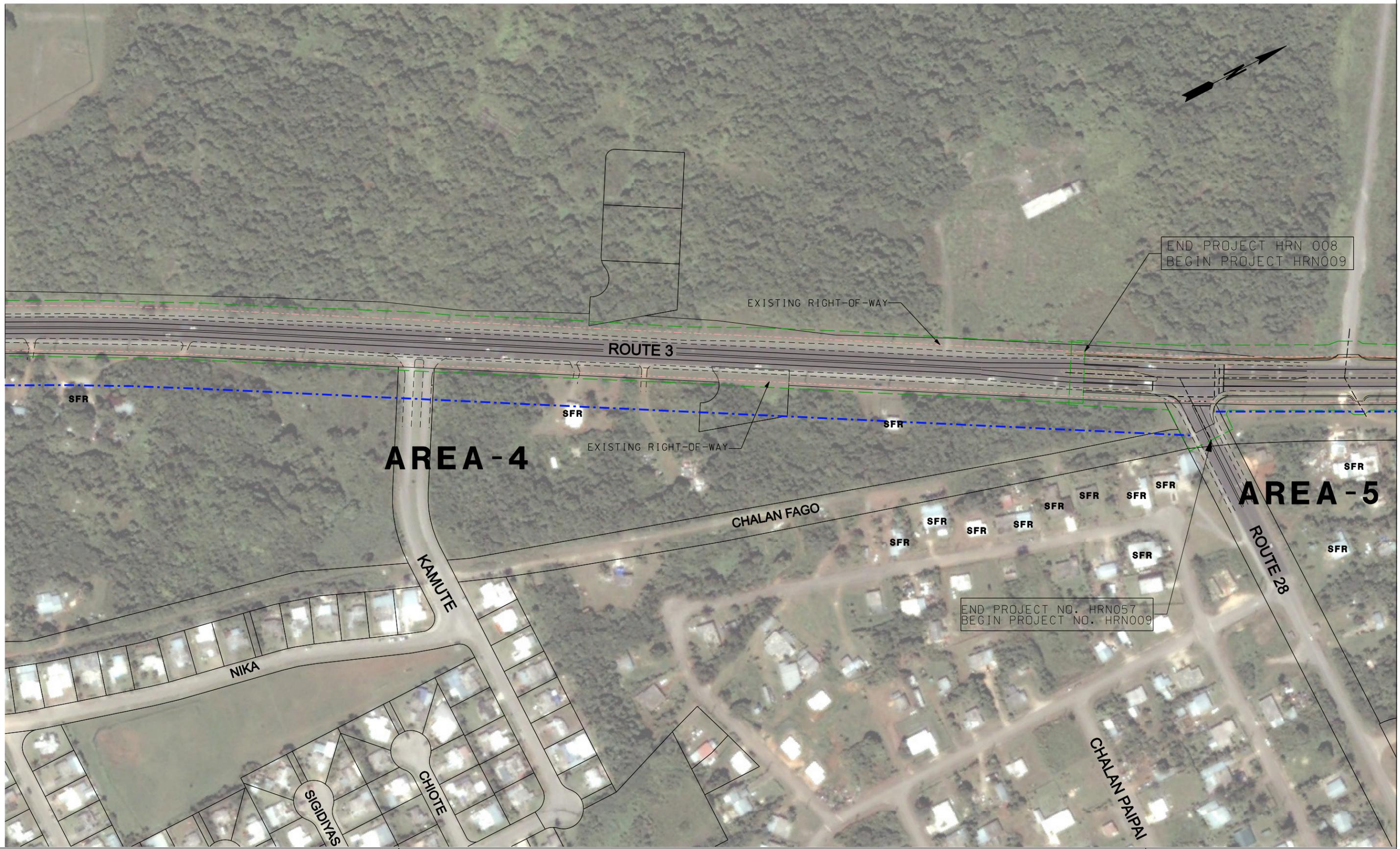
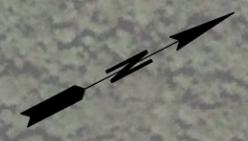
**PARSONS**  
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CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 5 of 69

MATCH LINE SEE HRN04

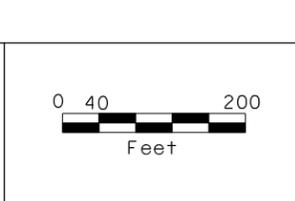


LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

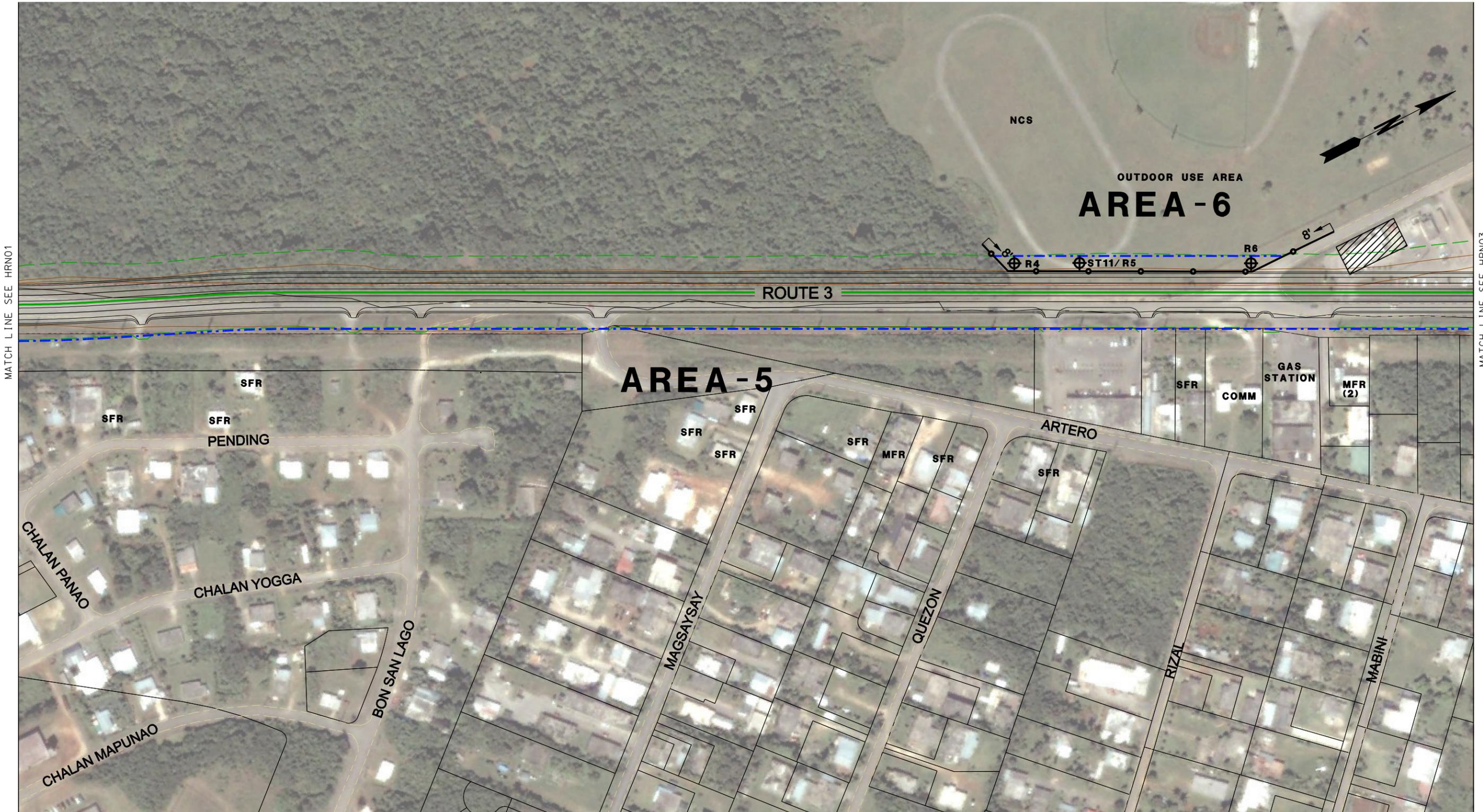
**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 3 (ROUTE 28 TO ROUTE 1)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
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CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN008 Sheet 5B of 69



MATCH LINE SEE HRN01

MATCH LINE SEE HRN03

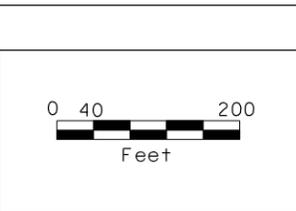
- PROPERTY WILL BE TAKEN DUE TO THE PROJECT ALIGNMENT

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 3 (RTE 28 TO NCTS FINEGAYAN)  
ROADWAY PLAN**

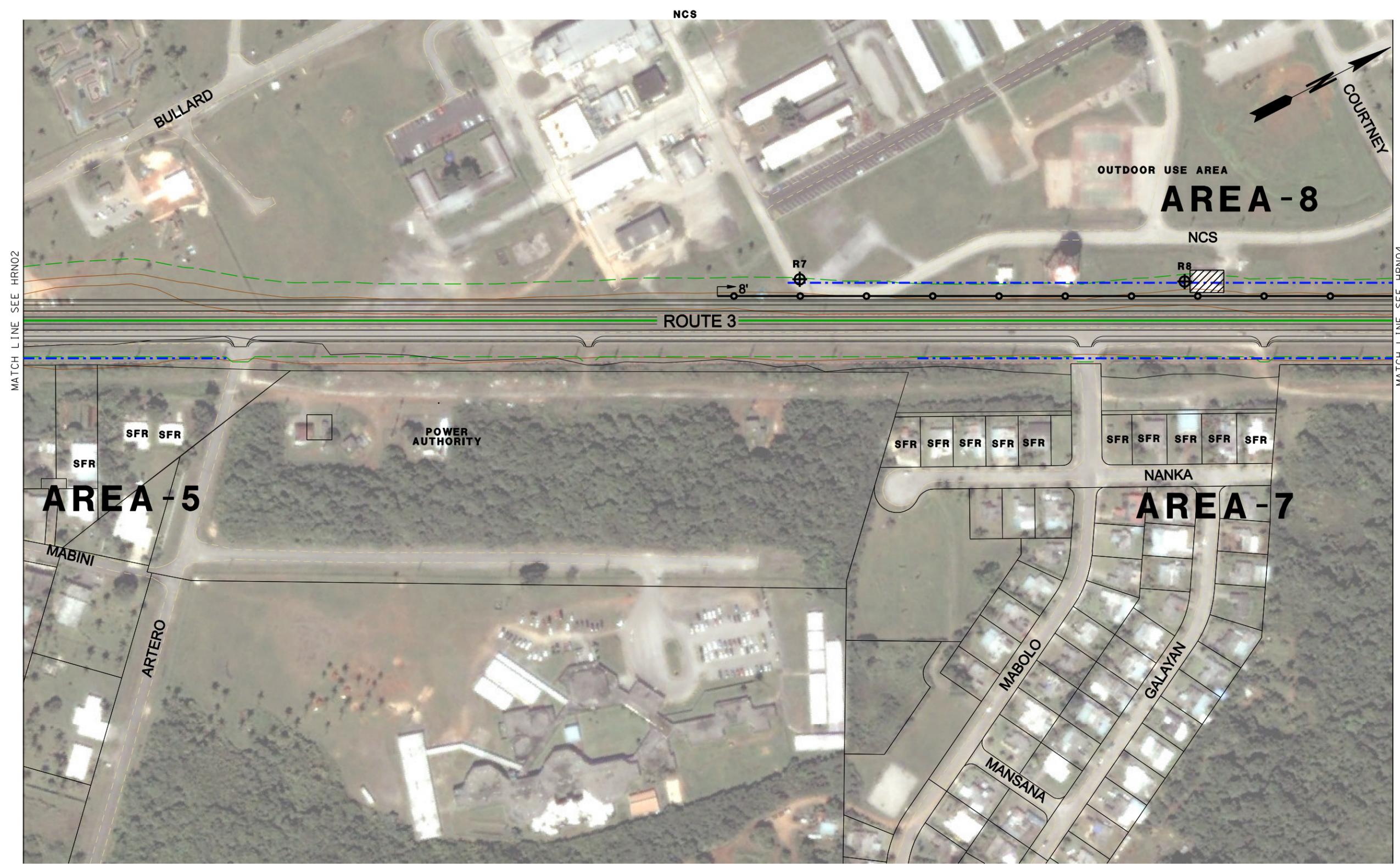
**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN009 Sheet 6 of 69

\$DATE\$ \$TIME\$ \$FILE\$



 - PROPERTY WILL BE TAKEN DUE TO PROJECT ALIGNMENT

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 3 (RTE 28 TO NCTS FINEGAYAN)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
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**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN009 Sheet 7 of 69

\$DATE\$ \$TIME\$ \$FILE\$

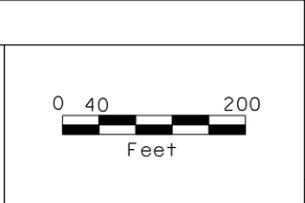


LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 3 (RTE 28 TO NCTS FINEGAYAN)  
ROADWAY PLAN**

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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN009 Sheet 8 of 69



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

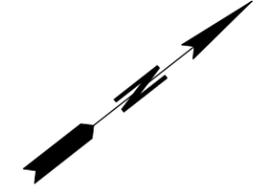
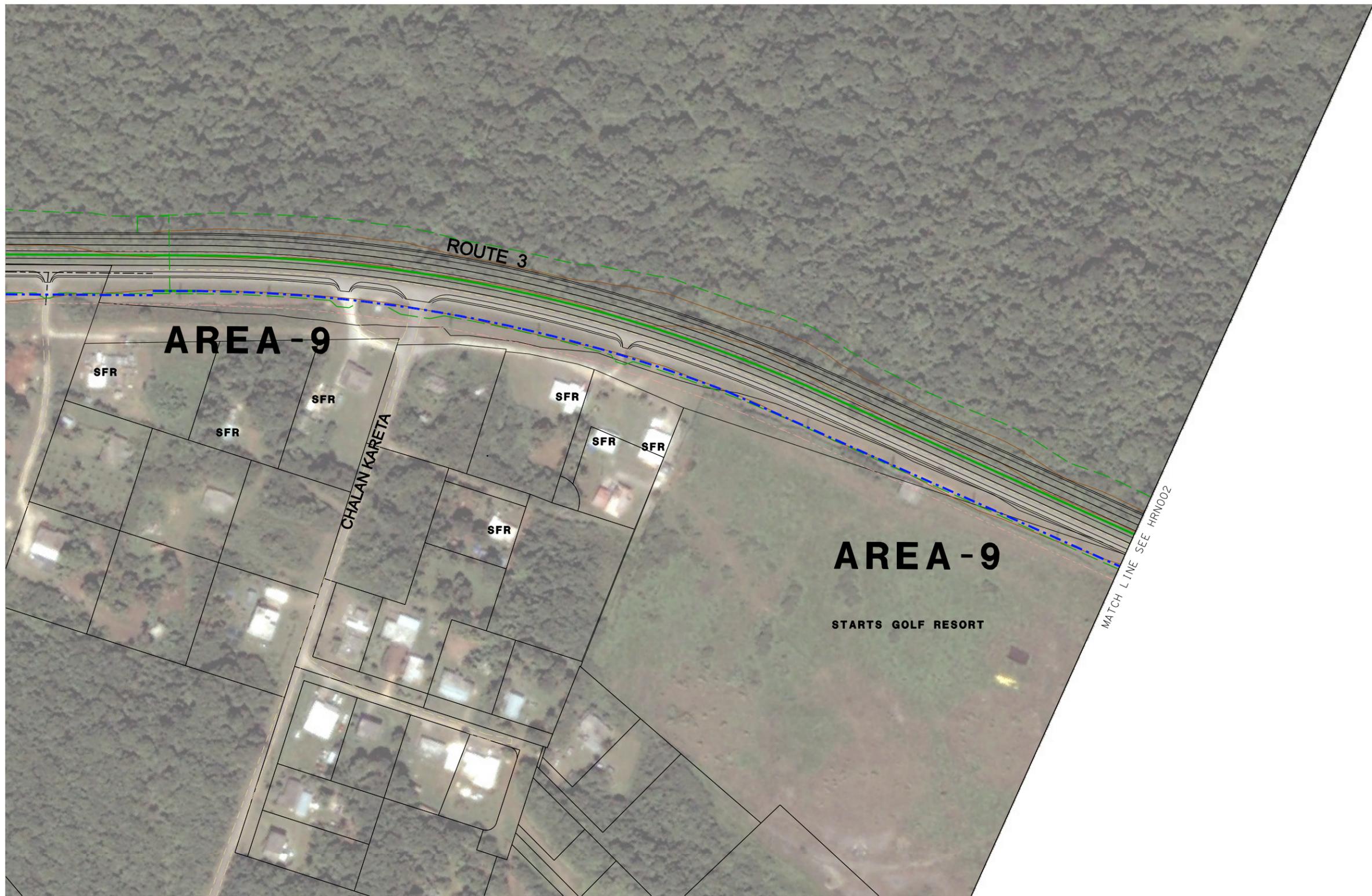
**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 3 (RTE 28 TO NCTS FINEGAYAN)  
ROADWAY PLAN**

**PARSONS**

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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



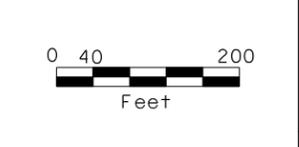
**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 3  
( NCTS FINEGAYAN TO ROUTE 9 )  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN010 Sheet 10 of 69



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 3  
( NCTS FINEGAYAN TO ROUTE 9 )  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
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PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN010 Sheet 11 of 69



END PROJECT NO. HRN010  
 BEGIN PROJECT NO. HRN022

MATCH LINE SEE SHT 2

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed blue)	- 66 dBA LINE FOR NON ABATEMENT
—○— (solid black)	- SOUNDWALL
--- (dashed black)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

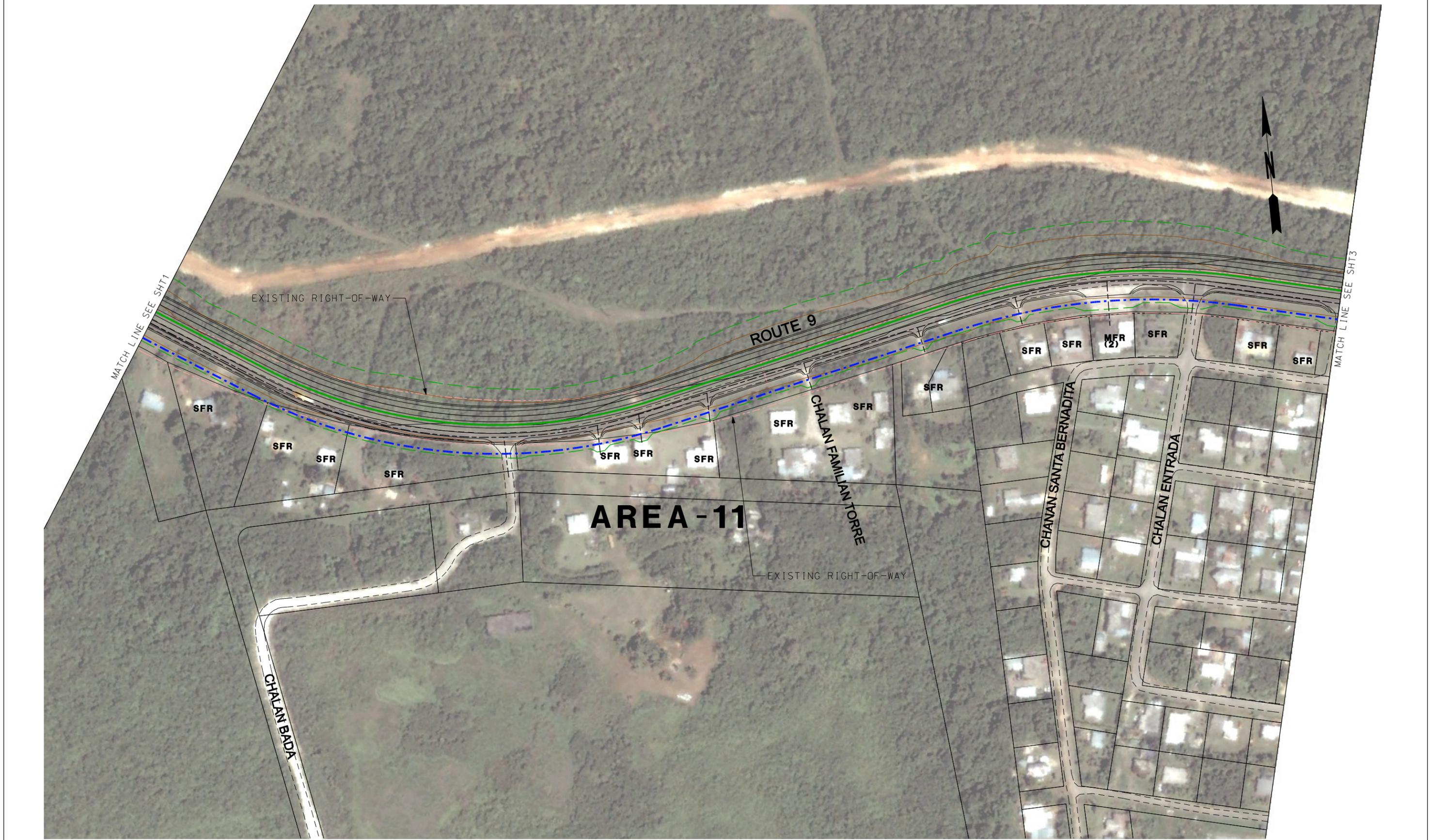
**PAVEMENT STRENGTHENING  
 ROUTE 9  
 ROUTE 3 TO AAFB NORTH GATE  
 ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
 Feet

**66 dBA NOISE  
 IMPACT CONTOUR LINE  
 FOR NON ABATEMENT**

Scale 1"=200 Drawing HRN022 Sheet 12 of 69

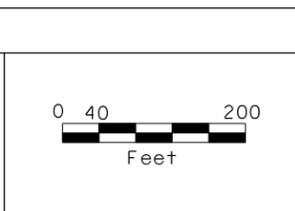


LEGEND	
⊕ LT	LONG TERM MEASUREMENT
⊕ ST	SHORT TERM MEASUREMENT
SFR	SINGLE FAMILY RESIDENCE
MFR	MULTI - FAMILY RESIDENCE
COMM	COMMERCIAL
-----	66 dBA LINE FOR NON ABATEMENT
—○—	SOUNDWALL
-----	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 9  
ROUTE 3 TO AAFB NORTH GATE  
ROADWAY PLAN**

**PARSONS**  
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PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200 Drawing HRN022 Sheet 13 of 69



MATCH LINE SEE HRN02

<b>LEGEND</b>	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 9  
ROUTE 3 TO AAFB NORTH GATE  
ROADWAY PLAN**

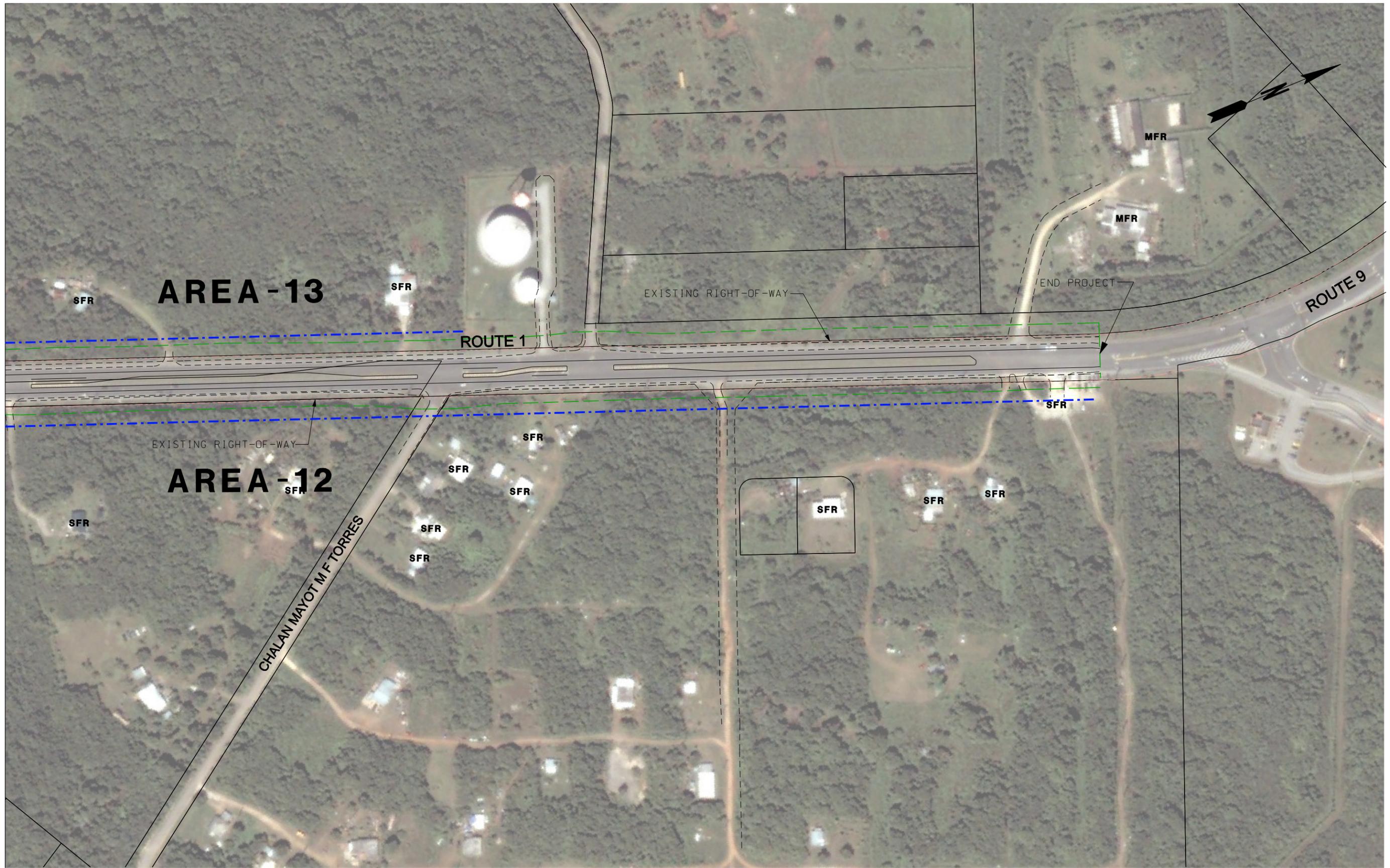
**PARSONS**

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PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200 Drawing HRN022 Sheet 14 of 69



MATCH LINE SEE HRN004

**AREA-13**

**AREA-12**

ROUTE 1

ROUTE 9

CHALAN MAYOT M/F TORRES

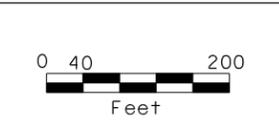
LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
	- 66 dBA LINE FOR NON ABATEMENT
	- SOUNDWALL
	- EXISTING WALL

C. LINCOLN

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

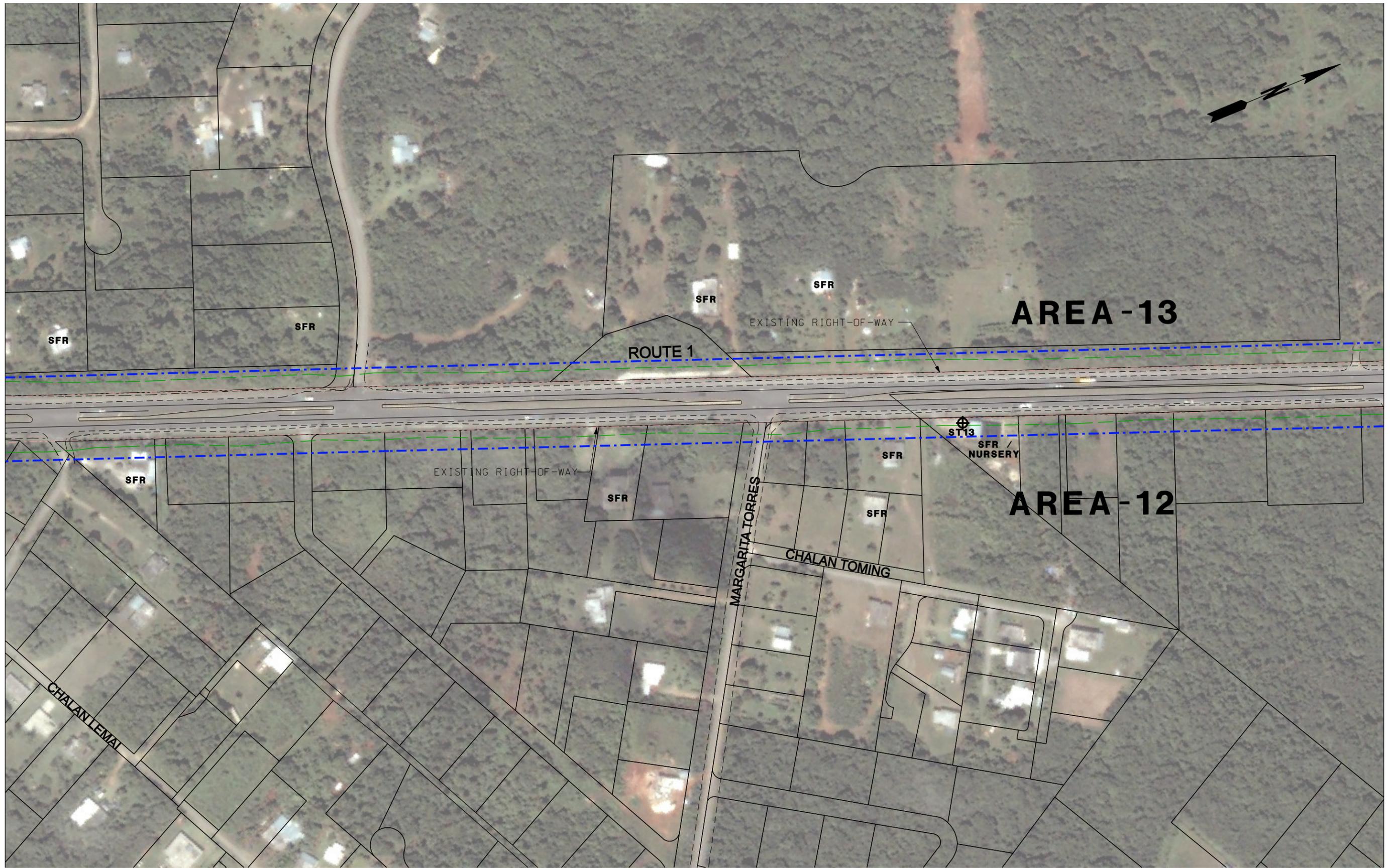
**PAVEMENT STRENGTHENING ROUTE 1 (CHALAN LUJUNA TO ROUTE 9Aafb) ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE IMPACT CONTOUR LINE FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN023 Sheet 15 of 69



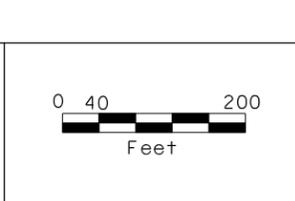
LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
-----	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
-----	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(CHALAN LUJUNA TO ROUTE 9Aafb)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN023 Sheet 16 of 69



MATCH LINE SEE HRN002

MATCH LINE SEE HRN004

**LEGEND**

- ⊕LT - LONG TERM MEASUREMENT
- ⊕ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(CHALAN LUJUNA TO ROUTE 9Aafb)  
ROADWAY PLAN**

**PARSONS**

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PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
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0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



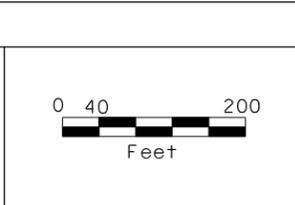
LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
-----	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
-----	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(CHALAN LUJUNA TO ROUTE 9Aafb)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
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**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN023 Sheet 18 of 69



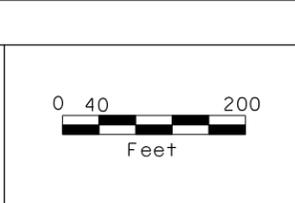
LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(CHALAN LUJUNA TO ROUTE 9Aafb)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN023 Sheet 19 of 69



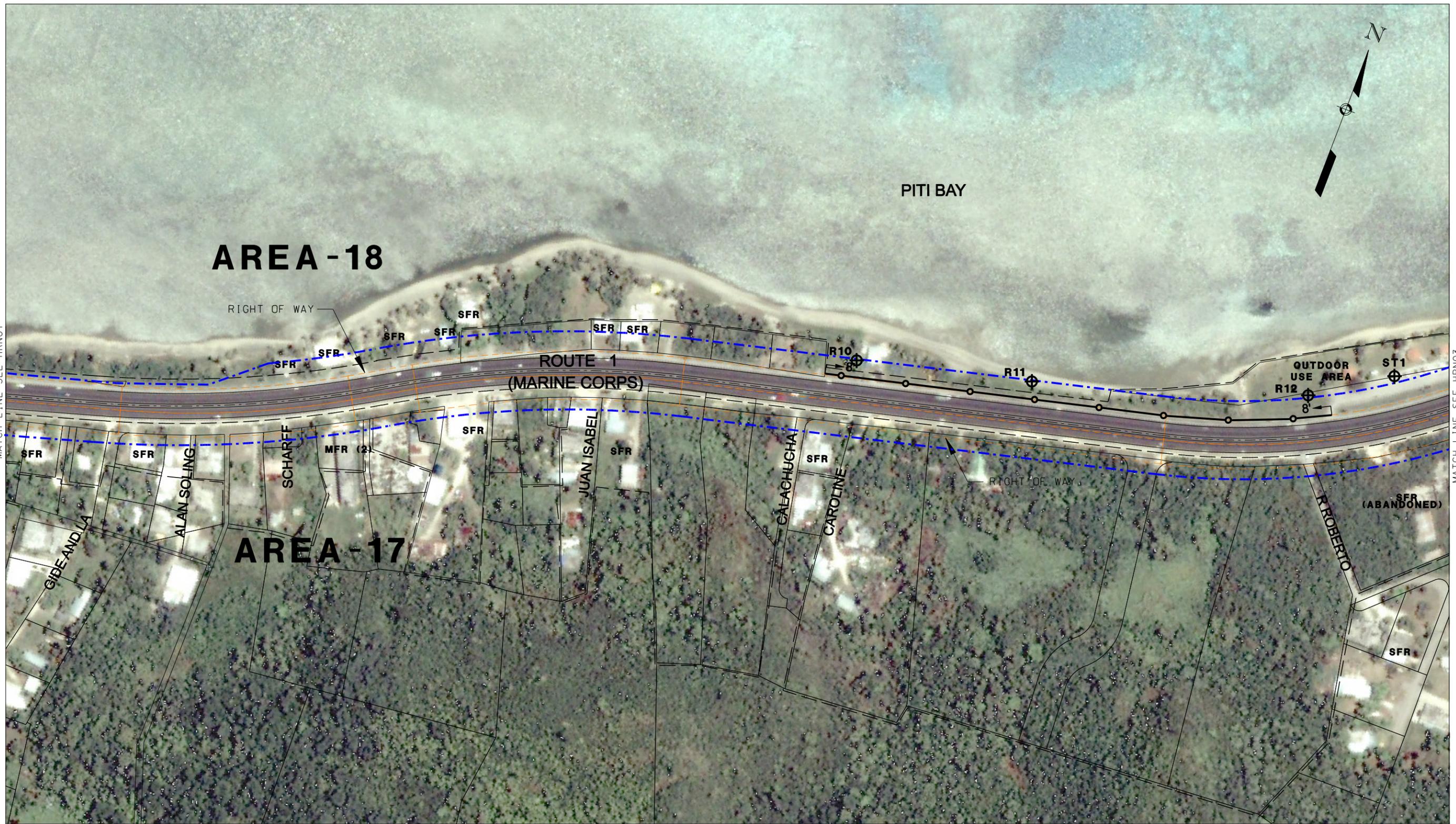
MATCH LINE SEE HRN02

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

<b>GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK</b>		<p>0 40 200 Feet</p>
<b>PAVEMENT STRENGTHENING ROUTE 1 (ROUTE 11 TO ASAN RIVER) ROADWAY PLAN</b>	<p>100 WALNUT ST. PASADENA, CALIFORNIA 91124 PHONE: (626) 440-6100 FAX: (626) 440-6200 CERTIFICATE OF AUTHORIZATION NO. 1838</p>	

<b>66 dBA NOISE IMPACT CONTOUR LINE FOR NON ABATEMENT</b>	
Scale	1"=200'
Drawing	HRN013
Sheet	20 of 69



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(ROUTE 11 TO ASAN RIVER )  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(ROUTE 11 TO ASAN RIVER)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



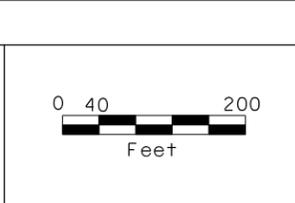
LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed line)	- 66 dBA LINE FOR NON ABATEMENT
—○— (line with circles)	- SOUNDWALL
--- (dashed line)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(ROUTE 11 TO ASAN RIVER)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN013 Sheet 23 of 69



MATCH LINE SEE HRN01

MATCH LINE SEE HRN03

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
ASAN RIVER TO ROUTE 6 (ADELUP)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



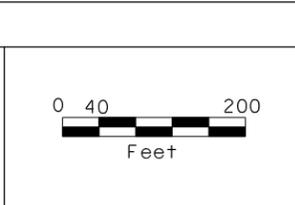
MATCH LINE SEE HRN01

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

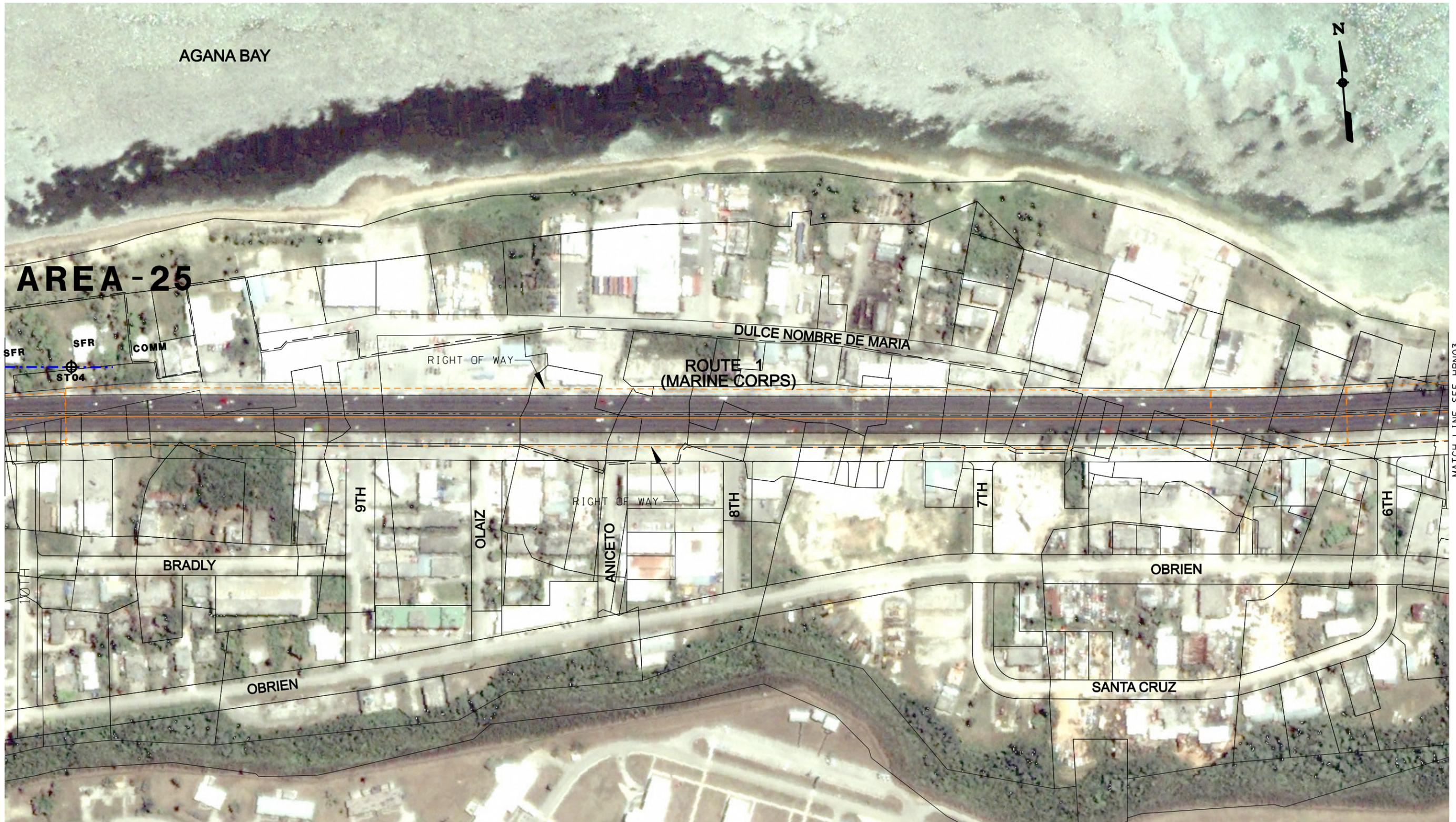
**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 1/RTE8 INTERSECTION)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN015 Sheet 25 of 69

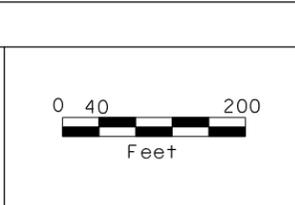


LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 1/RTE 8 INTERSECTION)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

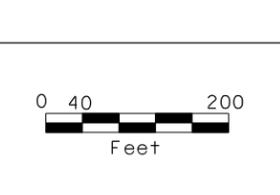
Scale 1"=200' Drawing HRN015 Sheet 26 of 69



LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 1 (RTE 1/RTE8 INTERSECTION)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN015 Sheet 27 of 69



MATCH LINE SEE HRN03

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—○—	- SOUNDWALL
- - - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 1/RTE8 INTERSECTION)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

<b>66 dBA NOISE IMPACT CONTOUR LINE FOR NON ABATEMENT</b>		
Scale	1"=200'	Drawing HRN015 Sheet 28 of 69



**LEGEND**

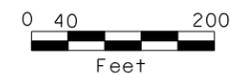
- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

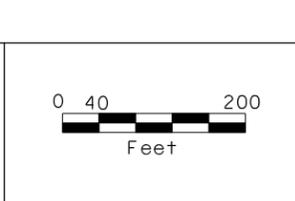


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

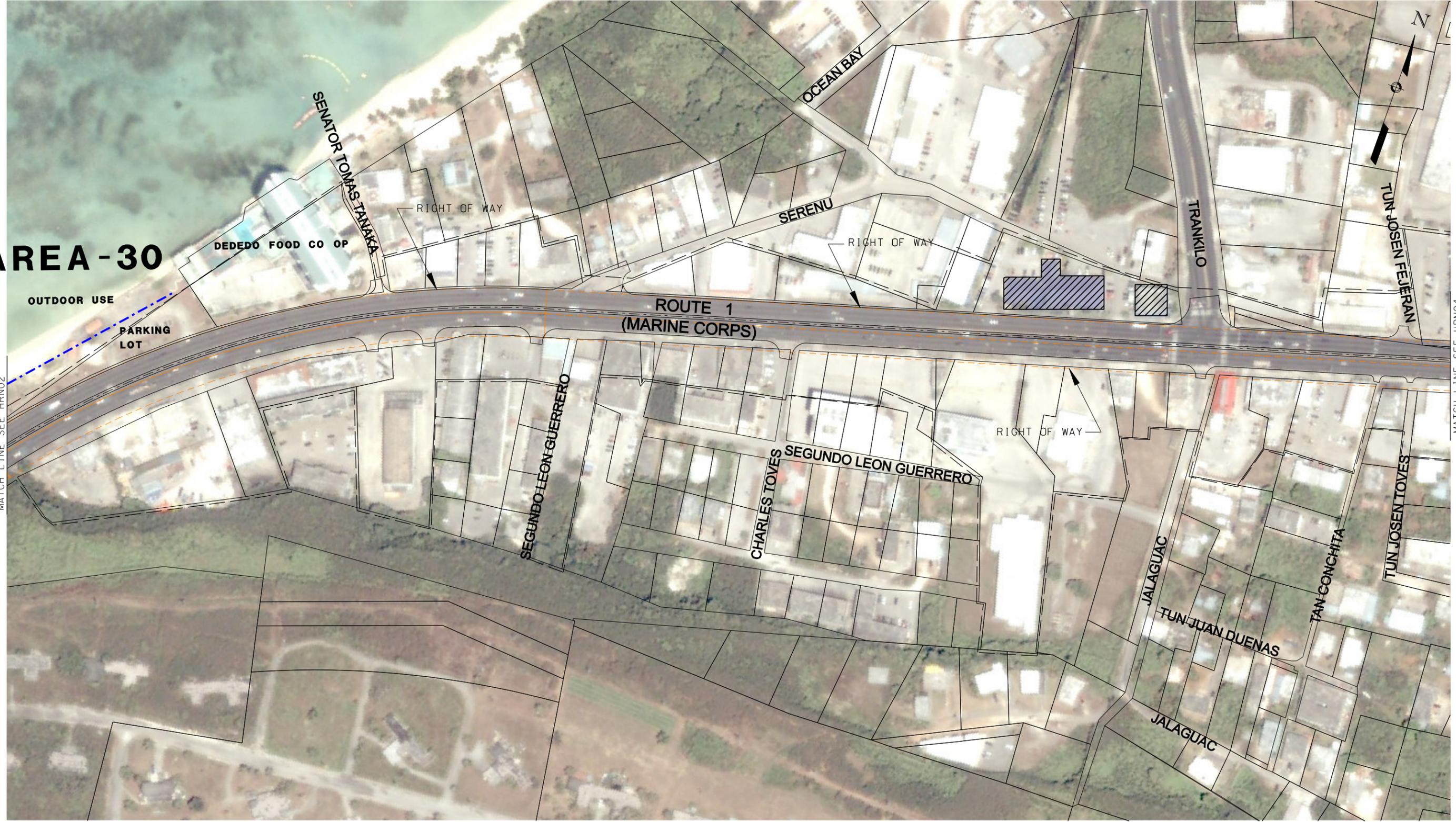
**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 30 of 69

# AREA - 30



MATCH LINE SEE HRN02

MATCH LINE SEE HRN04

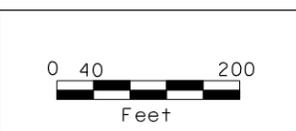
 - PROPERTY TO BE TAKEN DUE TO PROJECT ALIGNMENT

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 31 of 69



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- 66 dBA LINE FOR NON ABATEMENT
- SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN04

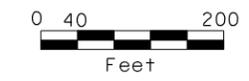
MATCH LINE SEE HRN06

 - PROPERTY TO BE TAKEN DUE TO PROJECT ALIGNMENT

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 1 (RTE 6 (ADELUP) TO RTE 4)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 33 of 69

\$DATE\$ \$TIME\$ \$FILE\$

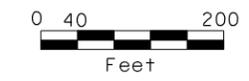


 - PROPERTY TO BE TAKEN DUE TO PROJECT ALIGNMENT

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 1 (RTE 6 (ADELUP) TO RTE 4)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

\$DATE\$ \$TIME\$ \$FILE\$

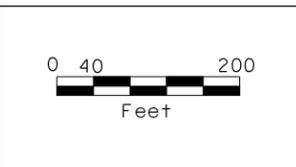


 - PROPERTY TO BE TAKEN DUE TO PROJECT ALIGNMENT

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 1 (RTE 6 (ADELUP) TO RTE 4)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 35 of 69



MATCH LINE SEE HRN07

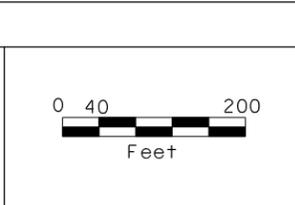
MATCH LINE SEE HRN08

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 36 of 69

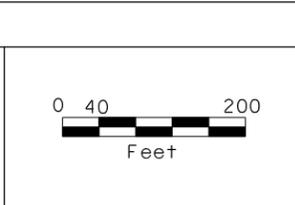


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
○—○	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 37 of 69



**LEGEND**

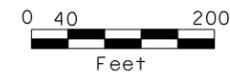
- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN10

MATCH LINE SEE HRN12

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 39 of 69

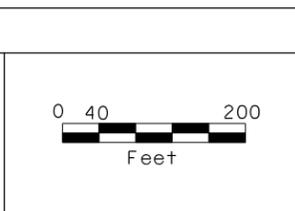


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
---	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
RTE 1 (RTE 6 (ADELUP) TO RTE 4)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN033 Sheet 40 of 69

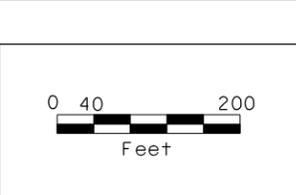


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (blue dashed)	- 66 dBA LINE FOR NON ABATEMENT
— (solid)	- SOUNDWALL
- - - (black dashed)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

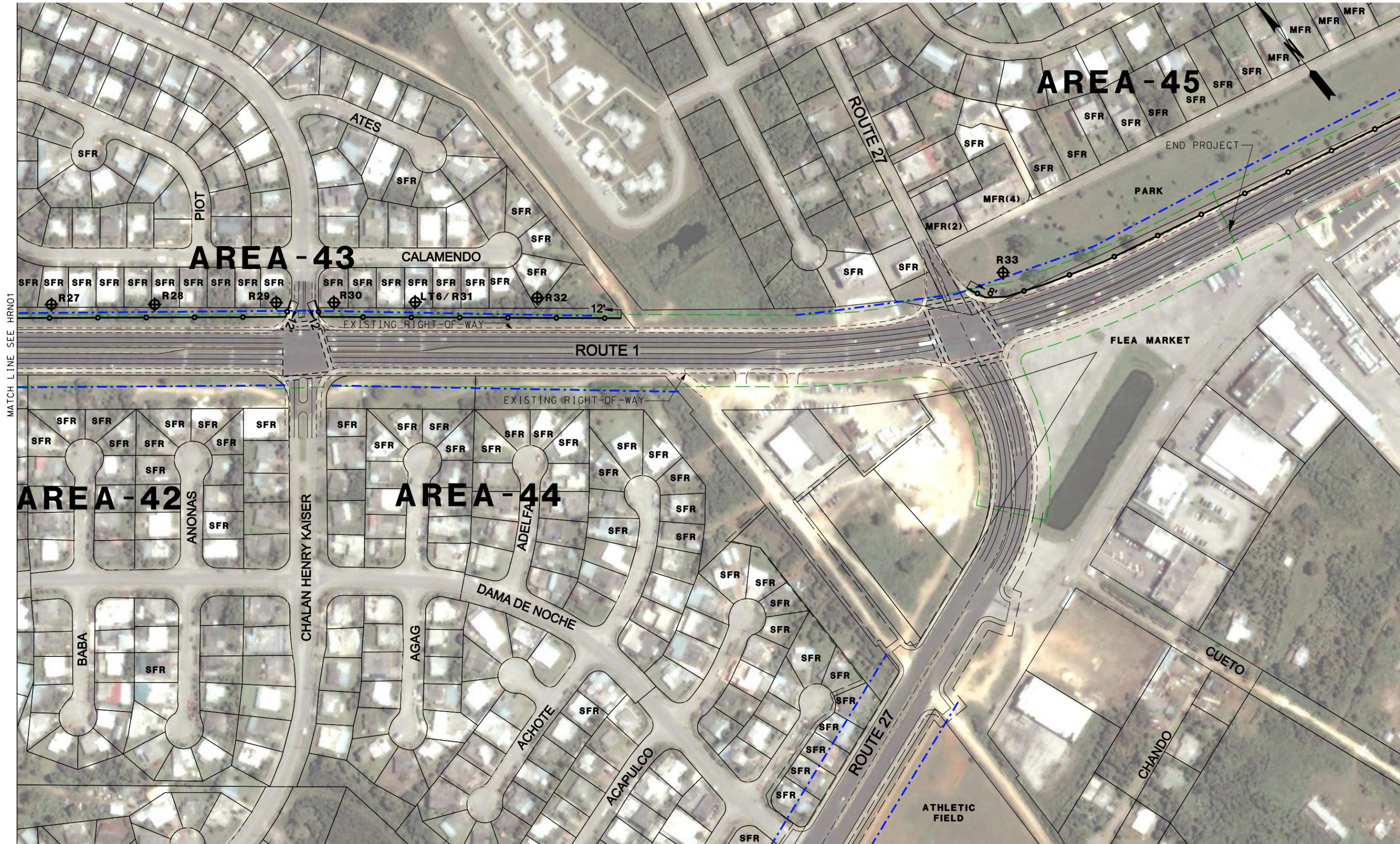
**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 1 (ROUTE 3 TO ROUTE 27)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN007 Sheet 41 of 69



LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed blue)	- 66 dBA LINE FOR NON ABATEMENT
--- (dashed green)	- EXISTING RIGHT-OF-WAY
--- (dashed black)	- EXISTING WALL
--- (dashed black)	- SOUNDWALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 1 (ROUTE 3 TO ROUTE 27)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

Scale 1"=200'

Drawing HRN007 Sheet 42 of 69

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**





MATCH LINE SEE HRN01

MATCH LINE SEE HRN03

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING**

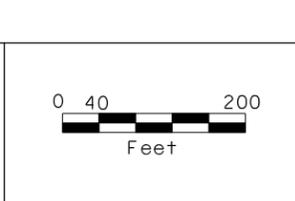
**ROUTE 1**

**(ROUTE 27 TO CHALAN LUJUNA)**

**ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**

**IMPACT CONTOUR LINE**

**FOR NON ABATEMENT**

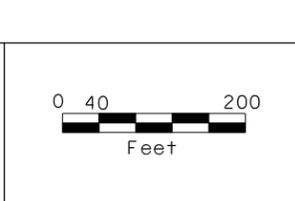
Scale 1"=200' Drawing HRN006 Sheet 44 of 69

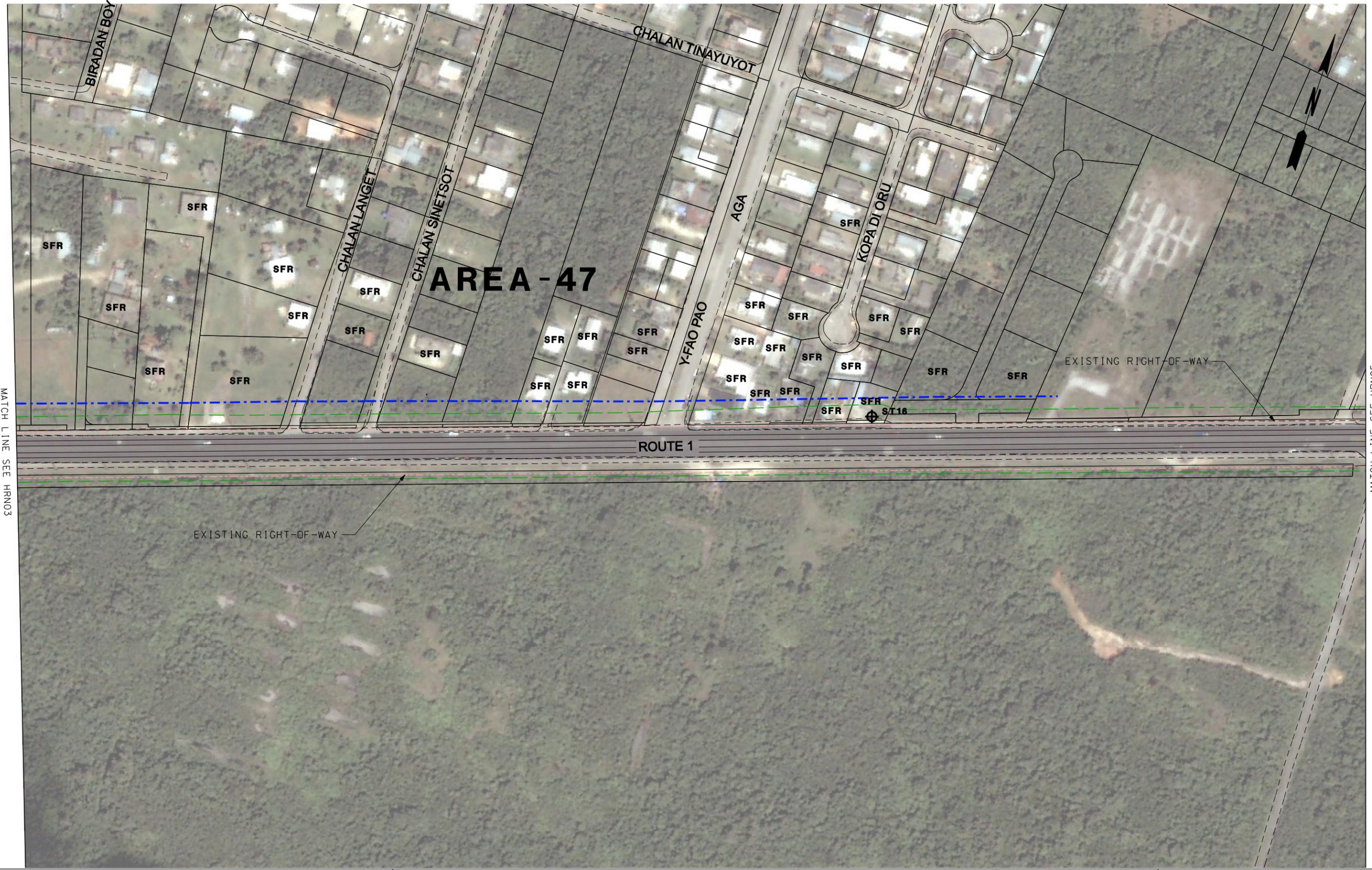


LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed blue)	- 66 dBA LINE FOR NON ABATEMENT
—○— (solid black)	- SOUNDWALL
--- (dashed black)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**PAVEMENT STRENGTHENING**  
**ROUTE 1**  
**(ROUTE 27 TO CHALAN LUJUNA)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
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 CERTIFICATE OF AUTHORIZATION NO. 1838





**AREA - 47**

**ROUTE 1**

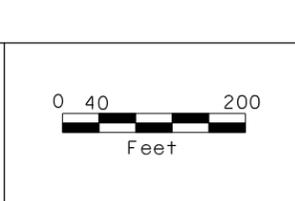
MATCH LINE SEE HRN03

MATCH LINE SEE HRN05

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**PAVEMENT STRENGTHENING**  
**ROUTE 1**  
**(ROUTE 27 TO CHALAN LUJUNA)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

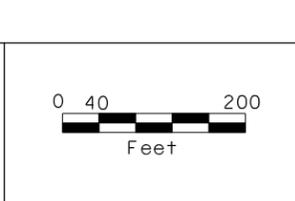
Scale 1"=200' | Drawing HRN006 | Sheet 46 of 69



LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (blue dashed)	- 66 dBA LINE FOR NON ABATEMENT
—○— (black solid)	- SOUNDWALL
- - - (black dashed)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**PAVEMENT STRENGTHENING**  
**ROUTE 1**  
**(ROUTE 27 TO CHALAN LUJUNA)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' | Drawing HRN006 | Sheet 47 of 69



MATCH LINE SEE HRN05

MATCH LINE SEE HRN07

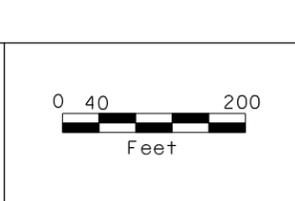


LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING ROUTE 1 (ROUTE 27 TO CHALAN LUJUNA) ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838





MATCH LINE SEE HRN06

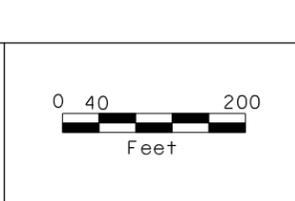
# AREA-16

LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 1  
(ROUTE 27 TO CHALAN LUJUNA)  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN006 Sheet 49 of 69



MATCH LINE SEE HRN 02

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 27  
ROUTE 1 TO ROUTE 16  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN01

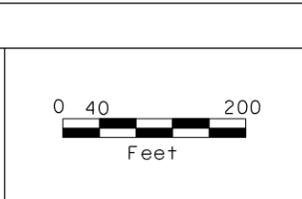
MATCH LINE SEE HRN03

LEGEND	
	LT - LONG TERM MEASUREMENT
	ST - SHORT TERM MEASUREMENT
<b>SFR</b>	SINGLE FAMILY RESIDENCE
<b>MFR</b>	MULTI - FAMILY RESIDENCE
<b>COMM</b>	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 27  
ROUTE 1 TO ROUTE 16  
ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN021 Sheet 51 of 69



MATCH LINE SEE HRN02

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL

- - - - - 66 dBA LINE FOR NON ABATEMENT
- SOUNDWALL
- EXISTING WALL

<b>GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK</b>		
<p><b>PAVEMENT STRENGTHENING</b>  <b>ROUTE 27</b>  <b>ROUTE 1 TO ROUTE 16</b>  <b>ROADWAY PLAN</b></p>	<p><b>PARSONS</b>          100 WALNUT ST.          PASADENA, CALIFORNIA 91124          PHONE: (626) 440-6100 FAX: (626) 440-6200          CERTIFICATE OF AUTHORIZATION NO. 1838</p>	<p>0 40 200 Feet</p>

<b>66 dBA NOISE IMPACT CONTOUR LINE FOR NON ABATEMENT</b>		
Scale	1"=200'	Drawing HRN021 Sheet 52 of 69



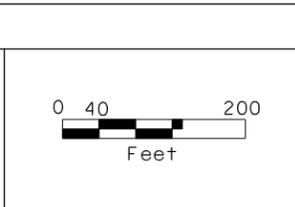
CHALAN SANTO PAPA  
JUAN PABLO DOS

MATCH LINE 1

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (blue dashed)	- 66 dBA LINE FOR NON ABATEMENT
— (solid)	- SOUNDWALL
- - - (dashed)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 8**  
**(RTE 1 TO TIYAN PWKY/BIANG ST)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838





MATCH LINE 1

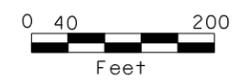
MATCH LINE 3

**AREA-54**

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed line)	- 66 dBA LINE FOR NON ABATEMENT
—○— (line with circles)	- SOUNDWALL
- - - (dashed line)	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 8**  
**(RTE 1 TO TIYAN PWKY/BIANG ST)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200'    Drawing HRN016    Sheet 54 of 69



**LEGEND**

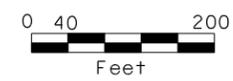
- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL

- - - - - 66 dBA LINE FOR NON ABATEMENT
- SOUNDWALL
- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**RTE 8**  
**(RTE 1 TO TIYAN PWKY/BIANG ST)**  
**ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL

- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**ROUTE 8**  
**(TIYAN PKWY/BIANG ST TO RTE 10)**  
**ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**



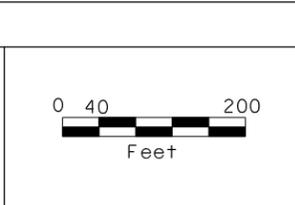
MATCH LINE 1

MATCH LINE 3

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
--- (dashed blue)	- 66 dBA LINE FOR NON ABATEMENT
--- (dashed orange)	- RIGHT OF WAY
--- (dashed black)	- EXISTING WALL
--- (solid black)	- SOUNDWALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**ROUTE 8**  
**(TIYAN PKWY/BIANG ST TO RTE 10)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' | Drawing HRN017 | Sheet 57 of 69



MATCH LINE 3

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 8  
(TIYAN PKWY/BIANG ST TO RTE 10)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN02

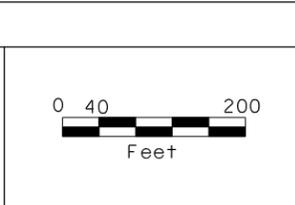
LEGEND	
	LONG TERM MEASUREMENT
	SHORT TERM MEASUREMENT
	SINGLE FAMILY RESIDENCE
	MULTI - FAMILY RESIDENCE
	COMMERCIAL
	66 dBA LINE FOR NON ABATEMENT
	SOUNDWALL
	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 16  
SABANA BARRIGADA DRIVE TO  
ROUTE 8/10  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN020 Sheet 59 of 69



**LEGEND**

- ⊕LT - LONG TERM MEASUREMENT
- ⊕ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**PAVEMENT STRENGTHENING**  
**ROUTE 16**  
**SABANA BARRIGADA DRIVE TO**  
**ROUTE 8/10**  
**ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**



**LEGEND**

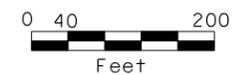
- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 16  
SABANA BARRIGADA DRIVE TO  
ROUTE 8/10  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

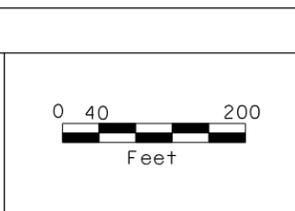


MATCH LINE SEE HRN03

LEGEND	
⊕ LT	LONG TERM MEASUREMENT
⊕ ST	SHORT TERM MEASUREMENT
SFR	SINGLE FAMILY RESIDENCE
MFR	MULTI - FAMILY RESIDENCE
COMM	COMMERCIAL
---	66 dBA LINE FOR NON ABATEMENT
—○—	SOUNDWALL
- - -	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**PAVEMENT STRENGTHENING**  
**ROUTE 16**  
**SABANA BARRIGADA DRIVE TO**  
**ROUTE 8/10**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN020 Sheet 62 of 69



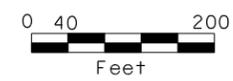
**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 16  
ROUTE 10A TO  
SABANA BARRIGADA DRIVE  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



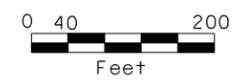
**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 16  
ROUTE 10A TO  
SABANA BARRIGADA DRIVE  
ROADWAY PLAN**

**PARSONS**  
100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838



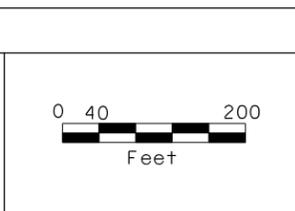
**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



LEGEND	
⊕ LT	LONG TERM MEASUREMENT
⊕ ST	SHORT TERM MEASUREMENT
SFR	SINGLE FAMILY RESIDENCE
MFR	MULTI - FAMILY RESIDENCE
COMM	COMMERCIAL
---	66 dBA LINE FOR NON ABATEMENT
—○—	SOUNDWALL
- - -	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**PAVEMENT STRENGTHENING**  
**ROUTE 16**  
**ROUTE 10A TO**  
**SABANA BARRIGADA DRIVE**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN019 Sheet 64 of 69



MATCH LINE SEE HRN02

**AREA - 61**

END PROJECT #19

REV AND TAX  
DEPARTMENT  
OF  
MOTOR VEHICLE

ROUTE 16

RIGHT OF WAY

RIGHT OF WAY

JUAN C FEJERAN

AGUJON

MACHECHE

ROUTE 8  
(PURPLE HESTRT MEMORIAL)

ROUTE 8  
(PURPLE HESTRT MEMORIAL)

PENDING

LEGEND	
⊕ LT	LONG TERM MEASUREMENT
⊕ ST	SHORT TERM MEASUREMENT
SFR	SINGLE FAMILY RESIDENCE
MFR	MULTI - FAMILY RESIDENCE
COMM	COMMERCIAL
---	66 dBA LINE FOR NON ABATEMENT
—○—	SOUNDWALL
---	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 16  
ROUTE 10A TO  
SABANA BARRIGADA DRIVE  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN019 Sheet 64Bof 69



MATCH LINE SEE HRN02

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT  
PAVEMENT STRENGTHENING  
ROUTE 16  
(ROUTE 27 TO ROUTE 10A)  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN02

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**ROUTE 16**  
**(ROUTE 27 TO ROUTE 10A)**  
**ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**



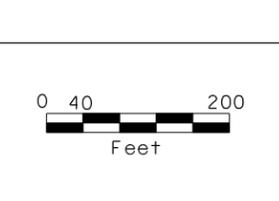
MATCH LINE SEE HRN01

**AREA-62**  
OUTDOOR USE

LEGEND	
⊕ LT	- LONG TERM MEASUREMENT
⊕ ST	- SHORT TERM MEASUREMENT
SFR	- SINGLE FAMILY RESIDENCE
MFR	- MULTI - FAMILY RESIDENCE
COMM	- COMMERCIAL
---	- 66 dBA LINE FOR NON ABATEMENT
—○—	- SOUNDWALL
- - -	- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**  
**CONCEPTUAL IMPROVEMENT PROJECT**  
**PAVEMENT STRENGTHENING**  
**ROUTE 16**  
**(ROUTE 27 TO ROUTE 10A)**  
**ROADWAY PLAN**

**PARSONS**  
 100 WALNUT ST.  
 PASADENA, CALIFORNIA 91124  
 PHONE: (626) 440-6100 FAX: (626) 440-6200  
 CERTIFICATE OF AUTHORIZATION NO. 1838



**66 dBA NOISE**  
**IMPACT CONTOUR LINE**  
**FOR NON ABATEMENT**

Scale 1"=200'    Drawing HRN018    Sheet 66 of 69



**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**CONCEPTUAL IMPROVEMENT PROJECT**

**PAVEMENT STRENGTHENING**

**ROUTE 16**

**(ROUTE 27 TO ROUTE 10A)**

**ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN02

LEGEND	
⊕ LT	LONG TERM MEASUREMENT
⊕ ST	SHORT TERM MEASUREMENT
SFR	SINGLE FAMILY RESIDENCE
MFR	MULTI - FAMILY RESIDENCE
COMM	COMMERCIAL
-----	66 dBA LINE FOR NON ABATEMENT
—○—	SOUNDWALL
-----	EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 10  
ROUTE 15 TO ROUTE 8 & 16  
ROADWAY PLAN**

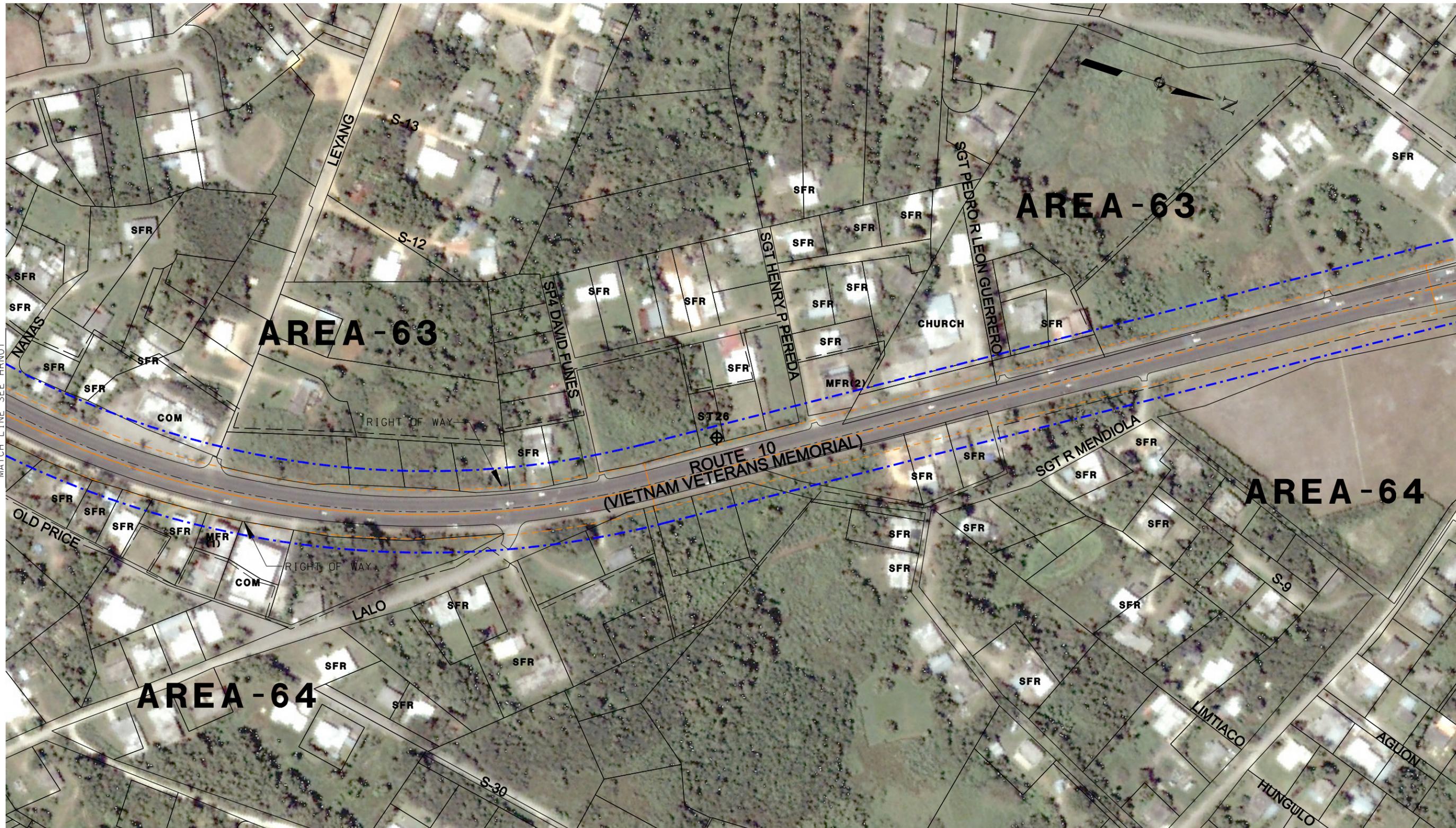
**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**

Scale 1"=200' Drawing HRN030 Sheet 67 of 69



MATCH LINE SEE HRN01

MATCH LINE SEE HRN03

**AREA - 63**

**AREA - 63**

**AREA - 64**

**AREA - 64**

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- 66 dBA LINE FOR NON ABATEMENT
- SOUNDWALL
- EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

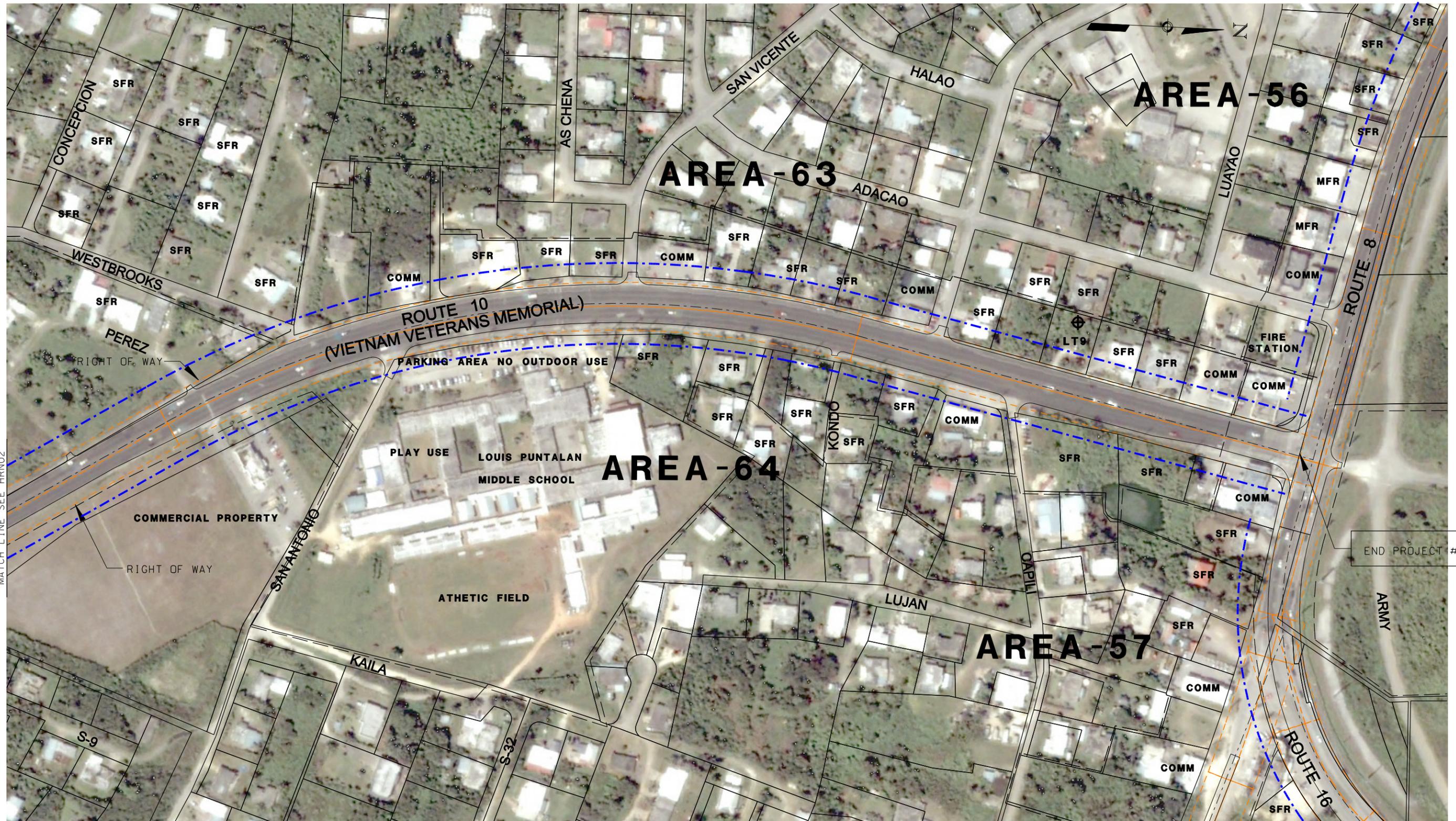
**PAVEMENT STRENGTHENING  
ROUTE 10  
ROUTE 15 TO ROUTE 8 & 16  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**



MATCH LINE SEE HRN02

END PROJECT #30

**LEGEND**

- ⊕ LT - LONG TERM MEASUREMENT
- ⊕ ST - SHORT TERM MEASUREMENT
- SFR - SINGLE FAMILY RESIDENCE
- MFR - MULTI - FAMILY RESIDENCE
- COMM - COMMERCIAL
- - 66 dBA LINE FOR NON ABATEMENT
- - SOUNDWALL
- - - - - EXISTING WALL

**GUAM COMMUNITY BUILD-UP: HAUL ROAD NETWORK**

**PAVEMENT STRENGTHENING  
ROUTE 10  
ROUTE 15 TO ROUTE 8 & 16  
ROADWAY PLAN**

**PARSONS**

100 WALNUT ST.  
PASADENA, CALIFORNIA 91124  
PHONE: (626) 440-6100 FAX: (626) 440-6200  
CERTIFICATE OF AUTHORIZATION NO. 1838

0 40 200  
Feet

**66 dBA NOISE  
IMPACT CONTOUR LINE  
FOR NON ABATEMENT**





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