# NGARDOK NATURE RESERVE

## MANAGEMENT PLAN

## 2010-2014

*The Place of Nature*

*Melekeok is a beautiful place.*
*A place of nature.*
*With lots of birds and trees.*

*The birds are so free.*
*With rainbows of colors.*
*The ocean is clean and blue.*

*Going to Melekeok, the breeze is cool.*
*The ocean and streams are clean.*
*The beautiful flowers are there everywhere you turn.*

*By:*
*Sonia E. Cepeda, Melekeok Elementary School*

**MELEKEOK STATE, REPUBLIC OF PALAU**

**Updated February 2010**

**Forward**

In December 1997, Melekeok State enacted Melekeok State Public Law (MSPL) 4-21 establishing the Ngardok Nature Reserve (amended in 1999; MSPL 4-32). The law established the Melekeok Nature Reserve Board, and called for a management plan by early 1999. Initial management plans have been through several revisions, resulting in this latest iteration for 2010-2014. This latest version of the Management Plan has been updated to include new information and priorities, and to reflect the Reserve's Membership in Palau's Protected Areas Network (PAN). The Reserve became the first member of PAN on January 14, 2008.

The Ngardok Reserve covers Lake Ngardok, the entire watershed draining into the lake, and a section of the Ngerdorch River below the lake. The Reserve contains forests, freshwater swamp forests, a large marsh, streams, and the largest permanent natural freshwater lake in Micronesia. The wetlands and rainforest provide important habitat for many of Palau's animals and plants, such as the Palauan fruit-dove (*biib*), the Palauan fruit-bat (*olik*), the critically endangered crocodile (*ius*), and the majestic native tree *kelel a charm*. The Reserve protects the native forests and good water quality, maintains the ecological integrity of key representative habitats in Palau, and provides for the enjoyment and education of visitors and locals alike.

The management plan gives a background to the history of the reserve and its natural and cultural resources. It describes the main threats to the environment and management actions to deal with these problems. This plan outlines the parties responsible for carrying out these actions. As required in the law, the management plan contains a chapter on regulations which lists prohibited activities, and guidelines for the issuing of permits for restricted activities. These regulations have the full force of law. This management plan is also intended to meet obligations under membership in the PAN.

We invite you learn more about our Reserve, and hope that the Ngardok Nature Reserve inspires you in the way that it has inspired us for many generations.

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| Lazarus Kodep<br>Governor, Melekeok State | Rafael Bao Ngirmang<br>REKLAI |
| _____<br>Date | _____<br>Date |

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**Executive Summary**

The Ngardok Nature Reserve protects the spectacular and unique Lake Ngardok and surrounding watershed in Palau's Melekeok State. This document outlines the goals and objectives for its protection, and management actions that will be carried out in the next five years (2010-2015). This document is only the latest iteration of Management Plans for the Reserve, which was established by Melekeok State Law in 1997.

The document begins by describing the natural and cultural features of the Reserve. Lake Ngardok feeds into the Ngerdorech River, and thus is an important source of water to Melekeok and the new Capital. The lake is also Palau's only Wetland of International Significance under the Ramsar Convention on Wetlands. Although historically and traditionally used for collections and farming, the area is currently managed for water and biodiversity protection. The Reserve is known as a biodiversity "hotspot" for both plants and animals. As the first member of Palau's Protected Areas Network, the Reserve occupies a unique niche in the PAN.

The Management Plan outlines six goals, pertaining to 1) erosion control, 2) enjoyment and education, 3) ecological integrity, 4) protection of plants and animals, 5) research, and 6) capacity building for effective management. Ecological targets in the reserve include native forest, some savanna species, freshwater – all types and communities, and harvested species of concern such as bats, birds, and crocodiles.

The Management Plan is also a legal document and outlines a list of allowable, allowable-with-permit, and prohibited actions. An appendix outlines permit application procedures.

Although protected, the Reserve faces significant threats from human disturbances (both permitted and overuse), poaching, fire, water use, erosion, invasive species, and climate change. Management activities are designed to minimize or reverse threats.

A short analysis identifies strengths, weaknesses, opportunities, and threats for the Reserve. Weaknesses, such as inadequate staffing and financing, are addressed through proposed management actions.

This Plan builds on many past activities and existing structures and frameworks that have been developed in the past two decades. It depends heavily on the existing framework for authority, which has links between traditional and elected leadership and a Reserve Board and Staff. Key staff members are identified. An appendix lays out key roles and responsibilities for all management staff and authorities.

General strategies are identified to achieve goals. To obtain high quality water and maintain ecological integrity, erosion control and reforestation activities are planned. To increase enjoyment and education, visitor development is planned. Enforcement activities supported by key staff are also proposed in order to protect key species. Monitoring priorities and indicators are proposed as well as part of a scientific monitoring program.

This document is designed to be iterative and updated regularly as a tool for adaptive management. It includes procedures for reviewing and changing the plan.

Appendices include a list of regulations and permit procedures and fees; a time-bound strategic plan laying out goals, objectives, activities, lead people responsible, proposed timeframe, and indicators. This strategic plan is a key piece to understanding how the Reserve will change in the next five years. Another appendix identifies the roles of the key stakeholders, staff, and authority figures in Melekeok. Day-to-day responsibilities are also listed for some staff. Another appendix identifies proposed indicators to judge effective conservation.

Several components of the Management Plan have yet to be developed. An Enforcement Plan must be developed in partnership with technical experts who understand laws and compliance. Similarly, the Monitoring Plan must also be finalized with the aid of technical experts, ideally in partnership with a national framework for monitoring. A Conservation Plan to guide erosion control measures will also be reviewed in the next year.

Very few of the activities in this Plan are currently funded, thus a proposed budget is included. Fundraising through sustainable financing mechanisms such as the PAN and visitor's fees will be pursued in order to make this plan a reality.

## Introduction

In December 1997, Melekeok State enacted Melekeok State Public Law (MSPL) 4-21 establishing the Ngardok Nature Reserve, later amended in 1999 (MSPL 4-32). This made Ngardok Nature Reserve unique in Palau – although there were several marine protected areas, Ngardok was the first conservation area on land. The law also established the Ngardok Nature Reserve Board, and required that the Board prepare and submit to the Governor of Melekeok a proposed management plan by January 5, 1999. Melekeok State has regularly confirmed the status of Ngardok Nature Reserve as a protected area, and in 2008 the site became the first member of Palau's Protected Areas Network. This newest iteration of the Ngardok Nature Reserve Management Plan outlines continuing and planned management actions.

This management plan is a legal document that describes the protection and use of Ngardok Nature Reserve. It gives a background to the Reserve and its unique natural and cultural resources. It outlines the main threats to water quality and integrity of the Reserve's ecosystems and what actions will be taken to deal with those threats. The plan also includes regulations that set forth which activities are permitted and which will be prohibited in the Reserve. These regulations have the full force and effect of the law, as provided for in MSPL 4-32.

## General information about the Ngardok Nature Reserve

*Location*
The republic of Palau comprises a curved archipelago of approximately 350 islands lying between 4 and 8 degrees north latitude and 131 – 135 degrees east longitude, at the western edge of the Caroline Islands, in a cultural region known as Micronesia.

The high island of Babeldaob covers 334 square kilometers (82,000 acres), accounting for over 80% of Palau's landmass. Melekeok State is centrally located on the eastern side of Babeldaob and covers approximately 27 square kilometers (6,800 acres).

Lake Ngardok (at 7º 31' N, 134º 34' E) is located in Melekeok State about 4 km northwest of the main residential area in Melekeok (Figure 1). The Ngardok Nature Reserve covers a total area of about 5 square kilometers (1250 acres).

Water flows out of Lake Ngardok and into the Ngerdorech River. The Ngerdorech River flows through Melekeok and Ngchesar states for about 12 kilometers (7.4 miles) before reaching the mangroves and the sea on the coast of Ngchesar, eastern Babeldaob.

The approximate boundary of the Reserve follows the ridges around the entire watershed as shown in Figure 1 and Appendix 6. The reserve includes the whole of the lake's watershed, and the watershed of the river, north of the pumping station. The Compact Road marks the eastern edge of the Reserve. Figure 1 and Appendix 6 gives an aerial photograph of the area.

In 2002, Lake Ngardok was named a Wetland of International Significance under the international Ramsar Convention on Wetlands.

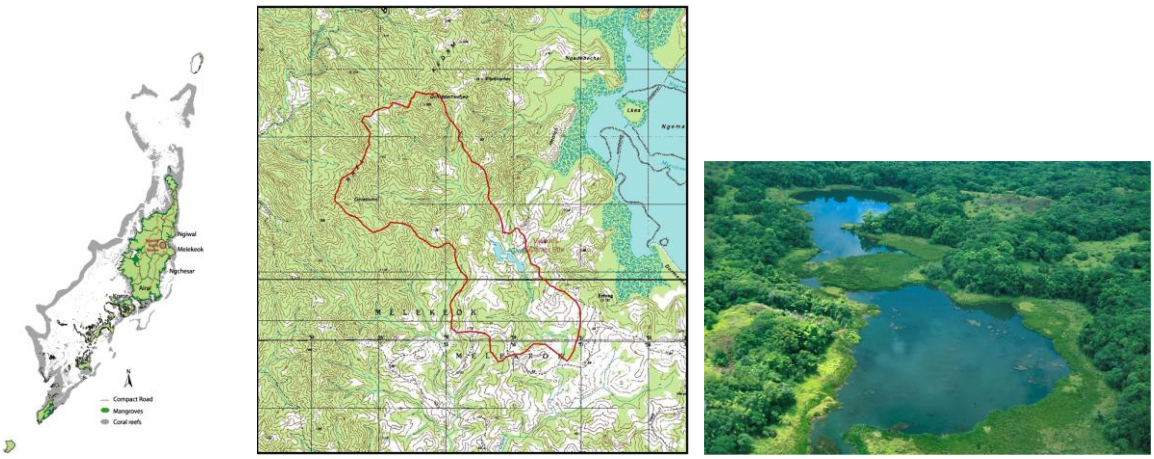

Figure 1. Map of Palau, boundary of Reserve, and aerial photo

***Socioeconomic, Cultural, and Historical Information***

Lake Ngardok has a long history of importance to the people of Melekeok and the neighboring states. Legends about the lake's creation and stories about its use date back many generations. It could well have been used for water supply during times of extreme drought for as long as people have lived in Babeldaob. Some people have said that the name *Ngardok* originally came from the words *ngar* (living) and *dok* (a spring). Hence, the name *ngardok* means "living spring".

The area around the lake was farmed during the Japanese period (1914-1945) and older residents of Melekeok recall there used to be a small village with a school. During that period the lake was presumably used for domestic water supply and for irrigation. Forest was cleared for farmland, and a road, which is still visible, was built to the village. Since the departure of the Japanese in 1945 the area has not been actively used and much of it has reverted to native secondary forest.

The Ngerdorech River provides water to the main residential area in Melekeok. Water is pumped from the pumping station on the river approximately a kilometer downstream from the lake and south of the Reserve boundary. This water source provided good quality water to the community of Melekeok and to the newly opened Capital.

***Biological and Ecological Information***

For a group of Pacific islands, Palau has remarkably biodiverse terrestrial environments. This is because of Palau's proximity to Southeast Asia and the age of the land, geologically the oldest in the Micronesian group.

*Climate*

Palau has a wet tropical climate, with little seasonal variation in temperature. The mean daily temperature throughout the year averages about 80º F (27ºC) with a daily range of about 10º F (7º C). Rainfall averages about 144 inches (370 cm) per year (US Army, 1956).

*Geology and Soil*
Babeldaob is a high island that originated in an underwater volcanic eruption. It was uplifted from the sea due to movement of the continental plates and is still gradually moving upwards. US Army (1956) suggests that Lake Ngardok was originally created by a natural dam formed by deposits of clay eroded during heavy rains.

The most common soils in Ngardok Nature Reserve are upland soils, which are made from highly weathered volcanic material. They are very easily eroded and when washed into the water, remain suspended, making the water cloudy. Thin organic soils cover the forested areas of the Reserve, formed by decomposing roots and leaf litter derived from forest and freshwater marsh vegetation. Grassland areas tend to have even thinner, less fertile organic soils. Smith (1983) gives detailed maps of all the soils in the Reserve. Over 90% of the Lake Ngardok watershed is classified as highly or very highly erodible due to its slope and soil type (USDA SCS, 1991). There are various areas inside the Reserve and along its boundaries where active erosion is taking place. A 2003 Conservation Plan (DeMeo, 2003) outlined priority areas for reforestation to reduce erosion (Appendix 3).

*Water Resources*
Ngardok is by far the largest natural freshwater lake in Palau, the next largest being Ngerkall in Ngaraard State, which covers only one-fifteenth the area of Ngardok. Ngardok Lake surface area was estimated in 1996 to be 22.7 acres (0.09 square km).

It is difficult to calculate the volume of the lake because of the plants growing on the surface of the lake and around its edge. A 1996 USGS study (Yeung and Wong, 1999) estimated the lake's volume to be about 34 million gallons (128,000 cubic meters) although other studies estimated the volume to be smaller (e.g. US Army 1956). A study of the changes in marsh reed extent (*Haranguana malayana*) in 2003 indicated that reed extent had increased between 1992 and 2003, reducing the surface area of the lake (Ongalibang, 2003), although the cause of this increase is unknown.

The southern end of the Reserve is a part of a large freshwater marsh along the Ngerdorch River. Water in the marsh is between 3 to 10 feet (1 to 3 meters deep) (Bright 1979). Water is pumped from the marsh, south of the Reserve boundary to the main residential area in Melekeok. Water quality testing has been performed by The Palau Environmental Quality Protection Board, but the USGS study in 1996 is the most comprehensive water quality study available. A 2006 survey of the Reserve found that USGS water quality monitoring equipment was no longer functioning and beyond repair (Booth, 2007).

In 2007 Melekeok State joined forces with Ngaremlengui State to form the Babeldaob Watershed Alliance (BWA). The BWA mission is to protect, restore, and conserve water resource in Babeldaob. Melekeok and Ngaremlengui's protected areas now protect the upper ridge that forms part of the western boundary of the Reserve.

*Vegetation*
The Reserve contains a range of vegetation types, including upland tropical rainforest, lowland rainforest, grassland, marsh and swamp forest (Cole *et al* 1987). Honigman and Division of Conservation and Entomology (1997) give a list of plants found in the Reserve in a 1992 survey.

Upland forest occupies most of the Ngardok watershed and harbors a wide variety of native and endemic species. One of the most common tree species that makes up the upper canopy is *kelel a charm (Campnosperma brevipetiolata)*. Others include *bkau (Parinari corymbosa), ukall (Serianthes kanehirae)* and *btaches (Calophyllum inophyllum)* (Cole et al 1987). Costion (2008) described the Reserve as a "hotspot" for native vegetation, pointing out high orchid diversity, important *Pandanus* marsh, and presence of the uncommon endemic *Rauvolfia insularis* tree. Kitalong and Holm (2004)

The freshwater marsh ecosystems around the lake and along the river downstream of the lake are important habitats for birds, crocodiles, frogs and other wetland species. The main marshland plant species are the sedge *bakkellild (Sceleria laevis)* and *cheuais (Hanguana malayana)* (Honigman and Division of Conservation and Entomology 1997).

In the Reserve's grassland areas, soils are very low in nutrients and organic matter. Only some grasses and ferns survive, such as *udel (Ischaemum)* grass and *Itouch (Gleichenia linearis)* fern as well as the *Ongor ra ked (Pandanus)* species characteristic of the western Caroline Islands (Cole *et al* 1987).

There are some bare parts of the Reserve where no vegetation grows at all due to poor soils, disturbance, rapid erosion, fire or a combination of these factors. Melekeok State Government and the Division of Agriculture have carried out reforestation in some parts of the Reserve since 1993 using *Acacia* trees. Because of the unfertile nature of these exposed soils, reforestation attempts can be difficult and laborious. Priority areas for reforestation are outlined in the 2003 Conservation Plan (DeMeo, 2003; Appendix 3).

*Mammals*
Palau's only endemic mammal is the *olik* (a subspecies of the Marian fruit bat, *Pteropus mariannus pelewensis)*. It occurs in the Reserve although the location of roosting sites and the numbers or condition of the population is not known. Wiles, Engbring and Otobed (1997) found some of the largest counts of their 1991 fruit bat survey in the area along the border between Melekeok and Ngiwal up to the *Rael Kedam* ridge, which is partly included in the Reserve.

Hunters in the area report frequent sightings of rats, evidence of pig activity and occasional sightings of feral cats and dogs.

*Birds*
There are 151 different species of birds recorded in Palau, of which 51 species nest and live in Palau all year round and as many as 12 are endemic. There are more bird species in Palau than in the Micronesian islands to the east, due to the relative proximity of land masses and the diversity of geology and habitats in Palau (Engbring 1988; Holm et al 2008).

In a field survey of the Reserve in 1992, Honigman and Division of Conservation and Entomology (1997) identified 16 species of birds. The birds observed include the *biib* (Palau fruit dove, *Ptilinopus pelewensis),* the uncommon *laib* (Nicobar pigeon, *Caloenas nicobarica*), and one of the rarest birds in Palau, *debar* (common moorhen, *Gallinula chloropus).* Many other bird species use the lake and the surrounding area as a breeding and foraging habitat.

*Amphibians and Reptiles*
Various species of snakes and lizards also occur in the Reserve, but no comprehensive surveys of these animals have been undertaken. The snakes that have been recorded elsewhere in Babeldaob include the *nguis* (Palau tree snake, *Dendrelaphis lineolatus*), *bersoech* (Pacific Island boa) and the Brahminy blind snake (*typhlops braminus*) (TTPI 1977). Skink species that also occur include the *chemaidechedui* (emerald or green skink, *Lamprolepis smaragdina)* and the endemic pandanus skink (*Aulacoplax leptosoma*) which can be found in the crowns of pandanus trees (TTPI 1977).

There is a large population of frogs around the lake, but they have not been studied. The Palauan endemic frog *dechedch* (*Platymantis pelewensis*) lives in the Reserve, as it is very common throughout Palau (TTPI 1977). Bright (1979) observed the introduced marine toad (*Bufo marinus*) at Lake Ngardok.

Lake Ngardok provides crucial habitat for the endangered *ius* (saltwater crocodile, *Crocodylus porosus*). Crocodile numbers in the whole of Palau are currently estimated to be fewer than 150 animals. A survey in 1991 counted 17 crocodiles in the lake area, which was one of only two of the viable populations found in the whole of Palau, along with Peleliu (Messel and King 1991). Female crocodiles nest in the vegetated wetlands close to secluded freshwater ponds and rivers. Studies by Peter Brazaitis (1998) found that the likely dispersal routes for crocodiles moving to adult habitats are overland to the east and southeast ends of the Reserve, towards the coastal mangrove habitats on the border of Melekeok and Ngiwal and south. Some crocodiles may move along the southwestern routes of the Ngerdorch river systems, particularly using shallow flood plains and protected edges of river banks. Brazaitis (1998) reported that the peak breeding, reproduction, and dispersal season was during the rainy months from June to September.

*Fish*
No comprehensive studies on fish have yet been undertaken in Lake Ngardok or the Ngerdorch River. Studies on freshwater habitats elsewhere in Babeldaob have shown that at least 40 species of fish need freshwater to survive (Bright 1979), and there are at least two endemic freshwater fish species (Gobies, *sicyopus sp.* and *Redigobius horiae*) (Bright and June 1981). The largest fish in Palauan freshwater is the *kitlel* (freshwater eel, *Anguilla marmorata*), of which the largest recorded specimen measured 3.7 feet (1.2 meters) (Bright and June 1981).

Bright (1979) identified two species of freshwater in fish in Lake Ngardok – *Kuhlia rupestris* and *Puntius sealei*.

*Invertebrates*
Little information is available on the terrestrial and aquatic invertebrates (such as snails, worms, shrimp and clams) of Lake Ngardok, the Ngerdorch River or the surrounding watershed. Bright

(1979) gives a list of insects, water mites, crustaceans and mollusks found in the lake and mentions that there are at least 18 species of shrimp and crab in Palauan freshwater habitats, including some endemic species. Rundell (2005) found 11 species of land snails during a rapid assessment of the Reserve.

## Management Goals

### *Purpose*

MSPL 4-32 "provides for the protection and preservation of the Ngardok watershed area."

### *Goal*

The following are objectives of management of Ngardok Nature Reserve, as stated with equal importance in the Nature Reserve Act of 1997 (amended 1999):

1. To provide high quality water supply for the people of Melekeok State
2. To provide for the enjoyment and education of the people of Melekeok State, Palau and visitors to Palau
3. To maintain the ecological integrity of Lake Ngardok and the natural habitats it provides
4. To provide for the protection of the native plants and animals within the watershed
5. To provide opportunities for research on the organisms and natural systems within the watershed
6. To raise capacity for effective management of natural resources within the State.

## Restricted and Allowable Uses

### *Prohibited at all times:*

No person may engage in, or to cause another person to engage in, the following activities in the Reserve:

- Swimming, picnicking, or camping;
- Consuming alcohol;
- Dumping litter or solid or liquid waste of any kind;
- Lighting fires;
- Introducing non-native plant or animal species not native to the Reserve;
- Feeding or harassing animals;
- Pumping water from lake Ngardok;
- Possessing, applying, or dumping chemicals or any other substance harmful to any living thing or which contaminates water quality;
- Residing on a permanent or long-term basis;
- Grazing livestock.

### *Allowable activities:*

The State reserves the right to charge an entry fee or require a permit for any allowable activity. Allowable activities include entry to the Reserve for the purposes of:

1. Research and monitoring
2. Education

3. Tourism
4. Subsistence harvesting
5. Maintenance

The State also reserves the right to zone the Ngardok Nature Reserve for allowable and prohibited activities. Currently, unguided visitors may only use the existing trail and may not stray off the trail. Entry by all other areas must be by permit or with a Ranger/Tour Guide.

*Allowable only with a permit:*
No person may engage in, or to cause another person to engage in, the following activities in the Reserve, unless they are in possession of a valid permit issued pursuant to section 7.3(a)(2):

- Modifying or disturbing the soil, forest, savanna or lake;
- Taking or killing birds, fruit bats, crocodiles, fish, or any other animal;
- Cutting or harvesting any trees, flowers, seeds, or plants of any kind;
- Constructing structures of any kind;
- Driving, entering, or causing to enter the Reserve in a motor vehicle or on a motor cycle;
- Constructing roads;
- Using a boat on the lake.

Legally applicable regulations, definitions, and permit application procedures and fees are included as Appendix 1.

**Key factors influencing the Ngardok Nature Reserve**

***Targets***
A 2008 meeting of Conservation Professionals in Palau identified 12 types of ecological targets. Of these, Ngardok Nature Reserve has four:
1. Forest (Volcanic and Swamp)
2. Savanna
3. Freshwater (all types – marsh, rivers, streams, lakes, springs)
4. Harvested species of concern (bats, megapodes, pigeons, crocodiles)

***Threats to targets***
There are a number of threats to the environment in the Reserve. The main potential and actual threats are:

*Human intrusions and disturbances*
Large numbers of visitors may lead to erosion of footpaths and trampling of the lake and river edges, setting of wildfires, trash, hunting and harassment of wildlife, and damage to vegetation.

*Biological Resource use*
Prohibited harvests (poaching) of the Micronesian Pigeon is a threat. Hunting of crocodiles may be a threat. Gathering of marsh plants beyond subsistence levels may also pose a threat.

*Natural System Modifications (fire and water extraction)*
Fire is a major threat to the Reserve because fire in a rainforest will kill all the trees, plants and animals. The fire also scorches the soil and destroys all its organic matter, leaving the soil bare. If heavy rainfall then occurs, the topsoil is washed into the waterways leaving bare infertile patches. Grass may grow on the site and the forest may never recover.

In the Ngardok Nature Reserve, large patches of bare areas are presumed to have resulted from fires.

When the population migration occurs from Koror to Babeldaob, there will be greater demand for water. Taking water from the Reserve and Ngerdorch River beyond its natural output will threaten the lake's ecological integrity and may have negative effects on the adjoining marshes and the swamp forests.

*Geological events (erosion)*
The Lake watershed is vulnerable to erosion, and there are several areas where erosion is a major concern. Severely eroded areas slow do not allow native plants to grow or provide habitat for animals. When soils are disturbed, especially during road construction, rain washes silt into the lake, the river below and out to the sea. This compromises the quality of the water for human consumption and will gradually fill in the lake and reduce its capacity to store water.

*Invasive and other problematic species*
Species introduced by visitors or the adjoining Compact Road are a threat as they may displace native vegetation or outcompete native animals. Pigs, cats, rats, and dogs are present in the Reserve and surrounding areas. These may negatively impact native species and water quality.

*Climate change and severe weather*
Changing climate may lead to a variety of outcomes. Drought may limit water resources, creating competition between human and natural uses. Extreme rainfall, on the other hand, may increase flooding and erosion. Either of these impacts may lead to a shift in natural vegetation and animals.

***Socioeconomic influences***
The human population in the Reserve is zero. The population in Melekeok fluctuates widely between day and night, when the Capital is fully staffed versus when the traditional residents of Melekeok are at home. Thus, the population varies from about 400 to over a thousand. This population relies on the water flowing out of the Ngardok Nature Reserve.

Although traditionally Lake Ngardok may have provided materials to support a subsistence lifestyle, today few individuals are dependent on the Reserve for their livelihoods. At the state level, however, visitor fees for entrance to the Reserve generate revenues for Melekeok State.

**Strengths, Weaknesses, Opportunities, Threats (SWOT) Analysis**

Analysis of the key factors influencing the Reserve can provide a picture about the strengths, weaknesses, opportunities, and threats operating on the Reserve. These in turn influence management policies.

| | Helpful | Harmful |
|---|---|---|
| Internal | **Strengths**<br>• Clear management authority (Governor, legislature, and Reserve Board)<br>• Existing funding mechanism (visitor fees)<br>• Existing staff have been trained in specific techniques<br>• Existing brochures, educational materials<br>• Existing resources such as visitor's center, graded road and lot<br>• Areas of pristine forest and ecosystems<br>• Existing monitoring sites | **Weaknesses**<br>• Inadequate staffing and resources<br>• Inadequate training for new employees<br>• Inadequate publicity (for tourism)<br>• Inadequate enforcement<br>• Exposed areas prone to erosion<br>• Inadequate experience with fundraising<br>• Need for more information |
| External | **Opportunities**<br>• Agency training programs<br>• External funding sources (Ramsar, PAN, US government, others)<br>• Available technical assistance (for construction and monitoring; PCS, PICRC, CAT, BNM, BOA, PVA)<br>• Global awareness and awareness materials through Ramsar | **Threats**<br>• Inadequate financing<br>• Fire, hunting, visitor impacts, climate change, invasives, erosion<br>• Declining tourist numbers |

**Management Policies and General Strategic Plan**

The first Management Plan for Lake Ngardok was developed in 1991, and revised again in 1998. Many activities have been conducted under these Plans. Today, the Reserve has a graded and graveled access road, trail, floating dock, nearly finished Visitor's Center and nursery, interpretive signs, and areas with active vegetation management (through replanting). The Reserve Board employed a Reserve Manager, and he and other key Reserve Members have received training in park management. Currently the Reserve Manager position is open. A Conservation Plan, including an Erosion Control and Reforestation Strategy, was developed in 2003 (DeMeo, 2003) and has informed reforestation activities to now. Several monitoring programs have been conducted, including forest monitoring, water quality monitoring, and marsh reed monitoring. Crocodiles, snails, birds, and vegetation have been surveyed. Brochures have been developed and printed, and tourists visit the lake infrequently. This Management Plan outlines the next round of activities (2010-2014) that are planned in order to achieve the goals of the Reserve, given the existing work that has already been completed.

***Management Authority and Personnel***

MSPL 4-32 that established the Reserve gave authority to carry out the Act to the State Governor and also established the 5-member Melekeok Nature Reserve Board. Board members are appointed by the Governor and High Chief Reklai and must be approved by the legislature. MSPL 4-32 dictates the terms by which Board Members must operate, including allowable terms. The Board is responsible for advising the Governor on management of the Reserve. The Board may also hire its own staff.

The Board has prioritized hiring of a Reserve Manager. The Manager's job will be to ensure that the regulations are enforced and all the management actions are undertaken. He or she will work closely with the Board and coordinate management and community activities involving government agencies, non-government agencies, organizations and individuals. In addition to the Manager, the Board has identified a number of other positions that may be filled under this management plan. These include:

1. Reserve Manager
2. Senior Park Ranger
3. Junior Park Rangers (2)
4. Visitor Center Attendant
5. Nursery Supervisor
6. General Maintenance operators (3)

***Management Strategies***

Management strategies are designed to meet each goal and minimize internal and external weaknesses and threats.

| **Goal** | **General Management Strategy** | **General category** | **Weakness, threats addressed** |
|---|---|---|---|
| | | | |
| High quality water | Implement and Review Erosion and Reforestation Strategy | Maintenance | Areas prone to erosion, visitor's impacts |
| Enjoyment and education | Implement and Review Education Strategy and Visitor Policies, including zoning map | Awareness, education, tourism, and interpretation | Inadequate training and publicity, all threats |
| Maintain ecological integrity | Implement and Review Erosion and Reforestation Strategy | Maintenance | Fire, climate change, invasives, erosion |
| Protect plants and animals | Prepare and Implement Enforcement Strategy | Surveillance and Enforcement | Inadequate enforcement, all threats |
| Provide opportunities for research | Establish Scientific Monitoring Program | Scientific Monitoring | All threats |
| Raise capacity for effective management | Establish funding sources for Reserve Staff and Materials | Administration | Inadequate resources, inadequate experience with fundraising, all threats |
| | Employ and train a Reserve Manager | All areas | Inadequate staffing |
| | Review, evaluate, and update Management Plan | All areas | Need for more information, all threats |

***Maintenance of the Reserve***
Maintaining pristine areas and improving impacted areas will proceed according to the Erosion Strategy and Reforestation Strategy. Ongoing erosion and reforestation activities include slope stabilization through tree planting; thus the Erosion Control and Reforestation Strategy will continue to use trees and vegetation produced by the Melekeok State Nursery. Erosion control will address invasive animal species and forest integrity activities will address invasive plants. The Erosion Control and Reforestation Strategy will be reviewed and revised within the period of this Plan. See Appendix 2 for a Strategic Plan detailing objectives and activities falling under each goal.

*Maintenance Objectives*

1. Erosion control and reforestation is accomplished and wildlife habitat and feeding areas are improved by planting native trees in the barren, grassland, and riparian areas
2. Tree and forest cover is improved through fire control
3. Soil erosion on barren areas is reduced with the use of mulch and groundcovers
4. Agricultural pest infestations, including weeds, insects, and diseases are managed to reduce adverse effects on plant growth, crop production, and environmental resources.

***Awareness, education, tourism, and interpretation***
Activities under the education strategy are included in this Plan. Existing activities include use and maintenance of the existing trail, visits by tourists, school groups, and other local and global visitors, and distribution of brochures. A Visitor's Center is nearing completion. See Appendix 2.

*Education objectives*

1. Awareness and appreciation has increased amongst all Palauans of the uniqueness of the lake and its habitats, threats and mitigation (wildfire, erosion, declines in water quality, hunting) and the interconnections between protecting vegetation, preventing soil erosion and maintaining water quality
2. Tourists visit the Reserve and Melekeok State and appreciate and are sensitive towards Palau's land-based attractions

Visitor's Policies, including methods for obtaining visitor's permits, are included in the Preliminary Education Strategy.

***Enforcement and Surveillance***
An Enforcement Plan will be developed within two years of completion of this Management Plan. The Enforcement Plan will incorporate existing findings from ongoing monitoring activities. See Appendix 2.

*Enforcement objectives*

1. Reduce unauthorized entry, illegal hunting, littering, and prohibited activities in the Reserve
2. Increase awareness of Reserve boundaries, prohibited activities, and permitting procedures

Park rangers hired to as part of the Enforcement Plan will conduct surveillance of activities in the park and ensure that they are properly permitted. Additional surveillance activities will be developed as part of the Enforcement Plan.

***Scientific Monitoring***

A detailed monitoring plan will be developed as part of a Scientific Monitoring Program (Appendix 5). Management of the Reserve requires a better understanding of the plants, animals, soil and water, and how these interact. Scientific research will be encouraged in the Reserve on a range of subjects such as vegetation, endangered animal species, and water quality. See Appendices 2 and 5.

*Scientific Research objectives*

1. Monitor trend and status of ecosystem targets
2. Monitor trend and status of water resources
3. Determine baseline status of historic sites
4. Encourage scientific research in the Reserve

The Scientific Monitoring Program will be developed within two years of completion of this Management Plan, but revised continually. Aspects of the Program, such as proposed monitoring techniques, will be tested before the Program is finalized. Park Rangers will test monitoring techniques and conduct ongoing monitoring in partnership with other agencies in Palau and the United States.

***Administration***

Although the Reserve Board and Governor are responsible for the long-term viability of the Ngardok Nature Reserve, daily implementation of existing and new plans will be the responsibility of the Reserve Manager. The Reserve Manager will work with the State and Partners to identify and manage funds to procure additional staff, including rangers, visitor's center attendant, nursery supervisor, and maintenance staff. See Appendix 2.

*Capacity Building*

The Reserve Board and Reserve Manager will work together to raise the capacity of staff to implement strategies. Staff will participate in the Conservation Officer Training Program (to be developed by the Palau Conservation Society and Partners) and will seek additional on- and off-island exchanges.

*Financial Management*

State personnel with experience with Federal block grants and disbursing and reporting on financial resources will dedicate time to managing funds associated with the Reserve. The State reserves the right to charge an entrance fee for the Reserve and to use these fees for maintenance of the Reserve or other State resources.

**Procedures for reviewing and updating the Plan and Conflict Resolution**

The Board may propose revisions to the Management Plan at any time. MSPL 4-32 outlines procedures for changes, including a 30 period of public notice, 30 days for comment, a public hearing, and final approval by the Governor and High Chief Reklai. Conflicts may also be addressed through a public hearing or through the State legislature.

**Relationship between different stakeholders in the agreement**

This Management Plan lays out activities of the Ngardok Nature Reserve Board and the Melekeok State Government. It does not expressly include other stakeholders, although these have been considered in drafting of the Plan. The relationship between the Board and the State is clearly defined in MSPL 4-32.

The Board and the State will seek assistance from other stakeholders and partners in implementation of this Plan. The Board will seek assistance from the Ministry of Justice to draft and implement the Enforcement Plan. The Board will continue to work with the Ministry of Natural Resources, Environment, and Tourism, Palau Conservation Society, Natural Resource Conservation Service, Environmental Quality Protection Board, and other partners to implement reforestation, education, and erosion-mitigation measures.

**Ngardok's Special Place in the PAN**

The Ngardok Nature Reserve has a unique place within Palau's Protected Areas Network. The Reserve houses Palau's largest and most biologically diverse freshwater lake. Ngardok is the only terrestrial site in the network with a full suite of terrestrial habitats represented: native primary forest, secondary forest, savanna, swamp forest, marsh, and riparian zones. The Reserve has unique vegetation, such as the native carnivorous flowering plant *Urticularia*, which is naturally only found on Lake Ngardok and is thought to have high genetic diversity for orchids (Costion, 2008). The lake is one of the few consistent places in Palau where the rare Common Moorhen resides. Lake Ngardok is Palau's only official recognized Wetland of International Importance (Ramsar Site).

The Ngardok Nature Reserve is also unique within the PAN because it currently represents the only protected area that can fully support visitors and thus increase understanding of Palau's terrestrial biodiversity. The site serves as a scientific laboratory, with ongoing restoration activities that can yield lessons applicable to the rest of Babeldaob. The Ngardok Nature Reserve truly epitomizes the spirit of the Protected Area Network. As a fragile site, it will benefit from National assistance. As a living laboratory it will provide information to the rest of Palau. And finally, as a biological, ecological, and cultural gem, it will reflect the promise of a network that protects and celebrates the best that Palau has to offer the world.

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## Appendix 1. REGULATIONS

*These regulations have been promulgated pursuant to Section 6(b)(1)(c and d) and Section 6(c)(2) of Melekeok State Public MSPL No. 4-21, the Ngardok Nature Reserve Act of 1997.*

*This appendix contains the rules, regulations, procedures, and boundaries that shall have the full force and effect of law pursuant to MSPL No. 4-21, Section 7(g) and Section 6(c)2.*

### 1. Definitions

"Enforcement Officer" means any person authorized pursuant to MSPL No. 4-21 to enforce the provisions of that Act and any rules, regulations, and procedures promulgated pursuant to that Act. It includes, but is not necessarily limited to, the Melekeok State "Nature Reserve Enforcement Officers" described in Section 9(a) of MSPL No. 4-21.

"Management Authority" means any institution, person, or persons authorized to implement this management plan, pursuant to MSPL No. 4-21, Section 6(c)(3), as amended.

"Permit" means a permit issued pursuant to section 9.4 of these regulations for the purpose of allowing entry into and certain activities within the Reserve.

"Reserve" means the Ngardok Nature Reserve, as established by MSPL No. 4-21 and with the boundaries as shown in Attachment A.

### 2. Prohibitions

"Reserve" means the Ngardok Nature Reserve, as established by MSPL No. 4-21 and with the boundaries as shown in Attachment A.

Enforcement Officers
Management Authorities
Persons in possession of a valid permit issued pursuant to section (7.3(a)(1).

### 3. Permits

Permit application procedures:

A person wishing solely to enter the Reserve, and not to engage in activities prohibited by subsection 7.2(c) shall apply for an entry permit from the Management Authority at the Melekeok State offices in Melekeok or Koror. A charge for the permit may be introduced at the discretion of the Governor.

A person wishing to engage in activities listed in section 7.2 shall apply for a use permit from the Management Authorities at the Melekeok State offices in Melekeok or Koror and shall include in their application the following written information, plus a receipt for a non-refundable application fee of $100 issued by the Management Authority:

A description of the proposed activities, their purpose, and likely benefits to come from the activities;
An explanation of how the proposed activities are consistent with the management objectives of the Reserve and with any other relevant provisions of the Reserve's management plan;
A description of the environmental and other impacts that are likely to occur as a result of the proposed activities and any proposed mitigation;
A time schedule of the proposed activities in the Reserve, any subsequent related activities such as data analysis, report writing, or submission of reports to the Management Authority.

Any further costs incurred by Melekeok State in making a decision on the issuance of a permit shall be borne by the applicant

(b) Permit issuance authority and procedures

Permits issued pursuant to section 7.2(a)(2) of these regulations shall be issued only by, and at the discretion of, the Management Authority.

The management Authority shall issue permits only for activities that are consistent with the management objectives of the Reserve and with all other relevant provisions of the Reserve's management plan.

Permits shall be in a form to be determined by the Management Authorities. At the least, a permit shall state its dates of validity, permitted activities are allowed, any conditions on those activities, a unique serial number, the number of persons covered by the permit, the amount paid for the permit and the names of the permit holder(s).

The Management Authority may put any conditions on the activities allowed by a permit. Such conditions shall be indicated on the permit.

The Management Authority may, at their discretion, issue a single permit to cover the activities of more than one person.

The Management Authority shall either issue the permit or notify the applicant of its denial of the application within 60 days of their receipt of the application.

The Management Authority may waive the $100 application fee in the case of a research project which is likely to significantly benefit knowledge and management of the Reserve.

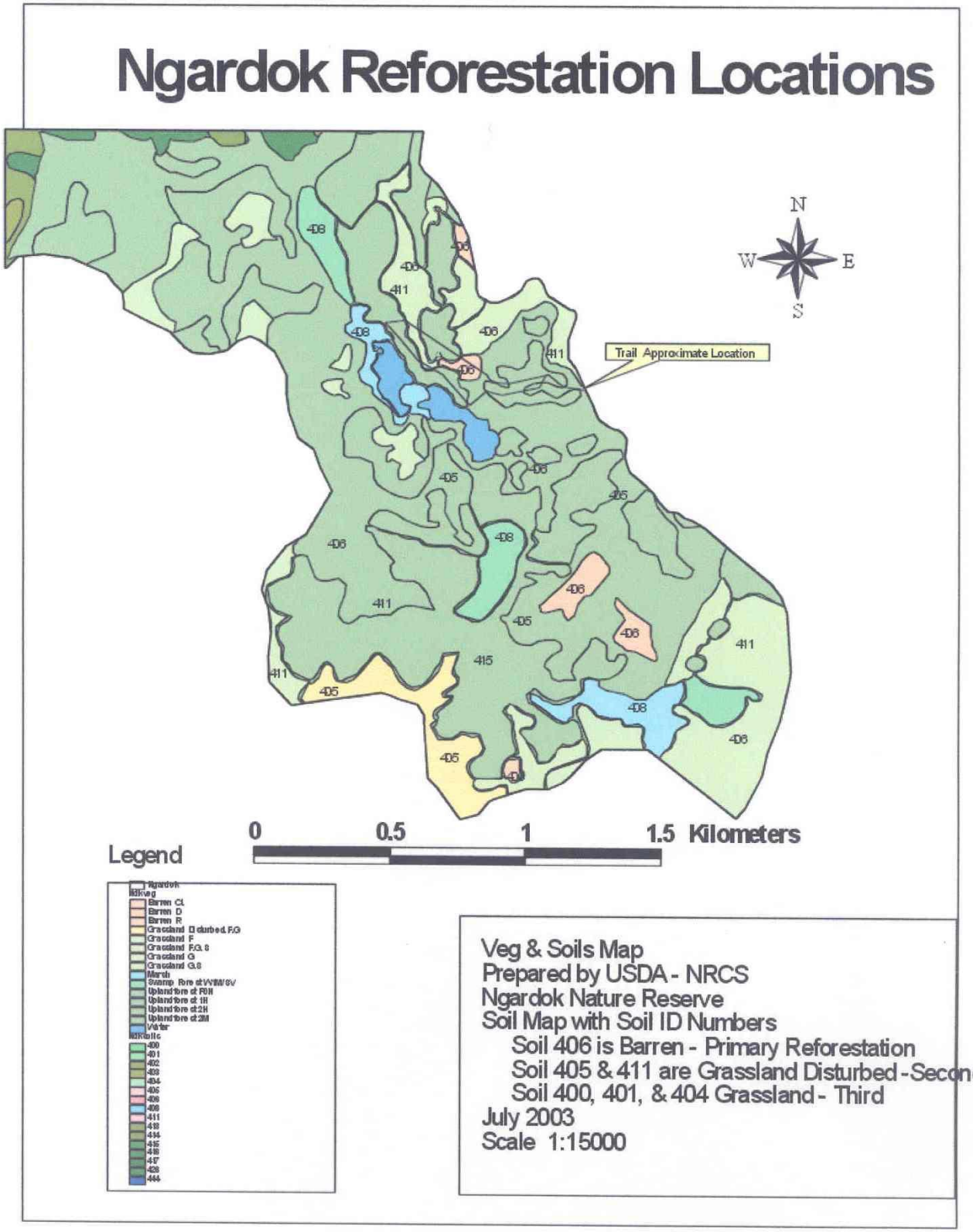
# Appendix 2. Strategic and Work Plan

| | | | | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Lead 1** | ***Lead 2/Partner*** | **2010** | | | | **2011** | | | | **2012** | | | | **2013** | | | | **2014** | | | | ***Indicators*** |
| **Goal 1** | **To provide high quality water supply for the people of Melekeok State** | | | | | | | | | | | | | | | | | | | | | | | |
| **Goal 3** | **To maintain the ecological integrity of Lake Ngardok and the natural habitats it provides** | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 1* | *1. Erosion control and reforestation is accomplished and wildlife habitat and feeding areas are improved by planting native trees* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Complete construction of State Nursery | Reserve Manager | *Nursery Supervisor* | | | | | | | | | | | | | | | | | | | | | *Completed State Nursery / Photo documentation* |
| | Maintain nursery and increase output of plants | Nursery supervisor | *Maintenance personnel* | | | | | | | | | | | | | | | | | | | | | *Number of trees produced* |
| | Replant according to Conservation Plan (Appendix 3) | Reserve Manager | *Nursery Supervisor* | | | | | | | | | | | | | | | | | | | | | *Number of trees planted / Square meters planted* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| Objective 2 | *2. Tree and forest cover is improved through fire control* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Conduct daily surveillance to detect fires | Senior Park Ranger | *Junior Park Rangers* | | | | | | | | | | | | | | | | | | | | | *Daily observation notes / # Fires observed / # calls to Fire substation* |
| | Raise awareness about risk conditions (red/orange/green) | Park Manager | *Rangers* | | | | | | | | | | | | | | | | | | | | | *# Calls to schools, state office, fire station* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 3* | *3. Soil erosion on barren areas is reduced with the use of mulch and groundcovers* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Apply mulch or native leaf litter to replanted and bare areas | Reserve Manager | *NRCS* | | | | | | | | | | | | | | | | | | | | | *Square meters with mulch* |
| | Pave entrance road and visitor's parking lot | Reserve Manager | | | | | | | | | | | | | | | | | | | | | | *Paved road and lot / Photo documentation* |
| | Maintain trail | Reserve Manager | *Maintenance personnel* | | | | | | | | | | | | | | | | | | | | | *# Meters of trail in good / poor condition* |
| | Pave eastern side access road | Reserve Manager | | | | | | | | | | | | | | | | | | | | | | *Paved road / Photo documentation* |
| | Monitor for unauthorized entry, development, or driving in the Reserve | Senior Park Ranger | *Junior Park Rangers* | | | | | | | | | | | | | | | | | | | | | *Daily observation notes / # observed prohibitions / # incident reports* |
| | Explore stabilization of steep slopes on open "blow-out" area abutting East side of reserve with sand bags or bunch grasses | Reserve Manager | *NRCS* | | | | | | | | | | | | | | | | | | | | | *# Meetings / # Visits to site with partners / Updated Conservation Plan* |
| | Review and update Conservation Plan | Reserve Manager | *NRCS* | | | | | | | | | | | | | | | | | | | | | *# Meetings / # Visits to site with partners / Updated Conservation Plan* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 4* | *4. Agricultural pest infestations, including weeds, insects, and diseases are managed to reduce adverse effects on plant growth, crop production, and environmental resources.* | | | | | | | | | | | | | | | | | | | | | | | |
| | Monitor for introduction or spread of invasive species | Nursery Supervisor | *Rangers* | | | | | | | | | | | | | | | | | | | | | *Daily observation notes / acres with invasive species / % monitoring plots with invasive species* |
| | Explore and encourage guided pig hunts in the Reserve | Reserve Manager | *Rangers* | | | | | | | | | | | | | | | | | | | | | *# Hunts / # Hunters / # Pigs removed* |
| | | | | | | | | | | | | | | | | | | | | | | | | |

| | | | | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Lead 1** | ***Lead 2/Partner*** | **2010** | | | | **2011** | | | | **2012** | | | | **2013** | | | | **2014** | | | | ***Indicators*** |
| **Goal 2** | **To provide for the enjoyment and education of the people of Melekeok State, Palau, and visitors to Palau** | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 1* | *1. Awareness and appreciation has increased amongst all Palauans of the uniqueness of the lake and its habitats, threats and mitigation (wildfire, erosion, declines in water quality, hunting) and the interconnections between protecting vegetation, preventing soil erosion and maintaining water quality* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Review and reprint brochures and maps | Reserve Manager | *PCS* | | | | | | | | | | | | | | | | | | | | | *# Brochures and maps printed* |
| | Distribute brochures and maps to visitors and in Palau | Reserve Manager | *Rangers* | | | | | | | | | | | | | | | | | | | | | *# Distribution points / # times distributed* |
| | Celebrate World Wetlands Day annually | Reserve Manager | *PCS* | | | | | | | | | | | | | | | | | | | | | *# Media articles* |
| | Hold public seminar and symposiums on the Reserve | Reserve Manager | *Board* | | | | | | | | | | | | | | | | | | | | | *# Symposiums* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 2* | *2. Tourists visit the Reserve and Melekeok State and appreciate and are sensitive towards Palau's land-based attractions* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Install interpretive signs along trail | Reserve Manager | *Maintenance* | | | | | | | | | | | | | | | | | | | | | *# Signs installed* |
| | Repair floating dock | Reserve Manager | *Maintenance* | | | | | | | | | | | | | | | | | | | | | *Dock repaired / Photo documentation* |
| | Source and install benches along trail | Reserve Manager | *Maintenance* | | | | | | | | | | | | | | | | | | | | | *# benches installed* |
| | Hire and train rangers/tour guides | Reserve Manager | *PCS/Koror State* | | | | | | | | | | | | | | | | | | | | | *# Rangers hired / # Rangers participating in training program* |
| | Conduct briefings with visitors | Visitor's Center Attendant | *Rangers* | | | | | | | | | | | | | | | | | | | | | *# Visitors briefed* |
| | Develop a user fee schedule depending on level of use | Reserve Manager | *Board* | | | | | | | | | | | | | | | | | | | | | *# Meetings / Management plan updated* |
| | Develop and obtain safety and educational materials for rangers/tour guides and visitor's center attendant | Reserve Manager | | | | | | | | | | | | | | | | | | | | | | *# First aid kits / # Educational materials produced* |
| | Finish Visitor's Center construction | Reserve Manager | | | | | | | | | | | | | | | | | | | | | | *Visitor's Center completed / Photo documentation* |
| | Hire and train Visitor's Center attendant | Reserve Manager | *PCS/Koror State* | | | | | | | | | | | | | | | | | | | | | *Visitor's Center Attendant hired / Visitor's Center Attendant participating in training program* |
| | Collect visitor fees and provide visitor safety services | Visitor's Center Attendant | *Rangers* | | | | | | | | | | | | | | | | | | | | | *$ Fees collected* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| **Goal 4** | **To provide for the protection of the native plants and animals within the watershed** | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 1* | *1. Reduce unauthorized entry, illegal hunting, littering, and prohibited activities in the Reserve* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Develop Enforcement Plan | Board | *Ministry of Justice* | | | | | | | | | | | | | | | | | | | | | *# Partners involved / # Meetings / Management Plan updated / Enforcement Plan completed* |
| | Monitor entry and permits, enforce laws, and aid with education, maintenance, and monitoring | Senior Park Ranger | *Junior Park Rangers* | | | | | | | | | | | | | | | | | | | | | *Daily observation notes / # observed prohibitions / # incident reports / #* |

| | | | | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | Jan - Mar | Apr - Jun | Jul - Sep | Oct - Dec | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **Lead 1** | ***Lead 2/Partner*** | **2010** | | | | **2011** | | | | **2012** | | | | **2013** | | | | **2014** | | | | ***Indicators*** |
| | | | | | | | | | | | | | | | | | | | | | | | | *monitoring reports* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| ***Objective 2*** | *2. Increase awareness of Reserve boundaries, prohibited activities, and permitting procedures* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Visibly mark the south and southeast boundaries of the Reserve with native plants | Reserve Manager | *Maintenance* | | | | | | | | | | | | | | | | | | | | | *# Trees planted / % boundary marked* |
| | Put up signs listing prohibited actions | Reserve Manager | *Maintenance* | | | | | | | | | | | | | | | | | | | | | *# Signs / % boundary in site of sign* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| **Goal 5** | **To provide opportunities for research on the organisms and natural systems within the watershed** | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 1* | *1. Monitor trend and status of ecosystem targets* | | | | | | | | | | | | | | | | | | | | | | | |
| *Activities* | Develop and test monitoring plan | Reserve Manager | *PCS/BNM/Forestry* | | | | | | | | | | | | | | | | | | | | | *Plan developed / # field visits to test plan* |
| | Track critical species and forest health over time | Reserve Manager | *Rangers* | | | | | | | | | | | | | | | | | | | | | *% Species trends / Monitoring logbooks* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 2* | *2. Monitor trend and status of water resources* | | | | | | | | | | | | | | | | | | | | | | | |
| | Participate in existing water monitoring programs | Reserve Manager | *EQPB* | | | | | | | | | | | | | | | | | | | | | *% Trends in water quality / # monitoring visits* |
| | Monitor spread of Hanguana malayana (cheuais) using existing permanent plots | Reserve Manager | *Rangers* | | | | | | | | | | | | | | | | | | | | | *% cover* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 3* | *3. Determine baseline status of historic sites* | | | | | | | | | | | | | | | | | | | | | | | |
| | Conduct survey and map historic sites | Reserve Manager | *Cultural Affairs* | | | | | | | | | | | | | | | | | | | | | *Map produced / # visits to Reserve / # participants* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 4* | *4. Encourage scientific research in the Reserve* | | | | | | | | | | | | | | | | | | | | | | | |
| | Participate in National collaborations | Reserve Manager | | | | | | | | | | | | | | | | | | | | | | *# Meetings* |
| | Increase the Reserve's presence on the Internet | Reserve Manager | *Board* | | | | | | | | | | | | | | | | | | | | | *Board controlled materials* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| **Goal 6** | **To raise capacity for effective management of natural resources within the State** | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 1* | *1. Raise the capacity of the Board, Manager, and staff to implement strategies* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Hire Reserve Manager | Board | | | | | | | | | | | | | | | | | | | | | | *Reserve Manager hired* |
| | Hire Staff | Board | | | | | | | | | | | | | | | | | | | | | | *# Staff hired* |
| | Rangers/Tour Guides participate in Conservation officer and Tour Guide training program | Reserve Manager | *Senior Park Ranger* | | | | | | | | | | | | | | | | | | | | | *# Participating in training programs* |
| | Develop partnerships and funding for off-site exchanges | Board | *Reserve Manager* | | | | | | | | | | | | | | | | | | | | | *# Exchanges / # Partnerships / $ Support raised* |
| | Review Management Plan | Board | *Reserve Manager* | | | | | | | | | | | | | | | | | | | | | *# Meetings to review plan / Management Plan updated* |
| | | | | | | | | | | | | | | | | | | | | | | | | |
| *Objective 2* | *2. Manage Reserve finances with integrity* | | | | | | | | | | | | | | | | | | | | | | | |
| Activities | Manage all funds and complete reports | Reserve Manager | *Board* | | | | | | | | | | | | | | | | | | | | | *# Reports / Reconciled bank statements* |
| | | | | | | | | | | | | | | | | | | | | | | | | |

**Appendix 3. Priority areas for reforestation/erosion control**



## Appendix 4: Roles and day-to-day responsibilities (Day-to-day Operational Plan)

**Traditional Leadership**

**Reklai**

***Role***: Oversight of activities in the Reserve to ensure cultural appropriateness; conflict resolution

***Responsibilities***

- Appoint Board Members
- Approve Management Plan and changes to Plan

**State Government Leadership**

**Governor**

***Role***: Ultimate oversight for implementation of the Plan and for financial management of funds for the Reserve

***Responsibilities***

- Appoint Board Members
- Approve Management Plan and changes to Plan
- Oversee financial and maintenance staff

**Legislature**

***Role***: Ensure that community vision is encapsulated in Management Plan

***Responsibilities***

- Approve Board Members
- Hold public hearings to hear comments on proposed changes to Plan

**State Government Staff**

**State Finance Personnel**

***Role***: Manage flow of funds and maintain accurate records of all expenditures

***Responsibilities:***

- Issue purchase orders, checks, and other financial procurement documents
- Track spending and maintain all financial files
- Report regularly to Governor
- Assist with preparation of yearly financial reports

**State Maintenance Personnel**

***Role***: Assist with maintaining the visual appearance and ecological functioning of the Reserve

***Responsibilities***:

- Assist with maintenance of Nursery, surveying for damage, fixing damages, and keeping nursery clean
- Plant trees
- Apply mulch to bare areas
- Survey trail and repair degraded areas
- Install signs
- Repair floating dock and regularly inspect dock, benches, trail, and other infrastructure for damages. Repair as necessary.
- Assist with completion of Visitor's Center

**Reserve Leadership**

**Reserve Board**

***Role***: Advise the Governor on implementation of the Plan and report regularly on financial aspects of management. Ensure that funds are spent with integrity.

***Responsibilities***

- Supervise Reserve Manager
- Identify training opportunities for staff
- Track financial spending
- Raise funds to support Reserve
- Develop partnerships for activities
- Review and suggest changes to Management Plan, Conservation (Reforestation and Erosion-Control), Education Plan
- Develop Enforcement Plan
- Source funds and expertise to develop marketing plan and increase visibility of Reserve on the Internet and in Palau

**Reserve Staff**

**Reserve Manager**

***Role***: Ensure that all regulations are enforced and all management actions occur according to schedule. Work closely with the Board to coordinate management activities, review the Plan, and oversee all associated staff.

***Responsibilities***

- Oversee and ensure finished construction of Visitor's Center, Road, Parking lot, and Nursery
- Supervise and coordinate nursery production and reforestation
- Supervise and coordinate placement of signs and benches
- Supervise and coordinate dock repair and trail maintenance
- Collect and analyze monitoring data and suggest changes to Management Plan as necessary
- Identify daily fire risk and communicate to partners
- Supervise and coordinate mulching activities
- Review and suggest changes to Management Plan, Conservation (Reforestation and Erosion-Control), Education Plan, and Enforcement Plan
- Coordinate pig hunts and invasive species activities
- Supervise and coordinate printing and distribution of educational materials
- Coordinate World Wetlands Day activities, symposiums, and other educational activities
- Supervise staff participate in training programs
- Supervise visitor experiences and fee collection
- Source and obtain safety kits and educational materials for rangers/tour guides
- Hear daily reports from Senior Park Ranger on enforcement issues
- Supervise and coordinate monitoring activities and baseline studies

**Senior Park Ranger/Tour Guide**

***Role***: Oversee compliance with prohibited and allowable activities, oversee and participate in monitoring, visitor experiences, educational, and restoration activities. Mentor junior rangers.

***Responsibilities***

- Participate in daily fire monitoring
- Participate in daily enforcement and compliance monitoring, check permits
- Follow legal procedures for reporting and stopping prohibited activities (according to Enforcement Plan)
- File incident reports
- Review and approve Enforcement Plan
- Participate in monthly research and scientific monitoring
- Participate in daily visitor tours and briefings on allowable activities (including large groups, school groups)
- Participate in and lead pig hunts (if necessary)
- Ensure visitor safety
- Participate in training opportunities and supervise participate of Junior Rangers/Tour Guides
- Mentor Junior Rangers/Tour Guides
- Review monitoring logs and incident reports from Junior Rangers/Tour Guides

**Junior Park Ranger/Tour Guide**

***Role***: Ensure compliance with prohibited and allowable activities, maintain visitor experiences, and participate in restoration activities.

***Responsibilities***

- Lead tours and brief visitors on allowable activities (including large groups, school groups)
- Participate in daily enforcement and compliance monitoring, check permits
- Participate in daily fire monitoring
- Follow legal procedures for reporting and stopping prohibited activities (according to Enforcement Plan)
- File incident reports
- Participate in monthly research and scientific monitoring
- Ensure visitor safety
- Participate in training opportunities
- Assist with reforestation activities

**Nursery Supervisor**

***Role***: Maintain effective functioning of the nursery and oversee use of trees in restoration and educational activities

***Responsibilities***

- Propagate and nurture trees and plants
- Supervise and participate in replanting activities
- Monitor Reserve for invasive plants

**Visitor's Center Attendant**

***Role***: Ensure a pleasant visitor experience, manage visitors' fees, and oversee maintenance of the center

***Responsibilities***

- Collect visitor fees and manage funds
- Brief visitors and answer visitor questions
- Manage vendor sales
- Report Visitor's Center maintenance needs to Reserve Manager
- Provide visitor safety services

Community

**Melekeok Community**

***Role***: Comply with the Plan and support Best Management Practices at all times

***Responsibilities***:

- Comment on proposed changes to plan during public notice period
- Refrain from prohibited activities
- Participate in reforestation and volunteer programs

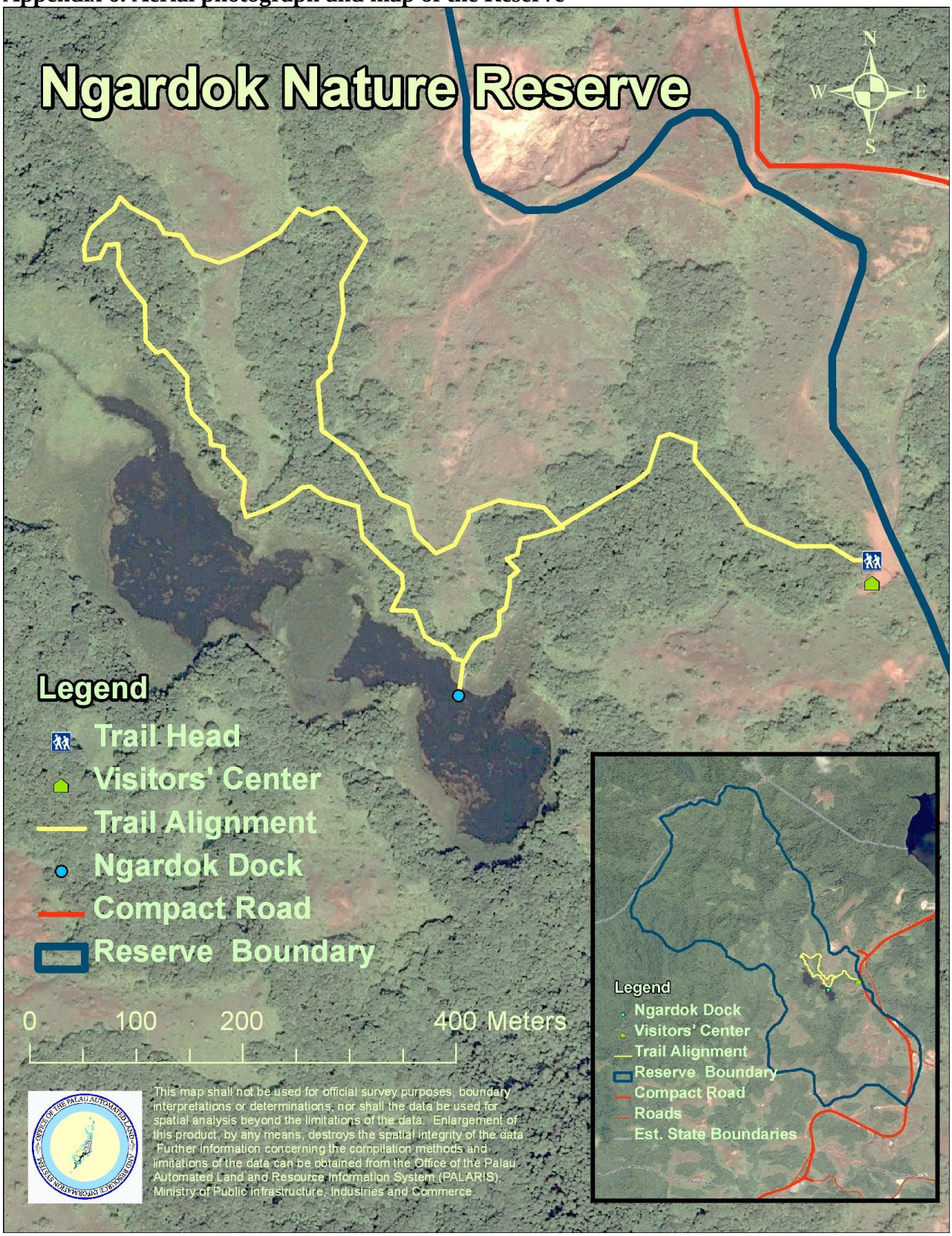
## Appendix 5. Indicators of Effective Conservation

A detailed Scientific Monitoring Program will be developed by the end of 2011. This Program will encourage research to identify key indicator species for detecting trends, establish baseline conditions for targets, and develop methodologies for ongoing monitoring and research. Several indicators for effective conservation have been identified or are being tested, and these are included here as examples of the structure of the monitoring program.

| Target | Indicator of Effective Conservation | Lead party | Methodology | Frequency |
|---|---|---|---|---|
| ***Goal 1. To provide high quality water supply for the people of Melekeok State*** | | | | |
| Lake and River water quality | Turbidity; Total suspended solids | EQPB/USGS | Secchi disk (minimal); infrared light meter | Continual, extreme events |
| Lake and River water quantity | Streamflow (cubic feet/second) | EQPB/USGS | Streamflow gauge | Continual, extreme events |
| ***Goal 2. To provide for the enjoyment and education of the people of Melekeok State, Palau and visitors to Palau*** | | | | |
| Awareness and participation by Melekeok community | 1. % community with positive awareness of Ngardok<br>2. # incident reports | Reserve Manager | Surveys, public comments, informants, incident reports | 3 to 5 years |
| Awareness in other Palauan communities | # adults, # youth visiting | Reserve Manager | Visitor's Center logs | Daily |
| Awareness and enjoyment in Visitors to Palau | 1. # Visitors, # youth,<br>2. % reaching minimal levels of awareness | Reserve Manager | Visitor's Center logs<br>Online surveys | 1. Daily<br>2. Monthly |
| ***Goal 3. To maintain the ecological integrity of Lake Ngardok and the natural habitats it provides*** | | | | |
| Forest | 1. % Species composition, # species % forest cover<br>2. Total area of forest | 1. Rangers<br>2. PALARIS | 1. Point-count or transect walk<br>2. Aerial imagery | Yearly |
| Savanna | 1. % bare area on savanna<br>2. Total area of savanna | 1. Rangers<br>2. PALARIS | 1. Point-count<br>2. Aerial imagery | Yearly |
| Bats | Population of fruit bats | Rangers | Point-count on existing transect | Monthly |
| Birds | Population of megapodes<br>Population of pigeons | Rangers | Point-count on existing transect | Monthly |
| Crocodiles | Population of crocodiles | Rangers | Nighttime spotlight counts at lake | Monthly |
| Marsh reeds | Extent of reeds from edge (estimate density and square area) | Rangers | Use existing permanent stations | Yearly |
| Lizards | # species of lizards | Rangers | Pitfall stations | Yearly |
| Insects | # species, %species composition | Rangers, Belau National Museum | TBD | Yearly |
| ***Goal 4. To provide for the protection of native plants and animals within the watershed*** | | | | |
| Invasive species | # species, %cover | Rangers, Nursery attendant | Transect | Monthly |
| Hunted species | # hunters intercepted, # species recovered, # signs of hunting | Rangers | Incident reports<br>Transect walk | Monthly |
| Forest habitat | # fires, area of fire | Rangers, PALARIS | Incident reports, visual surveillance, aerial imagery | Monthly |

| | | | | |
|---|---|---|---|---|
| ***Goal 5. To provide opportunities for research on the organisms and natural systems within the watershed*** | | | | |
| Understanding and awareness of Board about conditions in reserve | # research studies ongoing, # reports | Reserve Manager | Project records | Yearly |
| ***Goal 6. To raise capacity for effective management of natural resources within the State.*** | | | | |
| Knowledge in Reserve Staff | # staff in training programs; % achieving minimal scores in programs | Board | Project records, training program tests | 3 to 5 years |
| Financial sustainability | # dollars cofinanced, # reports, audit score | Board | Project records, visitor's logs, public audits | 3 to 5 years |

**Appendix 6. Aerial photograph and map of the Reserve**



## Appendix 7: Proposed Budget