

# Final Field Report for Baseline Terrestrial Resources Surveys for the Sea Port in Yap, Federated States of Micronesia

Submitted to:



Naval Facilities Engineering Systems Command, Pacific

Prepared by:

Cardno GS – AECOM Pacific Joint Venture

Under Contract No.: N62742-18-D-1802

Task Order: N6274223F0128

November 2023

This page intentionally left blank.

## Contact Information

### **AECOM**

1001 Bishop Street  
Suite 1600  
Honolulu, HI 96813

### **Stantec GS Inc. (Formerly Cardno GS)**

737 Bishop Street  
Suite 3050, Mauka Tower  
Honolulu, HI 96813

## Document Information

**Submitted to:** Naval Facilities Engineering  
Systems Command, Pacific

**Project Name:** Baseline Resources Surveys for the  
Sea Port in Yap, FSM

**Date:** November 10, 2023

**Recommended Citation:** Cardno GS – AECOM Pacific Joint Venture (CAP JV). 2023. *Final Field Report for Baseline Terrestrial Resources Surveys for the Sea Port in Yap, Federated States of Micronesia*. Honolulu, HI. Naval Facilities Engineering Systems Command, Pacific under Contract No. N62742-18-D-1802, Task Order N6274223F0128. November 10.

This page intentionally left blank.

## EXECUTIVE SUMMARY

This field report summarizes the results of baseline terrestrial surveys conducted in and near Yap Port in the Federated States of Micronesia in 2023. Baseline terrestrial surveys were conducted between April 26 and May 1, 2023 (Yap time zone) to assess the occurrence of terrestrial special status species and to map vegetation/land cover types within the identified terrestrial survey area. Completion of a Yap State biodiversity database and an official list of rare species in Yap is a current action goal of the Federated States of Micronesia Yap Biodiversity Strategy and Action Plan (Yap State 2019). Therefore, for the purposes of this survey, the special status species occurring on Yap were considered wildlife and plant species on the International Union for Conservation of Nature Red List and/or bird species protected under the Migratory Bird Treaty Act. Results of the terrestrial surveys included observations of two International Union for Conservation of Nature Red List species, the Yap flying fox (*Pteropus pelewensis yapensis*) and Burmese rosewood (*Pterocarpus indicus*), as well as the following seven species of birds protected under the Migratory Bird Treaty Act: intermediate egret (*Ardea intermedia*), ruddy turnstone (*Arenaria interpres*), cattle egret (*Bubulcus ibis*), greater sand plover (*Charadrius leschenaultia*), white tern (*Gygis alba*), yellow bittern (*Ixobrychus sinensis*), and Pacific golden plover (*Pluvialis fulva*). The Yap Port and adjacent areas are largely developed and/or disturbed habitats; however, habitats for special status and other wildlife and plant species do occur, both within the developed/disturbed areas and the vegetated portions of the terrestrial survey area.

This page intentionally left blank.

## **ACRONYMS AND ABBREVIATIONS**

FSM	Federated States of Micronesia	GPS	Global Positioning System
GIS	Geographic Information System	MBTA	Migratory Bird Treaty Act

This page intentionally left blank.

# TABLE OF CONTENTS

<b>Executive Summary</b> .....	<b>iii</b>
<b>Acronyms and Abbreviations</b> .....	<b>v</b>
<b>Table of Contents</b> .....	<b>vii</b>
<b>1 Introduction</b> .....	<b>1-1</b>
1.1 Background.....	1-1
1.1.1 Potentially Occurring Special Status Species.....	1-1
1.1.2 Previously Mapped Vegetation and Land Cover Types.....	1-6
1.2 Purpose and Objectives of the Terrestrial Surveys.....	1-6
1.3 Survey Area.....	1-6
1.4 Survey Schedule and Personnel .....	1-6
<b>2 Survey Methodology</b> .....	<b>2-1</b>
2.1 Terrestrial Survey Methods .....	2-1
2.2 Survey Equipment and Standards.....	2-1
2.3 Data Collected for Special Status Species.....	2-3
<b>3 Survey Results</b> .....	<b>3-1</b>
3.1 Special Status Wildlife Species .....	3-1
3.2 Non-Special Status Wildlife Species Observed.....	3-4
3.3 Special Status Plant Species.....	3-4
3.4 Vegetation and Land Cover Types .....	3-4
3.4.1 Urban Builtup .....	3-5
3.4.2 Mangrove Forest.....	3-5
3.4.3 Urban Cultivated-Food.....	3-5
3.4.4 Urban Cultivated–Ornamental .....	3-6
3.4.5 Coastal Mixed .....	3-6
3.4.6 Secondary Vegetation.....	3-6
3.4.7 Agroforest.....	3-6
3.4.8 Potential Coastal Wetland.....	3-6
3.5 Other Notable Vegetation .....	3-7
<b>4 Discussion</b> .....	<b>4-1</b>
4.1 Yap Flying Fox.....	4-1
4.2 Migratory Bird Treaty Act Protected Species .....	4-1
4.3 Burmese Rosewood .....	4-1
4.4 Survey Notes and Recommendations.....	4-2
<b>List of Preparers</b> .....	<b>P-1</b>
<b>References</b> .....	<b>R-1</b>

## Appendices

- A Survey Photographic Record
- B Survey Summary Data Matrix
- C Complete List of Species Observations

## List of Figures

1-1	Federated States of Micronesia Location Map .....	1-2
1-2	Yap Location Map .....	1-3
1-3	Yap Port Location Map.....	1-4
1-4	Terrestrial Survey Area Location Map .....	1-7
2-1	Survey Tracks .....	2-2
3-1	Survey Results–Chamorro Bay Linear Survey Area.....	3-2
3-2	Survey Results–Yap Port Survey Area .....	3-3

## List of Tables

1-1	International Union for Conservation of Nature Red List Species Known or with the Potential to Occur in Yap .....	1-5
1-2	Survey Dates, Times, and Weather Conditions .....	1-8
1-3	Project Team and Survey Personnel .....	1-8
3-1	Special Status Wildlife Species Observed .....	3-1
3-2	Migratory Bird Treaty Act Species Observed.....	3-1
3-3	Special Status Plant Species Observed .....	3-4
3-4	Vegetation and Land Cover in the Chamorro Bay Linear Survey Area .....	3-4
3-5	Vegetation and Land Cover in the Yap Port Survey Area .....	3-5
C-1	Species List–Plants.....	C-3
C-2	Species List–Wildlife .....	C-5

# 1 Introduction

---

## 1.1 Background

The Federated States of Micronesia (FSM) is one of the three sub-regions of Pacific Ocean islands, which also include Melanesia and Polynesia (Figure 1-1). The FSM is composed of four states—Yap, Chuuk, Kosrae, and Pohnpei—that collectively include over 607 islands (CIA 2023). Yap consists of four main islands, Yap Island (Maraba'-Numagil), Gagil-Tamil, Maap, and Rumung (Figure 1-2). The outer 134 small, low coralline Yap islands span more than 100,000 square miles (259 square kilometers) and are collectively referred to as the outer or neighboring islands, or "Remathau" (FSM 2018).

Yap State's total land area is 46 square miles (119 square kilometers). The maximum elevation of Yap Island (Maraba'-Numagil) is 571 feet (174 meters), while the outer islands' maximum height is 16.4 feet (5 meters) (FSM 2018). Colonia, located on Yap Island, is the capital of Yap State and contains Colonia (Tamil) Harbor. Tamil Harbor is surrounded by coral reef and mangrove habitat. Yap Port is located on the north side of the largely developed peninsula and provides services for international and domestic cargo, fuel tankers, interisland passenger ships, and occasional longline-fishing vessels (Figure 1-3). Ships travel through a 1.5-mile-long (2.5-kilometer-long) reef passageway, Tamil Channel, to the 230-foot-long (70-meter-long) wharf in Yap Port.

People have lived on Yap for more than 2000 years (Napolitano 2021) and was subject to colonial rule since the 19th century. European traders and missionaries sporadically visited Yap and its outer islands from the 16th to 18th centuries (Hezel 1979). In 1885, Spain purchased Blelaach, a small island off Colonia from a CHamoru woman living on Yap, whose husband received ownership from Nimar village. During the late 19th century, German merchants began transporting goods throughout the region, ushering in a new era of commerce and tension between Spanish and German economic and political interests. Later in 1885, Pope León XIII declared the Caroline Islands to be owned by Spain. In 1899, Germany purchased the Caroline Islands and the Northern Mariana Islands (present day Commonwealth of the Northern Marianas) (Lévesque 2005b, 354–355). Japan began military occupation of Yap in 1914 and officially assumed control of Yap as a protectorate in 1919 (CIA 2022; Yap Visitors Bureau, n.d.). Military installations including concrete foundations, buildings, harbor piers, and other types of infrastructure were built around Yap during a fortification effort from the Japanese administration until the United States' occupation of Yap in 1945 (DON 2022). Following the United States' campaign across the Pacific during World War II, Yap came under United States administration in the Trust Territory of Pacific Islands in 1947 (CIA 2022).

The Cardno GS – AECOM Pacific Joint Venture (CAP JV) prepared a cultural desktop analysis report in 2022 and used this for planning purposes to inform what historic properties and other cultural resources may exist in the terrestrial and marine cultural survey areas. The CAP JV prepared a work plan and dive operations plan in 2023 that outlined proposed methodology, data management, reporting, planning contingencies, schedule, and personnel roles during the prescribed fieldwork (DON 2023; CAP JV 2023). This field report summarizes the cultural surveys that occurred between April and May 2023.

### 1.1.1 Potentially Occurring Special Status Species

The International Union for Conservation of Nature Red List maintains a running list of special status species known or with the potential to occur in Yap (IUCN Red List 2022). A total of 13 species on the International Union for Conservation of Nature Red List were identified with the potential to occur in Yap and are presented in Table 1-1. Yap Port and adjacent areas are largely developed and/or contain disturbed habitats; therefore, it was not expected that all species in Table 1-1 would or have the potential to occur in the terrestrial survey area.

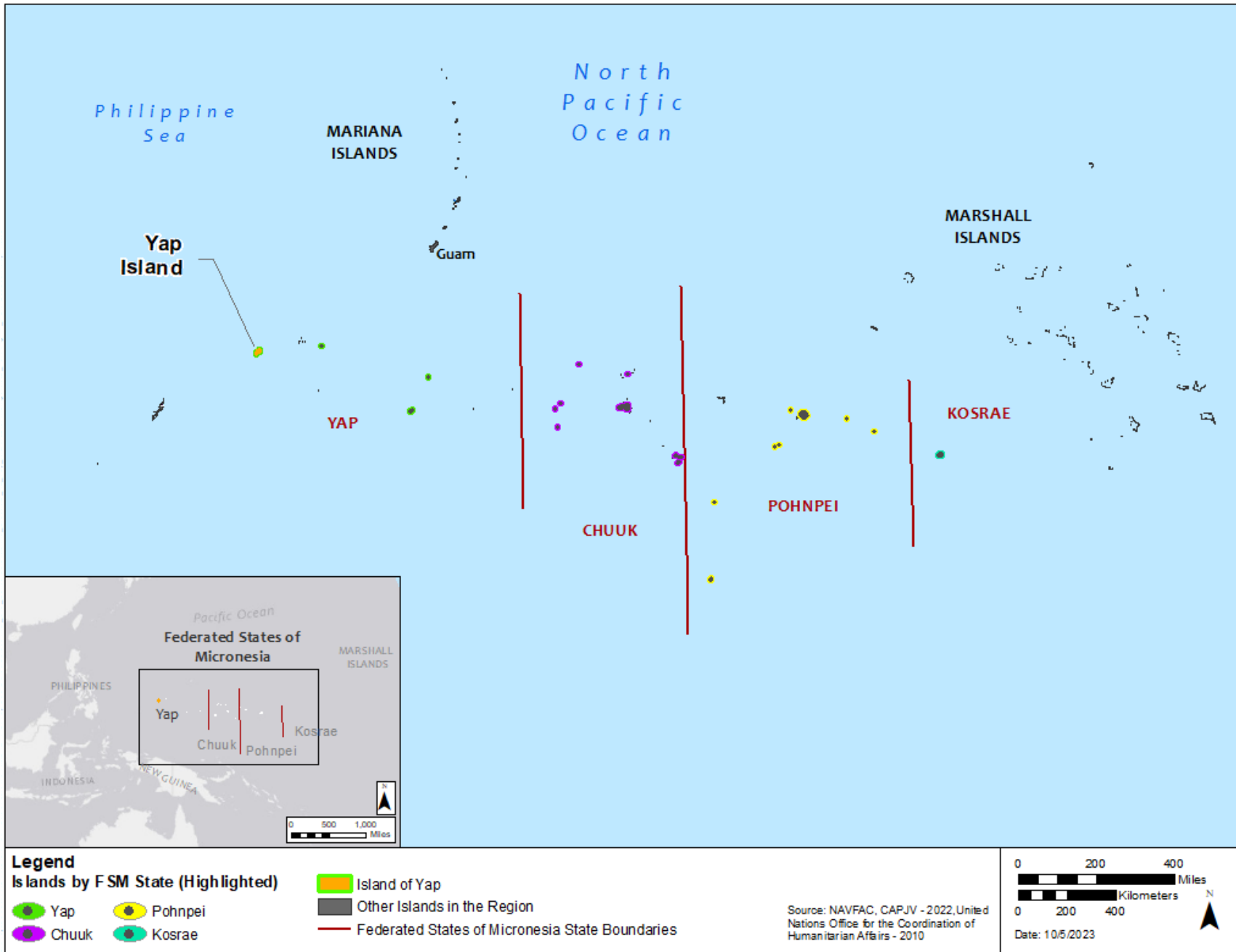


Figure 1-1 Federated States of Micronesia Location Map

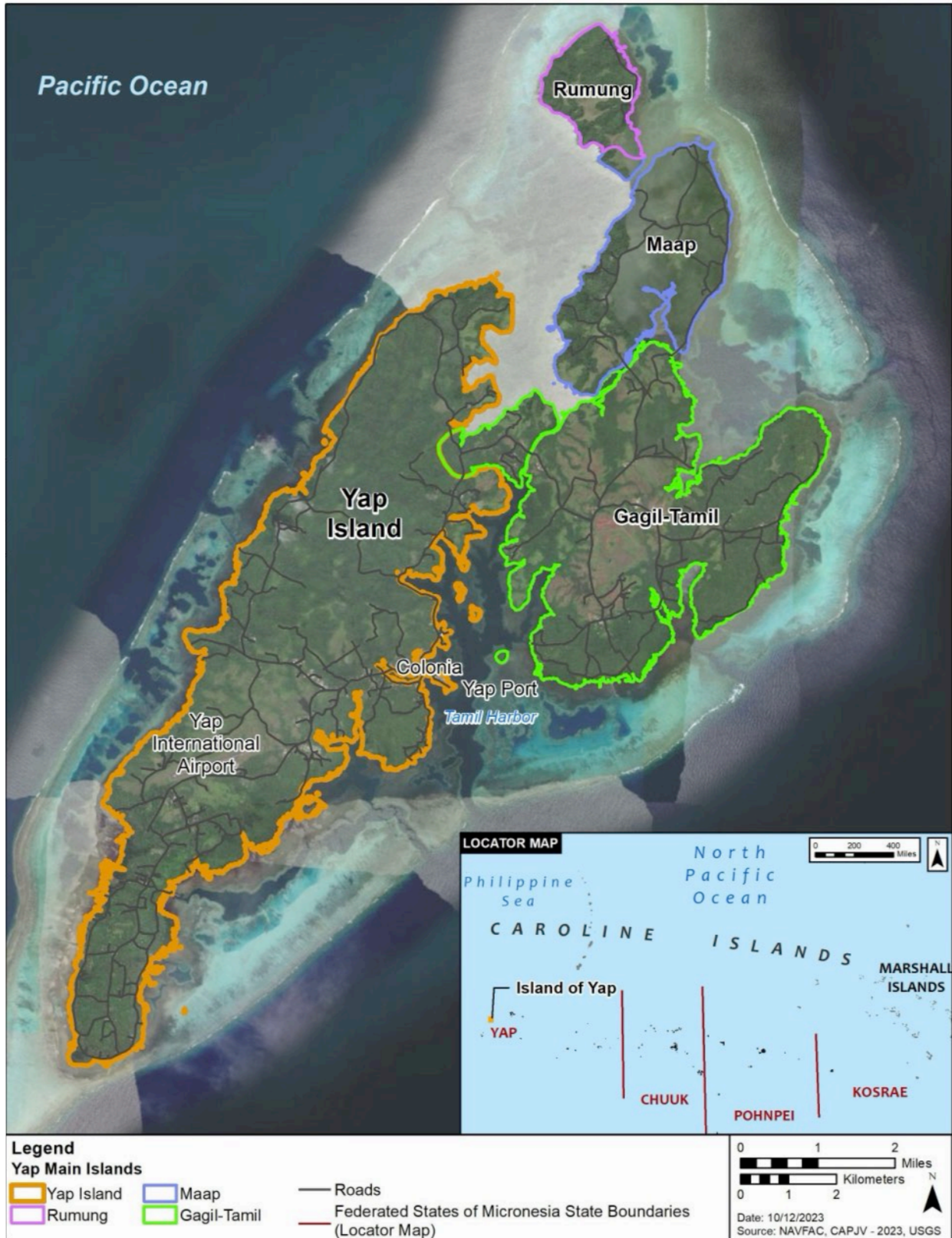


Figure 1-2 Yap Location Map

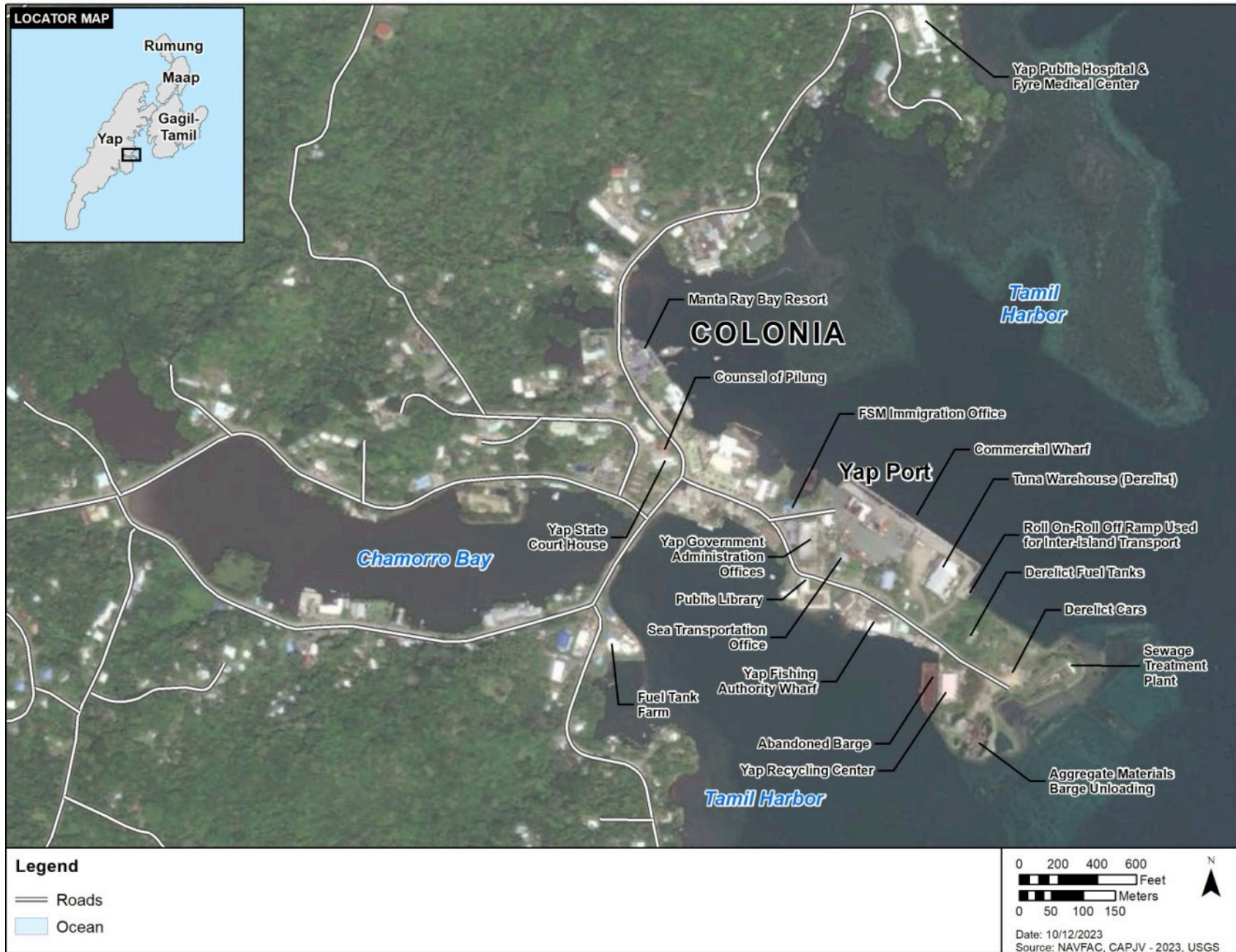


Figure 1-3 Yap Port Location Map

**Table 1-1 International Union for Conservation of Nature Red List Species Known or with the Potential to Occur in Yap**

Scientific Name	Common Name	IUCN Red List Status	Habitat
<b>Birds</b>			
<i>Pseudobulweria becki</i>	Beck's petrel	Critically Endangered	Seabird that is likely to nest in burrows on the slopes of high mountains on larger islands but may also breed on small islets.
<i>Edolisoma nesiotis</i>	Yap cicadabird	Endangered	Recorded in both forest and savanna habitats but at four times the density in forests than savannas.
<i>Pampusana xanthonura</i>	White-throated ground dove	Near Threatened	Inhabits native forests, secondary forests, plantations, introduced <i>Leucaena leucocephala</i> thickets, and habitat mosaics including fields, but appears more frequently in native forests than in disturbed habitats.
<i>Monarcha godeffroyi</i>	Yap monarch	Near Threatened	Inhabits virtually all forest types, including mangroves and secondary forests.
<i>Zosterops hypolais</i>	Yap plain white-eye	Near Threatened	Found in nearly all forest and vegetation types, including brushy thickets in open savannas and meadows.
<i>Zosterops oleagineus</i>	Yap olive white-eye	Near Threatened	Widely distributed in all forest types and woody vegetation, including mangroves, but shows a preference for better-developed forests.
<b>Reptiles</b>			
<i>Perochirus ateles</i>	Micronesian saw-tailed gecko	Vulnerable	Found in palm leaf axils, in shrubs and bushes, and under loose, flaking bark on trees. Highly arboreal and occurs in both disturbed and natural forests.
<b>Mammals</b>			
<i>Pteropus pelewensis yapensis</i>	Yap flying fox	Vulnerable	Roosts and forages mainly in mangroves and secondary forests.
<b>Plants</b>			
<i>Cycas micronesica</i>	Federico nut	Threatened	Shrub to tree (up to 39 feet tall) that occurs in closed forests on coral limestone or coral sand, and occasionally on volcanic soils.
<i>Intsia bijuga</i>	Pacific teak	Near Threatened	Lowland rainforest tree (up to 82 feet tall), often found on sand and coral beaches, but also in periodically inundated localities further inland. It also occurs in dryland mangroves.
<i>Pericopsis mooniana</i>	Nandu wood	Vulnerable	Large tree (up to 131 feet tall), mainly found scattered within coastal forests.
<i>Pterocarpus indicus</i>	Burmese rosewood	Endangered	Large tree (up to 131 feet tall) found in lowland primary and some secondary forests, mainly along tidal creeks, and rocky shores, but can occur up to 4,265 feet above sea level.
<i>Metroxylon amicarum</i>	Ivory nut palm	Near Threatened	Large palm (up to 82 feet tall). Occurs from sea level up to 1,804 feet above sea level.

Legend: IUCN = International Union for Conservation of Nature.

Sources: Falanruw (2002); FSM (2019); IUCN Red List (2022).

### **1.1.2 Previously Mapped Vegetation and Land Cover Types**

Figure 1-4 depicts 11 vegetation and land cover types in the Colonia area previously mapped in 2005 (iREi 2005). Five types were previously mapped within the terrestrial survey area, including agroforest, barren, mangrove forest, urban builtup, and urban cultivated using geospatial information published by the Department of Environment, Climate Change & Emergency Management of FSM (iREi, WERI, and DECEM 2023).

## **1.2 Purpose and Objectives of the Terrestrial Surveys**

The purposes of the terrestrial surveys were to document flora and fauna presence within the terrestrial survey area at Yap Port and the surrounding areas (Figure 1-4) by mapping and describing vegetation and land cover types, as well as to identify the presence of special status wildlife and vegetation species. The primary objective of the terrestrial surveys was to identify what resources exist within the port and associated survey areas in Yap to support any environmental evaluations and consultations potentially required by laws, regulations, or policies.

The survey report will provide the United States Indo-Pacific Command with the necessary information to conduct future analysis regarding harbor development on terrestrial biological resources, and to comply with United States federal, FSM, or Yap State environmental laws, regulations, and policies potentially applicable to federal actions.

## **1.3 Survey Area**

The terrestrial survey area is located on the southeast coast of Yap Island along the north side of a largely developed peninsula (Figure 1-3). For the purpose of this project, the survey area was divided into two distinct survey areas. The Yap Port Survey Area includes approximately 22.9 acres (9.3 hectares) on the publicly accessible developed peninsula where the sea port and numerous buildings are located. The Chamorro Bay Linear Survey Area is a loop along approximately 1.3 miles (2.1 kilometers) of a public road around Chamorro Bay, including a road that connects the Yap Port to the Chamorro Bay Linear Survey Area. These distinct survey areas are depicted in Figure 1-4.

## **1.4 Survey Schedule and Personnel**

Surveys were conducted on six consecutive days from April 26 to May 1, 2023 (Yap time zone). Survey start/end times and weather descriptions for each survey day are included in Table 1-2. As few wildlife individuals were observed during midday periods, surveyors shifted the survey window from midday to the morning and late afternoon/evenings to optimize opportunities to document species presence on separate occasions. Overall, the total field time spent conducting the terrestrial surveys was 34 hours.

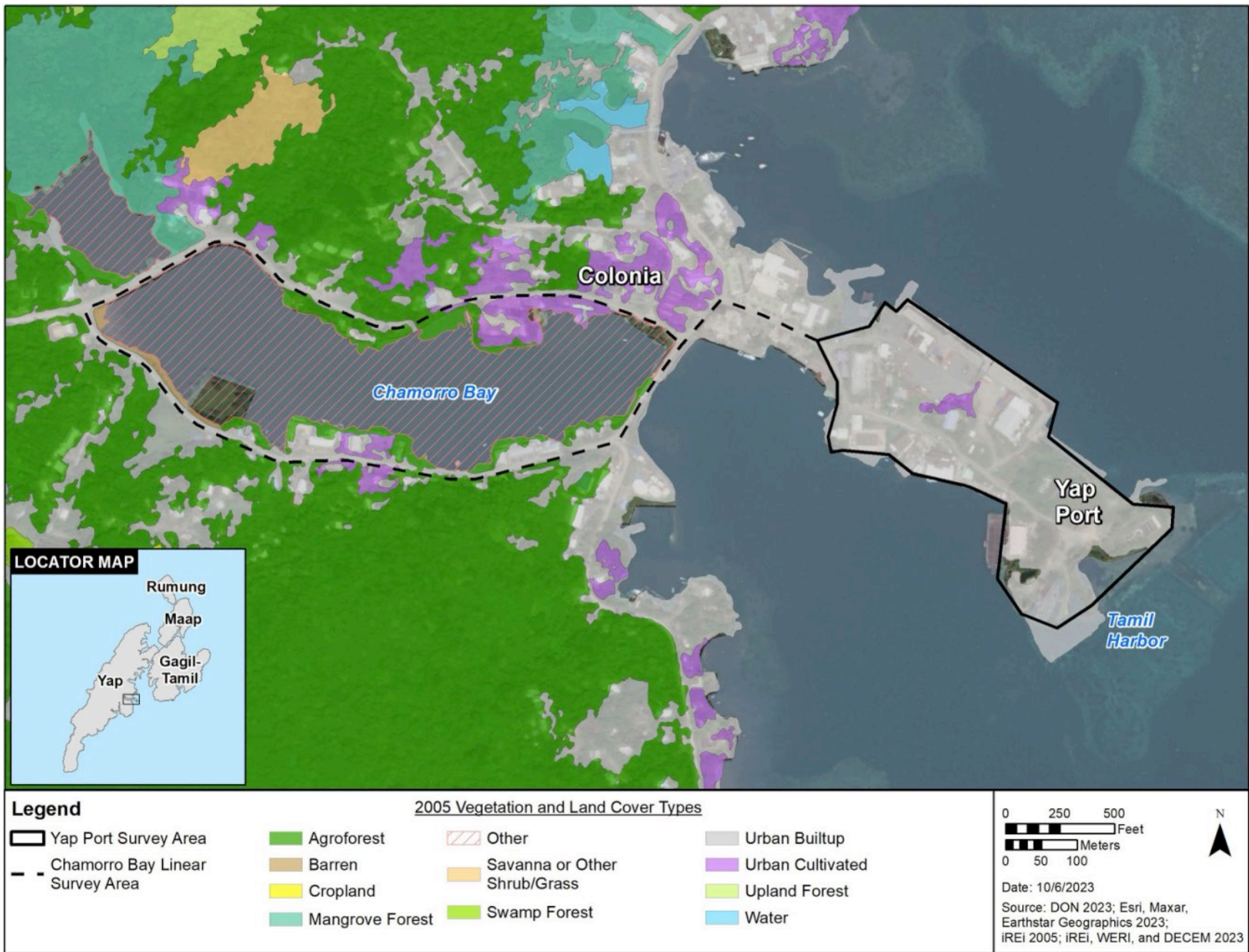


Figure 1-4 Terrestrial Survey Area Location Map

**Table 1-2 Survey Dates, Times, and Weather Conditions**

Survey Date <sup>a</sup>	Start Time	End Time	Total Time (Hours)	Weather Conditions
April 26, 2023	9:45 a.m.	12:00 p.m.	2.25	Clear, little wind, no rain, mid-80s (°F)
April 27, 2023	5:45 a.m.	7:30 a.m.	1.75	Clear, little wind, no rain, mid-80s (°F)
April 27, 2023	8:30 a.m.	2:45 p.m.	6.25	Clear, little to no wind, no rain, mid-80s (°F)
April 27, 2023	6:30 p.m.	7:30 p.m.	1.00	Clear, little wind, no rain, mid-80s (°F)
April 28, 2023	5:45 a.m.	7:30 a.m.	1.75	Clear, little wind, light rain, mid-80s (°F)
April 28, 2023	1:30 p.m.	5:45 p.m.	4.25	Clear, little wind, light rain, p.m. thunderstorm, mid-80s (°F)
April 29, 2023	6:00 a.m.	8:00 a.m.	2.00	Scattered clouds, slight breeze, light rain, mid-80s (°F)
April 29, 2023	2:45 p.m.	7:30 p.m.	4.75	Scattered clouds, slight breeze, light rain, mid-80s (°F)
April 30, 2023	6:30 a.m.	9:00 a.m.	2.50	Scattered clouds, breezy, scattered heavy rain, mid-80s (°F)
April 30, 2023	12:30 p.m.	2:00 p.m.	1.50	Scattered clouds, breezy, no rain, mid-80s (°F)
April 30, 2023	3:00 p.m.	5:00 p.m.	2.00	Cloudy, breezy, no rain, mid-80s (°F)
May 1, 2023	6:30 a.m.	10:00 a.m.	3.50	Cloudy, breezy, scattered rain, high-80s (°F)
May 1, 2023	11:30 a.m.	12:00 p.m.	0.50	Cloudy, breezy, scattered rain, high-80s (°F)

Legend: °F = degree Fahrenheit.

<sup>a</sup> Survey date noted in Yap time zone (YAPT).

The team members involved in performing the project tasks are listed in Table 1-3 along with their project-specific roles. The survey personnel consisted of Hannah Hubanks (field biologist) and Michele Lefebvre (field biologist).

**Table 1-3 Project Team and Survey Personnel**

Role	Name	Organization
Field Biologist/Health and Safety Coordinator	Hannah Hubanks	Stantec GS Inc.
Field Biologist	Michele Lefebvre	
Terrestrial Biologist/CAP JV/ Stantec Deputy Project Manager	Clint Scheuerman	
Stantec Project Manager	Ben Berridge	
CAP JV Program Manager	William Halperin	
GIS Analyst	Travis Gahm	
Field Coordinator	Christian Warren	
AECOM Deputy Project Manager	Brittany Obando	
CAP JV Project Manager and QA/QC Manager	Kevin Butterbaugh	
TOCOR	Lorraine Shaughnessy	NAVFAC
Alternate TOCOR	Jill Sears	
Alternate TOCOR	Maria Carnevale	
Contracting Specialist	Casey Sugihara	

Legend: AECOM = AECOM Technical Services, Inc.; CAP JV = Cardno GS – AECOM Pacific Joint Venture; GIS = geographic information system; QA = quality assurance; QC = quality control; Stantec = Stantec GS Inc.; TOCOR = Task Order Contracting Officer’s Representative; NAVFAC = Naval Facilities Engineering Systems Command.

## 2 Survey Methodology

---

### 2.1 Terrestrial Survey Methods

Two terrestrial biologists, Hannah Hubanks and Michele Lefebvre, surveyed the entire survey area using the geographic information system (GIS)-provided boundaries in Figure 1-4. One surveyor carried a portable Global Positioning System (GPS) unit with a tracking application to continuously track the movements of the surveyors, as depicted by the survey tracks in Figure 2-1. The Chamorro Bay Linear Survey Area was surveyed by walking along both sides of the public access shoulders of the loop road. Pedestrian surveys were conducted in the Yap Port Survey Area by meandering to ensure full visual inspection. No transects were required as full visual inspections could be completed via the meandering survey method. A large area of debris on the northeastern end of Yap Port was encountered during the surveys that contained herbaceous vegetative growth over derelict vehicles and refuse materials. This area was surveyed visually without entering it due to safety concerns. This method was communicated and confirmed with the Naval Facilities Engineering Systems Command representative on site at the time (April 26, 2023). Vegetation and land cover types were mapped using both line data (along each side of the Chamorro Bay Linear Survey Area) and polygon data (Yap Port Survey Area). Special status wildlife and plant species observations were also recorded during these surveys.

Where special status species were identified, surveyors stopped to map the location(s) of species and collect baseline data (refer to Section 2.3 for the types of data collected). Locations of special status species were mapped using portable GPS units with sub-meter accuracy. For any observed plant species of interest that grew in clumps, groves, or stands, the boundaries of the population were mapped on the GPS in the form of a polygon (or a line, if the plants were observed along a private property). Likewise, for wildlife species of interest that occurred in multiples on the ground, the boundaries of the population were mapped on the GPS in the form of a polygon. When wildlife species of interest in multiples were not on the ground, a data point was taken instead of a polygon.

In some instances, particularly within areas of debris in Yap Port, piles of miscellaneous scrap metal prohibited surveyors from walking through certain areas. In such cases, surveyors walked as close as safely possible to the edge of the refuse materials and visually scanned the area with binoculars. In all cases, the surveyors had complete visual coverage of the survey area. In addition, surveyors walked a very short distance outside of the survey boundaries in certain areas where they thought there might be an opportunity to view wildlife/plant species of interest and/or gain a better view into portions of the survey area (Figure 2-1). However, minimal time was spent doing this (up to 5 minutes) and survey efforts were focused on the survey areas as indicated by the survey tracks in Figure 2-1.

### 2.2 Survey Equipment and Standards

The surveyor team was equipped with one portable/handheld Trimble Geo7x GPS unit with sub-meter level mapping accuracy. Following surveys, data were downloaded, backed up, and viewed using Pathfinder Office software to ensure data completeness prior to survey completion. Field survey personnel were equipped with proper clothing, personal protective equipment, and binoculars.



Figure 2-1 Survey Tracks

## **2.3 Data Collected for Special Status Species**

Where special status species were detected; the field survey personnel documented the following on a GPS unit:

1. Species name.
2. GPS location (sub-meter level accuracy).
3. For individual occurrences of an organism, a single data point was collected, and relevant data noted.
4. For any species detected that occurred in multiples (e.g., colony, clumps, groves, or stands) the locations were mapped in the form of a polygon along with the number of individuals within the polygon.
5. Host plant species (if applicable).
6. Life stage (e.g., adult, juvenile, sapling, seedling, egg, larva, chrysalis) (if applicable and discernible in the field).
7. Reproductive stage (e.g., flowering, fruiting) (if applicable and discernible in the field).
8. Condition (if applicable and discernible in the field):
  - a. Excellent (no sign of deterioration; very healthy)
  - b. Good (appears healthy/vigorous)
  - c. Fair (relatively healthy; signs of loss of vigor)
  - d. Poor (poor vigor; signs of dying)

This page intentionally left blank.

## 3 Survey Results

Results of the baseline terrestrial surveys are summarized in Table 3-1 through Table 3-5 and are depicted in Figure 3-1 and Figure 3-2 as 2023 vegetation types. Where more than a single individual was observed, callouts are provided in Figure 3-1 and Figure 3-2 to specify the number of individuals observed, including where groups of individuals occurred in close proximity to each other. Appendix A contains a photo log of the survey area, including wildlife that could be captured on camera, as well as special status plants and vegetation and land cover types. Appendix B contains a complete data matrix for GIS species data collected during the surveys. All GIS survey data collected in the field have been provided to Naval Facilities Engineering Systems Command as a part of this deliverable.

### 3.1 Special Status Wildlife Species

Table 3-1 details the survey data collected for the special status wildlife species that were observed and mapped. In total, two individual Yap flying foxes (*Pteropus pelewensis yapensis*) were observed and mapped. Table 3-2 summarizes the survey data collected for species protected under the MBTA that were observed and mapped. Seven species of birds protected under the MBTA were documented performing a variety of activities such as flying, foraging, and resting. Discussions of mapped individuals of special status and protected wildlife species are provided in Section 4.

**Table 3-1 Special Status Wildlife Species Observed**

Scientific Name	Common Name	IUCN Red List Status	Mapped Individuals	Life Stage/Condition/Notes
<i>Pteropus pelewensis yapensis</i>	Yap flying fox	Vulnerable	2	Adults observed in flight, flying separately, and appeared healthy given the limited visibility

Legend: IUCN = International Union for Conservation of Nature.

**Table 3-2 Migratory Bird Treaty Act Species Observed**

Scientific Name	Common Name	Mapped Individuals	Life Stage/Condition/Notes
<i>Ardea intermedia</i>	Intermediate egret	2	Healthy adult individuals, each observed foraging in grass and vegetation
<i>Arenaria interpres</i>	Ruddy turnstone	8	Healthy adult individuals observed foraging in grass
<i>Bubulcus ibis</i>	Cattle egret	1	Foraging adult, appeared healthy
<i>Charadrius leschenaultii</i>	Greater sand plover	1	Healthy juvenile observed foraging in grass
<i>Gygis alba</i>	White tern	15	Groups of adult individuals observed in flight as well as perched in trees, appeared healthy
<i>Ixobrychus sinensis</i>	Yellow bittern	1	Adult observed flying and then perched in a young mangrove, appeared healthy
<i>Pluvialis fulva</i>	Pacific golden plover	3	Healthy adult individuals, observed foraging and in flight

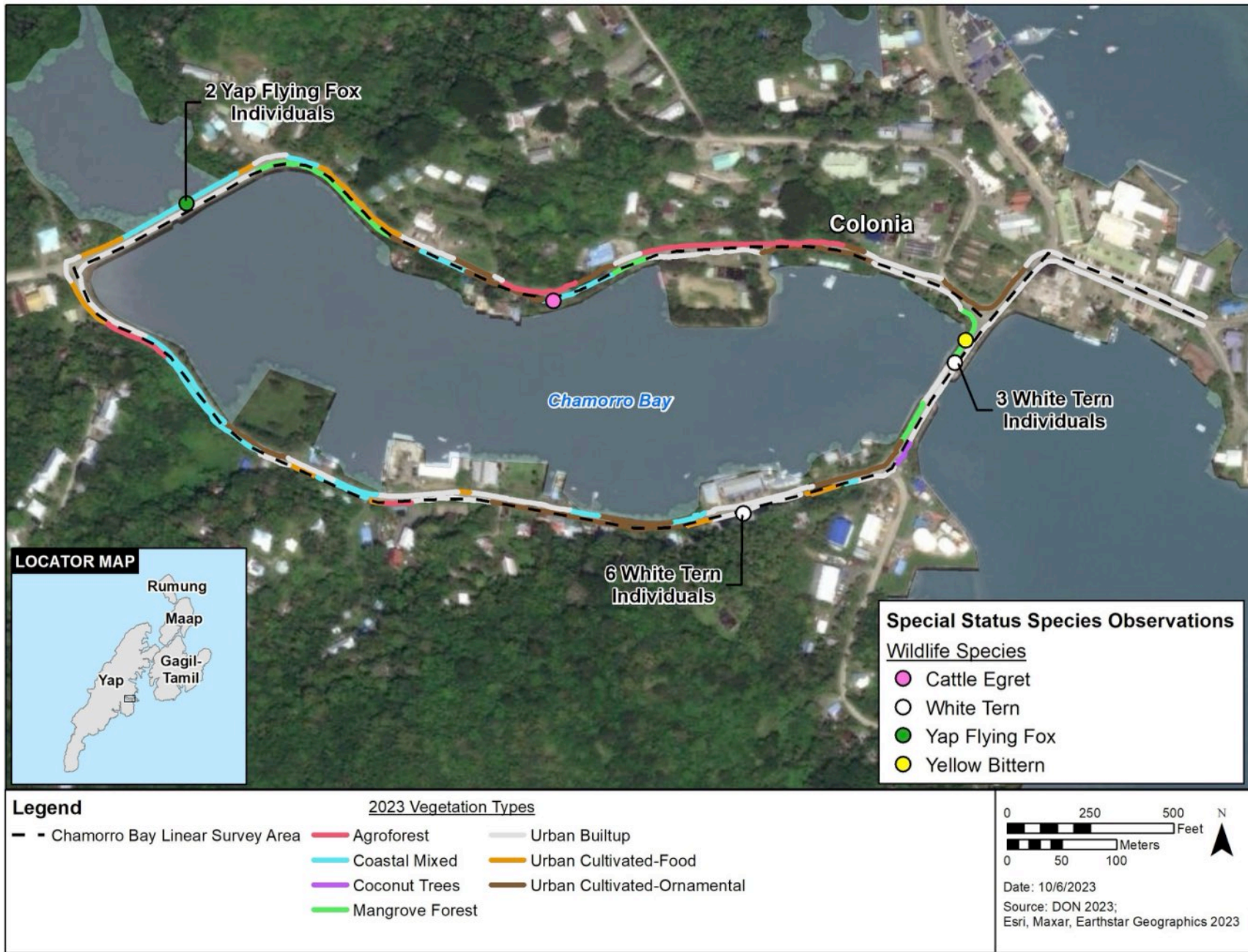


Figure 3-1 Survey Results—Chamorro Bay Linear Survey Area

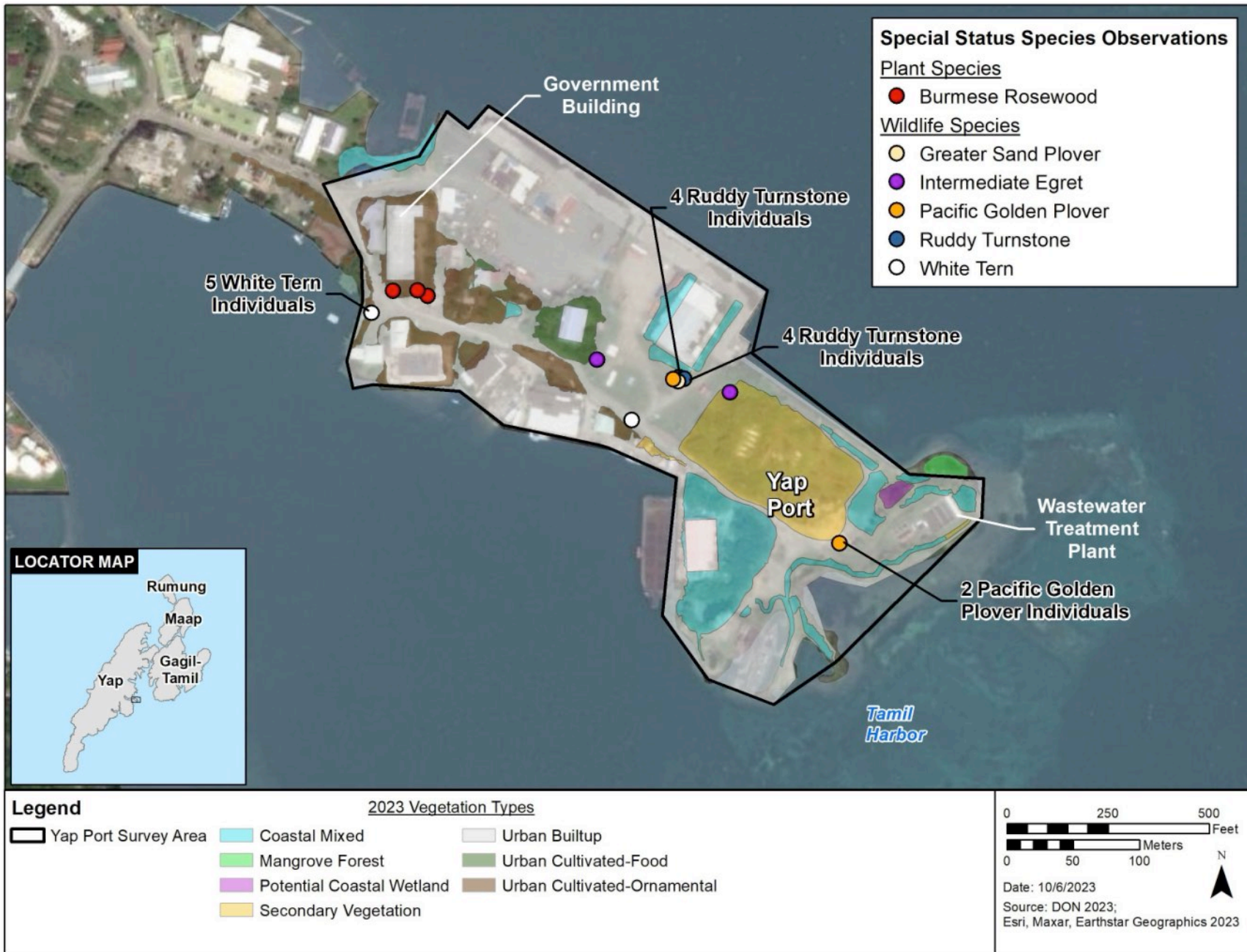


Figure 3-2 Survey Results–Yap Port Survey Area

### 3.2 Non-Special Status Wildlife Species Observed

Common bird species were observed throughout the survey area performing a variety of activities such as flying, foraging, and resting/perching. Common bird species observed included the Micronesian starling (*Aplonis opaca*), Micronesian myzomela (*Myzomela rubratra*), and Eurasian tree sparrow (*Passer montanus*). One individual rufous fantail (*Rhipidura rufifrons*) was documented. The emerald tree skink (*Lamprolepis smaragdina*) was commonly observed, and one occurrence of the littoral whiptail skink (*Emoia atrocostata*) was documented. Total counts of each species collected during the surveys are documented in Appendix B.

### 3.3 Special Status Plant Species

Table 3-3 details the survey data collected for the special status plant species that were observed and mapped. In total, three Burmese rosewood (*Pterocarpus indicus*) were mapped in the Yap Port Survey Area. A discussion of mapped individuals of special status and protected plant species is provided in Section 4.

**Table 3-3 Special Status Plant Species Observed**

Scientific Name	Common Name	IUCN Red List Status	Mapped Individuals	Life Stage/Condition/Notes
<i>Pterocarpus indicus</i>	Burmese rosewood	Endangered	3	Adults, mature, and fruiting; approximately 40 to 50 feet in height

Legend: IUCN = International Union for Conservation of Nature.

### 3.4 Vegetation and Land Cover Types

Table 3-4 and Table 3-5 provide the total linear distance or acreage of each vegetation and land cover type documented in both survey areas (Figure 3-1 and Figure 3-2). The dominant vegetation/land cover type in both the Chamorro Bay Linear Survey Area and Yap Port Survey Area is urban builtup, followed by coastal mixed and urban cultivated–ornamental. A list of all species observed during the surveys are documented in Appendix C.

**Table 3-4 Vegetation and Land Cover in the Chamorro Bay Linear Survey Area**

Vegetation and Land Cover Type	Linear Distance (Feet)
Agroforest <sup>a</sup>	1,137.4
Coastal Mixed <sup>b</sup>	2,127.1
Mangrove Forest <sup>a</sup>	923.8
Urban Builtup <sup>a</sup>	5,943.2
Urban Cultivated <sup>a</sup> –Food <sup>b</sup>	985.1
Urban Cultivated <sup>a</sup> –Ornamental <sup>b</sup>	2,642.3
<b>Total</b>	<b>13,758.9</b>

<sup>a</sup> iREI, WERI, and DECEM (2023).

<sup>b</sup> Identified based on field observations.

**Table 3-5 Vegetation and Land Cover in the Yap Port Survey Area**

<b>Vegetation and Land Cover Type</b>	<b>Acreage</b>
Coastal Mixed <sup>a</sup>	2.54
Coastal Wetland <sup>a</sup>	0.01
Mangrove Forest <sup>a</sup>	0.07
Urban Builtup <sup>a</sup>	2.36
Secondary Vegetation <sup>c</sup>	15.10
Urban Cultivated <sup>b</sup> –Food <sup>a</sup>	0.47
Urban Cultivated <sup>b</sup> –Ornamental <sup>a</sup>	1.91
<b>Total</b>	<b>22.46</b>

<sup>a</sup> Identified based on field observations.

<sup>b</sup> iREI, WERI, and DECEM (2023).

<sup>c</sup> Falanruw (2002).

Eight vegetation and land cover types were documented in the survey area: urban builtup; mangrove forest; urban cultivated–food; urban cultivated–ornamental; coastal mixed; secondary vegetation; agroforest; and potential coastal wetland (no formal wetland delineation was conducted). Descriptions of the vegetation and land cover types and their characteristic species are included below. A list of plant species encountered is included in Appendix C.

### **3.4.1 Urban Builtup**

Urban builtup are areas where buildings, roads, and bridges are interspersed with manicured grass, herbaceous weeds and grasses growing within cracks in the concrete or gravel, or no vegetation at all. These areas were located along the Chamorro Bay Linear Survey Area on bridges, parking lots, and commercial and residential developments (Figure 3-1). Urban builtup areas were found in the Yap Port Survey Area in areas containing Yap Government facilities, buildings, and roads (Figure 3-2).

### **3.4.2 Mangrove Forest**

Mangrove forests are the most distinctive vegetation type in Yap, with species that have specialized roots inundated at least periodically by sea water. Mangroves surround most of Yap’s coast and serve as a natural filtering and nutrient buffering system between the island and lagoon, settling silt and providing for a slow sustained release of nutrients (Falanruw et al. 1987).

The presence of mangrove forest in the survey area was distinguished by the exclusive presence of the prop-rooted mangrove tree (*Rhizophora apiculata*). This vegetation type in the survey area consisted of narrow bands of mangrove trees growing along the water’s edge near the two bridges in the Chamorro Bay Linear Survey Area (Figure 3-1) and north of the Colonia Wastewater Treatment Plant in the Yap Port Survey Area (Figure 3-2).

### **3.4.3 Urban Cultivated-Food**

The urban cultivated–food vegetation type was found in residential gardens in the Chamorro Bay Linear Survey Area (Figure 3-1) and around Yap Government buildings in the Yap Port Survey Area (Figure 3-2) that were intentionally planted and actively cultivated. Species observed in this vegetation type included the following: banana (*Musa* sp.), betel nut (*Areca catechu*), breadfruit (*Artocarpus altilis*), citrus (*Citrus* spp.), coconut (*Cocos nucifera*), mango (*Manifera indica*), giant swamp taro (*Cytosperma merkusii*), Indian mulberry (*Morinda citrifolia*), papaya (*Carica papaya*), sugar cane (*Saccharum officinarum*), sweet taro (*Colocasia esculenta*), and Jamaican cherry (*Muntingia calabura*).

### **3.4.4 Urban Cultivated–Ornamental**

The urban cultivated–ornamental vegetation type was found in residential gardens in the Chamorro Bay Linear Survey Area (Figure 3-1) and around Yap Government buildings in the Yap Port Survey Area (Figure 3-2) that were planted and actively cultivated with ornamental species predominantly consisting of herbs and shrubs, as well as dispersed trees including the following species: beach spider lily (*Hymenocallis littoralis*), bamboo (*Bambusa* sp.), red ginger (*Alpinia purpurata*), ornamental red ti (*Cordyline* sp.), Chinese hibiscus (*Hibiscus rosa-sinensis*), Arabian jasmine (*Jasminum sambac*), bougainvillea (*Bougainvillea* sp.), plumeria (*Plumeria* sp.), ixora (*Ixora* sp.), and bristly copperleaf (*Acalypha hispida*).

### **3.4.5 Coastal Mixed**

Coastal mixed includes both native and non-native coastal species and were located along the coast in the Chamorro Bay Linear Survey Area (Figure 3-1) and Yap Port Survey Area (Figure 3-2). Dominant species in this vegetation type included mango pine (*Barringtonia asiatica*), ironwood (*Casuarina equisetifolia*), sea hibiscus (*Hibiscus tiliaceus*), screwpine (*Pandanus tectorius*), and morning glory vine (*Ipomea pes-caprae*). Additional species encountered in this vegetation type included the following: beach pea (*Vigna marina*), chastetree (*Vitex trifolia*), climbing vine (*Derris trifoliata*), dodder laurel (*Cassytha filiformis*), fan flower (*Scaevola* sp.), large morning glory (*Merremia* spp.), nephrolepsis (*Nephrolepsis* sp.), pongame oiltree (*Millettia pinnata*), and sea almond (*Terminalia catappa*).

### **3.4.6 Secondary Vegetation**

Secondary vegetation is a forested or shrubby vegetation class that is somewhat intermediate between forest and non-forest. Secondary vegetated areas are generally covered with fast-growing weedy species (Falanruw et al. 1987). The dominant species for this vegetation type included morning glory vine, wedelia (*Sphagneticola trilobata*), and giant sleeping grass (*Mimosa invisa*). Other species encountered in this vegetation type include the following: koa haole (*Leucaena leucocephala*), wedelia (*Wedelia triloba*), sleeping grass (*Mimosa pudica*), threeleaf cayratia (*Cayratia trifolia*), barnyard grass (*Echinochloa crus-galli*), cutleaf groundcherry (*Physalis angulata*), riverhemp (*Sesbania* sp.), and frog fruit (*Phyla nodiflora*).

### **3.4.7 Agroforest**

Agroforest areas in Yap consist of a mixture of food and other useful trees found growing around villages. Scattered coconut trees and breadfruit trees are indicators of agroforest. The canopy is often uneven and may be interspersed with open areas of taro patches, croplands, and areas of secondary vegetation or upland forest too small to be separately mapped (Falanruw et al. 1987).

Agroforest was identified in the Chamorro Bay Linear Survey Area and dominant species present included a mixture of the following food or resource trees: banana, betel nut, breadfruit, coconut, and mango.

### **3.4.8 Potential Coastal Wetland**

A potential coastal wetland (based on the presence of wetland hydrology and the occurrence of known wetland plant species) was located adjacent to the Colonia Wastewater Treatment Plant and was comprised of standing water surrounded by a mud flat near the coast adjacent to the mangrove forest. The following species were encountered in this vegetation type: ficus (*Ficus* sp.), sedges (*Cyperus* sp., *Eleocharis* sp., *Fimbristylis* sp.), rush (*Juncus* sp.), beach mahogany (*Calophyllum inophyllum*), bantigue (*Pemphis acidula*), sea hibiscus (*Hibiscus tiliaceus*), and pongame oiltree (*Millettia pinnata*).

### **3.5 Other Notable Vegetation**

In addition to the special status plant species discussed above, one noteworthy species was identified during the survey, beach mahogany. This species is found in strand vegetation close to shore (above the high tide line) as well as inland habitats. The species is a culturally important plant in Yap, providing timber for use in construction of canoes, tools, house frames and pillars, and handicrafts. It is also used for firewood and a source of medicine (Merlin et al. 2019). Two individuals were documented in the potential coastal wetland area approximately 20 feet (6.1 meters) from the shore northwest of the Colonia Wastewater Treatment Plant in the Yap Port Survey Area (Figure 3-2).

Additionally, a strand of coconut trees was recorded on the east side of the Chamorro Bay Linear Survey Area that measured approximately 74 feet (22.5 meters) in length (Figure 3-1).

This page intentionally left blank.

## 4 Discussion

---

This section provides details on the special status species observed and mapped during the terrestrial surveys. Specific coordinates of all mapped points and polygons for species locations are provided in Appendix B.

### 4.1 Yap Flying Fox

The Yap flying fox is found on the four main islands of Yap plus Ulithi Atoll in the FSM. Limited information on abundance and trend are known, as no comprehensive surveys have been conducted since the mid-1980s (Wiles and Waldien 2021). The population was drastically reduced in the late 1970s via commercial hunting; however, qualitative observations indicate that the population is currently viable and healthy (Wiles and Waldien 2021).

Two adult Yap flying foxes were documented flying into Chamorro Bay over the west bridge at dusk and appeared to be in healthy condition. No daytime observations were made, although fruit trees were observed beyond the boundaries of the public roadway that could offer a food source for the Yap flying fox. It appeared to the surveyors that the two individual flying foxes were flying toward an agroforested area south of Chamorro Bay. Pteropodid bats feed by squeezing out the juices of plant parts, which they swallow, and then spit out pellets known as “ejecta” that contain the fibers and often seeds of the plant (Aziz et al. 2021). Ejecta can be an indicator of fruit bat day roost locations (Aziz et al. 2021); however, no ejecta was observed in the survey areas. Some suitable habitat for Yap flying foxes is located along the Chamorro Bay Linear Survey Area where agroforest fruit trees exist, as well as some mature mangrove forests adjacent and to the west of the loop road.

### 4.2 Migratory Bird Treaty Act Protected Species

Seven species of birds protected under the MBTA were observed performing a variety of activities such as flying, foraging, and resting within the survey area (Table 3-2). All individuals appeared healthy, and all were adults with the exception of one juvenile greater sand plover (*Charadrius leschenaultia*).

Two individuals of an additional unidentified shorebird species were observed drinking from a temporary puddle within the gated sea port; however, the birds were quickly startled and departed before they could be identified by surveyors. Suitable habitat exists for a variety of migratory birds within both survey areas.

### 4.3 Burmese Rosewood

Burmese rosewood is widely distributed throughout southeast Asia and the Pacific, grows well in tropical habitats up to 1,970 feet (600 meters) in elevation, and is widely cultivated as a timber tree and ornamental (National Tropic Botanical Garden 2023).

Three mature individuals of this species were documented adjacent to the Yap Government building along the road in Yap Port (Appendix A) (Figure 3-2). All three individuals were healthy, over 40 feet (13 meters) in height, and producing fruit at the time of the survey. Burmese rosewood fruit is found in round pods that are thick in the center with thin edges, bearing one to three seeds (Falanruw 2015).

It is anticipated, based on their location, that the trees were planted as ornamentals. The trees are suitable for landscaping and provide abundant shade for employees at the Yap Government building.

#### 4.4 Survey Notes and Recommendations

Incidental observations of wildlife by surveyors outside of the survey period and/or outside of the survey area suggest that a variety of additional bird species may frequent the Yap Port and Tamil Harbor area. The Yap monarch (*Monarcha godeffroyi*), Pacific reef heron (*Egretta sacra*), and white-throated ground dove (*Pampusana xanthonura*) were all seen along roadways near Colonia outside of the survey area. The common greenshank (*Tringa nebularia*) as well as another unidentified species of tattler (*Tringa* sp.) and an unidentified species of plover (*Pluvialis* sp.) were observed within the survey area after the survey period had commenced (species could not be confirmed without binocular use).

Birds and bats were more active and visible during early morning and evening hours than during the daytime. After an initial midday reconnaissance of the survey area, the surveyors used professional judgement to determine that there would be higher likelihood of observing wildlife species at dawn and dusk and conducted multiple surveys at these times (Table 1-2). Since the probability of detection is intrinsically linked to effort, the frequency of visits conducted during the survey reduced false absences and yielded a better reflection of the species richness and species use in the survey areas (Garrard et al. 2015). To improve methodology of surveys in the future, an emphasis on dawn and dusk survey times is encouraged which may improve opportunities for species observations (in addition to the daytime surveys necessary to ensure survey coverage of wildlife such as reptiles). It is recommended that the International Union for Conservation of Nature-listed endangered Burmese rosewood trees be preserved and protected because they are native to Yap, add to the biodiversity of the area, are rare, and provide habitat for species in this primarily urban environment. Following the development of a detailed project description, specific recommendations including environmental protection measures should be developed to avoid and minimize potential impacts to all special status wildlife and plant species and their habitats identified in the survey areas.

# List of Preparers

---

## **AECOM Technical Services, Inc.**

Kevin Butterbaugh, CAP JV Project Manager and Quality Assurance/Quality Control Manager  
Senior reviewer, project and technical content oversight, and quality assurance/control manager.

Brittany Obando, Deputy Project Manager  
Project content oversight, document content consistency, and finalization.

David Pecora, Technical Reviewer  
Technical content review.

Haley Cremer, Project Support  
Document content consistency and finalization.

Selena Qiu and Christopher Stoll, GIS Support  
GIS figure template development, revisions, and quality control.

Lily Nazareno and Austin Oshima, Technical Editors  
Document formatting, editing consistency, and finalization.

## **Stantec GS Inc.**

Clint Scheuerman, Terrestrial Biologist  
Supporting author and senior reviewer.

Hannah Hubanks, Field Biologist  
Primary technical author.

Michele Lefebvre, Field Biologist  
Supporting author.

Travis Gahm, GIS Analyst  
GIS figure development and revision.

Kimberly Wilson, Technical Editor  
Document editing and production.

This page intentionally left blank.

# References

---

- Aziz, Sheema Abdul, Kim R. McConkey, Krizler Tanalgo, Tuanjit Sritongchuay, Mary-Ruth Low, Joon Yee Yong, Tammy L. Mildenstein, Christine Ely Nuevo-Diego, Voon-Ching Lim, and Paul A. Racey. 2021. "The Critical Importance of Old World Fruit Bats for Healthy Ecosystems and Economies." *Frontiers in Ecology and Evolution* 9. <https://doi.org/10.3389/fevo.2021.641411>.
- Cardno GS – AECOM Pacific Joint Venture (CAP JV). 2023. *Pacific Deterrence Initiative Baseline Surveys for the Sea Port in Yap, Federated States of Micronesia, Final Dive Operations Plan*. Honolulu, HI: Naval Facilities Engineering Systems Command, Pacific under Contract No. N62742-18-D-1802, Task Order N6274222F0201. April 7.
- Central Intelligence Agency (CIA). 2022. "Northern Mariana Islands." *The World Factbook*. November 14, 2022. <https://www.cia.gov/the-world-factbook/countries/northern-mariana-islands/>.
- . 2023. "Micronesia, Federated States Of." *The World Factbook*. May 16, 2023. <https://www.cia.gov/the-world-factbook/countries/micronesia-federated-states-of/>.
- Department of the Navy (DON). 2022. *Draft Yap Port, Federated States of Micronesia Preliminary Joint Area Development Plan*. Prepared by MNDPI Pacific JV. Prepared for U.S. Indo-Pacific Command under the guidance of Naval Facilities Engineering Systems Command, Pacific. June.
- . 2023. *Final Work Plan for Baseline Cultural Resources Surveys for the Sea Port in Yap, Federated States of Micronesia*. Prepared by Cardno GS – AECOM Pacific Joint Venture. Honolulu, HI: Naval Facilities Engineering Systems Command, Pacific. March 13.
- Falanruw, Marjorie C. 2002. "Terrestrial Biodiversity of the Federated States of Micronesia." FSM National Biodiversity Strategy and Action Plan Project.
- . 2015. "Trees of Yap: A Field Guide." United States Department of Agriculture. [https://www.fs.usda.gov/psw/publications/documents/psw\\_gtr249/psw\\_gtr249.pdf](https://www.fs.usda.gov/psw/publications/documents/psw_gtr249/psw_gtr249.pdf).
- Falanruw, Marjorie C., Craig D. Whitesell, Thomas G. Cole, Colin D. MacLean, and Alan H. Ambacher. 1987. *Vegetation Survey of Yap*. Berkeley, CA: Pacific Southwest Forest and Range Experiment Station, U.S. Department of Agriculture. June. [https://www.fs.usda.gov/psw/publications/falanruw/psw\\_1987\\_falanruw002.pdf](https://www.fs.usda.gov/psw/publications/falanruw/psw_1987_falanruw002.pdf).
- Federated States of Micronesia (FSM). 2018. *The Federated States of Micronesia National Biodiversity Strategy and Action Plan, 2018–2023*. <https://www.cbd.int/doc/world/fm/fm-nbsap-v2-en.pdf>.
- . 2019. *FSM Renewable Energy Development Project. Initial Environmental Examination 49450-023*.
- Garrard, Georgia E., Sarah A. Bekessy, Michael A. McCarthy, and Brendan A. Wintle. 2015. "Incorporating Detectability of Threatened Species into Environmental Impact Assessment." *Conservation Biology* 29 (1): 216–25. <https://doi.org/10.1111/cobi.12351>.

- Hezel, Francis X. 1979. *Foreign Ships in Micronesia; a Compendium of Ship Contacts with the Caroline and Marshall Islands 1821-1885*. Saipan, Mariana Islands: Published in cooperation with the Trust Territory Historic Preservation Office and the U.S. Heritage Conservation and Recreation Service.
- Island Research & Education Initiative (iREi). 2005. "Digital Atlas of Micronesia." 2005. <https://islandatlas.org/>.
- Island Research & Education Initiative (iREi), Water and Environmental Research Institute of the Western Pacific (WERI) WERI, and FSM Department of the Environment Climate Change and Emergency Management (DECCEM) DECCEM. 2023. "Digital Atlas of Micronesia." 2023. <https://islandatlas.org/>.
- International Union for Conservation of Nature Red List (IUCN Red List). 2022. "IUCN Red List Searchable Data List." 2022. <https://www.iucnredlist.org/>.
- Merlin, Mark, Andrew Kugfas, James Juvik, and Danko Taboroši. 2019. "Plants and People of Yap." *Plants and People of Micronesia*.
- Napolitano, Matthew F. 2021. "Improving Chronologies in Island Environments: A Global Perspective." Unpublished Ph.D. diss., Eugene, OR: University of Oregon.
- National Tropic Botanical Garden. 2023. "Tropical Plant Database – Plant Details: Pterocarpus Indicus." 2023. <https://ntbg.org/database/plants/detail/Pterocarpus-indicus>.
- Wiles, G., and D. L. Waldien. 2021. "Pteropus Pelewensis." The IUCN Red List of Threatened Species. 2021. <https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T118093652A206768055.en>.
- Yap State. 2019. *The Federated States of Micronesia Yap Biodiversity Strategy and Action Plan*. January.
- Yap Visitors Bureau. n.d. "History of Yap." Visit Yap. <https://www.visityap.com/culture/history-of-yap/>.

# **Appendix A**

## **Survey Photographic Record**

This page intentionally left blank.

## Survey Photographic Record

---



Photo 1. *Pterocarpus indicus* (Burmese rosewood) producing fruits in “healthy” condition



Photo 2. *Pterocarpus indicus* (Burmese rosewood) producing fruits in “healthy” condition

## Survey Photographic Record

---



**Photo 3. Area of debris and secondary vegetation in Yap Port Survey Area, facing northeast**



**Photo 4. Area of debris and secondary vegetation in Yap Port Survey Area, facing northwest**

## Survey Photographic Record

---



**Photo 5.** Area of debris and secondary vegetation in Yap Port Survey Area, facing northwest along middle path



**Photo 6.** The sewer treatment plant in Yap Port Survey Area, facing east

## Survey Photographic Record

---



**Photo 7. Adult *Aplonis opaca* (Micronesian starling) perched in *Casuarina equisetifolia* (common ironwood) on the easternmost end of Yap Port Survey Area south of the sewage treatment plant**



**Photo 8. Adult *Emoia atrocostata* (littoral whiptail skink) basking on the easternmost end of Yap Port Survey Area south of the sewage treatment plant**

## Survey Photographic Record

---



Photo 9. Adult *Lamprolepis smaragdina* (emerald tree skink) basking on a tree at the easternmost end of the Chamorro Bay Linear Survey Area



Photo 10. Adult *Lamprolepis smaragdina* (emerald tree skink) basking on a tree at the easternmost end of the Chamorro Bay Linear Survey Area

## Survey Photographic Record

---



**Photo 11. Mangrove forest along far east shoreline of Yap Port Survey Area adjacent to potential coastal wetland, facing northwest**



**Photo 12. Potential coastal wetland in Yap Port Survey Area**

## Survey Photographic Record

---



**Photo 13. Coastal mixed vegetation along far east shoreline of Yap Port Survey Area, facing southeast**



**Photo 14. Refuse facility with scrap metal throughout in Yap Port Survey Area, surrounded by coastal mixed vegetation**

## Survey Photographic Record

---



Photo 15. Three mature *Pterocarpus indicus* (Burmese rosewood) individuals identified in Yap Port Survey Area



Photo 16. Mangrove forest in Chamorro Bay Linear Survey Area

## Survey Photographic Record

---



**Photo 17. Urban builtup land cover in Chamorro Bay Linear Survey Area**



**Photo 18. Urban cultivated – food vegetation in Chamorro Bay Linear Survey Area**

## Survey Photographic Record

---



**Photo 19. Urban cultivated – ornamental vegetation in Chamorro Bay Linear Survey Area**



**Photo 20. Coastal mixed vegetation in Chamorro Bay Linear Survey Area**

## Survey Photographic Record

---



**Photo 21. Secondary vegetation in Chamorro Bay Linear Survey Area**



**Photo 22. Healthy *Calophyllum inophyllum* sapling in Yap Port Survey Area**

## Survey Photographic Record

---



**Photo 23. Urban cultivated – food vegetation in Yap Port Survey Area**



**Photo 24. Urban cultivated – ornamental vegetation in Yap Port Survey Area**

## Survey Photographic Record

---



**Photo 25. Coastal mixed vegetation in Yap Port Survey Area**



**Photo 26. Potential coastal wetland in Yap Port Survey Area**

## Survey Photographic Record

---

This page intentionally left blank.

## **Appendix B**

### **Survey Summary Data Matrix**

This page intentionally left blank.

GIS Identification Number	Species Name	Organism Type	Quantity	Life Stage	Condition	Reproductive Stage	Activity	Northing (m)	Easting (m)
1	Ixobrychus sinensis	Bird	1	Adult	Good	N/A	Perched	1053172.40750	183950.711329
2	Gygis alba	Bird	3	Adult	Good	N/A	Flying	1053152.06824	183941.348761
3	Lamprolepis smaragdina	Lizard	7	Adult	Good	N/A	Basking	1053201.07134	183942.187035
4	Aplonis opaca	Bird	1	Adult	Good	N/A	Perched	1053192.16235	183955.218378
5	Pteropus pelewensis yapensis	Bat	2	Adult	Good	N/A	Flying	1053283.52591	183243.835518
10	Pterocarpus indicus	Tree	1	Mature	Good	Fruiting	N/A	1053113.66888	184236.546924
11	Pterocarpus indicus	Tree	1	Mature	Good	Fruiting	N/A	1053117.76198	184228.833346
12	Pterocarpus indicus	Tree	1	Mature	Good	Fruiting	N/A	1053117.40193	184210.321602
17	Rhipidura rufifrons	Bird	1	Adult	Good	N/A	Foraging	1053001.83061	183678.157344
24	Terminalia catappa	Tree	1	Mature	Good	Flowering	N/A	1053135.62543	184247.196497
26	Callophylum inophyllum	Tree	1	Sapling	Good	Not flowering or fruiting	N/A	1052969.47898	184590.125949
27	Hibiscus tiliaceus	Tree	1	Mature	Good	Fruiting	N/A	1053233.44907	184053.599635
28	Ardea intermedia	Bird	1	Adult	Good	N/A	Foraging	1053065.70055	184363.961710
29	Arenaria interpres	Bird	4	Adult	Good	N/A	Foraging	1053024.85257	184392.033776
30	Arenaria interpres	Bird	4	Adult	Good	N/A	Foraging	1053006.15629	184422.329340
31	Ardea intermedia	Bird	1	Adult	Good	N/A	Foraging	1053041.12715	184464.038816
32	Myzomela rubratra	Bird	2	Adult	Good	N/A	Foraging	1053029.40500	184459.058683
33	Aplonis opaca	Bird	1	Adult	Good	N/A	Flying	1052986.28656	184426.761001
34	Myzomela rubratra	Bird	1	Adult	Good	N/A	Perched	1053068.60399	184329.638785
35	Lamprolepis smaragdina	Lizard	1	Adult	Good	N/A	Basking	1053123.87102	184228.618927
36	Gygis alba	Bird	5	Adult	Good	N/A	Resting/Flying	1053100.96015	184194.212194
37	Myzomela rubratra	Bird	1	Adult	Good	N/A	Perched	1052932.68832	184523.071515
38	Emoia atrocostata	Lizard	1	Adult	Good	N/A	Basking	1052914.48844	184535.165087
39	Pluvialis fulva	Bird	2	Adult	Good	N/A	Flying	1052927.62162	184546.553365
40	Passer montanus	Bird	Dozens	Adult	Good	N/A	Flying	1052927.34475	184545.933906
41	Myzomela rubratra	Bird	1	Adult	Good	N/A	Perched	1052927.23182	184497.770929
42	Aplonis opaca	Bird	1	Adult	Good	N/A	Perched	1052913.66930	184511.699571
43	Aplonis opaca	Bird	1	Adult	Good	N/A	Perched	1053228.08929	183993.672405
44	Passer montanus	Bird	Dozens	Adult	Good	N/A	Flying	1053181.40925	183966.236856
45	Gygis alba	Bird	6	Adult	Good	N/A	Resting/Flying	1053012.46149	183752.381462
46	Myzomela rubratra	Bird	1	Adult	Good	N/A	Perched	1053243.36763	184017.384304
47	Bubulcus ibis	Bird	1	Adult	Good	N/A	Foraging	1053201.62347	183577.170345
48	Myzomela rubratra	Bird	1	Adult	Good	N/A	Perched	1053195.40141	184232.642475
49	Aplonis opaca	Bird	1	Adult	Good	N/A	Perched	1053141.48661	184243.678095
50	Charadrius leschenaultii	Bird	1	Juvenile	Good	N/A	Foraging	1053024.14468	184390.418995
51	Pluvialis fulva	Bird	1	Adult	Good	N/A	Foraging	1053025.51071	184390.005392
52	Gygis alba	Bird	1	Adult	Good	N/A	Flying	1053020.42474	184389.886325
53	Aplonis opaca	Bird	1	Adult	Good	N/A	Perched	1053108.52685	184469.872880
54	Unidentified Shorebird	Bird	2	Unknown	Unknown	N/A	Flying	1053236.71589	184277.241410

This page intentionally left blank

## **Appendix C**

### **Complete List of Species Observations**

This page intentionally left blank.

Table C-1 Species List—Plants

Scientific Name	English Common Name	Family
<b>Trees</b>		
<i>Acacia auriculiformis</i>	Earleaf wattle	Fabaceae
<i>Araucaria heterophylla</i>	Norfolk pink	Araucariaceae
<i>Areca catechu</i>	Betel nut	Arecaceae
<i>Artocarpus altilis</i>	Breadfruit	Moraceae
<i>Bambusa</i> sp.	Bamboo	Gramineae
<i>Barringtonia asiatica</i>	Mango pine	Lecythidaceae
<i>Barringtonia racemosa</i>	Brackwater mangrove	Lecythidaceae
<i>Calophyllum inophyllum</i>	Beach mahogany	Guttiferae
<i>Carica papaya</i>	Papaya	Caricaceae
<i>Casuarina equisetifolia</i>	Ironwood	Casuarinaceae
<i>Citrus</i> spp.	Citrus	Rutaceae
<i>Ficus</i> sp.	Ficus	Moraceae
<i>Hibiscus tiliaceus</i>	Sea hibiscus	Malvaceae
<i>Leucaena leucocephala</i>	Koa haole	Fabaceae
<i>Lumnitzera littorea</i>	Red teruntum	Combretaceae
<i>Macaranga carolinensis</i>	—	Euphorbiaceae
<i>Mangifera indica</i>	Mango	Anacardiaceae
<i>Millettia pinnata</i>	Pongame oiltree	Fabaceae
<i>Morinda citrifolia</i>	Indian mulberry	Rubiaceae
<i>Muntingia calabura</i>	Jamaican cherry	Muntingiaceae
<i>Musa</i> spp.	Banana	Musaceae
<i>Pandanus tectorius</i>	Screwpine	Pandanaceae
<i>Premna serratifolia</i>	—	Lamiaceae
<i>Premna obtusifolia</i>	—	Lamiaceae
<i>Saccharum officinarum</i>	Sugar cane	Poaceae
<i>Pterocarpus indicus</i>	Burmese rosewood	Fabaceae
<i>Plumeria rubra</i>	Plumeria	Apocynaceae
<i>Rhizophora apiculata</i>	Red mangrove	Rhizophoraceae
<i>Spondias pinnata</i>	Sour plum	Anacardiaceae
<i>Terminalia catappa</i>	Sea almond	Combretaceae
<i>Thespesia populnea</i>	Portia tree	Malvaceae
<b>Shrubs</b>		
<i>Acalypha hispida</i>	Bristly copperleaf	Euphorbiaceae
<i>Alpinia purpurata</i>	Red ginger	Zingiberaceae
<i>Asplenium nidus</i>	Bird's nest fern	Aspleniaceae
<i>Colocasia esculenta</i>	Sweet taro	Araceae
<i>Cordyline</i> sp.	Ornamental red ti	Asparagaceae
<i>Crinum asiaticum</i>	Poison bulb	Amaryllidaceae
<i>Cyrtosperma merkusii</i>	Giant swamp taro	Araceae
<i>Hibiscus rosa-sinensis</i>	Chinese hibiscus	Malvaceae
<i>Hymenocallis littoralis</i>	Beach spider lily	Amaryllidaceae
<i>Ixora</i> spp.	Ixora	Rubiaceae
<i>Jasminum sambac</i>	Arabian jasmine	Oleaceae
<i>Pemphis acidula</i>	Bantigue	Lythraceae
<i>Physalis angulata</i>	Cutleaf groundcherry	Solanaceae
<i>Polyscias scutellaria</i>	Shield aralia	Araliaceae
<i>Polyscias fruticosa</i>	Ming aralia	Araliaceae
<i>Scaevola</i> sp.	Fan flower	Goodeniaceae
<i>Sesbania</i> sp.	Riverhemp	Fabaceae
<i>Tradescantia spathacea</i>	Moses in the cradle	Commelinaceae
<i>Tecoma stans</i>	Yellow-bells	Bignoniaceae
<i>Tithonia diversifolia</i>	Tree marigold	Asteraceae

Scientific Name	English Common Name	Family
<b>Vines</b>		
<i>Bougainvillea</i> sp.	Bougainvillea	Nyctaginaceae
<i>Cayratia trifolia</i>	Threelaf cayratia	Vitaceae
<i>Cassytha filiformis</i>	Dodder laurel	Cayratieae
<i>Derris trifoliata</i>	Climbing vine	Fabaceae
<i>Ipomoea pes-caprae</i>	Morning glory	Convolvulaceae
<i>Merremia</i> spp.	Large morning glory	Convolvulaceae
<i>Passiflora foetida</i> var. <i>hispida</i>	Passionflower	Passifloraceae
<i>Vigna marina</i>	Beach pea	Fabaceae
<i>Vitex trifolia</i>	Chaste tree	Lamiaceae
<b>Herbs</b>		
<i>Bacopa monnieri</i>	Bacopa	Plantaginaceae
<i>Bidens pilosa</i>	Beggarticks	Asteraceae
<i>Hymenocallis littoralis</i>	Beach spider lily	Amarylloidaceae
<i>Melanthera biflora</i>	Sea daisy	Asteraceae
<i>Mimosa invisa</i>	Giant sleeping grass	Fabaceae
<i>Mimosa pudica</i>	Sleeping grass	Fabaceae
<i>Nephrolepis</i> sp.	Nephrolepis	Nephrolepidaceae
<i>Physalis angulata</i>	Groundcherry	Solanaceae
<i>Phyla nodiflora</i>	Frog fruit	Verbenaceae
<i>Polypodium cambricum</i>	Limestone polypody	Polypodiaceae
<i>Stachytarpheta</i> sp.	Snakeweed	Verbenaceae
<i>Wedelia triloba</i>	Wedelia	Asteraceae
<b>Grasses, Rushes, and Sedges</b>		
<i>Cyperus</i> sp.	Sedge	Cyperaceae
<i>Echinochloa crus-galli</i>	Barnyard grass	Poaceae
<i>Eleocharis</i> sp.	Sedge	Cyperaceae
<i>Fimbristylis</i> sp.	Sedge	Cyperaceae
<i>Juncus</i> sp.	Rush	Juncaceae
<i>Paspalum distichum</i>	Knotgrass	Poaceae
<i>Panicum</i> sp.	Panicgrass	Poaceae
<i>Sporobolus</i> sp.	Smutgrass	Poaceae

Legend: — = No standard common name; scientific name is used as its common name.

**Table C-2 Species List–Wildlife**

<b>Scientific Name</b>	<b>English Common Name</b>	<b>Life Form</b>
<i>Pteropus pelewensis yapensis</i>	Yap flying fox	Mammal
<i>Ixobrychus sinensis</i>	Yellow bittern	Bird
<i>Ardea intermedia</i>	Intermediate egret	Bird
<i>Gygis alba</i>	White tern	Bird
<i>Bubulcus ibis</i>	Cattle egret	Bird
<i>Pluvialis fulva</i>	Pacific golden plover	Bird
<i>Charadrius leschenaultii</i>	Greater sand plover	Bird
<i>Arenaria interpres</i>	Ruddy turnstone	Bird
<i>Aplonis opaca</i>	Micronesian starling	Bird
<i>Myzomela rubrata</i>	Micronesian myzomela	Bird
<i>Passer montanus</i>	Eurasian tree sparrow	Bird
<i>Rhipidura rufifrons</i>	Rufous fantail	Bird
<i>Emoia atrocostata</i>	Littoral whiptail skink	Reptile
<i>Lamprolepis smaragdina</i>	Emerald tree skink	Reptile

This page intentionally left blank.