Natural Resources Survey Report

Environmental Impact Statement for Yap International Airport Improvement Project, State of Yap, Federated States of Micronesia

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Abbreviations and Acronyms

°F	degrees Fahrenheit
CoFA	Compact of Free Association
DAF	Department of the Air Force
DoAF	Division of Agriculture and Forestry
ERW	explosive remnants of war
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FSM	Federated States of Micronesia
IUCN	International Union for the Conservation of Nature
JRM	Joint Region Marianas
spp.	species
U.S.	United States
YSC	Yap State Code

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1. Introduction

1.1 Natural Resources Survey Purpose

The Department of the Air Force (DAF) proposes to construct and operate facilities and infrastructure at the Yap International Airport to conduct military readiness activities which include training exercises and operations.

The purpose of the natural resources survey conducted at the Yap International Airport was to record the natural resources the DAF identified within the environmental survey area that encompasses the proposed project to improve the capabilities of Yap International Airport and support any applicable environmental planning processes.

This *Natural Resources Survey Report* provides a brief overview of the project location and proposed action, desktop review results, survey area and methodology, and survey findings. This report provides information about current conditions to support environmental planning analysis and anticipated natural resources coordination with the Yap State Division of Agriculture and Forestry (DoAF). Natural resources coordination between the DAF and DoAF will comply with Title One, Article VI (Environmental Protection) of the CoFA (DOS 2003), which identifies U.S. government obligations for actions within the FSM. Additionally, the DAF incorporated Yap State Code (YSC) Title 18, *Conservation and Resources*; Chapter 10, Sections 1001 through 1011, *Wildlife Conservation*; and Chapter 11, Section 1101, *Fruit Bat Sanctuary Act 2013* (revised 2015), referred to as Yap regulated in tables and text, when designing the survey methodology.

In accordance with Title One, Article VI of the CoFA, the DAF is required to comply with U.S. federal protections. The Endangered Species Act (ESA) of 1973 prohibits take of any listed species without prior approval of the U.S. Secretary of the Interior. Take is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct.” Other laws identified such as the Ocean Dumping Act and the Clean Water Act have substantive standards that indirectly affect natural or biological resources and would be addressed in environmental planning.

1.2 Project Description

1.2.1 Project Location

The Proposed Action would occur at the Yap International Airport, which is on Yap Island within the State of Yap, FSM (see **Figure 1-1**). The FSM is a sovereign island nation in the western Pacific Ocean. The State of Yap is the westernmost state of the FSM and spans over 100,000 square miles, approximately 520 miles southwest of Guam. The State of Yap consists of four main islands (Yap, Tamil-Gagil, Maap, and Rumung) and 134 smaller islands, 22 of which are populated (BSAP 2004). According to the 2021 census projection, approximately 11,600 residents are on Yap (HRSA 2023).

The Yap International Airport is on the southwestern portion of Yap Island, approximately 3 miles southwest of Colonia (see **Figure 1-2**). The airport has a terminal complex and one runway (07/25) that is approximately 6,000 feet long and 150 feet wide, has 25-foot-wide

shoulders (total of 200 feet wide), and has turnarounds at both ends. It is a U.S. Federal Aviation Administration (FAA) certified airport and is governed by FAA criteria for clear zones, imaginary surfaces, and other airfield restrictions (DAF 2020). The land surrounding the airport is primarily vegetated and undeveloped.

1.2.2 Proposed Action

DAF is proposing airport improvements at the Yap International Airport to augment and adapt the DAF's and the Department of the Navy's military readiness capabilities within the FSM to conduct military readiness activities to support evolving mission requirements to meet U.S. national security objectives and fulfill U.S. obligations to provide for the defense of the FSM per Title Three of the CoFA between the U.S. and the FSM. The Proposed Action is limited to construction and military readiness activities.

Natural resources surveys, completed in March 2024, were conducted on the environmental survey area covering approximately 919 acres on and around the airport, including the seaport-to-airport road. Only approximately 265 acres (i.e., project area) of the 919-acre environmental survey area (see **Figure 1-3**) would be disturbed during construction and would either be developed, resurfaced with ground cover (e.g., gravel), or revegetated once construction is complete.

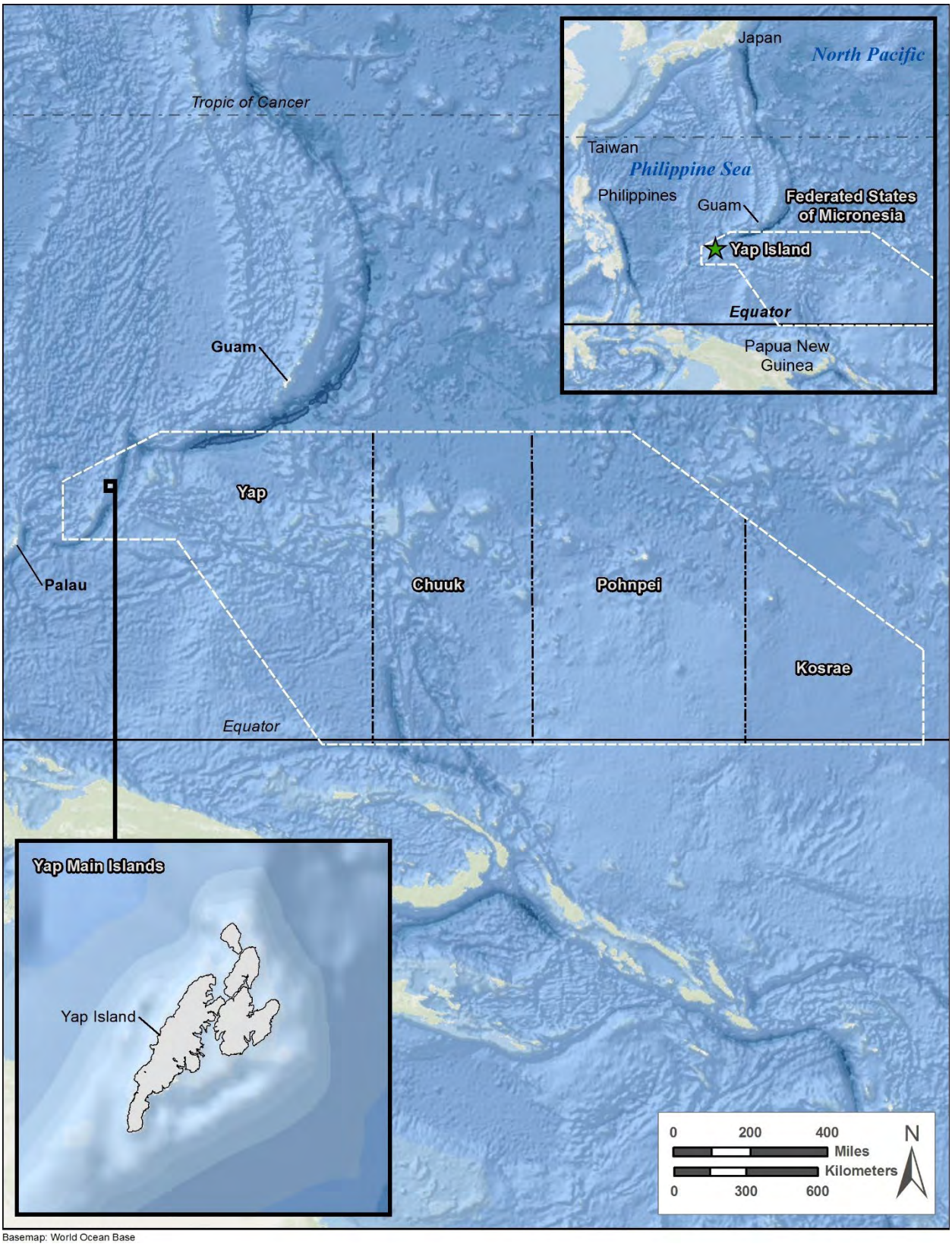

Figure 1-1. Yap Island, State of Yap, and Federated States of Micronesia

Figure 1-2. Yap International Airport

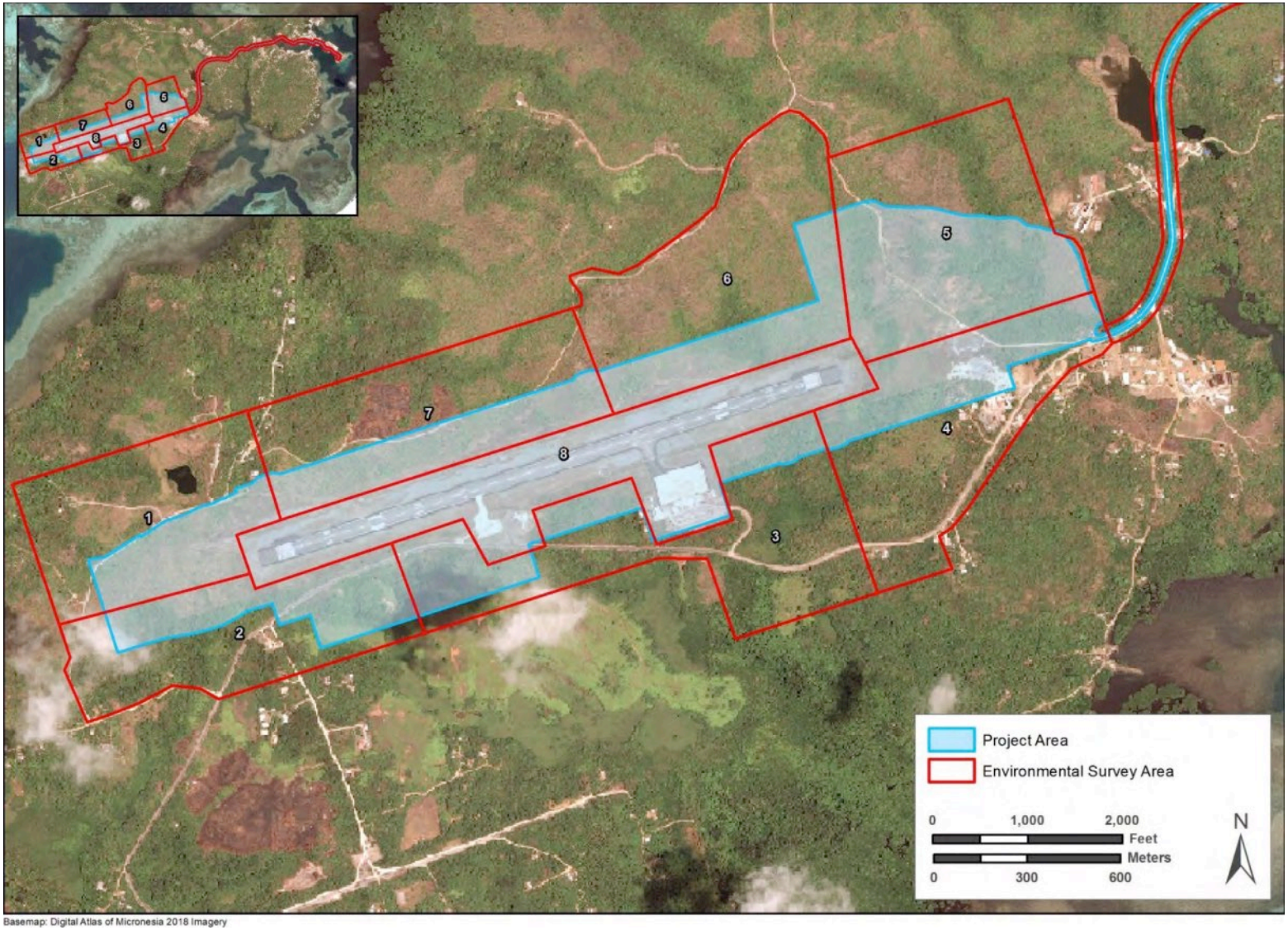

Figure 1-3. Environmental Survey Area and Project Area

2. Desktop Research

2.1 Background

Throughout the text of this report, the first introduction of a plant or wildlife species includes the scientific name, followed by the common and local names, if appliable, in parenthesis. Subsequent references to species use the common name whenever possible. In the absence of common names, the shortened scientific name is used.

Previous Surveys: Biological monitoring surveys were conducted in support of geotechnical site investigations between March 2 and 28, 2023. These surveys were focused around the perimeter of, and extending east and west of, the airport. The survey team documented seven sensitive plant species: *Calophyllum inophyllum* (beach mahogany/biyuuch), *Cyrtosperma merkusii* (Giant swamp taro/lak), *Pandanus tectorius* (Tahitian screwpine/choi), *Pandanus yapensis* (tha), *Robiquetia* spp. (pouched orchid), *Timonius albus* (gathemach), and *Trichosperma ikutai* (wapof). Additionally, eight sensitive wildlife species were documented: *Anous minutus* (black noddy), *Arenaria interpres* (ruddy turnstone), *Bubulcus coromandus* (Eastern cattle egret), *Gygis alba* (white tern), *Ixobrychus sinensis* (yellow bittern), *Monarcha godeffroyi* (Yap monarch), *Pluvialis fulva* (Pacific golden plover), and *Zosterops hypolais* (Yap plain white-eye) (NAVFACPAC 2024).

Climate and Vegetation. Yap consists of four metamorphic, old volcanic high islands and a group of approximately 15 coralline atolls. Yap's climate is characterized by heavy rainfall, and high temperatures and humidity. The mean annual rainfall is approximately 122 inches, with the driest months occurring between February and April (FSM 2024). The mean annual temperature is 81 degrees Fahrenheit (°F), with generally less than 3°F difference between the warmest and coolest months (USDA 1987, FSM 2024).

A U.S. Department of Agriculture vegetation study was completed in 2019 to update and standardize the vegetation community classification for Yap Island (USDA 2019). The study assigned vegetation community and land use categories from aerial imagery, previous vegetation mapping, and field visits where appropriate. In total, ten vegetation community categories were developed and applied across the island, with all but one class (mangroves) represented within the project area. Since 2003, a net increase of 57 percent agroforest and net decreases of 27 percent mangroves and more than 160 percent fern savannas have occurred (USDA 2019). General decline in natural vegetation is likely a combined pressure on natural resources to produce food for growing populations combined with Japanese agricultural practices, droughts, and burning practices (USDA 1987). **Table 2-1** provides a breakdown of vegetation classes across Yap Island; descriptions of land classes is provided in **Appendix A, Table A-1**.

Table 2-1. Yap Island Vegetation Classes

Class	Acres	Percentage
Agroforest	6,766.6	28.4
Barren	184.1	0.8
Mangrove forest	2,637.5	11.0
Marsh	310.2	1.3
Savanna	4,097.4	17.2
Secondary vegetation	985.2	4.1
Swamp forest	61.9	0.3
Upland forest	7,737.3	32.4
Urban built-up/ cultivated	1,021.1	4.3
Open water	22.2	0.1
Total	**23,823.5**	**99.9** [a]

Source: USDA 2019
Key:[a] Numbers do not add up to 100 percent due to rounding issues

Mammals. There is one native mammal known to inhabit Yap Island, *Pteropus pelewensis yapensis* (Yap flying fox/maagul'aew). The Global Invasive Species Database notes an additional five mammals that are considered invasive and have been documented on Yap (GISD 2024). *Rusa marianna* (Philippine brown deer) may also be present on Yap, but that has not been confirmed (iNaturalist 2024d). The Yap flying fox is listed on the IUCN Red List as vulnerable and this species is provided State of Yap protections against "the taking, hunting, exporting, purchasing or selling" under YSC Title 18, Chapter 11, Section 1101 (Wiles et al. 2008, YSC 1987a). Additional protections are provided under the Ninth Legislature of the State of Yap Bill 9-18, which amends Chapter 11 and establishes a flying fox sanctuary defined as "all mangroves, known roosting sites and forests of Yap" (LSY 2015). See **Appendix A, Table A-3** for a list of invasive mammal species.

Birds. Approximately 106 birds, including 9 endemic and 6 introduced species, have been recorded on Yap. Endemic species include the *Acrocephalus astrolabii* (Mangareva reed warbler [presumed extinct]), *Acrocephalus syrinx* (Carolinian reed warbler), *Aplonis opaca* (Micronesian starling), *Edolisoma nesiotis* (Yap cicadabird), *Myzomela rubratra* (Micronesian myzomela), Yap monarch, *Pampusana xanthonura* (white-throated ground dove), Yap plain white-eye, and *Zosterops oleagineus* (Yap olive white-eye) (Avibase 2023). See **Appendix A, Table A-2** for the full species list.

Reptiles and Amphibians. Yap herpetological surveys have been sporadic and predominantly focused on Yap atolls. No published surveys have occurred for Yap Island; however, between 2010 and 2013, up to 15 species of reptiles and amphibians were recorded between Fais Island, Sorol Atoll, and Ngulu Atoll. Reptile species included two sea turtles, six geckos, six skinks, and one monitor lizard (Buden, 2010, 2011, 2013). Incidental observations on Yap Island have documented eight reptiles and one amphibian (iNaturalist 2024a, 2024b). Additionally, *Perochirus ateles* (Micronesia saw-tailed gecko/qadburruq) is considered a widespread resident of Yap Island and is listed as vulnerable by the International Union for the Conservation of Nature (IUCN; Buden 2011). Two reptiles, *Emoia boettgeri* (Boettger's Emo skink) and *Hemidactylus frenatus* (common house gecko), are suspected, not confirmed, to inhabitant Yap Island. The monitor lizard is an invasive species (GISD 2024), and the green

anole and cane toad are introduced; it is not clear if the remaining species are considered native or endemic. See **Appendix A, Table A-2** for a complete species list.

Invertebrates. No comprehensive surveys of invertebrates have been published for Yap Island or the surrounding islands or atolls. Eleven incidental sightings of invertebrates have occurred (iNaturalist 2024c). Additionally, *Birgus latro* (coconut crab) is known to occur on the island. This species is listed on the IUCN Red List as vulnerable and is protected under YSC Title 18, Chapter 10, Section 1004, which designates hunting limitations and selling of coconut crab (Cumberlidge 2020, YSC 1987b). One species, *Wasmannia auropunctata* (little fire ant), is an invasive species (GISD 2024). No threatened invertebrate species listed on the IUCN Red List are known to occur on Yap Island. See **Appendix A, Table A-2** for a complete species list.

Special Status Species. Nineteen special status species identified by DAF, listed in **Table 2-2**, could occur on or around the environmental survey area, including 6 plant and 13 animal species. Field team members documented all birds observed to ensure any migratory species were included in this report (see **Table 4-4** in **Section 4.2**).

Invasive Species. According to the Global Invasive Species Database, 41 invasive terrestrial species have been documented on Yap Island, including 35 plant and 6 wildlife species (GISD 2024). See **Appendix A, Table A-3** for a complete invasive species list.

2.2 Special Status Species Review

DAF conducted a desktop search for species that have U.S. federal, FSM, and Yap State protections. Additionally, IUCN at risk species (https://www.iucnredlist.org./) were considered to identify special status species that have not been formally recognized by the State of Yap as sensitive and vulnerable to extinction.

2.2.1 Plants

The potential exists for one U.S. federally listed and five IUCN-listed plants to occur within the environmental survey area (ARW 1998, Bachman and Chadburn 2015, Barstow 2018, Barstow 2020, DOI 2016, Omosowon and Kell 2019).

***Cycas micronesica* (cycad/faltir)**: Cycads are typically unbranched trees with a thick trunk that can grow 26 to 39 feet tall. Leaves can be 3 to 8 feet long, are pinnate, and spiral in a round crown at the top. Leaves have a pinnate pattern that are a glossy dark green. Cycads do not flower but produce male and female cones on separate trees. Cycads are threatened by the invasive *Aulacaspis yasumatsui* (aulacaspis scale), which is currently known to occur in Guam, Rota, and Palau. Cycads prefer slightly acidic, well-draining soils and can tolerate full sun to partial shade (Bösenberg 2022). The U.S. Fish and Wildlife Service and IUCN list this species as endangered (DOI 2016); Yap has an estimated total of approximately 288,450 cycads between four populations (DOI 2016).

***Dioscorea nummularia* (Pacific yam/thap)**: The Pacific yam is a climbing perennial plant that annually produces twining stems from a tuberous rootstock. The species grows best within lowland areas with well-draining, sandy loam soil, and is cultivated throughout Micronesia as a food source (UTPD 2014). Yap population estimates for the Pacific yam are not available;

however, the IUCN identifies a trending decreasing population. The IUCN 2019 assessment considers the Pacific yam to be near threatened due to deforestation, expanding human settlements, and associated agriculture (Omosowon and Kell 2019).

***Intsia bijuga* (Borneo teak/throrrot)**: Borneo teak is a tall tree that can grow up to 150 feet tall, with a smooth-barked trunk. Leaves are compound, with four wavy leaflets that are 3 to 6 inches long with medium to dark green coloration. This species prefers forest edges, and grows best within lowland areas with well-drained soils and full sun (USDA 2015, Orwa et al. 2009). Yap population estimates for the Borneo teak are not available; however, the IUCN identifies a trending decreasing population. The IUCN 2020 assessment considers the Borneo teak to be near threatened due to fire, flooding, deforestation, expanding human settlements, and associated agriculture (Barstow 2020).

***Metroxylon amicarum* (Caroline ivory nut palm)**: The Caroline ivory nut palm is a tall palm tree that can grow up to 60 feet tall, with a massive trunk and short root spines. This palm is endemic to Pohnpei and Chuuk, and only occasionally planted on Yap. Leaves are pinnate fronds that grow up to 15 feet long; fronds have a woolly appearance. This species prefers moist forest edges above 1,500 feet elevation, wetlands, and coastal rainforests (USDA 2015, PFAF 2024). Yap population estimates for the Caroline ivory nut palm are not available, and the trending population status is unknown. The IUCN 2011 assessment considers the Caroline ivory nut palm to be near threatened due to flooding, deforestation, expanding human settlements, and associated agriculture (Bachman and Chadburn 2015).

***Pericopsis mooniana* (nedun tree)**: The nedun tree can grow up to 120 feet tall and has thin, flaking bark. Leaves are pinnate with a sharp tip, with five to nine leaflets that are 1 to 3 inches long. This species is typically found along rivers and coasts, and is considered uncommon on Yap (USDA 2015). Yap population estimates for the nedun tree are not available, and the trending population status is unknown. The IUCN 1998 assessment considers the nedun tree to be vulnerable due to logging and wood harvesting (ARW 1998).

***Pterocarpus indicus* (rosewood/lach)**: Rosewood is a tall tree that can grow up to 120 feet tall with a stout, buttressed trunk. Leaves are compound pinnate leaves up to 12 inches long, with 6 to 12 leaflets that are pointed at the tip. This species is most commonly found along rocky shores, tidal creeks, and coasts but can be found in savannas and uplands (USDA 2015). Yap population estimates for rosewood are not available; however, the IUCN identifies a trending decreasing population. The IUCN 2018 assessment considers rosewood to be endangered due to logging and wood harvesting (Barstow 2018).

2.2.2 Wildlife

The potential exists for 10 IUCN-listed birds, 1 IUCN-listed reptile, 1 IUCN-listed and State of Yap-protected mammal, and 1 State of Yap-protected crustacean to occur within the environmental survey area (BLI 2017a, BLI 2017b, BLI 2017c, BLI 2018a, BLI 2018b, BLI 2019, BLI 2020, BLI 2022a, BLI 2022b, BLI 2022c, BLI 2022d, BLI 2023).

Birds

***Calidris tenuirostris* (Great knot)**: The great knot is a stocky, medium sized shorebird. It has a black bill, a blackish back and mottled chest with an orange upper wing patch (eBird 2024a). This species prefers mudflats, coastal marine, wetlands, and intertidal habitats. Great knots nest and breed in Russia. Yap and worldwide population estimates are not available; however, records indicate that this species is declining (BLI 2019). The IUCN 2016 assessment considers the great knot to be an endangered species due to habitat impacts, development, pollution, climate change, and agriculture (BLI 2019).

***Ducula oceanica* (Micronesian imperial-pigeon/buleogol)**: The Micronesian imperial-pigeon is a large forest pigeon with green wings, a predominantly gray body, and a diagnostic black fleshy knob above the bill. This species is found across most habitats, but it prefers undisturbed forest (BLI 2020). No information is available about foraging and nesting preferences; however, other imperial-pigeon species are known to forage fruits within the dense tree canopy in pairs or groups and nest in pairs or colonies in mangroves or forests (Backyard 2024a). Yap population estimates are not available; however, the IUCN estimates 2,500 to 12,200 mature individuals across the pigeon's range, with a trending decreasing population. The IUCN 2020 assessment considers the Micronesian imperial-pigeon to be a vulnerable species due to habitat impacts, hunting, logging and wood harvesting, and agriculture (BLI 2020).

***Edolisoma nesiotis* (Yap cicadabird [formerly common cicadabird])**: The Yap cicadabird is a long-bodied and long-billed species. Males are dark slate gray, with a predominantly gray body. This species is found across most habitats, but it prefers undisturbed forest habitats (BLI 2022a). No information is available about foraging and nesting preferences; however, other cicadabird species are known to forage for insects, fruits, and seeds in tree crowns and build shallow nests made of bark, twigs, grass, and spiderwebs on horizontal branches (Backyard 2024b). Yap population estimates for cicadabird are 180 mature individuals across the species' range, with a trending stable population. The IUCN 2022 assessment considers the Yap cicadabird to be an endangered species due to habitat impacts, invasive species, and fire concerns (BLI 2022a).

***Limosa lapponica* (bar-tailed godwit)**: The bar-tailed godwit has a barred tail with a white underwing, and lacks a white wing-bar; females are larger and paler with a longer bill. This species is generally found on sandy beaches and intertidal habitats. Bar-tailed godwits nest and breed on the Arctic tundra. Yap population estimates are not available; however, the IUCN estimates are 1,099,000 to 1,149,000 mature individuals across the species' range, with a trending decreasing population. The IUCN 2016 assessment considers the bar-tailed godwit to be a near threatened species due to habitat impacts, invasive species, pollution, and agriculture (BLI 2017a).

***Limosa limosa* (black-tailed godwit)**: The black-tailed godwit has a long bill with a small head and long neck and legs; it has a striking wing-bar and rump. This species is generally found on grasslands, wetlands, and intertidal habitats. Black-tailed godwits nest and breed in cooler northern climes. Yap and worldwide population estimates are not available; however, records indicate that this species is rapidly declining (BLI 2017b). The IUCN 2016 assessment considers

this godwit to be a near threatened species due to habitat impacts, invasive species, pollution, and agriculture (BLI 2017b).

***Monarcha godeffroyi* (Yap monarch)**: The Yap monarch is black and white; the male has a white body with a black head, tail, and wings; females are black overall with a while collar. Juveniles are dull brown with a grayish head. This species is found across most habitats, including mangroves and savannahs (BLI 2022b). No information is available about foraging and nesting preferences for the Yap monarch; however, other monarch species are known to forage insects in the forest understory and build a small cup nest made of bark, moss, fibers, and spiderwebs in hanging vines or tree forks 3 to 18 feet above the ground, typically near water (Backyard 2024c). The IUCN 2022 assessment for the Yap monarch population estimates are 10,000 to 30,000 mature individuals, with a trending stable population. The IUCN considers the Yap monarch to be a near threatened species due to habitat impacts, invasive species, and fire concerns (BLI 2022b).

***Numenius madagascariensis* (Far-Eastern curlew)**: The far-Eastern curlew has a long and decurved bill, a light brown rump, and underwings that are heavily marked (eBird 2024b) This species is generally found in coastal marine areas, estuaries, intertidal flats and mangrove swamps. Far-Eastern curlews nest and breed in Mongolia and Russia. Yap population estimates are not available; however, the IUCN estimates approximately 32,000 mature individuals occur across the species' range, with a trending decreasing population. The IUCN 2017 assessment considers the far-Eastern curlew to be an endangered species due to habitat impacts, pollution, development, and agriculture (BLI 2017c).

***Numenius tahitiensis* (bristle-thighed curlew)**: The bristle-thighed curlew has a long and decurved bill with bristled feathers on the legs and light, spotted brown belly plumage. This species is generally found on coral reefs, intertidal flats, palm forests, rocky shores, and beaches. Bristle-thighed curlews nest and breed on the Arctic tundra. Yap population estimates are not available; however, the IUCN estimates approximately 10,000 mature individuals occur across the species' range, with a trending decreasing population. The IUCN 2020 assessment considers the bristle-thighed curlew to be a near threatened species due to habitat impacts, invasive species, pollution, and agriculture (BLI 2022c).

***Pampusana xanthonura* (white-throated ground dove)**: The white-throated ground dove is a medium-sized bird; males are brown with a white head and chest, while females are a shade of brown. This species inhabits a variety of areas, including native and secondary forest, fields, and developed areas such as plantations. White-throated ground doves forage for fruits, flowers, and seeds within the canopy but have been known to forage on the ground on Yap. This species builds twig nests placed highly in trees and generally mate for life (Animalia 2024). Yap population estimates are not available; however, the IUCN estimates 10,000 to 19,999 mature individuals occur across the species' range, with a trending population that is unknown. The IUCN 2023 assessment considers the white-throated ground dove to be a near threatened species due to hunting and invasive species impacts (BLI 2023).

***Pseudobulweria becki* (Beck's petrel)**: Beck's petrel is dark brown on the back, head, and throat with a distinct wing-bar; the belly and breast are white. This species is likely to nest in burrows of high mountains but may breed on small islets. No documented observations have

occurred on Yap, but it is within the range. The IUCN estimates 50 to 249 mature individuals exist across the species' range, with a trending decreasing population. The IUCN 2018 assessment considers the Beck's petrel to be a critically endangered species due to habitat impacts, invasive species, and agriculture (BLI 2018a).

***Zosterops hypolais* (Yap plain white-eye)**: The Yap plain white-eye is a small warbler endemic to Yap, with a grayish body and pale-yellow throat with a narrow white eye-ring. This species prefers shrublands, grasslands, forests, and savannahs (eBird 2024c). Not much has been published about this warbler species, but similar warblers eat insects and berries, and tend to forage in flocks and nest up to 50 feet high on horizontal branches (BA 2024). The IUCN estimates 40,000 to 80,000 mature individuals occur across the species' range, with a trending population that is stable. The IUCN 2022 assessment considers the Yap plain white-eye to be a near threatened species due to habitat changes and invasive species impacts (BLI 2022d).

***Zosterops oleagineus* (Yap olive white-eye)**: The Yap olive white-eye is a small warbler endemic to Yap, with dark-brown-olive coloration, a bright white eye-ring, and yellow legs. This species prefers forest habitats, including forest edges and mangroves (eBird 2024d). Not much has been published about this warbler species, but similar warblers eat insects and berries, and tend to forage in flocks and nest up to 50 feet high on horizontal branches (BA 2024). The IUCN estimates 13,000 mature individuals occur across the species' range, with a trending population that is stable. The IUCN 2018 assessment considers the Yap olive white-eye to be a near threatened species due to habitat changes, fire, and invasive species impacts (BLI 2018b).

Reptiles

***Perochirus ateles* (Micronesia saw-tailed gecko/qadburruq)**: Micronesia saw-tailed gecko is a relatively large gecko weighing 4 to 5 grams; it is endemic to Micronesia and, with the exception of Fais Island, is considered widespread and common on all Yap islands (Buden 2011). This species inhabits forests and introduced vegetation, and has been observed in bushes and shrubs, and under bark. No IUCN population estimate exists; however, the trending population is decreasing. The IUCN 2018 assessment considers the Micronesia saw-tailed gecko to be a vulnerable species due to habitat changes and invasive species impacts (Allison et al. 2017).

Mammal

***Pteropus pelewensis yapensis* (Yap flying fox/maagul'aew)**: The Yap flying fox is endemic to Yap and is a subspecies of the Pelew flying fox (*Pteropus pelewensis*). This small to medium-sized frugivorous bat in the Pteropididae family weighs under a pound with forearm lengths between 115 and 138 millimeters. The mantle coloration varies with shades of yellow to buff, the backside is mostly black-brown, and there are silver hairs in the belly area. This species of flying fox produces pups throughout the year and forms colonies and roosts, primarily in mangrove swamps (Falanruw and Manmaw 1992). In 1986, the population estimate was between 2,500 and 5,000 individuals; there is no current population estimate. Threats to the Yap flying fox include habitat loss, typhoons, and illegal hunting (Wiles et al. 2008). No IUCN population estimate exists and the trending population is unknown. The 2008 IUCN assessment considers the Yap flying fox to be a vulnerable species due to hunting, habitat changes, and agricultural impacts (Wiles et al. 2008).

Crustacean

***Birgus latro* (coconut crab)**: The coconut crab is a large terrestrial crab that inhabits forests and marine tidal areas. This species can have a carapace that exceeds 8 inches, a leg span of 30 inches, and a weight of up to 9 pounds (SDZ 2024). Coconut crabs are a slow-growing species, with males being larger than females. No IUCN population estimate exists. The trending population is decreasing (Cumberlidge 2020). The 2018 IUCN assessment considers the coconut crab to be a vulnerable species due to hunting, habitat changes, invasive species, and agricultural impacts (Cumberlidge 2020).

Table 2-2 summarizes the special status species that could potentially occur within the project area.

Table 2-2. Special Status Species with the Potential to Occur within the Environmental Survey Area

Scientific Name	Common/Yapese Name	Status	Required Habitat	Potential to Occur within Project Area
Plants				
Cycas micronesica	Cycad/faltir	FE/ IUCN E	Occurs most often on coastal limestone and cliffsides, and occasionally on back strands	Possible
Dioscorea nummularia	Pacific yam/thap	IUCN NT	Occurs mostly in lowland areas with well-draining sandy loam soil	Likely
Intsia bijuga	Borneo teak/throrrot	IUCN NT	Found along forest edges, grows best within lowland areas with well-drained soils and full sun	Possible
Metroxylon amicarum	Caroline ivory nut palm	IUCN NT	Prefers moist forest edges above 1,500 feet, wetlands, and coastal rainforests	Not likely
Pericopsis mooniana	Nedun tree	IUCN V	Occurs along rivers and coasts	Not likely
Pterocarpus indicus	Rosewood/lach	IUCN E	Occurs along rocky shores, tidal creeks, and coasts; occasionally in savannas and uplands	Possible
Birds				
Calidris tenuirostris	Great knot	IUCN E	Prefers mudflats, coastal marine, wetlands, and intertidal habitats	Not likely
Ducula oceanica	Micronesian imperial-pigeon/buleogol	IUCN V	Found across most habitats, but prefers undisturbed forest	Possible
Edolisoma nesiotis	Yap cicadabird	IUCN E	Found across most habitats, but prefers undisturbed forest	Possible
Limosa lapponica	Bar-tailed godwit	IUCN NT	Occurs on sandy beaches and intertidal habitats	Not likely
Limosa limosa	Black-tailed godwit	IUCN NT	Occurs on grasslands, wetlands, and intertidal habitats	Possible
Monarcha godeffroyi	Yap monarch	IUCN NT	Occurs across most habitats including mangroves and savannahs	Likely
Numenius madagascariensis	Far Eastern curlew	IUCN E	Found along coastal marine areas, estuaries, intertidal flats and mangrove swamps	Not likely
Numenius tahitiensis	Bristle-thighed curlew	IUCN NT	Found along coral reefs, intertidal flats, palm forests, rocky shores, and beaches	Not likely
Pampusana xanthonura	White-throated ground-dove	IUCN NT	Found in native and secondary forest, fields, and developed areas	Likely
Pseudobulweria becki	Beck's petrel	IUCN CR	Nests in burrows of high mountains but may breed on small islets	Not likely

Scientific Name	Common/Yapese Name	Status	Required Habitat	Potential to Occur within Project Area
Zosterops hypolais	Yap plain white-eye	IUCN NT	Found in shrublands, grasslands, forests, and savannahs	Possible
Zosterops oleagineus	Yap olive white-eye	IUCN NT	Found in forest habitats, including forest edges and mangroves	Possible
Reptiles				
Perochirus ateles	Micronesia saw-tailed gecko/qadburruq	IUCN V	Inhabits forests and introduced vegetation	Likely
Mammals				
Pteropus pelewensis yapensis	Yap flying fox/maagul'aew	IUCN V/ Yap Regulated	Inhabits forests and mangroves	Likely
Crustaceans				
Birgus latro	Coconut crab	IUCN V/ Yap Regulated	Inhabits forests and marine tidal areas	Possible

Key: CR = Critically Endangered; E = Endangered; F = Federal; NT = Near Threatened; V = Vulnerable

3. Methods

DAF conducted a natural resources survey of 919 acres, hereafter the environmental survey area, surrounding the project area between January 8 to March 1, 2024 (Chuuk Time Zone). Surveys were conducted during appropriate weather conditions, sunny to light precipitation. The environmental survey area was divided into eight survey zones (see **Figure 1-3**). The purpose of these zones was to allow the natural resources survey to occur concurrently with cultural and environmental baselines surveys without overlap of field surveyors who might startle fauna, potentially introducing observational error. Species observations were recorded using a Trimble Geo7X Global Positioning System. A data dictionary, also referred to as attribute data, was developed prior to field surveys for species known or with potential to be present within the environmental survey area.

No marine, marsh, swamp, mangrove, or wetland assessments were conducted as a part of the natural resources survey.

Species names for plants were established using the Integrated Taxonomic Information System to verify the most current accepted taxonomy (https://www.itis.gov). Common names include Yapese names where available.

The environmental survey included a generalized habitat survey, special status species, invasive species, and incidental observations of interest encountered during transect surveys to include water features, taro patches, World War II artifacts, potential burials, and non-special status species wildlife.

3.1 Vegetation/Habitat Survey

A generalized vegetation survey was conducted in conjunction with the special status species surveys to confirm the vegetation communities within the environmental survey area. Previously collected information regarding the vegetation communities and habitat types was downloaded from the 2019 U.S. Geological Survey and other publicly available land cover data (https://www.usgs.gov/programs/gap-analysis-project/science/land-cover). Prior to the field survey, a project map was created and uploaded to the Trimble. This data was used in the field to aid in navigation, and confirm coverage of various land cover and habitat types.

3.2 Special Status Species Surveys

The field team members performed meandering pedestrian and windshield surveys of the environmental survey area (see **Figure 1-3**) to determine the presence or absence of special status species, as discussed in **Section 2.2** and **Table 2-2**. Meandering surveys were done along pre-determined transects (as permitted by topography and terrain) to ensure the most accurate and adequate coverage that allowed for actual field conditions. The field team documented incidental observations of all species observed. Special status surveys did not include any hands-on survey techniques (e.g., trap and release) or avian call-backs. The field team took representative photographs when possible (see **Appendix B**).

3.3 Survey Methodologies

3.3.1 Transect Methodology

To document special status species, field team members walked meandering surveys in systematic, parallel transects (as vegetation and terrain permitted) of approximately 826 acres of the main environmental survey area. The spacing between each field team member was approximately 15 meters (see **Appendix B, Photo 1**). Transect spacing was adjusted based on visibility of special status species, suitable habitat conditions, and safety considerations. Additionally, incidental observations of invasive species, taro patches, water features (e.g., surface water, streams), and potential World War II artifacts were documented on the Trimble and the size was estimated, if appropriate.

3.3.2 Windshield Survey Methodology

Approximately 3.8 miles of road with a 200-meter buffer (approximately 93 acres) connecting the main project area to the port was surveyed for special status species using a "windshield" method. This method consisted of field team members driving the road and stopping every 250 meters, or the approximate distance that could safely be stopped and parked; getting out of the vehicle; visually inspecting the area for special status species and general habitat; and listening for 5 minutes. This methodology was used on both sides of the seaport-to-airport road.

3.3.3 Bird and Bat Observation Station Methodology

Surveys for the Yap flying fox and birds within the environmental survey area were conducted using protocols outlined in the "Landscape counts for solitary bats" in the *Joint Region Marianas Mariana Fruit Bat Monitoring Protocol*, dated September 2010 (JRM 2010). See **Appendix D**.

Bird and bat monitoring stations were identified based on field observations and vantage points. A total of 14 observation locations that provided line of sight to different aspects of the environmental survey area were selected to conduct surveys. Bird and bat surveys included 2 hours of dawn or 2 hours of dusk surveys, depending on the monitoring station. For dawn surveys, the field team members were in place as soon as it was light enough to see, and the survey continued for a full 2 hours after full light. For dusk surveys, surveys were conducted in the same location, approximately 2 hours prior to sunset until it was too dark to distinguish shapes and movement.

4. Results

Environmental surveys of the 919 acres documented nine special status species within the larger environmental survey area (see **Table 4-5**, **Table 4-6**, and **Table 4-7**). Eight special status species individuals were documented in either the main project area or during the windshield survey of the seaport-to-airport road; one special status species was documented outside both the main project area and seaport-to-airport road.

The results of these surveys are considered valid for the duration of project planning, biological coordination, and construction. Survey methods provided coverage of the project area. Special status species that were not observed were presumed absent from the area. Numbers of individuals for special status species may change between now and the implementation of the Proposed Action due to natural changes, such as decline in plant health, wildlife movement, or storm events.

4.1 Vegetation

The vegetation community categories and mapping from 2019 Yap vegetation surveys conducted by the U.S. Department of Agriculture and the 2005 Digital Atlas of Micronesia that mapped Yap Island from satellite imagery, computer modeling, and visual interpretation (USDA 2019) were reviewed. Of the 10 vegetation types or land uses present on Yap, all 10 were mapped within the environmental survey area, and 9 were mapped within the project area (i.e., main project area and the seaport-to-airport road) (see **Figure 4-1** and **Figure 4-2**). Field team members reviewed the vegetation communities while completing transects. The field team did not observe substantial deviations from the vegetation community mapping. **Table 4-1** and **Table 4-2** summarize acreages for each description of vegetation communities identified within the environmental survey area and project area, respectively. Descriptions for the vegetation communities present within the project area were derived from the U.S. Department of Agriculture 1987 mapping (USDA 1987) and provided in **Appendix A, Table A-1**. See **Appendix B, Photos 2 - 15** for representative photographs.

Table 4-1. Vegetation Communities within the Environmental Survey Area

Vegetation Type/ Land Cover	Survey Area (acres)	% of Survey Area	% of Yap Island Area
Agroforest	64.00	6.95	0.27
Barren	37.55	4.08	0.16
Mangrove forest	9.40	1.02	0.04
Marsh	1.85	0.20	0.01
Savanna	414.01	44.94	1.74
Secondary vegetation	95.46	10.36	0.40
Swamp forest	1.60	0.17	0.01
Upland forest	96.47	10.47	0.40
Urban build-up/cultivated	194.50	21.11	0.82
Water	6.25	0.68	0.03
Total	921.09	99.98 [a]	3.87

Source: USDA 2019
Key: [a] Numbers do not add up to 100 percent due to rounding issues

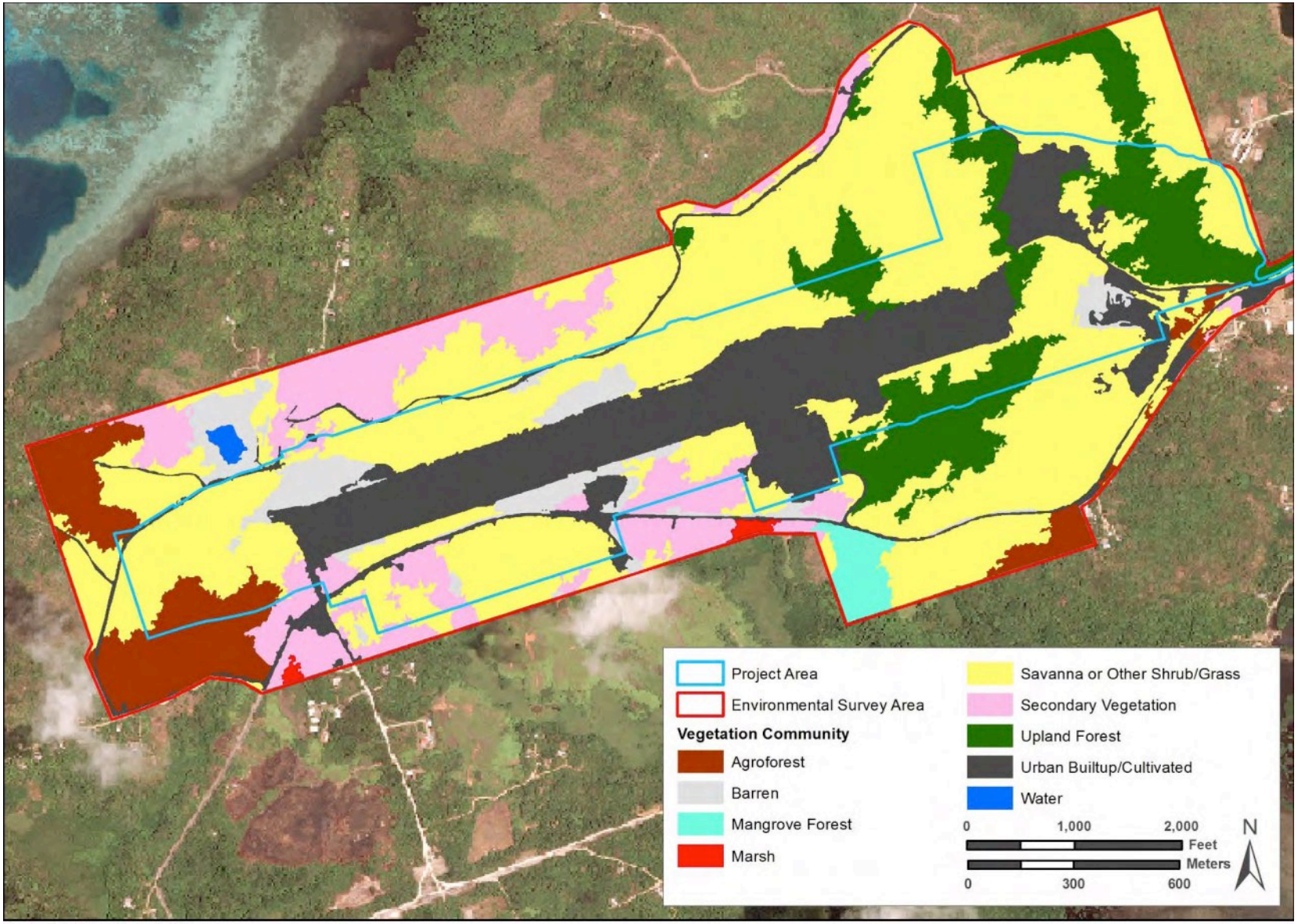

Figure 4-1. Vegetation Communities in the Environmental Survey Area and Project Area

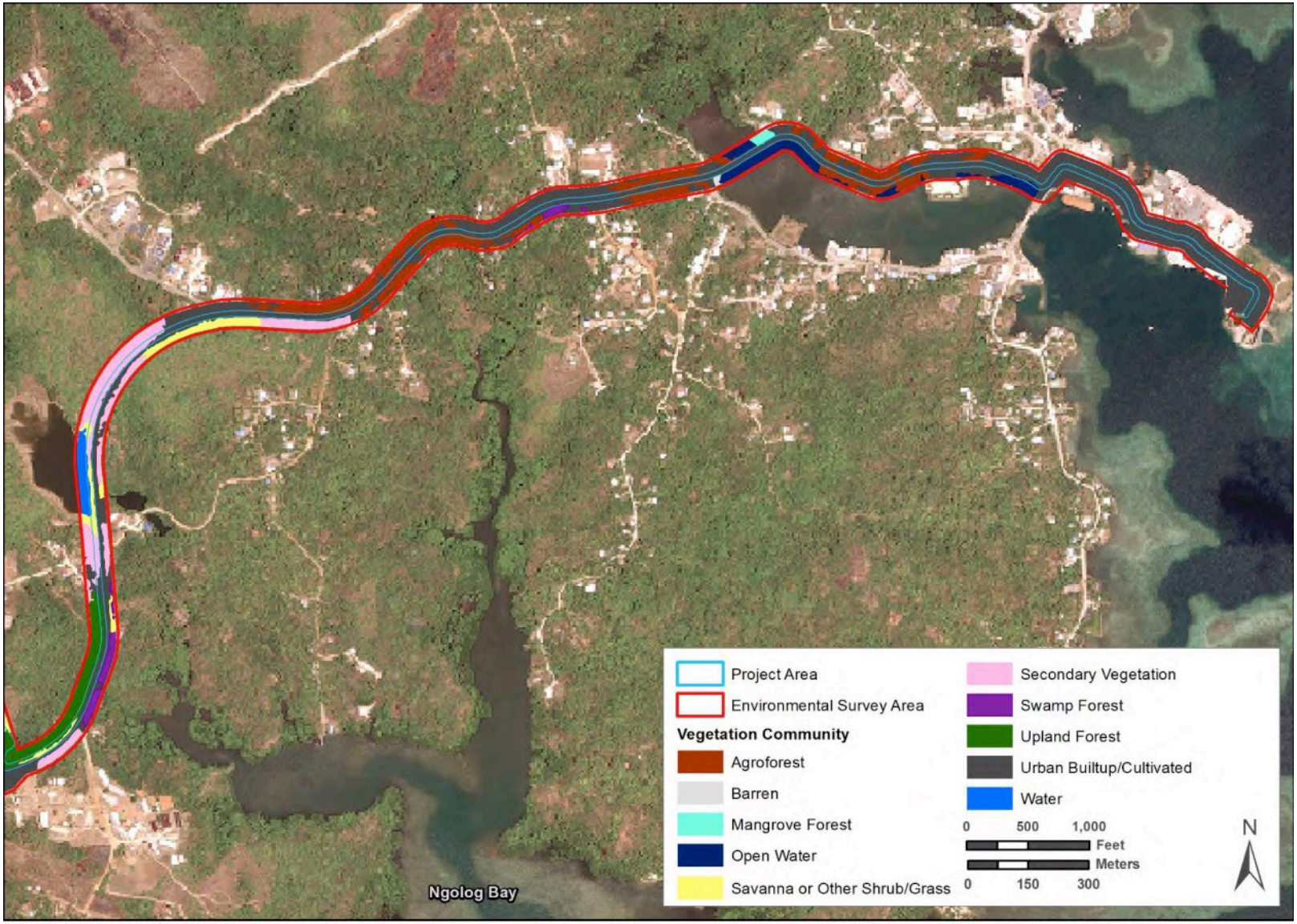

Figure 4-2. Vegetation Communities in the Environmental Survey Area and Seaport-to-Airport Road

Table 4-2. Vegetation Communities within the Project Area

Vegetation Type/ Land Cover	Main Project Area (acres)	Seaport-to-Airport Road (acres)	% of Project Area	% of Yap Island Area
Agroforest	8.81	1.00	2.27	0.01
Barren	25.63	0.00	5.92	0.02
Mangrove forest	0.00	0.01	<0.01	<0.01
Savanna	178.57	0.77	41.43	0.17
Secondary vegetation	15.52	1.41	3.91	0.02
Swamp forest	0.00	0.01	<0.01	<0.01
Upland forest	51.49	0.73	12.07	<0.01
Urban build-up/cultivated	137.61	11.02	34.35	0.14
Water	0.00	0.13	0.03	<0.01
Total	**417.64**	**15.09**	**99.98** [a]	**0.42**

Source: USDA 2019
Key: [a] Numbers do not add up to 100 percent due to rounding issues

Common Plant Species

The vegetation types within the survey zones contain mixtures of native and non-native vegetation. **Table 4-3** presents the most common plant species observed throughout all zones. A list of plants documented within each zone is included in **Appendix A, Table A-3.** A summary of all plants documented within the environmental survey area is included in **Appendix A, Table A-4**.

Table 4-3. Most Common Plant Species Observed Within the Environmental Survey Area

Scientific Name	Common/Yapese Name
Alysicarpus vaginalis	White moneywort
Euphorbia hypericifolia	Graceful sandmat
Chromolaena odorata[a]	Jack in the bush
Cocos nucifera	Coconut palm/ntew
Desmodium triflorum	Threeflower ticktrefoil
Leucaena leucocephala	Tangantangan
Mikania scandens	Climbing hempvine
Morinda citrifolia	Indian mulberry/magarwek
Pandanus tectorius	Tahitian screwpine/choi
Passiflora suberosa	Corkystem passionflower
Phyla nodiflora	Turkey tangle fogfruit
Microsorum scolopendria	Monarch fern
Pilea microphylla	Rockweed
Portulaca oleracea	Common purslane
Premna serratifolia	Malbau
Pyrrosia lanceolata	Lanceleaf tongue fern
Tridax procumbens	Coat buttons

Key: [a] Invasive

4.1.1 Main Project Area Vegetation

The main project area is approximately 418 acres. Urban build-up/cultivated and savanna make up approximately 75 percent of the main project area. There is approximately 68 acres of upland forest and secondary forest that likely provide habitat for native and special status wildlife species (see **Figure 4-1** and **Table 4-2**).

4.1.2 Vegetation Along the Seaport-to-Airport Road to the Port

The seaport-to-airport road (40 feet wide including the road and shoulders) and adjacent area (20-feet on either side) of the seaport-to-airport road is predominantly urban build-up/cultivated and secondary vegetation (see **Figure 4-2** and **Table 4-2**). There is 0.01 acres of mangrove forest, 0.01 acres of swamp forest, and 0.13 acres of water that overlap the area. These three class types are important for species protections and foraging (e.g., the Yap flying fox) as well as ecosystem health (e.g., fish larvae).

4.2 Wildlife

Transect surveys were conducted to locate and record target special status species (see **Table 2-2**). Survey methods to detect other wildlife species, such as avian point counts, game cameras, or live traps, were not used. Incidental observations of wildlife were recorded during the transect surveys as discussed in the following sections. **Table 4-4** provides wildlife species without special status protections that were observed within the environmental survey area during the transect surveys.

Table 4-4. Non-Special Status Wildlife Species Observed within the Environmental Survey Area

Common Name	Scientific Name	Status
Mammals		
Canis familiaris	Domestic dog, feral	Invasive
Felis catus	Domestic cat, feral	Invasive
Birds		
Anous stolidus	Brown noddy	Migratory
Aplonis opaca	Micronesian starling	Migratory
Egretta garzetta	Little egret	Migratory
Gallus gallus	Red junglefowl	Introduced
Gygis alba	White tern	Migratory
Ixobrychus sinensis	Yellow bittern	Migratory
Myzomela rubratra	Micronesian myzomela	Native
Passer montanus	Eurasian tree sparrow	Introduced
Pluvialis fulva	Pacific golden plover	Migratory
Reptiles and Amphibians		
Carlia ailanpalai	Curious skink	Introduced
Lamprolepis smaragdina	Emerald tree skink	Native

Rhinella marina	Cane toad	Invasive
Varanus indicus	Monitor lizard	Invasive
Mollusks		
Tuerkayana hirtipes	Pacific land crab	Native
Insects and Arachnids		
Agrionoptera insignis	Grenadier	Native
Hypolimnas bolina	Great eggfly	Introduced
Neurothemis terminata	Indonesian red-winged dragonfly	Introduced
Orthetrum serapia	Green skimmer	Introduced
Papilio polyte	Common mormon	Introduced

4.3 Special Status Species

4.3.1 Transect and Windshield Surveys

Transect surveys were conducted to document special status species within the main project area between January 8 and February 26, 2024; the windshield survey of the seaport-to-airport road was conducted on January 10, 2024. **Table 2-2** lists species for which field team members were surveying. Three plant, one mammal, one reptile, and four bird species were documented within the environmental survey area; three plant, one mammal, and four bird species were documented within the project area. **Table 4-5** summarizes the special status species recorded within the environmental survey area. The transects walked during the special status species surveys are included in mapbooks in **Appendix C**. See **Appendix B, Photos 16-24** for representative photographs.

Table 4-5. Special Status Species Observed within the Environmental Survey Area

Scientific Name	Common/Yapese Name	Individuals within the Environmental Survey Area	Individuals within the Main Project Area	Individuals within the Seaport-to-Airport Road
Cycas micronesica	Cycad/faltir	2	1	1
Ducula oceanica	Micronesian imperial-pigeon/ buleogol	1	0	1
Dioscorea nummularia	Pacific yam/thap	8	3	0
Monarcha godeffroyi	Yap monarch	46	11	0
Pampusana xanthonura	White-throated ground-dove	9	2	0
Perochirus ateles	Micronesia saw-tailed gecko/ qadburruq	1	0	0
Pterocarpus indicus	Rosewood/lach	1	0	1
Pteropus pelewensis yapensis	Yap flying fox/ maagul'aew	1	1	0
Zosterops hypolais	Yap plain white-eye	2	1	0

4.3.2 Yap Fuit Bat and Bird Station Surveys

Yap flying fox and bird surveys were conducted at 14 monitoring stations between February 27 and March 1, 2024. Inclement weather precluded evening surveys on March 1, 2024. **Figure 4-3** shows the locations of Yap flying fox and bird monitoring stations. Survey results are discussed in the sections below. Field team members observed possible foraging marks from Yap flying foxes on *Pandanus* fruits (either Tahitian screwpine or *Pandanus yapensis*) throughout the environmental survey area.

Yap Flying Foxes

The survey team recorded a total of 18 observations of the Yap flying fox at Stations 1, 8, 11, and 12 within the environmental survey area during monitoring station surveys. Field team members detected bat ejecta, droppings, and scent at Station 8. The survey team found no obvious droppings on or throughout the rest of the stations. **Table 4-6** summarizes observations of Yap flying foxes observed during monitoring station surveys.

Table 4-6. Yap Flying Fox Monitoring Station Survey Results

Station Identifier	Bat Detections	Observations
February 27, 2024		
1	13	Bats were observed flying east of Zone 5, over Zone 4, and to the south outside the main project area
2	0	No observations
3	0	No observations
4	0	No observations
February 28, 2024		
5	0	No observations
6	0	No observations
7	0	No observations
8	2	Bats came in from Zones 4 or 5, and roosted in an unknown tree; field team members detected bat ejecta, droppings, and scent around the station
February 29, 2024		
9	0	No observations
10	0	No observations
11	2	Bats observed flying north over the main project area
12	1	Bats observed flying north over the main project area
March 1, 2024		
13	0	No observations
14	0	No observations

Special Status Species Birds

The survey team observed a total of 16 special status birds between February 27 and March 1, 2024. **Table 4-7** summarizes observations of special status birds during the bird station surveys. During both dusk and dawn survey events, field team members heard general bird sounds throughout monitoring stations. The Yap monarch was observed approximately 12 times between Stations 1, 3, 6, and 13; white-throated ground doves were observed four times between Stations 3 and 11.

Table 4-7. Bird Monitoring Station Survey Results

Station Identifier	Bird Detections	Observations
February 27, 2024		
1	2	2 Yap monarchs observed in flight
2	0	No observations
3	9	3 white-ground doves observed foraging on the ground underneath a mango tree 6 Yap monarchs observed in flight
4	0	No observations
February 28, 2024		
5	0	No observations
6	3	3 Yap monarchs observed in flight
7	0	No observations
8	0	No observations
February 29, 2024		
9	0	No observations
10	0	No observations
11	1	1 white-ground dove observed foraging on the ground
12	0	No observations
March 1, 2024		
13	1	1 Yap monarch observed in flight
14	0	No observations

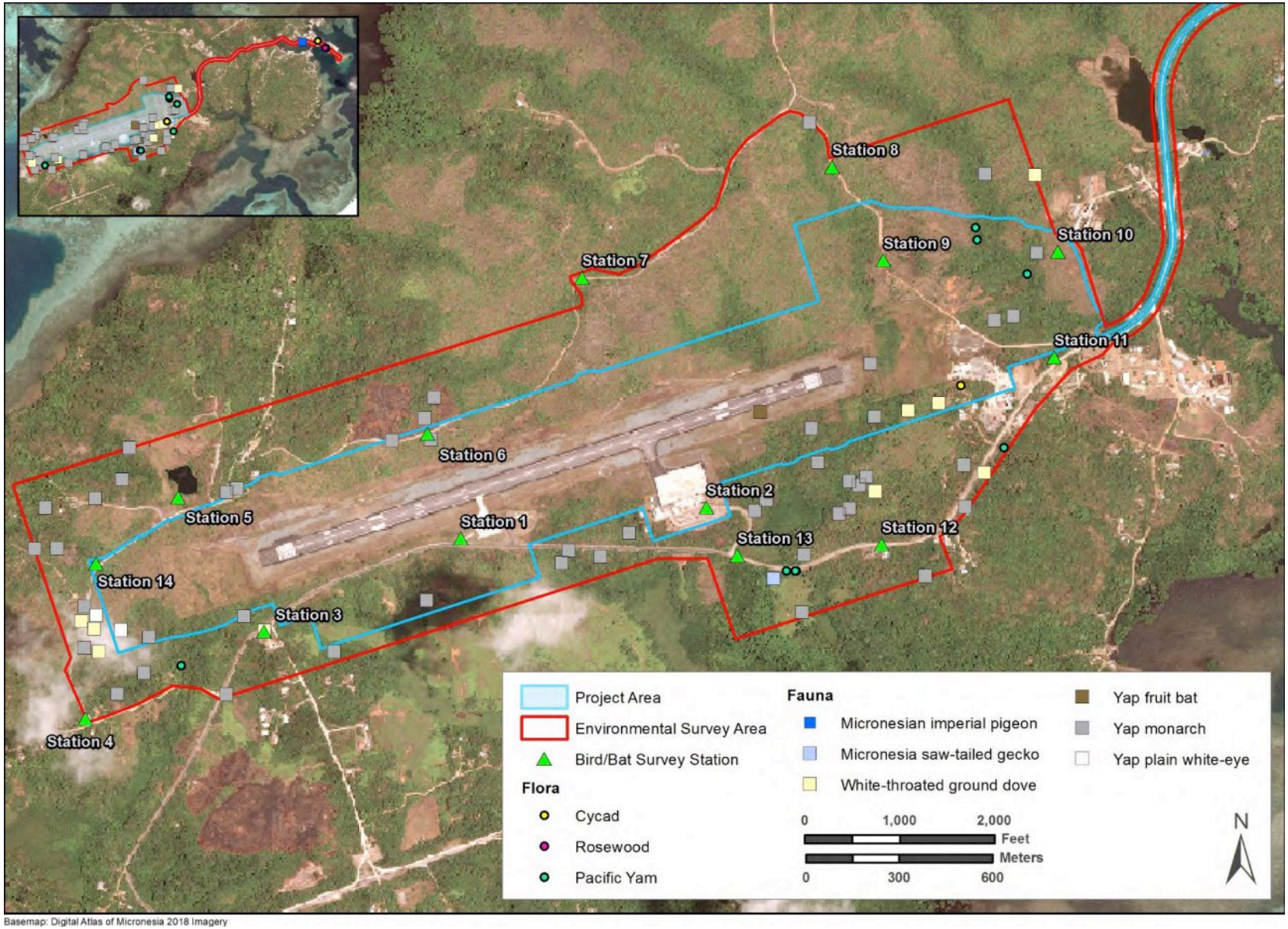

Figure 4-3. Special Status Species Documented within the Environmental Survey Area

4.3.3 Main Project Area Special Status Species

***Dioscorea nummularia* (Pacific yam/thap)**: There were eight documented occurrences of Pacific yams within the environmental survey area, three individuals were documented within the eastern portion of the main project area (see **Figure 4-3**). See **Appendix B, Photo 16** for a representative photograph.

***Monarcha godeffroyi* (Yap monarch)**: A total of 46 Yap monarchs were documented during transect surveys, and 12 were documented during bird monitoring station surveys within the environmental survey area. See **Appendix B, Photo 17** for a representative photograph. Of the 58 Yap monarchs documented, up to 20 individuals (some observations were in flight), could be within the main project area (see **Figure 4-3** and **Table 4-7**).

***Pampusana xanthonura* (white-throated ground dove):** Ten white-throated ground doves were documented during transect surveys and four were documented during bird monitoring station surveys within the environmental survey area. See **Appendix B, Photos 18** and **19** for representative photographs. Of the 14 white-throated ground doves documented, 3 individuals were within the main project area (see **Figure 4-3** and **Table 4-7**).

***Pteropus pelewensis yapensis* (Yap flying fox/maagal'aew)**: Six tree species that the Yap flying fox is known to use to forage were documented within the environmental survey area: *Artocarpus altilis* (breadfruit), *Glochidion ramiflorum,* beach mahogany*, Campnosperma brevipetiolata*, coconut palm, and Tahitian screwpine. Beach mahogany*, Campnosperma brevipetiolata*, coconut palm, and Tahitian screwpine were common throughout the environmental survey area. See **Appendix A, Table A-6** for a full list of trees the Yap flying fox is known to forage (Wiles and Fujita 1992).

There were no Yap flying fox colonies documented during transect surveys or observed during monitoring station surveys. Field team members observed three flying foxes during transect surveys. Two flying foxes were observed in early morning while driving to the survey transects within the main project area. Both times, flying foxes were flying from north to south across the seaport-to-airport road; one on January 12, 2024 and the other on January 16, 2024. Field team members observed a third flying fox during surveys within Zone 8, flying from north to south over the runway. Eighteen Yap flying foxes were documented during monitoring station surveys (see **Figure 4-3** and **Table 4-6**).

***Zosterops hypolais* (Yap plain white-eye):** Field team members documented two Yap plain white-eyes during transect surveys within the environmental survey area, one of those individuals was documented within the main project area (see **Figure 4-3**).

4.3.4 Special Status Species Along the Seaport-to-Airport Road

***Cycas micronesica* (Cycad/faltir)**: Cycads are protected by the U.S. Fish and Wildlife Service as federally endangered and are considered endangered by the IUCN. Yap has an estimated total of approximately 288,450 cycads between 4 populations (DOI 2016). Two cycads were documented within the environmental survey area. One was outside the main project area at a residence to the south and the other was along the seaport-to-airport road at a business/residence (see **Figure 4-3**). See **Appendix B, Photo 20** for a representative photograph. Both cycads appeared healthy. No cycads were documented within the main project area.

***Pterocarpus indicus* (Rosewood/lach)**: Three rosewood trees were documented within 15 feet of the western portion of the seaport-to-airport road and no rosewood trees were documented within the main project area (see **Figure 4-3**). See **Appendix B, Photos 21** and **22** for representative photographs. They appeared to be in good health and were being maintained by a business/residence.

***Ducula oceanica* (Micronesian imperial-pigeon/buleogol)**: One Micronesian imperial-pigeon was documented during windshield surveys of the seaport-to-airport road (see **Figure 4-3**). The bird was in a cage at The Pines restaurant. No Micronesian imperial-pigeons were documented within the main project area.

4.3.5 Special Status Species Surveyed but Not Recorded

Special status species that have the potential to occur within the environmental survey area but were not observed during the field surveys are discussed below. These species are not expected to move into the environmental survey area during the planning and construction period due to various factors, including:

- Lack of suitable habitat or host plants;
- Distance from the closest known potential source;
- Limited numbers of individuals on Yap;
- Limited extent on Yap; and/or
- No known occurrences in the wild.

Plants: The survey team did not document Borneo teak, Caroline ivory nut palm, or the nedun tree during the environmental surveys.

Wildlife: The survey team did not document the Yap cicadabird, bar-tailed godwit, black-tailed godwit, far-eastern curlew, bristle-thighed curlew, great knot, Beck's petrel, Yap olive-white-eye, or the coconut crab during the environmental surveys.

4.4 Additional Observations

Incidental observations of water features (e.g., surface water, streams), taro patches, and potential World War II artifacts were documented and are discussed in sections below.

4.4.1 Water Features

Surface Water

The field team members observed 43 water features (totaling approximately 3.72 acres) within the environmental survey area with 21 water features (approximately 1.42 acres) within the main project area. One water feature was historically a quarry; the rest of the water features appear to be moist depressions of water that are isolated from the known streams. Field team members observed two streams with slow moving water within the environmental survey area. One stream ran from the southern edge of the main project area, through the environmental survey area south of it, and outside the survey boundaries. This stream was approximately 1,040 feet long; with 180 feet of the stream within the project area (see **Figure 4-4**). The second stream originated in the northeastern corner of the environmental survey area, curved through the main project area, and out the southeastern boundary of the environmental survey area. This stream was approximately 3,220 feet long; with 2,020 feet of the stream within the project area (see **Figure 4-4**). See **Appendix B, Photos 25 - 33** for representative photographs.

Additionally, Yap Protected Areas and Areas of Biodiversity Significance were reviewed. No Yap Protected Area overlaps with the environmental survey area. Approximately 9.8 acres of the environmental survey area overlaps with the Area of Biodiversity Significance; there is no overlap of the project area (see **Figure 4-4**).

4.4.2 Taro

Taro Patches

Taro belongs to the Araceae family, which includes 110 genera and more than 2,500 species worldwide. Three main species of taro grow on Yap. The most common taro grown is Giant swamp taro/lak, the second is *Colocasia esculenta* (wild taro/mal), and the least common is *Xanthosoma sagittifolium* (arrowleaf elephant's ear/ Honolulu). On Yap, taro is grown using almost a dozen different methods, including around the house; in intermittent mixed garden within natural skylight openings of forest trees; and in dry depressions surrounded by raised dikes (Falanfuw n.d.).

Field team members observed 195 (approximately 7.39 acres) taro patches within the environmental survey area; 43 (approximately 0.70 acres) taro patches were within the main project area (see **Figure 4-4**). No taro patches were observed along the seaport-to-airport road. The majority of the taro patches observed were in moist depressions with raised dikes. See **Appendix B, Photos 34 - 38** for representative photographs.

4.4.3 Observations of Interest

In addition to the special status species surveys, bird and bat surveys, and documentation of water features and taro patches, field team members documented World War II evidence. Team members documented suspected impact craters, depressions of unknown origin, World War II artifacts, and suspected explosive remnants of war (ERW).

Impact Craters

The field team encountered numerous deep, uniform depressions approximately 20 feet in diameter and 10 feet deep that were assumed to be potential impact craters from World War II

bombing. The survey team observed 18 impact craters within the environmental survey area; with 11 of the impact craters within the main project area (see **Figure 4-5**). Except for four occurrences, all impact craters were located along the westernmost portion of the environmental survey area and project area. See **Appendix B, Photo 39** for a representative photograph.

Depressions

In addition to the uniform crater depressions, field team members also encountered numerous non-uniform depressions that varied in size and depth. It was unclear whether these depressions were human-made or natural and they did not contain water at the time of observation. The survey team observed 33 depressions of unknown origin within the environmental survey area, 17 of these depressions were within the main project area (see **Figure 4-5**). See **Appendix B, Photo 40** for a representative photograph.

World War II Artifacts and Other Observations of Note

Several World War II artifacts were observed during surveys (see **Figure 4-5**):

- Two crashed airplanes were documented: one in the western portion of the project area and one along the southwestern edge of the environmental survey area outside the project area. See **Appendix B, Photos 41 - 42** for representative photographs.
- Three World War II weapons were documented within the project area along the northern edge. See **Appendix B, Photos 43 - 44** for representative photographs.
- An assumed World War II generator was documented along the southwestern edge of the environmental survey area outside the project area. See **Appendix B, Photo 45** for a representative photograph.

Additionally, an aircraft engine was observed south of the runway immediately inside the project area and a cave was documented in the northeastern corner of the environmental survey area outside the project area.

Explosive Remnants of War

The survey team documented one suspected ERW during surveys within the project area north of the airport. The field team member stopped as soon as the suspected ERW was observed, took pictures, flagged at a safe location, and submitted the location and photographs to the DAF Yap liaison via email the same day (see **Figure 4-5**). See **Appendix B, Photo 46** for a representative photograph.

4.4.4 Notes and Observations

Burial Sites: There were numerous potential burial sites the natural resources survey team members encountered throughout the environmental survey area. When a potential burial site was observed during the natural resources survey, field team members flagged it, took a Trimble position and a photograph, and sent the information to the cultural resources survey team as soon as possible, but not later than the end of the day. As soon as identified, field team members were respectful of any potential burial area and carefully moved around the area to resume transect surveys on the other side. See **Appendix B, Photos 51 - 53** for representative photographs.

Cleared Areas: During the natural resource surveys, field team members observed several areas that appeared to have been cleared of vegetation prior to surveys based on terrestrial churn and recently downed trees. Most of these disturbances were north of the airport. Field team members did their best to survey these areas; however, there were many areas that needed to be widely surveyed to maintain safety with unstable vegetation debris. There was one area (east of the airport) that was actively being cleared with heavy equipment during the natural resource surveys. For safety reasons, field team members were unable to survey the approximately 13.9 acres of Zone 5 (see **Figure 4-5**). See **Appendix B, Photos 54 - 62** for representative photographs

4.4.5 Invasive Species

There were ten invasive species documented during the natural resources surveys: two monitor lizards were observed in the southwestern portion of the environmental survey area; domestic dogs, domestic cats, cane toads, common bamboo, hairy beggerticks, Jack in the bush, Bermuda grass, nutgrass, and the shameplant were observed throughout the environmental survey area and project area. See **Appendix B, Photos 47 - 50** for representative photographs.

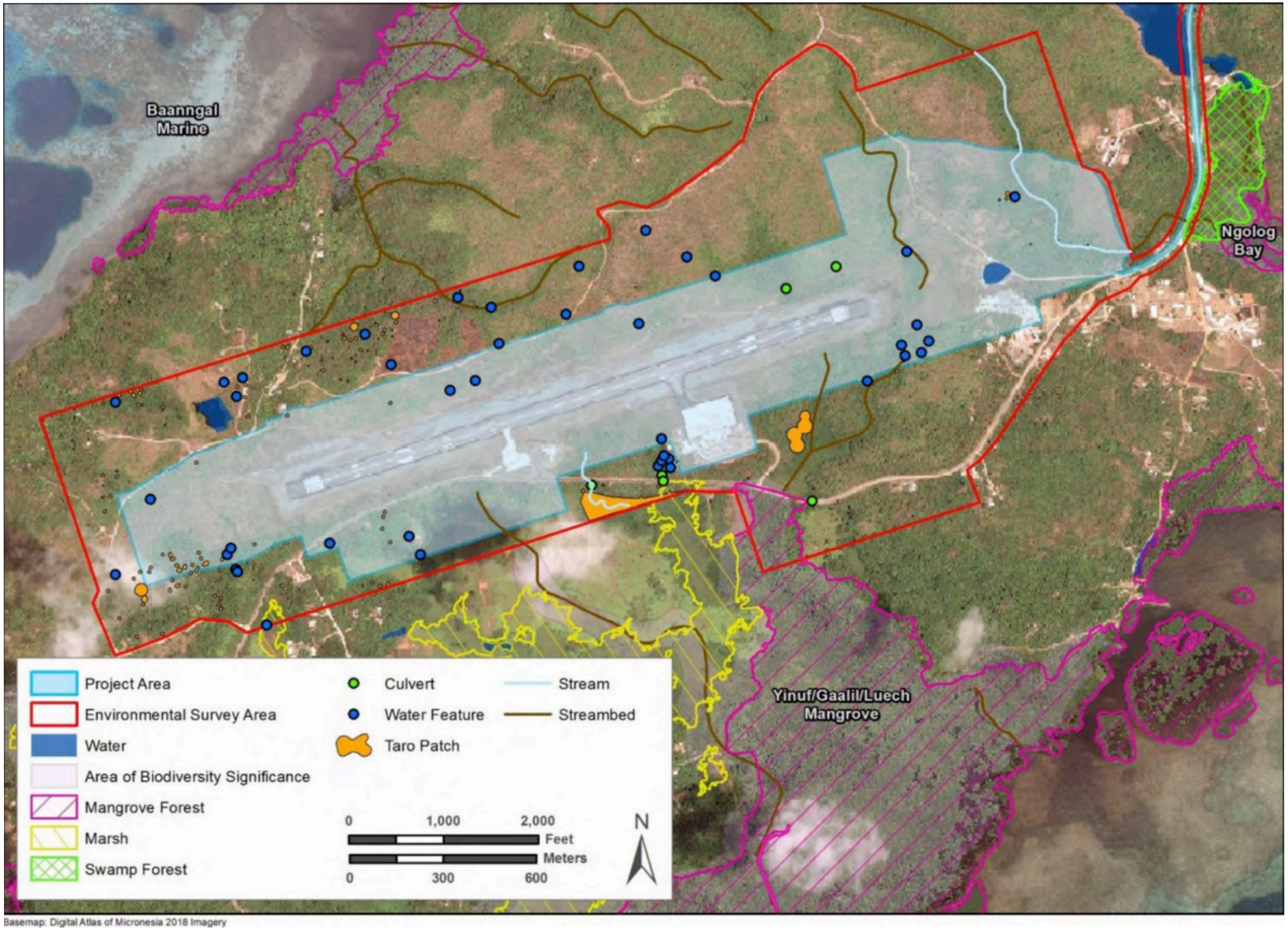

Figure 4-4. Water Features and Taro of Interest Documented within the Environmental Survey Area

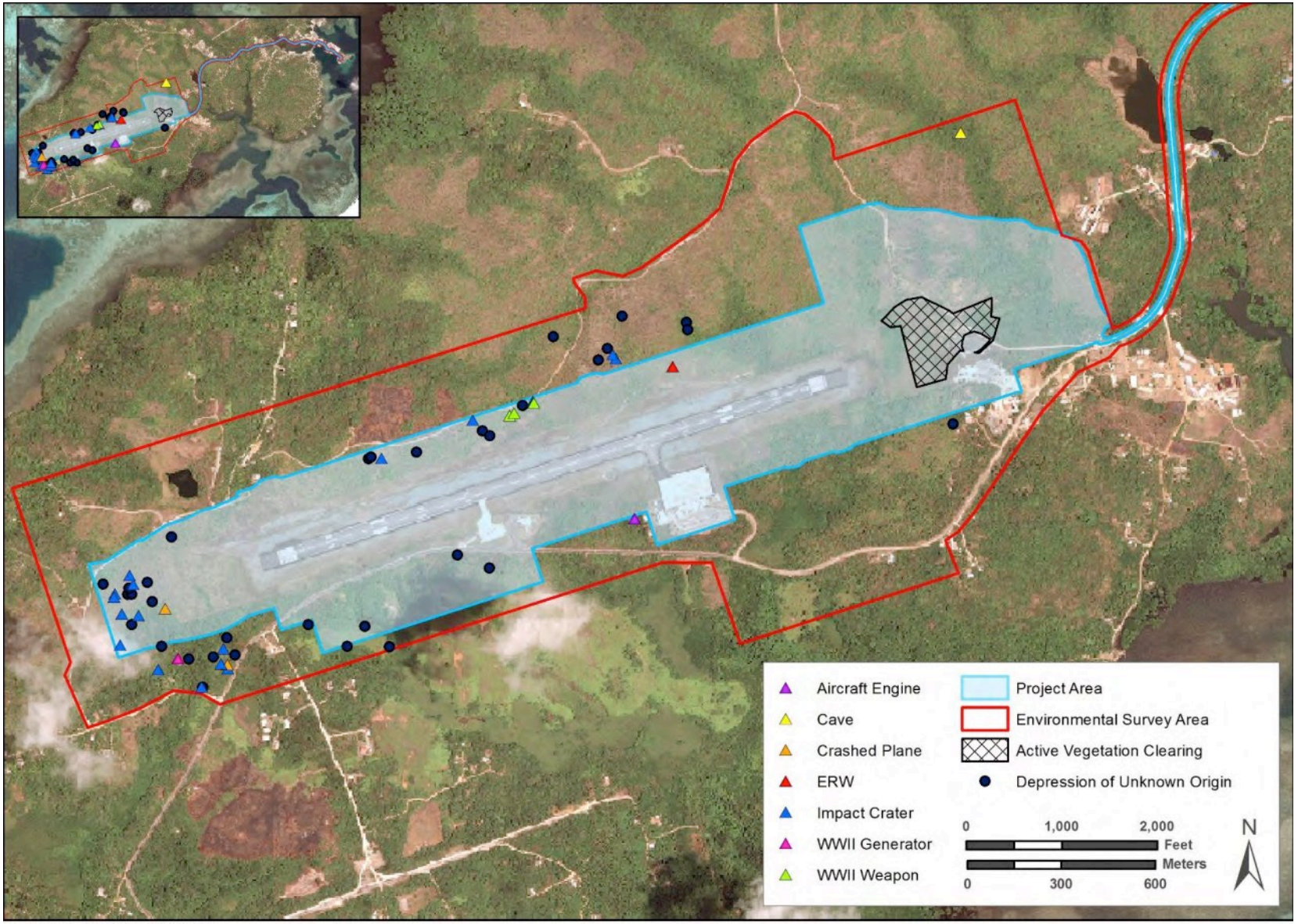

Figure 4-5. Observations of Interest Documented within the Environmental Survey Area

5. Conclusion

The natural resources surveys conducted at the Yap International Airport confirmed the presence of 2 cycads, 8 Pacific yams, 3 rosewood trees, 1 Micronesian imperial-pigeon, 58 Yap monarchs, 14 white-throated ground doves, 21 flying foxes, and 2 Yap plain white-eyes within the environmental survey area. There were no Yap flying fox colonies or roosts documented within the environmental survey area. Within the main project area there were 3 Pacific yams, 20 Yap monarchs, 3 white-throated ground doves, 3 Yap flying foxes (in flight), and 2 Yap plain white-eyes documented. There were 2 cycads, 3 rosewood trees, and 1 Micronesian imperial-pigeon documented along the seaport-to-airport road. Survey findings were consistent with expectations for the species potentially present in the environmental survey area.

Sensitive status species that were not recorded during the natural resource surveys are presumed absent from the project area.

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Appendix A.

Species Lists

Table A-1. Yap Island Forest Classes

Scientific Name	Common/Yapese Name
Agroforest	Found growing around villages and consisting of a mixture of food and useful trees. The canopy is often uneven and may be interspersed with open areas of croplands, taro patches, and secondary vegetation. Tree gardens, taro patches, and open gardens work together for food. Some examples of tree species include: *Artocarpus altilis* (breadfruit/thow), *Cocos nucifera* (coconut palm/ntew), *Pangium edule* (football fruit/rowal), *Areca catechu* (betel palm/buw), *Calophyllum inophyllum* (beach mahogany), *Citrus aurantifolia* (lime), *Crateva religiosa* (garlic pear/abtuuch), and *Psidium guajava* (guava/abas). The understory may consist of shrubs, herbs, epiphytes, vines, and ground cover plants. Additionally, taro patches may be developed in low areas and connected via water channels; varieties of *Colocasia esculenta* (wild taro/mal) and *Cyrtosperma merkusii* (swamp taro/lak) are typical. Many gardens will include *Dioscorea* spp. (yams) and other crops.
Barren	Bare ground, unvegetated areas, and disturbed areas that lack natural vegetation.
Mangrove	Mangrove forests have specialized roots periodically inundated by sea water and are found around coastal areas, specifically mud flats at the mouths of drainage systems. This habitat serves as a nutrient buffering and natural filtering system between the lagoon and island, fish nurseries, and habitat for flying foxes and birds. Some examples of species include *Rhizophora* spp. (true mangroves), *Bruguiera gymnorhiza* (Burmese mangrove/rok), *Nypa fruticans* (nipa palm/eang), *Sonneratia alba* (mangrove apple/abrur), *Ceriops tagal*, *Xylocarpus granatum* (cannonball mangrove/yamgur), *Lumnitzera littorea* (yiy), Scyphiphora *hydrophylacea* (guad), and *Excoecaria agallocha* (blinding mangrove/bat').
Marsh	Areas of herbs, grasses, and sedges that grow in standing water. There are two types of marshes: • Saline marshes are generally along the coast and adjacent mangroves, and are only periodically inundated by salt water. Some examples of common species include *Derris trifoliata* (threeleaf derris/gabati), *Cyperus javanicus* (Javanese flatsedge), *Vigna marina* (notched cowpea), *Paspalum distichum* (knotgrass), and *Melanthera biftora* (Honolulu nehe). • Freshwater marshes are generally located just above sea level, landward of mangroves, or in upland depressions. Some examples of common *Phragmites karka* (tall weed), *Carex* spp. (sedges), *Ludwigia hyssopifolia* (seedbox), *Hanguana malayana*, and *Acrostichum aureum* (golden leatherfern/welbrob). Freshwater marshes are often cultivated for taro.
Savanna	Areas thought to be the result of some form of destruction, like fire or soil exposure to rain and sun. Some examples of common species include *Dicranopteris linearis* (old world forked fern), Tahitian screwpine, *T. albus*, *Decaspermum fruticosum*, *Melastoma malabathricum*, *Myrtella bennigsiana*, *Nepenthes mirabilis* (aad), *Morinda citrifolia* (Indian mulberry/magarwek), *Scaevola taccada* (beach naupaka), and *Tacca leontopetaloides* (batflower).
Secondary vegetation	This includes landcover that is not forest and savanna, and is generally covered with weedy species. Some examples of common species include *Talipariti tiliaceum* (sea hibiscus), *Macaranga carolinensis* (bith), *Rhus taitensis* (sumac/glad), *Commersonia bartramia* (brown kurrajong/guguw), *Mimosa diplotricha* (giant false sensitive plant), *Lantana camara* (largeleaf lantana), *Premna serratifolia* (arr), *Hyptis capitata* (false ironwart), and *Casuarina equisetifolia* (ironwood tree/natch).
Swamp forest	Swamp forests occur when soils are inundated with fresh or slightly saline water and are generally found in low, wet areas inland of mangroves. They are lower in elevation than the surrounding terrain but above tidal influences. Swamp forests on Yap are limited, and are heavily disturbed and poorly developed. Some examples

Scientific Name	Common/Yapese Name
	of common species include *Dolichandrone spathacea* (mangrove trumpet/riyou), *Millettia pinnata* (ngelak), *Barringtonia racemose* (wathol), *Dalbergia candenatensis* (prain), *Cynometra ramiflora* (manbul), *Inocarpus fagifer* (buoy), *Ficus tinctoria* (dye fig/wacheguy), and *Pandanus polycephalus*.
Upland forest	This forest type may be a mixture of native, secondary, agroforest, and introduced plant species. Some representative plant species that may be found in better native forests include *Campnosperma brevipetiolata* (ramlieu), *S. venenosus*, *Inocarpus fagifer* (buoy), *Buchanania engleriana*, *Pterocarpus indicus* **(**rosewood/lach), *Garcinia rumiyo* (titol), *Serianthes kanehirae* var. *yapensis* (gumor), *Ficus prolixa* (banyan tre/aw), sumac, beach mahogany, *T. albus*, *Meryta senjftiana*, and *Ixora casei* (gachiow). • **Higher elevation**: Higher elevation forests have better drainage. These forests may include species such as *Diospyros ferrea* (achingal)*, Ixora triantha*, *Aidia cochinchinensis*, *T. albus*, and cycad. • **Lower elevation**: Lower elevation forests are commonly located in ravines or coastal areas and retain more water. These forests may include species such as *Trichospermum ikutai*, *C. brevipetiolata*, brown kurrajong, sumac, beach mahogony, *Pouteria obovata*, *Guettarda speciosa* (blaw), *Hernandia sonora* (mago/gachal), *Vitex negundo* (negundo chastetree), and *Pemphis acidula* (gangiy).
Urban built-up/ cultivated	This type includes paved, compacted, impervious, unvegetated, and cultivated areas that are generally associated with villages and towns.
Water	Inland water includes freshwater, brackish water, and enclosed saltwater bays.

Table A-2. Wildlife Species Documented on Yap

Scientific Name	Common/Yapese Name	Status
Mammals		
Mus musculus	House mouse	Invasive
Pteropus pelewensis yapensis	(Yap flying fox/maagul'aew)	Endemic
Rattus exulans	Polynesian rat	Invasive
Rattus norvegicus	Brown rat	Invasive
Rattus rattus	Black rat	Invasive
Birds		
Sus scrofa	Wild boar	Invasive
Accipiter soloensis	Chinese sparrowhawk	Migratory
Actitis hypoleucos	Common sandpiper	Migratory
Acrocephalus astrolabii	Mangareva reed warbler	Endemic
Acrocephalus syrinx	Caroline reed warbler	Endemic
Aerodramus inquietus	Caroline Islands swiftlet	None
Anas acuta	Northern pintail	Migratory
Anas crecca	Green-winged teal	Migratory
Anous minutus	Black noddy	Migratory
Anous stolidus	Brown noddy	Migratory
Anthus cervinus	Red-throated pipit	Migratory
Aplonis opaca	Micronesian starling	Endemic
Ardea alba	Great egret	Migratory
Ardea cinerea	Gray heron	Migratory
Ardea intermedia	Medium egret	Migratory
Arenaria interpres	Ruddy turnstone	Migratory
Aythya fuligula	Tufted duck	Migratory
Aythya marila	Greater scaup	Migratory
Bubulcus coromandus	Eastern cattle egret	Unknown
Bulweria bulwerii	Bulwer's Petrel	Migratory
Butastur indicus	Gray-faced buzzard	Migratory
Butorides striata	Striated heron	Unknown
Calidris acuminata	Sharp-tailed sandpiper	Migratory
Calidris alba	Sanderling	Migratory
Calidris ferruginea	Curlew sandpiper	Migratory
Calidris pugnax	Ruff	Migratory
Calidris ruficollis	Red-necked stint	Migratory
Calidris subminuta	Long-toed stint	Migratory
Calonectris leucomelas	Streaked shearwater	Migratory
Charadrius alexandrinus	Kentish plover	Unknown
Charadrius dubius	Little ringed plover	Migratory
Charadrius leschenaultii	Greater sand-plover	Unknown
Charadrius mongolus	Siberian sand-plover	Unknown
Chlidonias hybrida	Whiskered tern	Migratory
Chlidonias leucopterus	White-winged tern	Migratory
Chroicocephalus ridibundus	Black-headed gull	Migratory
Columba livia	Rock pigeon	Introduced
Cuculus optatus	Oriental cuckoo	Migratory
Ducula oceanica	Micronesian imperial-pigeon	IUCN-V/Introduced
Edolisoma nesiotis	Yap cicadabird	IUCN-E/Endemic
Egretta garzetta	Little egret	Migratory
Egretta sacra	Pacific reef-heron	Migratory
Eurystomus orientalis	Dollarbird	Unknown
Falco peregrinus	Peregrine falcon	Migratory

Scientific Name	Common/Yapese Name	Status
Fregata ariel	Lesser frigatebird	Migratory
Fregata minor	Great frigatebird	Unknown
Gallinula chloropus	Eurasian moorhen	Migratory
Gallinago megala	Swinhoe's snipe	Migratory
Gallus gallus	Red junglefowl	Introduced
Glareola maldivarum	Oriental pratincole	Unknown
Gygis alba	White tern	Migratory
Himantopus himantopus	Black-winged stilt	Migratory
Himantopus leucocephalus	Pied stilt	Unknown
Himantopus mexicanus	Black-necked stilt	Migratory
Hirundo rustica	Barn swallow	Migratory
Oceanodroma matsudairae	Matsudaira's storm petrel	Migratory
Ixobrychus cinnamomeus	Sinnamon bittern	Unknown
Ixobrychus sinensis	Yellow bittern	Migratory
Limosa lapponica	Bar-tailed godwit	IUCN-NT
Limosa limosa	Black-tailed godwit	IUCN-NT
Lonchura punctulate	Scaly-breasted munia	Introduced
Mareca penelope	Eurasian wigeon	Migratory
Microcarbo melanoleucos	Little pied cormorant	Migratory
Monarcha godeffroyi	Yap monarch	IUCN-NT/Endemic
Motacilla cinerea	Ray wagtail	Migratory
Motacilla tschutschensis	Eastern yellow wagtail	Migratory
Muscicapa griseisticta	Gray-streaked flycatcher	Migratory
Myzomela rubratra	Micronesian myzomela	Endemic
Numenius madagascariensis	Far Eastern curlew	IUCN-E
Numenius phaeopus	Whimbrel	Migratory
Numenius tahitiensis	Bristle-thighed curlew	IUCN-NT
Nycticorax nycticorax	Black-crowned night heron	Migratory
Onychoprion fuscatus	Sooty tern	Migratory
Onychoprion lunatus	Gray-backed tern	Migratory
Pampusana xanthonura	White-throated ground dove	IUCN-NT/Endemic
Pandion haliaetus	Osprey	Migratory
Passer montanus	Eurasian tree sparrow	Introduced
Phaethon lepturus	White-tailed tropicbird	Migratory
Phalacrocorax carbo	Great cormorant	Migratory
Pluvialis fulva	Pacific golden-plover	Migratory
Pluvialis squatarola	Black-bellied plover	Migratory
Poliolimnas cinereus	White-browed crake	Unknown
Pseudobulweria rostrata	Tahiti petrel	Migratory
Puffinus bailloni	Tropical shearwater	Unknown
Puffinus carneipes	Flesh-footed shearwater	Migratory
Puffinus pacifica	Wedge-tailed shearwater	Migratory
Puffinus tenuirostris	Short-tailed shearwater	Migratory
Rhipidura versicolor	Micronesian rufous fantail	Unknown
Spatula clypeata	Northern shoveler	Migratory
Sternula albifrons	Little tern	Migratory
Sterna hirundo	Common tern	Migratory
Sterna sumatrana	Black-naped tern	Migratory
Streptopelia dusumieri	Philippine collared-dove	Introduced
Sula dactylatra	Masked booby	Migratory
Sula leucogaster	Brown booby	Migratory
Sula sula	Red-footed booby	Migratory

Scientific Name	Common/Yapese Name	Status
Thalasseus bergii	Great crested tern	Migratory
Tringa brevipes	Gray-tailed tattler	Migratory
Tringa glareola	Wood sandpiper	Migratory
Tringa incana	Wandering tattler	Migratory
Tringa nebularia	Common greenshank	Migratory
Tringa stagnatilis	Marsh sandpiper	Migratory
Tringa totanus	Common redshank	Migratory
Urodynamis taitensis	Long-tailed koel	Migratory
Xenus cinereus	Terek sandpiper	Migratory
Zosterops hypolais	Plain white-eye	ICUN-NT/Endemic
Zosterops oleaginous	Yap white-eye	ICUN-NT/Endemic
Reptiles and Amphibians		
Anolis carolinensis	Green anole	Unknown
Carlia ailanpalai	Curious skink	Introduced
Emoia atrocostata	Littoral whiptail skink	Unknown
Emoia impa	Azure-tailed skink	Unknown
Emoia jakati	Kopstein's emo skink	Unknown
Eretmochelys imbricata	Hawksbill sea turtle	Endemic
Lamprolepis smaragdina	Emerald tree skink	Unknown
Perochirus ateles	Micronesia saw-tailed Gecko/qadburruq	Endemic
Ramphotyphlops hatmaliyeb	Blind snake/hatmaliyeb	Unknown
Rhinella marina	Cane toad	Introduced
Varanus indicus	Monitor lizard	Invasive
Invertebrates		
Agrionoptera insignis	Grenadier	Unknown
Birgus latro	Coconut crab	Endemic
Camponotus erythrocephalus	No common name	Unknown
Coenobita rugosus	Tawney hermit crab	Unknown
Cryptophyllium yapicum	Hidden leaf insect	Unknown
Hypolimnas bolina	Great eggfly	Unknown
Neurothemis terminata	Indonesian red-winged dragonfly	Unknown
Olethrius carolinensis	No common name	Unknown
Orthetrum serapia	Green skimmer	Unknown
Papilio polytes	Common Mormon swallowtail	Unknown
Tuerkayana hirtipes	Pacific land crab	Unknown
Wasmannia auropunctata	Little fire ant	Invasive

Source: Avibase 2023; Buden 2011; iNaturalist 2024a, 2024b, 2024c; USFWS 2023
Key: E = Endangered; F = Federal; IUCN = International Union for Conservation of Nature and Natural Resources; NT = Near Threatened; V = Vulnerable.

Table A-3. Invasive Species Documented on Yap

Scientific Name	Common/Yapese Name
Plants	
Abelmoschus moschatus	Muskmallow
Acacia confusa	Ayangile
Ageratum conyzoides	Billygoat weed
Alternanthera sessilis	Sessile joyweed
Angiopteris evecta	Elephant fern
Antigonon leptopus	Mexican creeper
Bambusa vulgaris	Common bamboo
Bidens pilosa	Hairy beggarticks
Canna indica	Indian shot
Cedrela odorata	No common name
Cenchrus polystachios	No common name
Cestrum nocturnum	Night blooming jasmine
Chromolaena odorata	Jack in the bush
Cynodon dactylon	Bermuda grass
Cyperus rotundus	Nutgrass
Dioscorea bulbifera	No common name
Eichhornia crassipes	Common water hyacinth
Falcataria moluccana	Moluccan Albizia
Imperata cylindrica	Cogon grass
Ischaemum polystachyum	Paddle grass
Lantana camara	West Indian lantana
Melaleuca quinquenervia	Punktree
Melia azedarach	Chinaberry
Merremia peltata	No common name
Mikania micrantha	No common name
Mimosa diplotricha	No common name
Mimosa pudica	Shameplant
Opuntia monacantha	Drooping prickly pear
Paspalum scrobiculatum	Kodo millet
Passiflora foetida	Stinking passionflower
Psidium guajava	Common guava
Pueraria montana var. lobata	No common name
Ricinus communis	Caster bean
Sphagneticola trilobata	Singapore daisy
Thevetia peruviana	Yellow oleander
Animals	
Mus musculus	House mouse
Rattus exulans	Polynesian rat
Rattus norvegicus	Brown rat
Rattus rattus	Black rat
Sus scrofa	Wild boar
Varanus indicus	Monitor lizard

Source: GISD 2024

Table A-4. Plant Species Observed by Zone in the Environmental Survey Area

Scientific Name	Common/Yapese Name
Zone 1	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Buchanania engleriana	omail
Calophyllum inophyllum	Beach mahogany/biyuuch
Campnosperma brevipetiolata	ramlieu
Cocos nucifera	Coconut palm/ntew
Commersonia bartramia	Brown kurrajong/guguw
Talipariti tiliaceum	Sea hibiscus/gal'
Melaleuca quinquenervia	Bottle brush tree
Melanolepis trees	No common name
Morinda citrifolia	Indian mulberry/magarwek
Ochrosia oppositifolia	mow
Pandanus tectorius	Tahitian screwpine/cho
Pandanus yapanensis	No common name
Premna serratifolia	arr
Tacca leontopetaloides	Batflower
Xanthosoma saggitifolium	tannia
Zone 2	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Areca catechu	betel palm/buw
Artocarpus altilis	Breadfruit/thow
Artocarpus mariannensis	meiyas
Bambusa vulgaris	Common bamboo
Buchanania engleriana	omail
Calophyllum inophyllum	Beach mahogany/biyuuch
Campnosperma brevipetiolata	ramlieu
Cocos nucifera	Coconut palm/ntew
Talipariti tiliaceum	Sea hibiscus/gal'
Lycopodium cernuum	Staghorn clubmoss
Melaleuca quinquenervia	Bottle brush tree
Melanolepis multiglandulosa	No common name
Morinda citrifolia	Indian mulberry/magarwek
Pandanus tectorius	Tahitian screwpine/cho
Pandanus yapanensis	No common name
Premna serratifolia	arr
Serianthes kanehirae	gumor
Tacca leontopetaloides	Batflower
Tuberolabium sp.	No common name
Xanthosoma sagittifolium	tannia
Zone 3	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Areca catechu	buw/ betel palm
Avicennia alba	dadit
Bambusa vulgaris	Common bamboo
Bruguiera gymnorrhiza	Oriental mangrove/yangach
Buchanania engleriana	omail
Calophyllum inophyllum	Beach mahogany/biyuuch

Scientific Name	Common/Yapese Name
Campnosperma brevipetiolata	ramlieu
Cocos nucifera	Coconut palm/ntew
Eleocharis ochrostachys	Spikerush
Garcinia rumiyo	tilol
Talipariti tiliaceum	Sea hibiscus/gal'
Lycopodium cernuum	Staghorn clubmoss
Melaleuca quinquenervia,	Bottle brush tree
Melanolepis multiglandulosa	No common name
Mimosa pudica	Shameplant
Morinda citrifolia	Indian mulberry/magarwek
Pandanus tectorius	Tahitian screwpine/cho
Pandanus yapanensis	No common name
Premna serratifolia	arr
Rhizophora spp.	No common name
Tacca leontopetaloides	Batflower
Xanthosoma sagittifolium	tannia
Xylocarpus granatum	yamgur
Zone 4	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Bambusa vulgaris	Common bamboo
Buchanania engleriana	omail
Campnosperma brevipetiolata	ramlieu
Calophyllum inophyllum	Beach mahogany/ biyuuch
Cocos nucifera	Coconut palm/ntew
Commersonia bartramia	Brown kurrajong/guguw
Talipariti tiliaceum	Sea hibiscus/gal'
Ixora triantha	No common name
Melaleuca quinquenervia	Bottle brush tree
Melanolepis multiglandulosa	No common name
Morinda citrifolia	Indian mulberry/magarwek
Pandanus tectorius	Tahitian screwpine/cho
Pandanus yapanensis	No common name
Premna serratifolia	arr
Tuberolabium **spp.**	No common name
Xanthosoma saggitifolium	tannia
Zone 5	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Buchanania engleriana	omail
Calophyllum inophyllum	Beach mahogany/biyuuch
Campnosperma brevipetiolata	ramlieu
Cocos nucifera	Coconut palm/ntew
Commersonia bartramia	Brown kurrajong/guguw
Garcinia rumiyo	tilol
Talipariti tiliaceum	Sea hibiscus/gal'
Lycopodium cernuum	Staghorn clubmoss
Mammea odorata	lubodol
Melaleuca quinquenervia	Bottle brush tree
Melanolepis multiglandulosa	No common name
Morinda citrifolia	Indian mulberry/magarwek
Pandanus tectorius	Tahitian screwpine/cho

Scientific Name	Common/Yapese Name
Pandanus yapanensis	No common name
Premna serratifolia	arr
Tacca leontopetaloides	Batflower
Zone 6	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Alphitonia carolinensis	Root beer tree/k'ing
Anacardium occidentale	Cashew
Buchanania engleriana	omail
Calophyllum inophyllum	Beach mahogany/biyuuch
Campnosperma brevipetiolata	ramlieu
Cocos nucifera	Coconut palm/ntew
Commersonia bartramia	Brown kurrajong/guguw
Glochidion ramiflorum	ngumol
Talipariti tiliaceum	Sea hibiscus/gal'
Ixora triantha	No common name
Leucaena leucocephala	White lead tree/ganinityuwan
Lycopodium cernuum	Staghorn clubmoss
Macaranga carolinensis	bith
Mallotus papillaris	burr
Melaleuca quinquenervia	Bottle brush tree
Mimosa pudica	Shameplant
Morinda citrifolia	Indian mulberry/magarwek
Ochrosia oppositifola	mow
Pandanus tectorius	Tahitian screwpine/cho
Pandanus yapensis	tha
Plumeria rubra	Plumeria/sawur
Premna serratifolia	arr
Rhus taitensis	Sumac/ glad
Scaevola taccada	Beach naupaka
Tacca leontopetaloides	Batflower
Tuberolabium sp.	No common name
Zone 7	
Acacia auriculifolia	akasia
Acacia mangium	akasia
Alphitonia carolinensis	Root beer tree/k'ing
Anacardium occidentale	Cashew
Buchanania engleriana	omail
Calophyllum inophyllum	Beach mahogany/ biyuuch
Campnosperma brevipetiolata	ramlieu
Cocos nucifera	Coconut palm/ntew
Commersonia bartramia	Brown kurrajong/guguw
Glochidion ramiflorum	ngumol
Talipariti tiliaceum	Sea hibiscus/gal'
Ixora triantha	No common name
Leucaena leucocephala	White lead tree/ ganinityuwan
Lycopodium cernuum	Staghorn clubmoss
Macaranga carolinensis	bith
Mallotus papillarus	burr
Melaleuca quinquenervia	Bottle brush tree
Morinda citrifolia	Indian mulberry/magarwek
Ochrosia oppositifolia	mow

Scientific Name	Common/Yapese Name
Pandanus tectorius	Tahitian screwpine/choi
Pandanus yapensis	choi
Plumeria rubra	Plumeria/ sawur
Premna serratifolia	arr
Rhus taitensis,	Sumac/ glad
Scaevola taccada	Beach naupaka
Tacca leontopetaloides	Batflower
Tuberolabium sp.	No common name
Zone 8	
Calophyllum inophyllum	Beach mahogany/biyuuch
Cocos nucifera	Coconut palm/ntew
Talipariti tiliaceum	Sea hibiscus/gal'
Melanolepis multiglandulosa	No common name
Mimosa pudica	Shameplant
Miscanthus floridulus	Japanese silvergrass
Pandanus tectorius	Tahitian screwpine/cho

Table A-5. Plant Species Documented within the Environmental Survey Area

Scientific	Common	Origin	Growth Form
Asplenium nidus	NCN	N	Epiphytic fern
Alysicarpus vaginalis	White moneywort	NN	Forb
Bambusa vulgaris	Common bamboo	I	Grass
Bidens pilosa	Hairy beggarticks	I	Forb
Bothriochloa bladhii	Caucasian bluestem	NN	Grass
Cassytha filiformis	NCN	N	Vine
Cenchrus echinatus	Southern sandbur	NN	Grass
Chamaesyce hirta	Pillpod sandmat	NN	Forb
Euphorbia hypericifolia	Graceful sandmat	NN	Forb
Chloris radiata	Radiate fingergrass	NN	Grass
Chromolaena odorata	Jack in the bush	I	Forb
Cochlidium punctatum	NCN	N	Epiphytic fern
Cocos nucifera	Coconut palm	NN	Tree
Cycas micronesica	Cycad	N	Tree
Cynodon dactylon	Bermuda grass	I	Grass
Cyperus compressus	Poorland flatsedge	NN	Sedge
Cyperus cyperoides	Pacific island flatsedge	N	Sedge
Cyperus rotundus	Nutgrass	I	Sedge
Dactyloctenium aegyptium	Egyptian grass	NN	Grass
Dendrocnide latifolia	NCN	N	Tree
Desmodium triflorum	Threeflower ticktrefoil	NN	Forb
Eleusine indica	Indian goosegrass	NN	Grass
Eragrostis brownii	Brown's lovegrass	NN	Grass
Eragrostis ciliaris	Gophertail lovegrass	NN	Grass
Euphorbia heterophylla	Mexican fireplant	NN	Forb
Fimbristylis cymosa	Hurricanegrass	N	Sedge
Geuttarda speciosa	Beach gardenia	N	Tree
Kyllinga nemoralis	Whitehead spikesedge	N	Sedge
Leucaena leucocephala	tangantangan	NN	Tree
Mangifera indica	Mango/manga	NN	Tree
Melanolepis multiglandulosa	NCN	N	Tree
Melochia villosissima	NCN	N	Shrub
Mikania scandens	Climbing hempvine	NN	Vine
Mimosa pudica	Shameplant	I	Forb
Morinda citrifolia	Indian mulberry	N	Tree
Nephrolepis acutifolia	NCN	N	Epiphytic fern
Nephrolepis biserrate	Giant swordfern	N	Terrestrial fern
Ochrosia oppositifolia	NCN	N	Tree
Oldenlandia corymbose	Flat-top mille grains	NN	Forb
Pandanus tectorius	Tahitian screwpine	N	Tree
Paspalum paniculatum	arrocillo	NN	Grass
Paspalum setaceum	Thin paspalum	NN	Grass
Passiflora suberosa	Corkystem passionflower	NN	Vine
Pennisetum polystachion	Mission grass	NN	Grass
Phyla nodiflora	Turkey tangle fogfruit	NN	Forb
Microsorum scolopendria	Monarch fern	N	Epiphytic fern
Pilea microphylla	Rockweed	NN	Forb
Pisonia grandis	NCN	N	Tree
Portulaca oleracea	Common purslane	N	Forb
Premna serratifolia	malbau	N	Tree
Chamaesyce prostrata	Prostrate sandmat	NN	Forb

Scientific	Common	Origin	Growth Form
Pyrrosia lanceolata	Lanceleaf tongue fern	N	Epiphytic fern
Saccharum spontaneum	Wild sugar cane	N	Grass
Sporobolus fertilis	Smut grass	N	Grass
Tridax procumbens	Coat buttons	NN	Forb
Tuberolabium spp.	NCN	N	Epiphytic forb
Urochloa maxima	Guineagrass	NN	Grass
Waltheria indica	uhaloa	NN	Forb

Source: GISD 2024
Key: I = Invasive; N = Native; NCN = No Common Name; NN = Non-native

Table A-6. Yap Flying Fox Foraging Trees

Scientific Name	Common/Yapese name
Annona muricata	Soursop/sausau
Artocarpus altilis	Breadfruit/thow
Artocarpus heterophyllus	Jackfruit
Calophyllum inophyllum	Beach mahogany/biyuuch
Campnosperma brevipetiolata	ramlieu
Carica papaya	Papaya
Ceiba pentandra	Kapok tree/batey
Citrus **spp.**	No common name
Cocos nucifera	Coconut palm/ntew
Freycinetia spp.	No common name
Ficus prolixa	Fig/aw
Glochidion ramiflorum	ngumol
Inocarpus fagifer	buoy
Lumnitzera littorea	yiy
Mangifera indica	Mango/manga
Melaleuca viridiflora	niauli
Musa spp.	Banana
Parinari spp.	No common name
Pandanus tectorius	Tahitian screwpine/choi
Terminalia catappa	India almond
Semecarpus venenosus	changath

Sources: Wiles and Fujita 1992; USDA 2015

Appendix B.

Survey Photos

Photo 1. Field team members lining up on respective transects.

Photo 2. General vegetation communities south of the airport.

Photo 3. Steep grade south of the airport.

Photo 4. General vegetation communities south of the airport.

Photo 5. General vegetation communities south of the airport.

Photo 6. Mangrove forest south of the airport.

Photo 7. General vegetation communities south of the airport.

Photo 8. General vegetation communities south of the airport.

Photo 9. Agroforest south of the airport.

Photo 10. General vegetation communities north of the airport

Photo 11. General vegetation communities north of the airport.

Photo 12. General vegetation communities north of the airport

Photo 13. Fern savanna north of the airport.

Photo 14. Vegetation composition from inside the airport fence.

Photo 15. Vegetation composition from inside the airport fence.

Photo 16. Pacific yam.

Photo 17. Female Yap monarch.

Photo 18. Female white-throated ground dove.

Photo 19. Male white-throated ground dove.

Photo 20. Cycad documented in Colonia during windshield surveys.

Photo 21. Rosewood documented in Colonia during windshield surveys.

Photo 22. Rosewood closeup with flowers.

Photo 23. Micronesia saw-tailed gecko.

Photo 24. Bird nest (unknown species); not likely to be from any special status species based on composition and height.

Photo 25. Surface water south of the airport.

Photo 26. Surface water south of the airport.

Photo 27. Marsh area directly south of environmental survey area.

Photo 28. Stream south of airport.

Photo 29. Eastern edge of the mangrove forest south of the airport.

Photo 30. Culvert located south of airport near main road on the edge of the Galil mangrove.

Photo 31. Surface water north of the airport.

Photo 32. Surface water north of the airport.

Photo 33. Surface water north of the airport (previously quarry).

Photo 34. Taro patch south of the airport.

Photo 35. Taro patch south of the airport.

Photo 36. Taro patch south of the airport.

Photo 37. Taro patch south of the airport.

Photo 38. Taro patch north of the airport.

Photo 39. Suspected impact crater north of the airport.

Photo 40. Depression of unknown origin north of the airport.

Photo 41. Downed aircraft south of the airport.

Photo 42. Downed aircraft west of the airport.

Photo 43. World War II weapon north of the airport.

Photo 44. World War II weapon north of the airport.

Photo 45. Presumed World War II generator west of the airport.

Photo 46. Potential explosive remnant of war north of the airport.

Figure 47. Invasive bamboo forest observed west of the airport

Figure 48. Invasive giant mimosa observed north of the airport fence.

Figure 49. Cane toad observed north of the airport.

Figure 50. Monitor lizard basking south of the airport.

Figure 51. Potential burial observed north of the airport.

Figure 52. Cemetery/burial ground west of the airport.

Figure 53. Burial hut surrounded by taro and betel nut south of the airport.

Photo 54. Cleared vegetation east of airport.

Photo 55. Cleared vegetation east of airport.

Photo 56. Cleared vegetation east of airport.

Photo 57. Active vegetation clearing east of airport.

Photo 58. Cleared vegetation east of airport.

Photo 59. Cleared vegetation east of airport.

Photo 60. Cleared road east of airport.

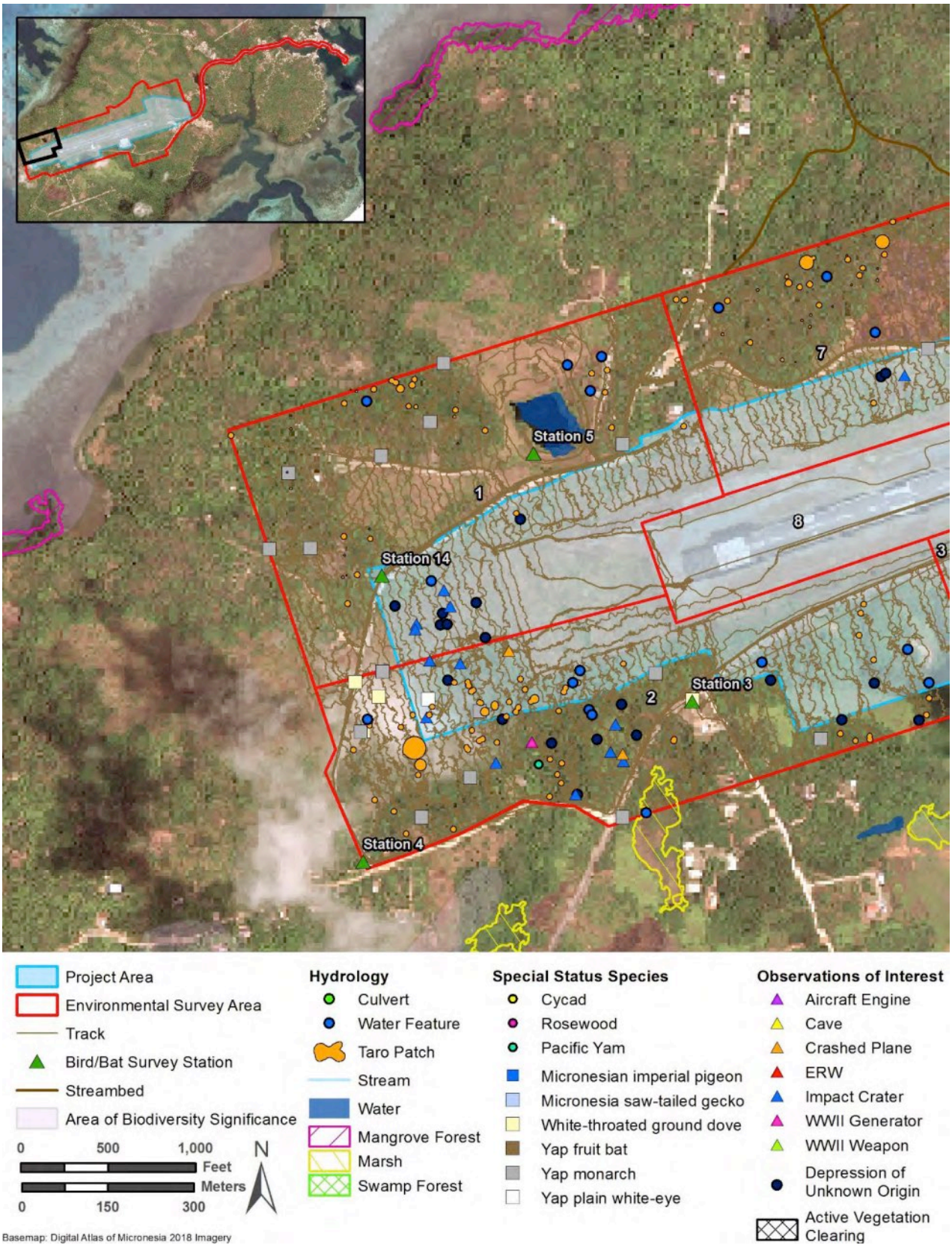
Photo 61. Construction area east of airport.

Photo 62. Construction staging area east of airport.

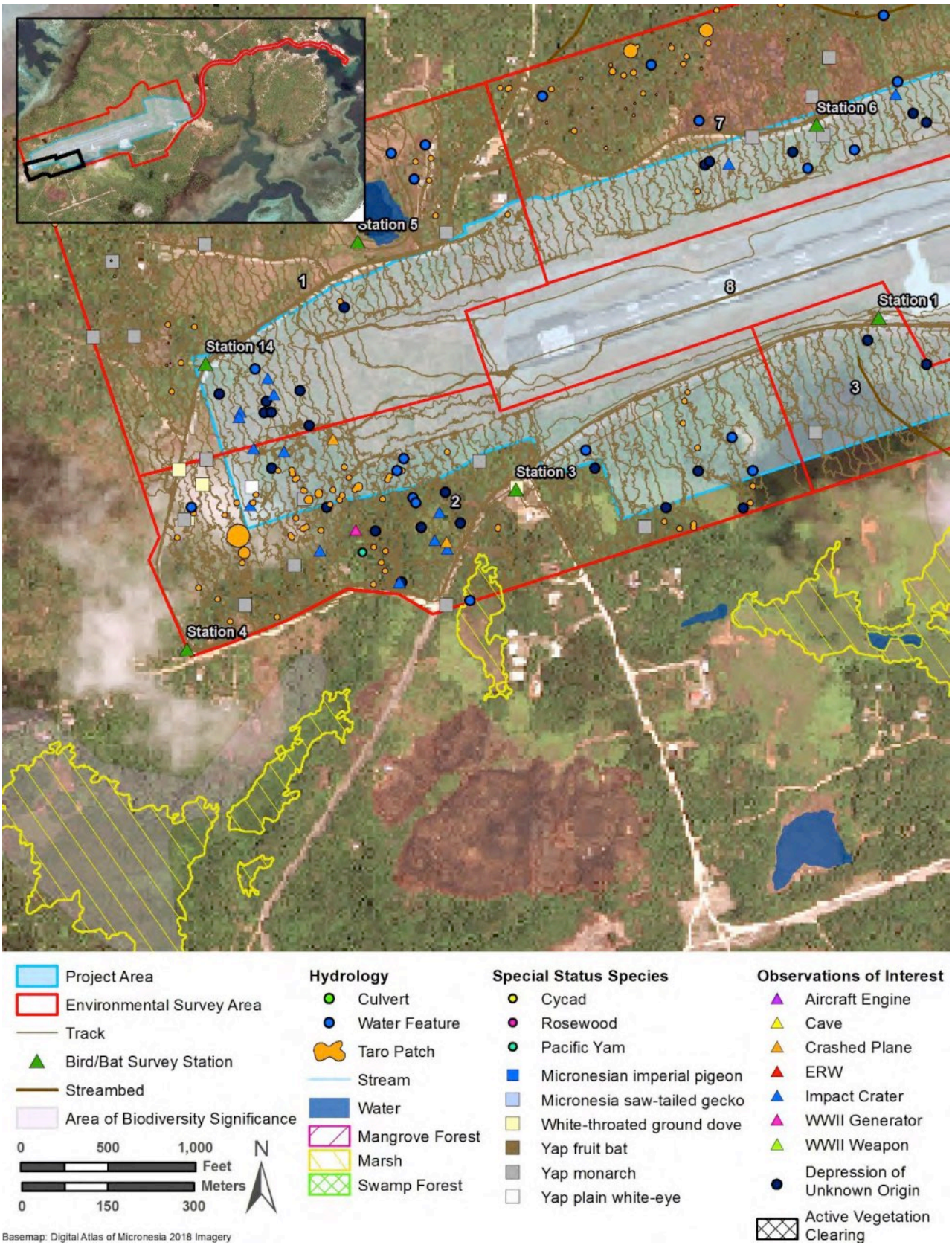
Appendix C.

Survey Mapbooks

Environmental Survey Area Mapbook Overview



Zone 1 Mapbook



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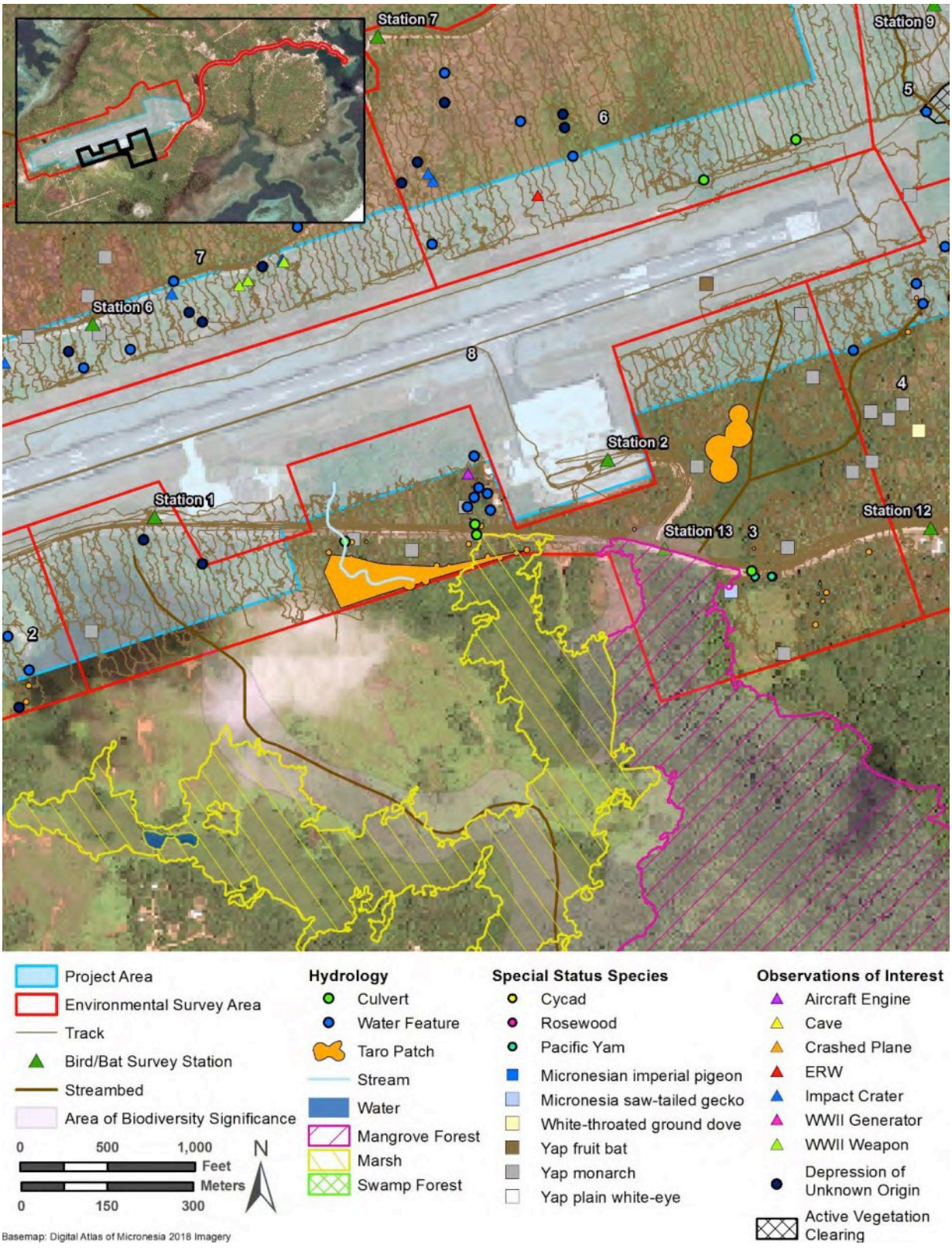

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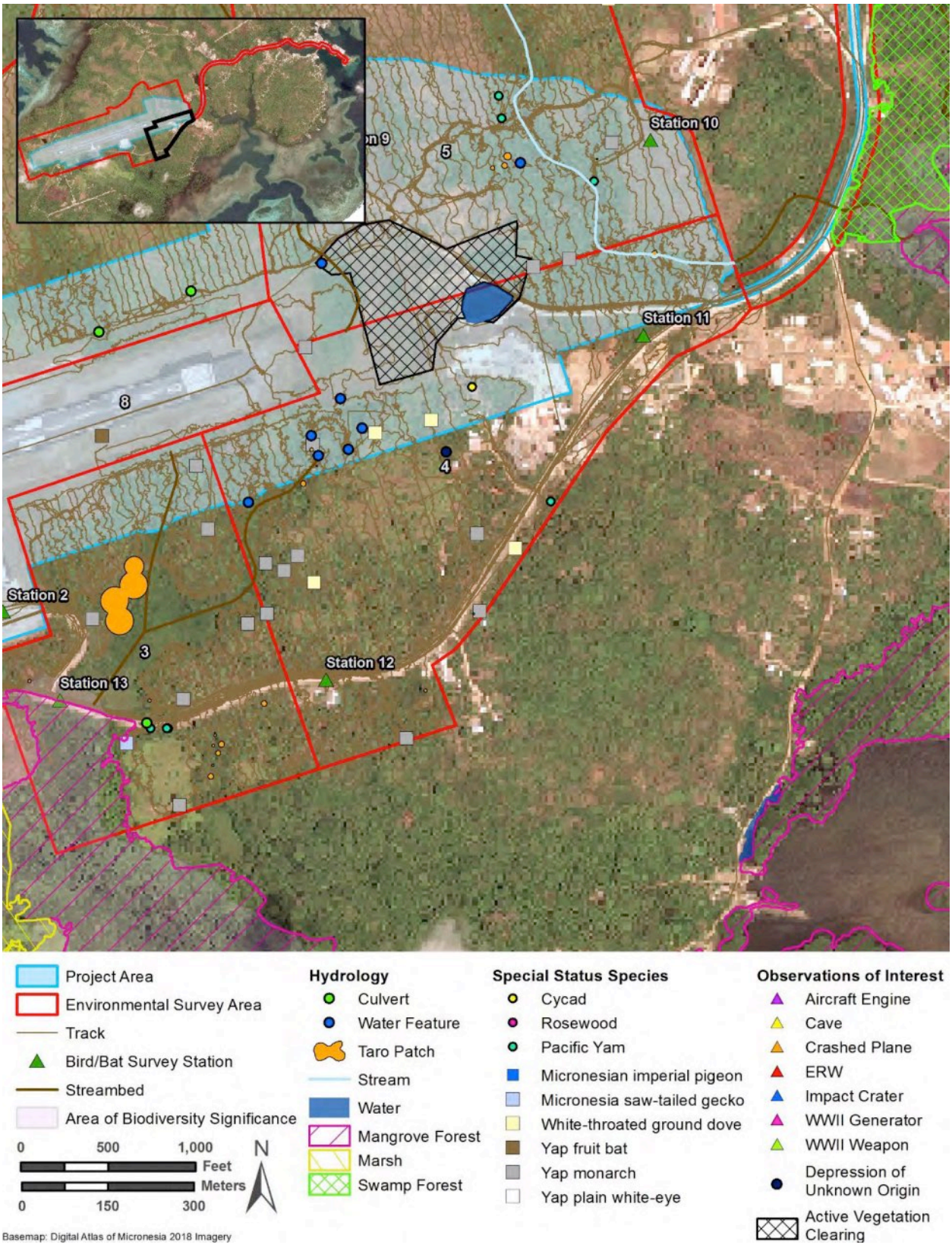
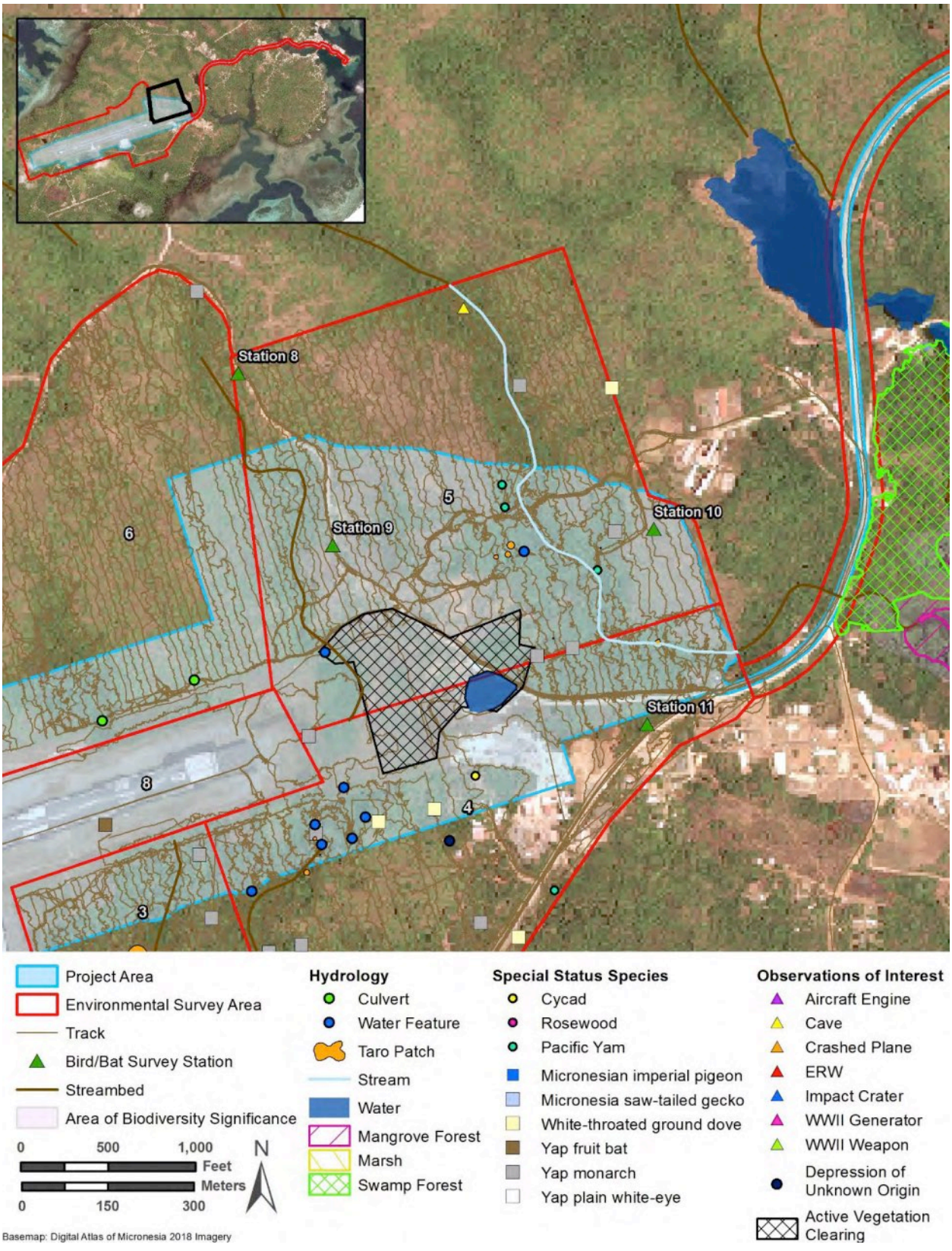
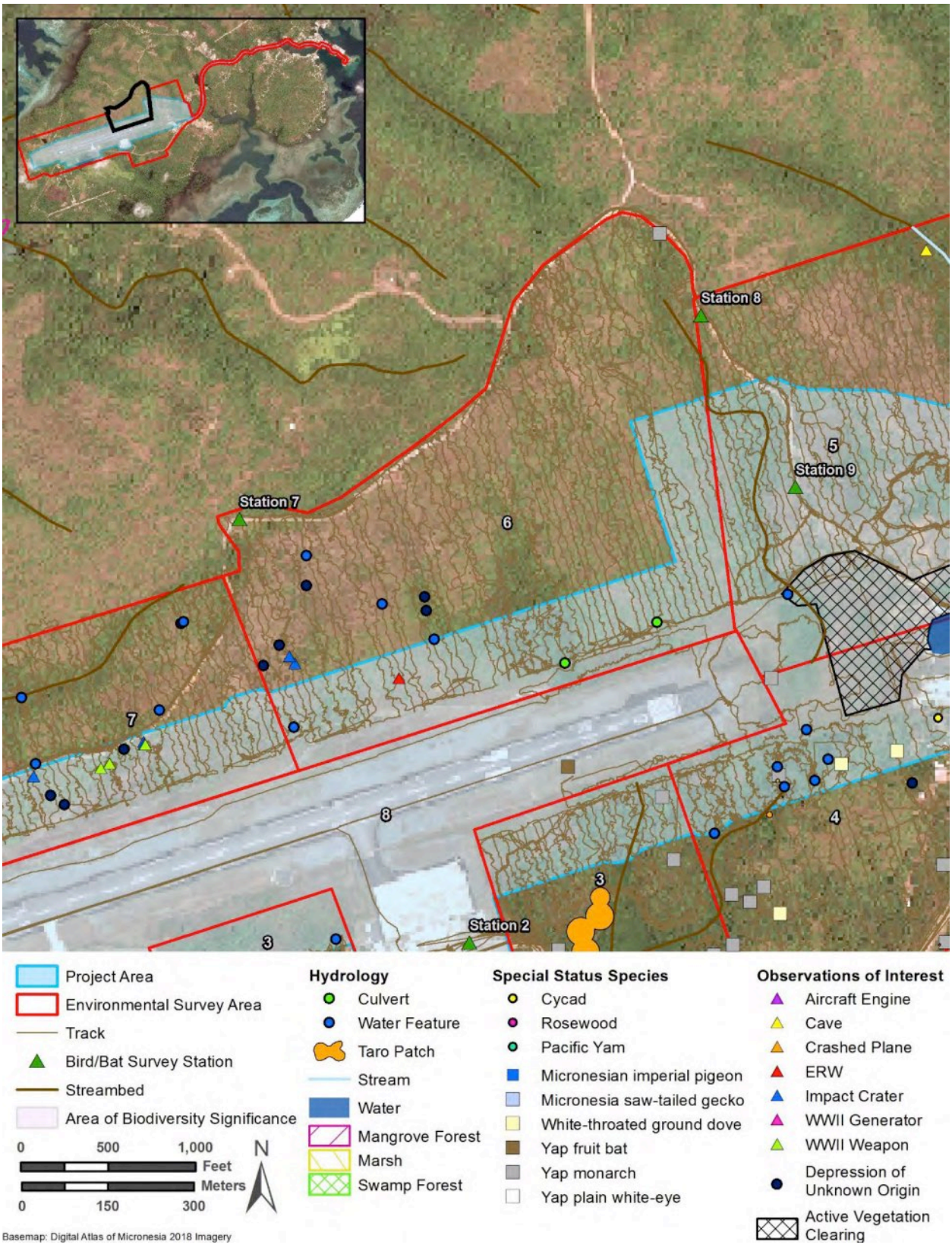


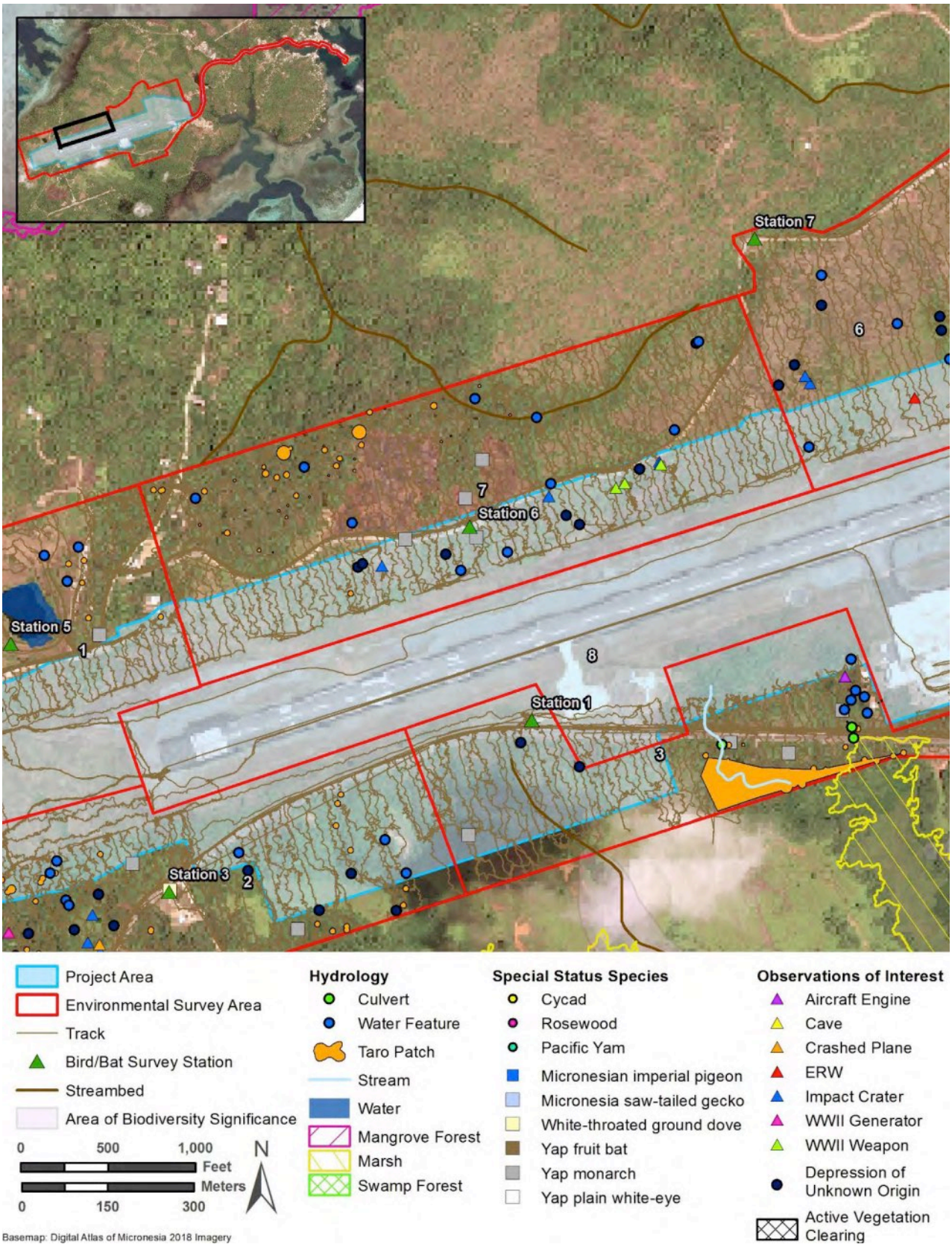
Zone 4 Mapbook



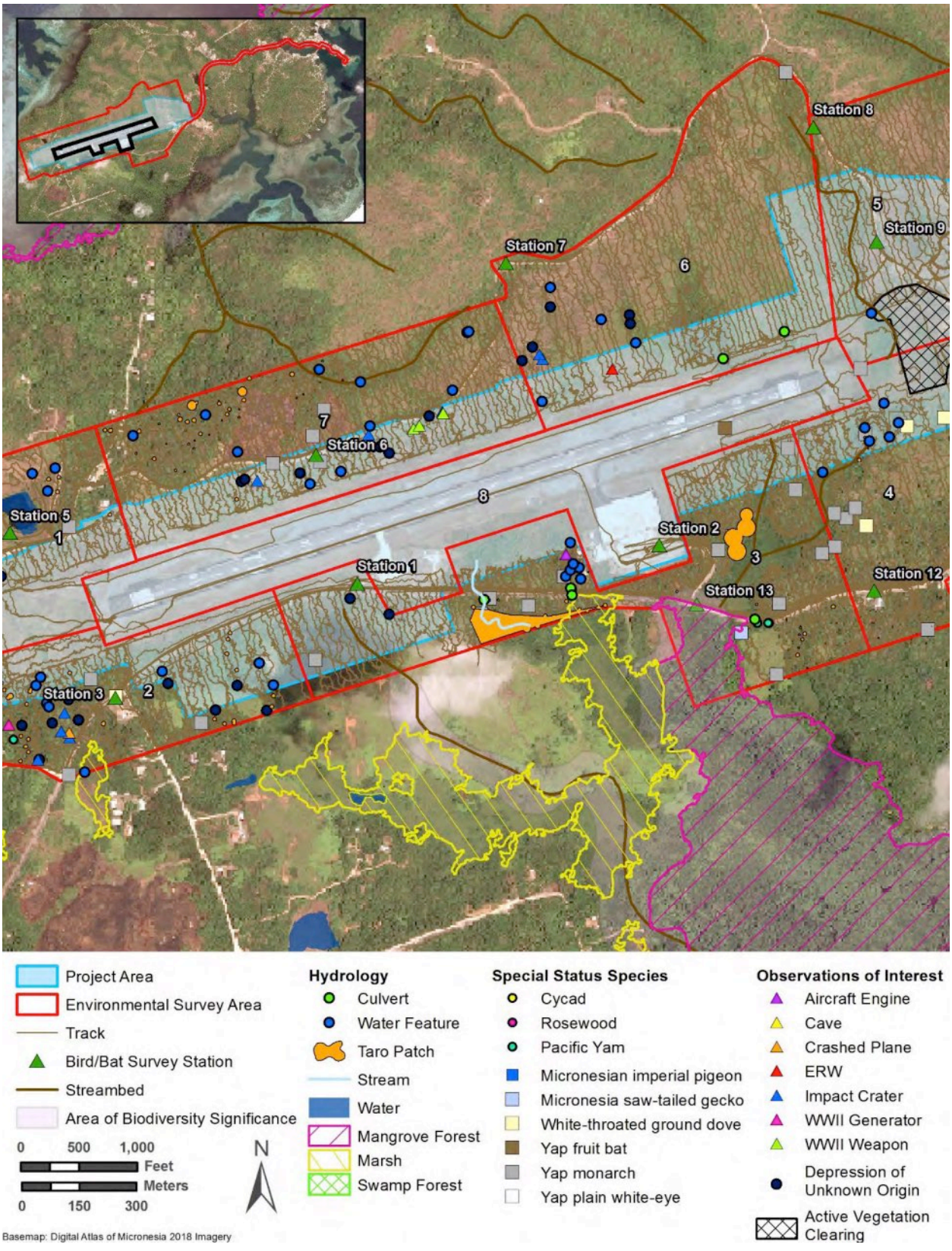
Zone 5 Mapbook



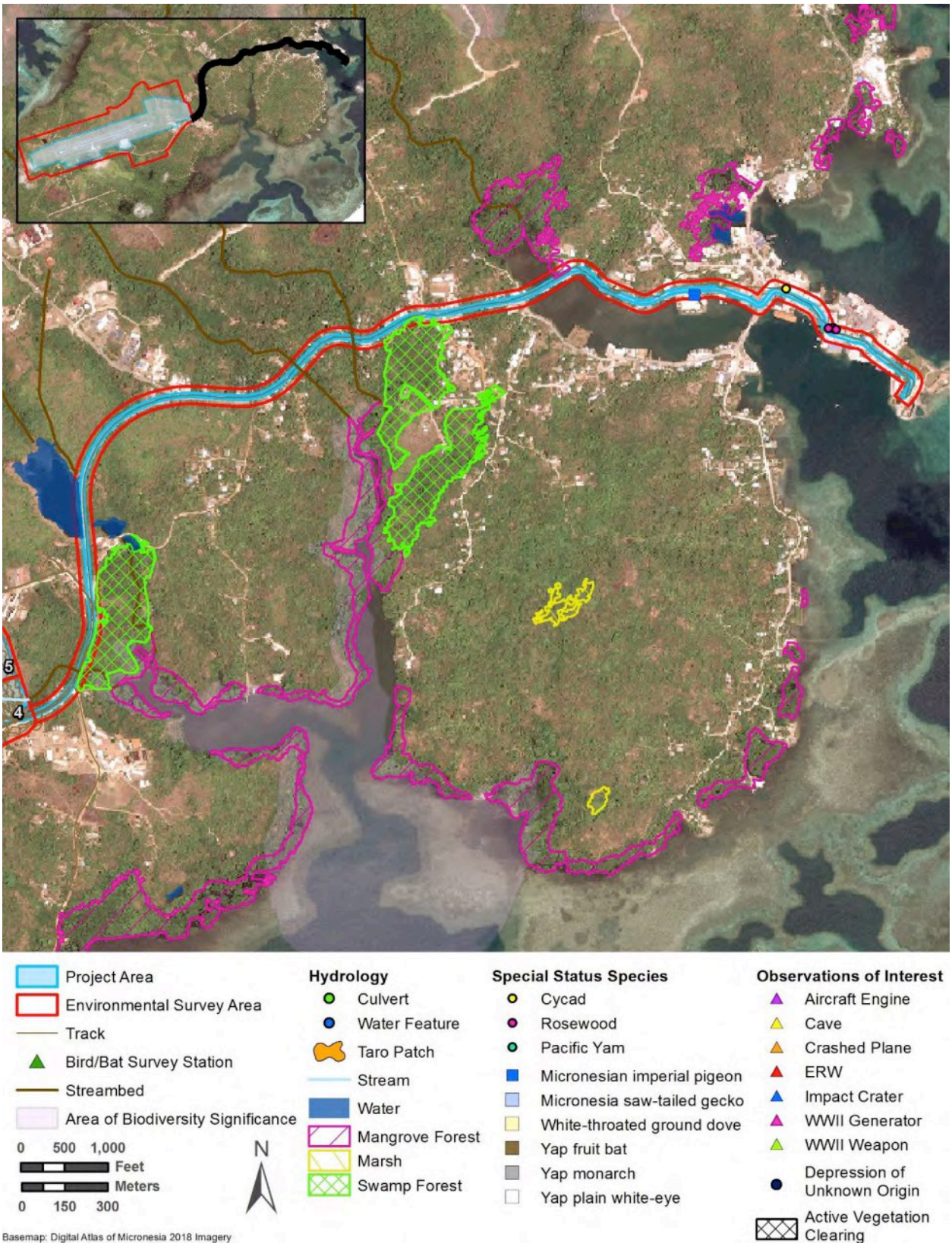
Zone 6 Mapbook



Zone 7 Mapbook



Zone 8 Mapbook



Road to the Port Survey Mapbook

Appendix D.

Fruit Bat Monitoring

Joint Region Marianas

Attachment 1: Joint Region Mariana Fruit Bat Monitoring Protocol

Fruit Bat Monitoring Program
Joint Region Marianas

Standard Operating Procedure (SOP) # 7:

Fruit Bat Surveys

Version 1.00

September 2010

Previous Version #	Revision Date	Author	Changes Made	Reason for Change	New Version #
#6	Sept 8, 2011	A. Brooke	minor	clarification	#7

Any changes made to SOP # **6** will be recorded in the above table. Version numbers increase incrementally by hundredths (e.g. 1.01, 1.02) for minor revisions (i.e. hours of training). Major revisions (sampling technique) require whole number increments (e.g. 2.0, 3.0). Record the previous version, date of revision, author of revision, paragraphs and pages of revision, reason for change, and the new version number.

Overview

The native mammalian fauna of Guam is limited to three bat species: the Mariana fruit bat (*Pteropus mariannus*), the little Marianas fruit bat (*P. tokudae*) and the Pacific sheath-tailed bat (*Emballonura semicaudata).* Only the Marianna fruit bat is still present on Guam, sheath-tailed bats are present only on Aguiguan in the Marianna archipelago and the little Mariana fruit bat is presumed extinct.

To monitor Fruit Bats on DON lands and assure compliance with appropriate laws, regulations, policies, and executive orders the Fruit Bat Monitoring Program will be implemented. This program and the data collected through it will be used as a tool to assure compliance for activities and projects, facilitate cooperation with existing monitoring plans evaluate effectiveness of the program, and develop strategies for managing natural resources on DON.

Authorities

- COMNAVMARIANAS Final Integrated Natural Resources Management Plan (INRMP) for Navy Lands, Guam (2001)
- U.S. Fish and Wildlife Service. 2010. Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi
- 50 FR 49 - Part 17 – Endangered and threatened wildlife and plants: Determination of endangered status for seven birds and two bats on Guam and the Northern Mariana Islands.
- 61755NR09 Species Survey – Long term monitoring of vegetation and wildlife on Navy Lands.
- M5240NR155 Threatened and Endangered Species Monitoring - Long term monitoring of vegetation and wildlife on Andersen Air Force Base.
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Objectives

- Identify and examine trends in the abundance of Mariana fruit bats

Personnel Requirements and Training

Observers conducting surveys must have the necessary skills to identify Mariana fruit bats and conduct counts at colony sites.

- The field crew of two people must be able to hike through difficult karst limestone terrain, including steep and rugged slopes.
- Observers must have a basic knowledge of the natural history and identification of fruit bats. The team leader must be familiar with and can identify Mariana fruit bats by sight, has prior experience carrying out all three survey techniques, and has extensive knowledge of suitable fruit bat roosting and foraging habitat. The team leader must be knowledgeable of data collection methods, data management, and field reporting.
- Sufficient prior experience is defined as having conducted a minimum of 4 bat surveys of each survey technique (landscape counts for solitary bats, direct colony counts and dispersal colony counts) under the direct supervision of an experienced observer. At each of these counts, bats must have been observed.
- Training will consist of conducting 4 counts of each survey technique under the direct supervision of an experienced observer.
- Experience conducting counts for Mariana swiftlets, seabirds or other aerial foraging birds can substitute for landscape counts.

Study Area

Mariana fruit bats are found throughout the native limestone forests on Guam, and may occasionally be found in other forested areas. Since the 1980s the limestone forest of Andersen Air Force Base (AAFB) has had solitary bats and small groups present in the forest. Solitary bats are also known from the Naval Ordnance Site. Since the 1980s, colonies consisting of five to several hundred bats are known from the northern cliff line area of AAFB and the Janapsan valley. The colony in the cliff line at Pati Point was the most commonly used site from the 1980s until 2010. The colony decreased in size with fewer than 20 bats recorded in 2009-2010. During 2011 only single bats have been seen passing through the previous colony site and roosting temporatily. The Pati Point site is

no longer being used as a colony and extensive surveys on AAFB have not found bats using an alternate site.

Methods

Frequency and timing

- To determine presence or absence of solitary fruit bats, at least five pre-dawn landscape counts are conducted within a one month period.
- Colony counts are conducted monthly at a minimum.

Observers per site

The physical characteristics of each study site (accessibility, size, and location of area) and the number of bats occupying the site determines the number of observers required to conduct a bat survey. The following guidelines are for the minimum number of observers required.

Pati Point colony site is only known remaining colony of fruit bats on Guam. The observation point used for surveys is an overlook of the colony area is located at the cliff edge on the terrace below the flight line.

- Surveys are conducted as early as possible in the morning; hikers should start for the observation point when there is sufficient light to see. The rising sun is directly east of the colony making it impossible to see the colony area and heat later in the morning make observations impossible. Cloudy days are also used for colony counts.
- Two observers are required for the Pati Point site; the observation point is too small to accommodate additional people.

Landscape counts for solitary bats are conducted by one or more observers. The size of the area being surveyed will dictate the number of observers required to adequately monitor.

Field Methods

Three survey techniques are utilized to assess fruit bat activity and abundance: solitary counts, colony exit counts, and colony direct counts (National Park 2009, Utzurrum *et al*. 2003). Solitary fruit bat counts are conducted to determine the presence or absence of fruit bats at a particular location (e.g. the proposed project site), as well as to evaluate flight paths, habitat use, and possibly reveal the location of a colony.

Equipment

- Binoculars
- Spotting scope and tripod
- Fruit bat data sheet
- Pencil
- Clipboard
- Cell phone
- Camera

Weather

Upon arriving at a site and before beginning the survey, observers will estimate and record percent cloud cover, precipitation, and wind speed on the Fruit Bat Count Data Form (Appendix N).

- Cloud cover is the estimated percentage of sky obstructed by clouds and recorded in 25% intervals.
- Precipitation will be recorded on a numeric scale (0 – 4) increasing with level/amount of precipitation (Table 1).
- Wind speed is estimated and recorded using the Beaufort Scale (Table 2).
- Visibility is estimated as the distance (< 50 m, <100 m < 500m, ≥ 500 m) that an object can be viewed unimpeded by weather conditions (i.e. fog).

Table 1. Codes and descriptions of precipitation.

Code	Description
0	No precipitation
1	Mist or fog
2	Light drizzle
3	Light rain
4	Heavy rain

Table 2. Codes and descriptions for wind (Beaufort scale).

Code	Speed (kph)	Description
0	< 2	Calm: smoke rises vertically
1	2 - 5	Light air: smoke drifts
2	6 – 11	Slight breeze: wind felt on face, leaves rustle
3	12 – 20	Gentle breeze: leaves and small twigs in constant motion
4	21 – 32	Moderate breeze: small branches sway, loose paper rises
5	33 – 40	Fresh breeze: small trees sway, thin branches sway
6	41 - 50	Strong breeze: large branches in motion

Data sheets

- Site or colony name
- Date (mm/dd/yyyy): Write in the month (2 digits), day (2 digits) and year (4 digits). Example: 07/21/2008.
- Tree species used for roosting: Record the tree species that is being used as a roost by the fruit bat colony, if trees can be identified (assumes training in species identification is acquired by observers prior to collection of this information)
- Lunar phase: Write in the current moon phase (New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Quarter, and Waning Crescent). If the moon is not visible, check the US Navy website (http://aa.usno.navy.mil/data/docs/RS_OneDay.php) before going into the field. This website also provides information on sun and moon rise and set times.

Landscape counts for solitary bats

- The area should be observed from one or more vantage points with a clear and unobstructed view. Observers should be close enough to clearly see birds and animals without binoculars.
- Surveys are conducted over two-hour periods pre-dawn and dusk. Observers should be in place pre-dawn to take advantage of bat movements in low light. Surveys begin when there is sufficient pre-dawn light to see and continue for approximately 2 hours after full light. Dusk surveys should be conducted from the same location, starting 2 hours before sunset and continue until it is too dark to accurately see. The area should be scanned for movement of flying animals without binoculars
- Where possible, stations should be situated so the observer is looking up (e.g. toward a hill or ridgeline) and the survey area comprises a large amount of sky to facilitate silhouetting and better observation of fruit bats.
- When an animal in flight is seen, use binoculars to identify if bat or bird. If a bat, follow it until it flies from sight or roosts in the forest.
- Note the location of bats observed on a sketch map of the area viewed. Each bat should be noted on the map showing where first seen, flight direction, and where it was lost from sight. Mark the location for each time a bat roosts, flies into or out of the area. If several bats are using the area, it may be difficult to determine the number of bats present. Each bat must be judged whether a new individual or if it has been seen earlier. If a bat flies into a tree to roost and a bat leaves from the same location assume it is the same bat. If a bat flies out from a very different part of a large tree, it may be a different individual. When it is not obvious whether the individuals are different, assume it is the same animal to avoid multiple counts of the same individual.

Colony direct count (Pati Point colony and other sites)

- Direct counts of roosting bats are made from a station that affords a clear view of the roosting bats. The observation point should be enough distance that the presence of people does not disturb the bats.
- Two observers are required for each count, viewing the same area and be positioned next to each other. Observers count simultaneously but independently of each other.
- As you approach a roost site, be aware of the potential disturbance that may be created by loud noises (e.g., snapping branches or rolling rocks) and sudden movements. Remain relatively quiet and well hidden so as not to startle the bat colony into flight or otherwise agitate them.
- The Pati Point colony is known to take flight if the wind shifts from east to west and carries human scent to the colony.
- Once observers arrive at a roosting colony, locate the station or stations using the UTM coordinates that should have been previously downloaded onto the GPS unit.
- Once settled in at a station, the observers spend about five minutes before the count looking to the left and right of the perceived colony to assess if there is bat

movement in other trees (e.g., wing-flapping behavior). Bats in other trees may not be obvious at first. Identify the spatial extent of the colony with other observers prior to counting, and perform counts within these established boundaries.

- Each observer should have a Fruit Bat Colony Count Data Form (Appendix S7.b), and should fill in survey and weather information at the top of the form in the appropriate fields
- The observers should agree in advance to use the same counting method (i.e. from left to right). At least two counts should be conducted at each station by each observer (e.g., left to right, right to left). Observers will not share with the results with each other until all counts have been conducted and recorded. Repeat counts at additional locations if possible. If possible, more than one count station should be used to see the area from different vantage points.
- Results are recorded on the Fruit Bat Colony Count Data Form. Any observations about the count should be written in the "Notes" section corresponding to the station number.
- A spotting scope is used to examine the forest as it gives better accuracy than binoculars. Bats will move back into dense leaves as heat increases. Where the observation site is at a distance from the colony, heat haze can make using a scope or binoculars impossible, early morning count times are best.

Colony dispersal count

Dispersal counts have not been routinely used on Guam because the Pati Point colony can only be monitored from above. Dispersal counts are used when bats can be silhouetted against the sky or the observation point is very close to the colony.

- Dispersal (exit or emergence) counts should be conducted the as same day as a direct count. The site for dispersal counts may be the same as for direct counts or different. Counts generally starts late in the afternoon and continues for about two hours until nightfall, or until observers can no longer see individual bats clearly. Observers station themselves at an observation point in clear view of the colony or flight path. A landscape feature should be used as a marker that delineates a bat leaving the area; bats are counted as they pass the marker. Animals that circle back should be noted so they are not counted twice.Dispersal counts depend on having a good view of the route taken by bats leaving the roost area as bats may leave in one direction or in several directions. A site evaluation is conducted prior to surveys to determine the possible flight paths used and number of observers required for the survey. . Bats may not leave until dusk or after dark where there is active hunting and thermal imaging should be used to supplement dispersal count data.

Data management and Analysis

- All field data will be entered and maintained in a GIS database.
- The Pati Point colony graph will be updated after every field survey. Field data and the colony graph will be available to USFWS and GDAWR after each survey.
- An annual report summarizing the findings will be prepared by 31 October.

Data sheets

- Site or colony name
- Date (mm/dd/yyyy): Write in the month (2 digits), day (2 digits) and year (4 digits). Example: 07/21/2008.
- Tree species used for roosting: Record the tree species that is being used as a roost by the fruit bat colony, if trees can be identified (assumes training in species identification is acquired by observers prior to collection of this information)
- Lunar phase: Write in the current moon phase (New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Quarter, and Waning Crescent). If the moon is not visible, check the US Navy website (http://aa.usno.navy.mil/data/docs/RS_OneDay.php) before going into the field. This website also provides information on sun and moon rise and set times.

Fruit Bat Count Data Sheet

Page#___of___

Colony or landscape site _____

Date _____ ***Observer(s)*** _____

Tree Species Used for Roosting _____

Lunar Phase _____ ***Cloud Cover (%)*** _____ ***Wind Speed*** _____ ***Precipitation Code*** _____

Temperature (° F) _____ ***Start Time*** _____ ***End Time*** _____ ***Field QA (initials)*** _____

Station # [1]	Roost Count #1			Roost Count #2		
	Observer #			Observer #		
	1	2	3	1	2	3
1						
2						
3						
4						
5						
6						

Station #	Notes
1	
2	

3	
4	
5	
6	

[1] The station number (1-6) refers to a point near the colony where observers perform counts. Up to three observers may perform counts at a roost station, and each person records their count number in the spaces provided. Up to six roost counts may be performed at any one station.

Dispersal Count

Colony _____ ***Date*** _____ ***Observer(s)*** _____

Lunar Phase _____ ***Cloud Cover (%)*** _____ ***Wind Speed*** _____ ***Precipitation Code*** _____

Temperature (° F) _____ ***Start Time*** _____ ***End Time*** _____ ***Field QA (initials)*** ☐

Entire Colony Count [1]	Observer #1	Observer #2	Observer #3	Total
Partial Colony Count [2]				

Notes

[1] The entire colony dispersing from a roost is counted by each observer. Record separate counts but do not average.

[2] A portion of the colony is counted by each observer. Two observers divide the sky and ground into equal sections. At the end of the count, the numbers derived by each