ECOLOGICAL RESTORATION PROJECT

Mt Vaea Reserve

Consultants Final Report Phase I

Prepared by Leatigaga Mark J. Bonin

for

Conservation International Pacific Islands Programme (CI PIP)

and the

Ministry of Natural Resources, Environment and Meteorology (MNRE)

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Nearly all project information derived from Global Positioning System (GPS) and mapping technologies used during the survey were the result of the very patient and steadfast support and tutorage of James and for this we (myself in particular) are all most grateful. Most of all a very special thanks to all those individuals who assisted in the often difficult field work and scaled Mt. Vaea during our plant survey work. They all certainly deserve my grateful thanks and appreciation especially for putting up with me as I struggled, grappled, slipped, and skated, moaned, groaned, and complained my way up and down the mountain side to each and every transect that I actually managed to arrive at. I would be an extremely dishonest Project Coordinator if I did not specifically acknowledge the tremendous support received from the many field and technical support staff tabled below especially: Moeumu, Toni, Setoa, Falani, Fialele, Manu, Uiti, Setone, Talie and again James.

PLATE 2: The consultant, Leatigaga Mark Bonin showing the wear and tear after a typical mountain excursion during the field survey work for the Mt. Vaea Restoration Project.

Last and certainly not least a very special vote of thanks is extended to my dear wife Sala Muliagatele Georgina and daughters, Meghan and Mishaela for their wonderful support, sympathy, patience and understanding for my domination over the family computer and Internet over the last few months. And last, but not least is a very special mention of my baby grand-daughter, Pualeina, whose winning smiles and comical ways, certainly made working from my home office, pleasant and inspiring.

TABLE 1. Mt. Vaea Restoration Project Committee and Key Technical Staff		
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Mr. Suemalo Talie Foliga	Senior National Parks and Reserves Officer/MNRE	Ph 28680
Dr. Jill Key	PILN Coordinator located at SPREP	Ph 21929 ext. 280
Dr. Alan Tye	Invasive Species Officer SPREP	Ph 21929 ext. 270
Mr. Afele Faiilagi	Principal Terrestrial/Biodiversity Officer/DEC MNRE	Ph 22481
Ms. Moeumu Uili	Terrestrial and Biodiversity Officer/DEC MNRE	Ph 22481
Mr. Setoa Apo	Senior Research Officer /Forestry Division	Ph 26932
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Mr. Joe Reti	Draftsman Officer/ Forestry Division	Ph 26932
Volipolo Sooaemalelagi	National Parks and Reserves Officer/MNRE	Ph 28680

TABLE 2. Mt. Vaea Restoration Project Key Field Technicians Support Staff MNRE		
Name	**Designation/Organization**	**Contact Details**
Mr. Fialele Enoka	Office Assistant/Equipment Manager	Ph. 28680
Mr. Uiti John	Foreman	Ph. 28680
Mr. Manu Lesiva	Groundsman	Ph. 28680
Mr. Francis Hunt	Weedeater Operator	Ph. 28680
Mr Faau Valoia	Nurseryman	Ph. 28680
Mr Sofeni Farani	Weedeater Operator	Ph. 28680
Mr Calando Aiga	Groundsman	Ph. 28680

Photo Credit: James Atherton provided the photos in plates 1 and 3 - 8.

TABLE OF CONTENTS

TABLES

PLATES

FIGURES

APPENDICES

ACRONYMS USED

BI:	Birdlife International
CBD:	Convention on Biological Diversity
CEPF:	Critical Ecosystem Partnership Fund
CI:	Conservation International
CI PIP:	Conservation International Pacific Islands Program
DBH:	Diameter Breast High
DEC:	Division of Environment and Conservation
GEF:	Global Environment Facility
GISD:	Global Invasive Species Database
GISP:	Global Invasive Species Programme
GPS:	Global Positioning System
IAS:	Invasive Alien Species
IS:	Invasive Species
ISA:	Invasive Species Abundance
ISD:	Invasive Species Dominance
ISM:	Invasive Species Management
ISSG:	Invasive Species Specialist Group
IUCN:	The World Conservation Union
MAF:	Ministry of Agriculture and Fisheries
MDGs:	Millennium Development Goals
M&E:	Monitoring and Evaluation
MEA's:	Multilateral Environment Agreements
MNRE	Ministry of Natural Resources, Environment and Meteorology
MVRP:	Mt. Vaea Restoration Project
NAP:	National Action Programme
NAPA:	National Adaptation Programme of Action
NBSAP:	National Biodiversity Strategy Action Plan
NDS:	National Development Strategy
NEMS:	National Environment Management and Development Strategies
NGO:	Non-Government Organizations
NIASIAP:	National Invasive Alien Species Implementation Action Plan
NPR:	National Parks and Reserve Section
NZAID:	New Zealand Aid
PII:	Pacific Invasives Initiative
PILN:	Pacific Invasives Learning Network
PISM:	Pacific Invasive Species Management (Programme)
SDS:	Samoa Development Strategy
SGP:	Small Grants Programme (UNDP/GEF)
SIDS:	Small Island Developing States
SNITT:	Samoa National Invasives Task Team
SPC:	Secretariat for the Pacific Community
SPREP:	Secretariat for the Pacific Regional Environment Programme
SSC:	Species Survival Commission of the IUCN
TNC:	The Nature Conservancy
UNCBD:	United Nations Convention on Biodiversity

EXECUTIVE SUMMARY: The Mt. Vaea Ecological Restoration Project started in earnest in mid-September 2007, when the Project Management (Conservation International) with the approval of the Implementing Agency, [MNRE, Division of Environment and Conservation (DEC), National Parks and Reserves Section (NPR)], seconded the Project Technical Expert (see TOR appendix A) to initiate and conduct the field work stipulated in the contract. Shortly following, a series of meetings took place which established a core project committee; and identified the key staff, equipment, and materials required; and set a scheduled time frame for the field work to commence.

The field survey and plant inventory work started in early October and took place over a six-week period which required 13 separate mountain excursions (8.10 to 21.11.07) to complete. The field surveys conducted thus far have provided volumes of information and there are still other surveys remaining to be completed, which will provide even more data. This presents a frequently overlooked but vitally important task of data management, analysis and interpretation. To this extent, this consultant/coordinator has attempted to document and save all relevant project information in as many formats as possible for future use.

Initial results paint a poor picture of overall forest health with the severe impacts of present invasive species being very obvious throughout the whole project area and reserve. Maps, using the survey data from both transect and observation blocks for each target species were generated using MapInfo GIS software and illustrate their distribution and relative importance (see attached figures B-I). The following general information has been gleaned from the project survey data sets and distribution maps:

- The whole project area has been severely impacted by invasive species as well as by both human related (e.g. agricultural and forestry) and natural calamities (e.g. cyclones, severe weather events, etc.) particularly over the last several decades.
- In all transects counted and measured (34/36), a total of 1,858 plant/stems were recorded and averaged 54.6 stems per transect with a low of 24 and a high of 114 stems measured.
- Within the transect blocks species diversity was generally low, with the total number of species recorded being 68 of the 78 total species recorded and/or observed and they ranged from a low of 3 to a high of 17 species per transect.
- Total percentage (over every measured transect = 34/36) of invasive species abundance (ISA) of all species recorded (68/78) = 62% with 57.6% being the top 5 target species alone.
- Total percentage of all invasive species (transect) by calculated dominance (ISD) of 60.6% with 59.29% being the top 5 target species alone.
- Invasive species scored high as well in the observation blocks (canopy 1&2) comprising a total of 42.3% of all the scores with 90% again, being the top 5 target species alone.
- Even the 5 least impacted transect blocks ranged from 9.8-29.8% ISD and had one or more of the target species present.

Based on all the survey results, the top five IAS were defined on the basis of their importance (abundance by stem number) within the project area and dominance amongst all the other invasive species present. Further criteria included their relative difficulty of control as are seen as species likely to be controlled but will not be replaced by desirable natives without an active restoration program. The top 5 target species were also ranked according to their respective severity using data collected on abundance, dominance (transects) and presence and/or relative importance in the observation blocks (Tables 8 & 9).The order of priority also considered these species as those that alter ecosystem processes and out-compete native

species, and that can prevent or depress recruitment of natives. The top 5 target species are further ranked as follows:

1. ***Castilla elastica*** [Mexican Rubber Tree], Samoan= "PULU MAMOE"
2. ***Funtumia elastica*** [African Rubber Tree], Samoan= "PULU VAO"
3. ***Spathodea campanulata*** [African Tulip Tree], Samoan= "FA'APASI/TULIPE"
4. ***Albizia falcataria*** [Albizia] Samoan= "TAMALIGI PA'EPA'E"
5. ***Albizia chinensis*** [Albizia] Samoan= "TAMALIGI ULIULI"

The Mt. Vaea Project in its initial phase has been quite successful in establishing a platform for continued research and a significant database for overall biodiversity (both plant and animal) and of course the identification and assessment of the key invasive species within the reserve to date. The following report describes the methods and materials used, details survey results/findings, illustrates distribution maps, interprets data obtained, identifies research needs, and develops a draft 5-year Workplan for future funding and implementation during the next phase of the project. The 5 year Workplan by necessity focuses on appropriate research which is to further define control methodologies for not only the target species themselves but to also identify clearly the additional threats to the overall forest restoration.

1. Introduction: Oceania as a whole has had the greatest number of species extinctions of any region of the world since 1600 and many more taxa are on the verge of extinction (CEPF, 2005). Invasive Alien Species (IAS) together, with unsustainable human practices, has been seen as the main contributors to this loss of biodiversity in the region. IAS is currently recognized as a major threat to ecosystems globally by major institutions throughout the world as well as by numerous international, regional and environmental NGO's, many of which have provided some assistance to Small Island Developing States (SIDS) such as Samoa in the past**.**

The Samoan archipelago is part of the Polynesia-Micronesia Biodiversity Hotspot because of its unique biogeography and relative isolation from any other continental plate or large landmass. This has resulted in a relatively high rate of endemism for both plant and animals. Despite this however, there is a prevailing belief amongst the scientific community that much of Samoa's biodiversity has yet to be properly assessed, inventoried, categorized and catalogued for our future generations to come. This is particularly true for those lesser-understood and appreciated life forms, which often fall between the cracks of any terrestrial or marine ecological surveys (e.g. invertebrates, micro-organisms, macro-fungi, algae, etc.). Initial investigations indicate that at present Samoa's biodiversity have a significant number of threatened plant (approximately 136 species) and animal species for both marine (approximately 18 species) and terrestrial (approximately 31 species) ecosystems (see also Table 3 below). Furthermore, over the last several decades in particular, an alarming number of IAS have arrived and have become established in Samoa either as "intentional" or "unintentional" introductions. The vast majority of these are related to human activities or human interactions with very few directly arriving through natural means. A number of these IAS now have already become, or now must be considered serious threats to the country's biodiversity, food security, sustainable development, and human livelihoods.

Samoa has recognized the threat certain IAS pose for the country and in 2003 established a National Invasive Alien Species (NIAS) Steering Committee (now called Samoa National Invasives Task Team = SNITT) comprising a stakeholder group of governmental Ministries and agencies, regional organizations, community groups, donor agencies and private sector individuals concerned with the prevention and reduction of the impacts of IAS.

For the last several years, this committee has been working on and setting the framework for the National Invasive Alien Species Implementation Action Plan (NIASIAP). This plan identifies the key actions needed to effectively assess and manage the threat and impacts of existing and potential invasive species. NIASIAP is expected to be completed by mid 2008 and submitted for Cabinet approval. Some of the proposed actions in NIASIAP have already been implemented in part with the financial and technical assistance of international donors and environmental NGO's involved with Samoa.

1.1 Samoa's Biodiversity: Whistler suggests that Samoa has the second largest native flora in all of Polynesia (second only to Hawaii), has six broad or major vegetative classes and is home to approximately 540 native flowering plant species and another 230 native fern and "fern ally" species. About one third of the native flowering plants are endemic to Samoa, i.e., they are found nowhere else on Earth. (Whistler, W.A., 2005 pers.comm.).

Unfortunately, Samoa also has a relatively high number of threatened species some of which it is believed to be functionally extinct within the last several decades (e.g. Sheath-tailed Bat *Emballonura semicaudata* and Samoan Wood Rail *Pareudiastes pacificus*). TABLE 3 illustrates the numbers of threatened species by life form for Samoa as known to date

although as mentioned earlier actual status and population estimates for most species in Samoa remains poorly understood and under researched.

TABLE 3. Samoa's Biodiversity (Approximate number of species by life form*)							
Life Form	**Approx. No. of Endemic Species**	**Approx. % of Endemics**	**Approx. No. of Native Species**	**Approx. No. of Introduced Species**	**Approx. No. of Threatened Species**	**Approx. No. of Total Species**	**Relative Regional Ranking Endemism[1]**
Flowering Plants[2]	174	30	540	500	136	770	5th
Ferns/Fern Allies[2]	40	18	228	?	?	228	?
Land Birds	8	23	33	3	14	36	5th
Sea Birds	NA	NA	NA	NA	NA	21	?
Reptiles	1	7	4	11	4	14	?
Ants[6]	12	18	30	7	?	68	?
Land Snails[3]	35-38	49-53	64	14[5]	12?	72	2nd
Butterflies	2	NA	19	NA	1	21	?
Aquatic Fauna[4]	NA	NA	25	4	NA	29	?
Corals	NA	NA	NA	NA	NA	NA	?
Marine Vertebrates	NA	NA	NA	NA	4	8	?
Marine Invertebrates	NA	NA	NA	NA	14	95	?
Fisheries	NA	NA	890	2	NA	991	?

*** =** Table adapted from Samoa's Biodiversity Strategy and Action Plan**:** keep the Remainder of the Basket. Government Samoa, 2001. 95pp.

1= Based on data from the 21 Polynesia-Micronesia Hotspot Countries and Territories taken from CEPF Ecosystem Profile Polynesia-Micronesia Biodiversity Hotspot. *Final Draft Submitted to the CEPF Working Group*. September 2005.

2= From Whistler, W.A. (pers. comm. 2005), Whistler, W.A, 2004, and Whistler, W.A., 2002 and includes a single genus which is endemic to Samoa (*Sarcopygme sp.*).

3= Data taken from Cowie R.H., 1999 and Cowie R.H. and Robinson, 2003.

4= Data taken from Bell, 2003

5= Includes 4 cryptogenic species

6= Data taken from Wetterer, J. K. and Vargo, D. L. 2003.

Samoa through various Ministries, NGO's and organizations also recognizes that there is a long road ahead in dealing with IAS thus this unique and innovative project is envisaged as a critical first step toward identifying management techniques, enhancing public awareness and strengthening national, regional and international networks and collaboration.

1.2 Mt. Vaea Project: A project proposal called the "Ecological Restoration of Mt. Vaea Reserve" was prepared by Mr. James Atherton of the Conservation International Pacific Islands Program (CI PIP) in April of 2007, which was later endorsed by the Ministry of Natural Resources, Environment, and Meteorology (MNRE) and its various partners/collaborators from international, regional, and civil society organizations involved in biodiversity conservation and invasive species management. This initial project was funded through a grant from the Robert Louis Stevenson Foundation.

The Mt. Vaea Ecological Restoration Project has two main objectives as follows:

1. To restore the Mt Vaea reserve forested area to its former state with the appropriate native rainforest forest tree species; and
2. To become a "classic" demonstration site of invasive species management (ISM) and habitat restoration for Samoa and the rest of the Pacific Island Region.

Mt. Vaea reserve is the most visited of all Samoan reserve areas and is a popular recreational area only 10 minutes drive from downtown Apia. The reserve is also an important historical site being the resting place for the famous Scottish author, Robert Louis Stevenson. However, the reserve is heavily impacted by invasive weeds which are slowly spreading in the reserve, a characteristic that has accelerated during post-cyclone periods. One of the impacts of the spread of invasive weeds is that the diversity of native birds, plants, reptiles and other native species are being reduced due to the loss of their natural habitats and ecosystems. The further loss of native biodiversity will continue unless invasive species management is imminently fast-tracked and implemented.

The project will involve two main elements:-
Firstly, the selective removal of invasive weeds from the reserve; and
Secondly, the replacement of invasive weeds with selected native species as part of forest restoration.

In order to be successful the project will require a sustained and continuous effort for at least 5 years, in two main phases as described below:-

> **Phase I:** the project planning phase, lasting four months; and
> **Phase II:** the project research and implementation phase lasting for at least 5 years, from 2008 until 2013, and longer if funds are available.

Invasive species management activities (particularly weeds) will necessarily become a core function of reserve management as the reserve area will continue to be at risk indefinitely from incursions of invasive weeds and other species (either accidentally or deliberately).

This project would be the first demonstration project of invasive species management and forest restoration in Samoa. Importantly, this project will help to achieve some of the objectives and priority actions highlighted in the National Invasive Alien Species Implementation Action Plan (NIASIAP), and Samoa's Biodiversity Strategy and Action Plan (NBSAP).

The significant benefits envisioned of this project would be as follows:

- Raising public awareness on invasive species, on invasive species management and on forest conservation and restoration;
- Determining the costs for weed management in the Samoan context (which can be used for other project proposals);
- Trialling a variety of invasive species management techniques of key invasive weeds;
- Training DEC staff, Samoa National Invasives Task Team (SNITT) members and others in the process behind designing and implementing an invasive species management project;
- Returning Mt Vaea to a more natural state with concomitant benefits for biodiversity, recreation and eco-tourism (economic gain); and
- Improved trails, signage and other facilities for visitors to the reserve area.

1.3 Mt. Vaea Project Partners:

- ***Conservation International Pacific Islands Program*: (CI PIP)** will be responsible for securing the funds for this project and for overall project design, management and supervision.
- ***MNRE:*** The Ministry of Natural Resources and Environment will be the key implementing agency for this project and will supply much of the labour needed for the project. The three Divisions that would be expected to be involved in this work are the Division of Environment and Conservation (DEC), the Forestry Division, and the Watershed Management Division.
- ***Samoa National Invasives Task Team (SNITT):*** It is hoped that SNITT members will assist in conducting the work and will provide technical assistance as required.
- ***SPREP:*** The Secretariat of the Pacific Regional Environment Program may be able to assist CI PIP to obtain funds and to get technical support for this project. The PILN coordinator, who is located at SPREP, has expressed a particular interest in supporting this proposal.
- ***JICA:*** The Japan International Cooperation Agency will be managing a project with MNRE on improving the management of the Mt. Vaea reserve and O Le Pupu Pue National Park. It is hoped that JICA will be able to fund some of the technical aspects of this project, including the preparation of a management plan for the reserve and possibly some of the other costs.
- ***PII:*** The Pacific Invasives Initiative (PII) may be able to provide technical support for this project.
- ***Others:*** The American Samoa Invasives Task Team (ASIST) has already expressed an interest in providing technical assistance, especially for Tamaligi (*Albizzia*) control.

1.4 Main Project Deliverables/Outcomes:

- Mt. Vaea Reserve is restored to a more natural state with benefits for native biodiversity and recreational potential;
- Raised public understanding and awareness of the impacts of invasive species and the importance of invasive species management;
- Yearly project progress reports on work done, lessons learned and project plans for the following year;
- A final project report on the work completed and the impacts on native biodiversity, research findings of various Invasive Species Management (ISM) techniques used as well as the costs for conducting ISM of key invasive species in Samoa available.

1.5 Project Management: The project will be managed by Conservation International, which will hire a Project Coordinator to supervise the project. As noted earlier, the project will be implemented by the Division of Environment and Conservation (DEC) of the Ministry of Natural Resources and Environment, specifically the National Parks and Reserves Section at Vailima.

1.6 Invasive Species Management Priorities: The determination of the invasive species management priorities will be based on the following three categories [Wittenburg, R., Cock, M.J.W. (eds.), 2001]:

Current and potential extent of the species on or near the site, with a focus in order of priority to first, prevent the establishment of new pests; second, eliminate small rapidly growing

infestations; third, prevent large infestations from spreading; and fourth, to reduce or eliminate large infestations.

A. Current and potential impact of the species. The order of priority will be: species that alter ecosystem processes, then species that kill hybridize or out-compete natives, then species that do not out-compete natives but prevent or depress recruitment of natives or promote populations of non native animals.

B. Difficulty of control. The order of priority will be based on species likely to be controlled or eradicated with available technology and resources, species likely to be controlled but will not be replaced by desirable natives without an active restoration program, species difficult to control with available technology and resources and finally species unlikely to be controlled with available technology and resources.

2. The Project Area Description: The total Mt. Vaea Reserve area is calculated at approximately 454 ac. 02r 0.87p or 183ha. An actual re-survey of the whole reserve's exterior boundaries was initiated during the early stages of this project and should be completed by the end of the planning phase. In the initial project committee discussions it was suggested that the "project area" be redefined for ease of workload, manageability and best public exposure. The actual project area was re-defined and focuses on the most heavily wooded area of the reserve inclusive of the public trails and excludes areas such as the adjacent old pasture land and the botanical garden. An agreement/MOU was established between the project coordinator (Technical Expert) and the Ministry's Mapping and Survey Division in order to obtain and utilize the appropriate topographical and digital information pertaining to the project area. This digital information was used for the generation of all field maps and the identification and labelling of survey transect observation blocks, species distribution maps, and future project planning. The actual project area boundaries were established using the base topographical map and the criteria mentioned above and readjusted to accommodate the long trail therefore, the actual "project area" is now calculated as being a total of 78ha or 42.6% of the total reserve area (see also Figure A: Mt. Vaea Project Area Map).

2.1 Project Area Maps: Digital project area maps were generated using GIS software MapInfo (version 7) and the Garmin GPS MAP60SX provided by Conservation International and Mt. Vaea project funds. The GPS unit was purchased by CI and later configured and calibrated for use during the project survey work. All data pertaining to each transect within the project area were recorded using this same equipment and included information on site location (e.g. start and end points), site elevation, site way-points (e.g. start and end point numbers). More definitive and accurate information on public trails and river locations were also placed on each map generated.

3. Survey Methodology: The designated project area (78ha) was further subdivided into working blocks (100m X 100m) each of 1ha in size and these working units were superimposed on the digital map as a grid to be used for the establishment of plant survey blocks throughout the whole project area. Each established transect (50m x 10m in size=500m^2) provided approximately 2.5% sampling area of each transect block. Transects were labelled and drawn on the map using MapInfo GIS software and approximately centred and placed in a direction parallel to the direction of the contour. Transect blocks were alternated in every second block starting from the blocks at the lowest elevation (nearest the station) and moving to highest elevation and snaking in a south to north and then a north to south direction throughout the whole project area equalling 36 one ha blocks in total. Alternate blocks were designated as observation blocks throughout the whole project area and labelled in a similar fashion (see Figure A below). Each block was then numbered (e.g.

Transect 1 = plot 1; Transect 2 = plot 2; etc.) and/or coded accordingly (e.g. OBS A = observation plot A; OBS B = observation plot B, etc.). Please refer to Appendix B for more details on the survey methodology.

All specific details recorded for each block (both transect and observation) were included in a data set or plant inventory and were noted on a field data sheet (see Data Sheet appendix C). Each transect was established in approximately the center of each plot (e.g. 50m up and 25m inside each block) and laid out and marked in the field according to the Whistler approach and followed as best as possible the contour of the slope in the immediate area. It should be noted that difficulties occasionally occurred during field excursions especially when attempting to find and pinpoint the designated transect site while using the GPS unit.

Additional data components from further field work such as bird surveys, reptile and gastropods surveys, IS management/control trials, etc., can be super-imposed over the existing transects as they will be required.

- **FIELD CREWS:** Initially one team of 4-6 men/women were required to reach and establish/layout each survey transect and to assess and record all data.
- **DATA COLLECTION:** Data was collected on each transect using one or two recorders/GPS operators and at least two main assessors on each side of the transect line (e.g. uphill and downhill side of the prevailing slope) while others marked out the transect boundaries using measuring tape and flagging tape. Assessors were decided and agreed upon on the basis of their respective taxonomic and botanical skills and usually comprised of existing staff of the MNRE Forestry, DEC, and/or National Parks divisions. Field teams varied for most of the 13 excursions and were dependent on each individual's availability and other commitments. In each transect/observation block notes were taken on the general floral features of the area including: ground cover, seedlings/saplings (e.g. medium or mid canopy) and upper canopy species. Additionally, in each transect photo-points were taken and all stems of living species greater than 5cm DBH were measured and recorded. DBH was measured to the nearest decimal cm. and each species was identified with specific notes also taken on the trees form (e.g. forked, broken, leaning, etc.). All questionable identifications were photographed for later confirmation.

FIGURE A: MT. VAEA PROJECT AREA MAP

---- = Reserve Public Trails **A, B, C = Observation Blocks** **1, 2, 3 = Transect Blocks** **___ = Initial Transect Location**

= Actual Bird Survey Sites *** * = Actual Transect Waypoints** **= RLS Tomb** **= 1 ha grid**

Mt. Vaea Project Survey Work Plates 3-8

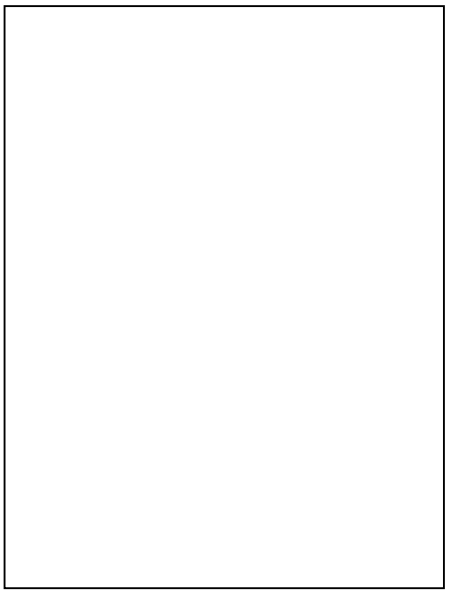
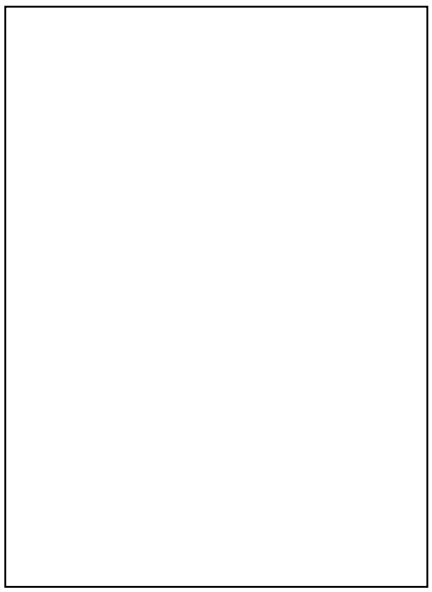


Plate 3



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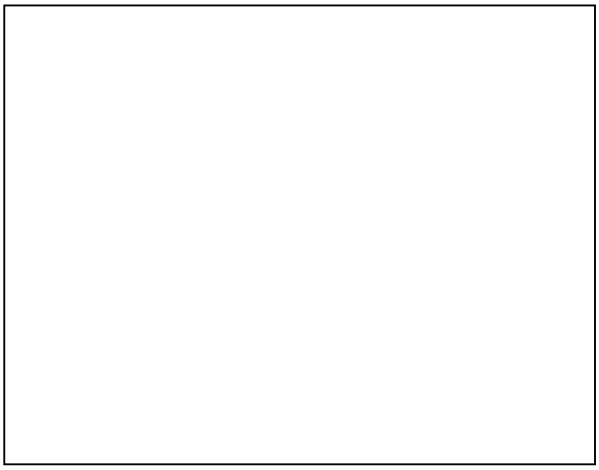

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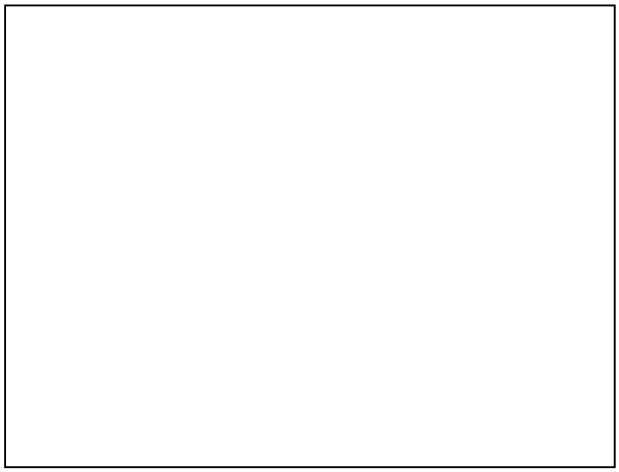

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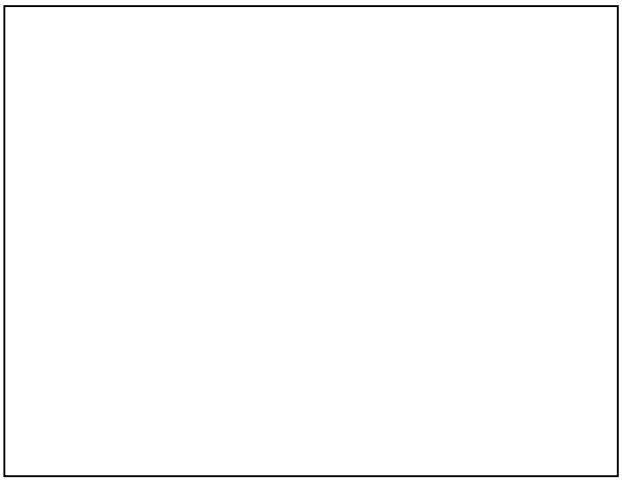

Plate 7

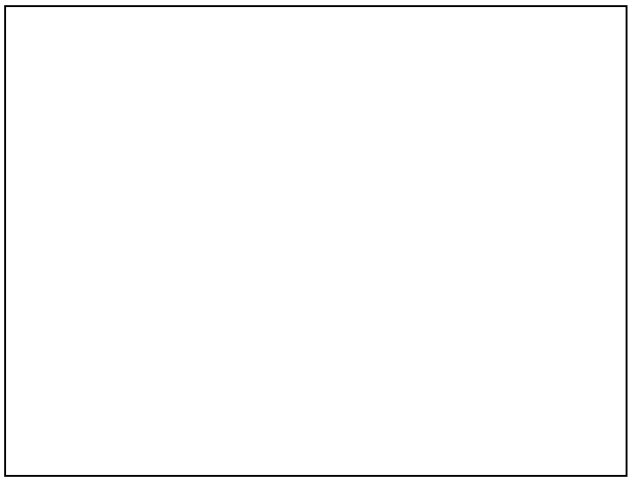

Plate 8

3.1 Survey Materials and Equipment Used: Various materials and equipment were used during the course of the project and included both items purchased by CI (see Table appendix H) specifically for the field work as well as, existing tools and equipment provided by the National Parks and Reserves Division. The materials used for the field survey work and data input/analysis included:

- Knapsacks/Backpacks (NPR);
- Bush Knives (NPR);
- Digital Camera (Consultant & NPR);
- Field recording materials (Consultant & NPR);
- General field gear and clothing (NPR & individuals);
- Desktop Computers (Consultant, NPR, CI, and DEC);
- Laptop Computer (Consultant);
- Appropriate software for mapping, analysis, etc. (Consultant/CI).

3.2 Additional Surveys Conducted and/or planned: In the broader sense the Mt. Vaea Restoration Project is designed to enhance all biodiversity within the reserve and therefore, additional surveys are required to establish baseline information and databases on all other life forms of importance to the fragile forest ecosystem, presently under threat. Early in the initial project discussions and design surveys were also planned for birds, mammals, reptiles and gastropods. Some of these additional surveys are being coordinated by the Principle Officer of the National Parks and Reserves, MNRE with the technical support of various members of the Project Committee and experts abroad. Furthermore, due to the complexity of the species involved, the methodologies used will (by necessity) vary greatly and are dependant on other ecological and climatic factors throughout a year (e.g. time of day, season, weather conditions, location, etc.). Some of this field work has already been initiated and/or is being planned and is described as follows.

A. Bird/Bat Surveys: Two field surveys have been completed to date using previously designed 5 minute bird counts. The survey was initially conducted at 11 stations and then later another was added at the northeast corner of the project area. Now, the 12 permanent stations are situated along the public trails and will be used for all future surveys to be done every 3 months during both morning and mid-day time periods, respectively (see attached data sheets dated 22.11.07, 28.11.07). During each survey, 5 minutes is spent at every station and any birds/bats seen and/or heard are recorded on a data sheet.

Due to the biology and nature of birds, certain species are likely to appear only on a seasonal basis following the flowering and fruiting patterns of favourite native tree species within the reserve. The comprehensive survey methodology and data sheet reflects this and comprises a total of 34 bird species including land, freshwater, sea and shore, and occasional migrant bird species. The three bat species present in Samoa are also included in the survey sheets and records and notes will be kept on any other vertebrate species of interest throughout the life of the project. The following table summarizes the bird and bat species in Samoa and their threat status.

TABLE 4. Summary of Bird and Bat Species and Status in Samoa[1]										
No. of Land Bird Species				No. of Sea/Shore Bird Species				No. of Bat Species	NO. OF SPECIES BY THREAT STATUS*	
ES	ER	INT	INV	ES	ER	INT	INV		Global	National
10	20	4	3						2EN/3VU/8LC	2EN/1AR/4CC/1VU/1NT
					1				1LC	?
								3	1EN/2VU	1EN/2CC

1 = Status categories adapted from Watling, D., 2001

*** ES =** Endemic to Samoa; **ER** = Endemic to Region**; INT =** Introduced to Samoa**; INV** = Invasive in Samoa; **EN** = Endangered in Samoa or region; **AR** = At risk in Samoa or region; **CC** = Conservation concern in Samoa; **VU** = Vulnerable in Samoa or region; **LC** = Least concern; **NT** = Near threatened; **DD** = Data deficient

B. Reptile Surveys: Samoa's total number of land reptiles is 14 species comprising 5 geckos, 8 skinks and a land snake. There are no endemic species present in Samoa with four of the skink species being regional endemics and restricted in their distribution. Investigations into survey protocols and techniques have been initiated recently by NPR staff with the technical assistance from the PILN Coordinator located at SPREP. Live capture techniques targeting skinks, using pitfall traps are being tested for success rates for effective identification and data collection during survey transects to be placed throughout the project area at a later date.

C. Gastropod Surveys: Cowie and Robinson (2002) suggest that Samoa has at least 72 documented species of terrestrial slugs and snails (58 native, 10 alien, 4 cryptogenic) and that at least 12 species have shown a probable or possible decline over the last several decades. Based on this data Samoa holds the second highest level of endemism amongst molluscs (approximately 50%) in the region. Some of the alien species are known to be invasive and have been implicated in the apparent decline of native species within Samoa and throughout the region. The well known Giant African snail (*Achatina fulica*) is amongst those alien species present in the reserve and specimens both live and dead were observed in nearly every transect block visited. The project committee recognises the importance of molluscs (particularly natives) in forest ecosystems and has agreed in principle that a comprehensive survey should be conducted in the project area. The details of such are being refined with guidance and suggestions being sought from regionally experienced malacologists in the hope of recruiting understudy postgraduate students to conduct surveys and conduct identifications.

D. Rodent Surveys: Samoa has 4 introduced rodent species (3 commensal species and 1 Polynesian introduction) common throughout the region. All species are known omnivores and eat a wide range of fruit, vegetation, invertebrates, skinks, geckos, birds and their eggs. These species have also been implicated in the deterioration of ecosystems throughout the region and beyond. Preliminary efforts into establishing protocols for indexing species abundance have been initiated and actual survey work is expected to be conducted during the next project phase.

4. Survey Results and Analysis: The plant inventory/survey work took place over a total of a six week period from 8.10-21.11.07 and required 13 separate field excursions, each lasting about 6-7 hours. The survey work was intermittently interrupted by key field staff availability (particularly assessors/recorders/GPS operators) and inclement weather.

As mentioned earlier a total of 36 transect blocks were initially placed on the map and a transect line of approximately 50m in length was centred and drawn along the mountains topographical contour as best as possible. Prior to each excursion the coordinates for each transect start point (in accordance with the agreed excursion approach) was located using

MapInfo and recorded to a field map and inputted into the GPS unit for use in field location. The survey details for the total area of 72 (1ha) blocks, inclusive of observation blocks are as follows: (see also Survey Plot Details appendix F)

- Total number of transects planned and mapped: 36
- Total number of transects recorded and re-mapped: 34 (2 transect blocks being too steep to establish transects)
- Total number of observation blocks planned and mapped: 36
- Total number of observation blocks recorded and re-mapped:38 (plus additional 2 transect blocks)
- Total Number of Bird Survey Stations = 12
- Highest block elevation = 495m above sea level (GPS)
- Lowest block elevation = 191 m above sea level (GPS)
- RLS Tomb bench mark recorded and mapped = 432m above sea level (GPS)
- Mt. Vaea public trails recorded and mapped (GPS)

All field data were entered into an Excel spreadsheet for storage and later analysis (see example appendix D). After the plant survey was completed a statistical analysis procedure was established again using the Excel format with the assistance again of CI. Specific transect data regarding identified species, number stems (count) of each species present, and sum of DBH cross sectional area by each species present, was organised and calculated in an Excel Pivot Table for each recorded transect in the project area (see Table 5 below).

TABLE 5. Mt. Vaea Survey Plant Data Analysis Using Excel Pivot Table for Transect 4

Species Name	Data	Total	Percent Dominance
Adenanthera pavonia	Sum of Cross-Sectional Area	62.21	0.55
	Count of Species Name	1	
Albizia falcataria	Sum of Cross-Sectional Area	1231.63	10.95
	Count of Species Name	1	
Balata sp.	Sum of Cross-Sectional Area	194.88	1.73
	Count of Species Name	3	
Castilla elastica	Sum of Cross-Sectional Area	6575.42	58.44
	Count of Species Name	53	
Cedrella ordorata	Sum of Cross-Sectional Area	945.70	8.40
	Count of Species Name	6	
Kleinhovia hospita	Sum of Cross-Sectional Area	2242.67	19.93
	Count of Species Name	3	
Total Sum of Cross-Sectional Area		**11252.52**	**100.00**
Total Count of Species/Name		**67**	

From all data sets derived from both transect (e.g. pivot tables) and observation blocks (both canopy and ground) several other Excel spread sheets were also tabulated and completed for general project use. These include:

- **Complete Transect Data Summary:** Includes actual species abundance (=total number of stems counted); relative % dominance/species (calculated as a total cross-sectional area of DBH/species using the area formula = πR^2/Total cross-sectional area by transect); % IAS abundance and dominance by transect. All data has been tabulated by species, individual transect and overall for the whole project area. (see attached spreadsheet = appendix H)
- **Final OBS Block Summary Canopy 1 & 2:** Which includes a subjective field assessment and given an individual ranking based on a score (0-3) of all species noted present in both the upper (1) and sub-canopy (2) levels [plants ≥ 1m in height]. All

data has been tabulated by species, individual observation block and for the overall for the project area. (see attached spreadsheet = appendix I)

- **Final OBS Block Summary Ground:** Which includes a subjective field assessment and given an individual ranking based on a score (0-3) of all species noted present in the ground area [< 1m height]. Refer attached spreadsheet = appendix J.

Data obtained from the field survey provided several types of important information for future technical planning, invasive management considerations, species distribution, and mapping as follows:

1. **Statistical/Empirical Information:** This includes all the actual counts and measurements taken within each transect and provided species specific information on relative distribution, abundance, dominance, importance and/or severity, etc.
2. **Qualitative/Subjective Information:** This includes observational information species presence, species relative importance, past agricultural and/or forestry activities.

As a result of the initial plant survey conducted on the Mt. Vaea Project area a total of 78 plant species were recorded and/or observed (see also Checklist Mt. Vaea Plant Species appendix G). While this record adequately serves its main purpose for the project's activities it should be noted here that the checklist is by no means a complete record of all plant species present in the project area. Many other plant species can be found in the area including the more obscure species of epiphytes, vines and grasses which were largely overlooked and/or not specifically recorded. Still, the checklist does provide a sound basis for general plant diversity and inventory throughout the project area. The major details of the species recorded/observed as present in the project area are in the following TABLE 6.

TABLE 6. Vascular Plant Species Recorded/Observed in Mt. Vaea Project Area and Status*

Plant Type	Total Number of Native Species	Total Number of Introduced non-invasive Species	Total Number of Introduced Invasive Species	Total Number of Species
Trees	40	11	8	59
Palms	2	-	-	2
Shrubs	-	-	5	5
Herbs	4	-	2	6
Vines	2	-	1	3
Grass	-	-	1	1
Ferns	2	-	-	2
TOTAL NO	**50**	**11**	**17**	**78**
% TOTAL	**64.1%**	**14.1%**	**21.8%**	**100%**

*= Status based on information obtained from SNITT Invasive Species Ranking Table, Whistler. W.A. 2002, Whistler. W.A. 2004, and Bonin, 2006 (IN PRESS).

The complete volume of information for each recorded species was tabled in the two spreadsheets mentioned earlier and is available for further investigation and analysis however; this is generally beyond the scope of this project. As the focus of the project is to assess the impacts of invasive weed species on biodiversity it was then necessary to glean details pertaining to the most important invasives in the project area and these have been summarized and ranked according to their respective importance. The top 5 target species were selected on the basis of the following criteria:

1. Abundance of each species throughout the project area.
2. Dominance of each species throughout the project area.
3. Distribution of each species throughout the project area.

Summary data on the top 5 target species is presented in the following tables 7-9 and their interpretation is discussed further in the next section.

TABLE 7. Mt Vaea target species details by all surveyed transects [34 out of 36 transects scheduled]

Transect No.	Total No. Stems Counted per Transect	Total No. Species Present Per Transect	% ISD Overall Transect	Mexican Rubber Tree [Pulu Mamoe] *(Castilla elastica)*[1,A]			Albizia [Tamaligi Pa'epa'e] *(Albizia falcataria)*[2,D]			African Rubber Tree [Pulu Vao] *(Funtumia elastica)*[3,B]			Albizia [Tamaligi Uliuli] *(Albizia chinensis)*[4,E]			African Tulip Tree [Fa'apasi/Tulipe] *(Spathodea campanulata)*[5,C]		
				NO.	% ISA	% DOM.	NO.	% ISA	% DOM.	NO.	% ISA	% DOM.	NO.	% ISA	% DOM	NO.	% ISA	% DOM
T1	45	10	76.7	27	60.0	40.25	2	4.44	36.18	1	2.22	0.26	0	0	0	0	0	0
T2	69	8	74.7	47	68.12	64.82	0	0	0	0	0	0	2	2.90	7.19	1	1.45	2.69
T3	65	9	58.1	31	47.69	48.65	1	1.54	8.03	4	6.15	1.26	0	0	0	0	0	0
T4	67	6	69.9	53	79.10	58.44	1	1.49	10.95	0	0	0	0	0	0	0	0	0
T5	42	4	97.3	31	73.81	60.49	1	2.38	8.6	0	0	0	0	0	0	8	19.05	28.18
T6	66	4	72.9	58	87.88	72.73	0	0	0	0	0	0	0	0	0	0	0	0
T7	57	13	24.9	11	19.30	13.61	1	1.75	8.01	3	5.26	1.44	0	0	0	0	0	0
T8	49	6	57.6	39	79.59	39.7	5	10.20	14.8	0	0	0	0	0	0	0	0	0
T9	67	4	37.4	26	38.41	34.41	0	0	0	0	0	0	1	1.49	2.96	0	0	0
T10	56	10	77.5	26	46.43	17.82	3	5.36	59.12	0	0	0	0	0	0	1	1.79	0.27
T11	36	9	9.8	7	19.44	8.13	0	0	0	0	0	0	1	2.78	0.32	0	0	0
T12	48	10	49.5	19	39.58	33.2	0	0	0	0	0	0	0	0		1	2.08	1.47
T13	42	14	29.8	6	14.29	13.3	0	0	0	3	7.14	2.45	1	2.38	2.59	0	0	0
T14	47	11	50.9	2	4.25	0.67	3	6.38	41.64	3	6.38	7.26	0	0	0	0	0	0
T15	48	3	100	30	62.5	76.98	0	0	0	14	29.17	17.94	0	0	0	4	8.33	5.07
T16	24	9	89.1	9	37.5	9.38	2	8.33	63.05	1	4.17	0.44	1	4.17	4.74	3	12.50	11.49
T17	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
T18	43	11	67.8	9	20.93	13.33	1	2.33	27.79	16	37.21	13.95	1	2.33	4.65	2	4.65	6.07
T19	63	13	76.8	28	44.44	69.17	0	0	0	13	20.63	6.59	1	1.59	0.25	1	1.59	0.56
T20	55	20	62.1	1	1.81	0.75	4	7.27	48.87	3	5.45	0.99	1	1.82	2.8	1	1.82	1.79
T21	66	6	99.7	28	42.42	28.5	0	0	0	24	36.36	12.13	3	4.54	39.78	9	13.64	19.13
T22	44	9	65.7	3	6.81	6.67	2	4.54	34.89	27	61.36	22.67	0	0	0	1	2.27	1.45
T23	69	12	74.5	2	2.90	16.65	3	4.35	34.07	45	65.22	23.75	0	0	0	0	0	0
T24	114	9	64.2	1	0.88	4.78	2	1.75	47.88	55	48.25	11.55	0	0	0	0	0	0

TABLE 7. –Cont'd																		
Transect No	**Total No. Stems Counted per Transect**	**Total No. Species Present Per Transect**	**% ISD Overall Transect**	**Mexican Rubber Tree [Pulu Mamoe] *(Castilla elastica)*[1,A]**			**Albizia [Tamaligi Pa'epa'e] *(Albizia falcataria)*[2,D]**			**African Rubber Tree [Pulu Vao] *(Funtumia elastica)*[3,B]**			**Albizia [Tamaligi Uliuli] *(Albizia chinensis)*[4,E]**			**African Tulip Tree [Fa'apasi/Tulipe] *(Spathodea campanulata)*[5,C]**		
				NO.	**% ISA**	**% Dom**	**NO.**	**% ISA**	**% Dom**	**NO.**	**% ISA**	**% Dom**	**NO.**	**% ISA**	**% Dom**	**NO.**	**% ISA**	**% Dom**
T25	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**
T26	50	14	77.2	4	8.00	6.91	5	10.00	50.45	25	50.00	19.71	0	0	0	1	2	0.12
T27	51	6	97.7	8	15.69	6.74	3	5.88	29.17	8	15.69	4.82	3	5.88	3.03	26	50.98	53.93
T28	38	7	29.7	0	0	0	0	0	0	22	57.89	18.69	0	0	0	3	7.89	11.02
T29	43	7	34.9	20	46.51	19.74	0	0	0	7	16.28	5.7	0	0	0	12	27.91	9.44
T30	81	13	59.9	2	2.47	1.24	1	1.23	32.17	46	56.79	24.56	0	0	0	3	3.70	1.96
T31	67	16	48.1	18	26.87	27.39	0	0	0	16	23.88	14.3	1	1.49	6.41	0	0	0
T32	45	8	72	4	8.89	13.67	0	0	0	30	66.67	42.34	2	4.44	16.04	0	0	0
T33	37	8	47	5	13.51	19.42	0	0	0	20	54.05	6.22	1	2.70	19.42	2	5.41	1.94
T34	51	13	49.1	0	0	0	0	0	0	12	23.53	7.31	1	1.96	37.26	1	1.96	4.49
T35	65	17	28.6	0	0	0	0	0	0	10	15.38	3.6	1	1.54	23.74	0	0	0
T36	48	10	30.6	8	16.67	26.21	0	0	0	9	18.75	4.41	0	0	0	0	0	0
Overall Totals No.	**1,858**	**68/78 species**	**X**	**563**	**X**	**X**	**40**	**X**	**X**	**417**	**X**		**21**	**X**	**X**	**80**	**X**	**X**
% Total	**100**	**87.2%**	**X**	**30.3**	**X**	**25.11**	**2.15**	**X**	**16.34**	**22.44**	**X**	**8.07**	**1.13**	**X**	**5.03**	**4.31**	**X**	**4.74**

% ISA = Percent Invasive Species Abundance (number stems/total stem count x 100);
% Dom. = Percent Invasive Species Dominance (calculated as the cross-sectional area of DBH by species/total sum of cross-sectional area x 100);
1-5 = Relative Target Species Ranking by % Dominance;
A-E = Relative Target Species Ranking by % Abundance;
= The 5 least impacted transects by all recorded invasive species.
= The 5 worst impacted transects by all recorded invasive species.

TABLE 8. Mt Vaea Transect data summary/severity ranking for top 5 target species and relative species distribution									
TARGET SPECIES	**Total No. Stems Counted**	**% ISA**	**Range ISA**	**Severity Rank**	**Mean % Dominance**	**Range % Dominance**	**Severity Rank**	**Total Number of Transects Present**	**Relative Species Distribution (% Blocks)**
Albizia chinensis	21	1.13	0-5.88	E	5.03	0-39.78	4	15/34	44.1
Albizia falcataria	40	2.15	0-10.2	D	16.34	0-63.05	2	17/34	50.0
Castilla elastica	513	30.30	0-87.88	A	25.11	0-76.98	1	31/34	91.2
Funtumia elastica	417	22.44	0-66.67	B	8.07	0-42.34	3	25/34	73.5
Spathodea campanulata	80	4.31	0-50.98	C	4.74	0-53.93	5	18/34	52.9
TOTALS	**1071/1858**	**57.6**	**0-87.9**	**A-E**	**59.29**	**0-76.9**	**1-5**	**34/36**	

% ISA = Percent Invasive Species Abundance (number stems/total stem count x 100);
Mean % Dom. = Mean Percent Invasive Species Dominance (calculated as the cross-sectional area of DBH by species/total sum of cross-sectional area x 100);
Relative Species Distribution = Percent of all transects (34) each species is present in;
1-5 = Relative Target Species Ranking by Mean % Dominance;
A-E = Relative Target Species Ranking by % Abundance.

TABLE 9. Mt Vaea Observation Blocks (canopy 1 and 2) data summary/severity ranking for top 5 target species and relative species distribution					
TARGET SPECIES	**Total Score**	**% of Overall IS Score**	**Severity Rank**	**Total Number of Blocks Present**	**Relative Species Distribution in Project Area (% Blocks)**
Albizia chinensis	33	13.81	D	16/38	42.1
Albizia falcataria	59	24.69	B	25/38	65.8
Castilla elastica	62	25.94	A	31/38	81.6
Funtumia elastica	40	16.74	C	23/38	60.5
Spathodea campanulata	21	8.79	E	11/38	28.9
TOTALS	**215/239**	**90%**	**A-E**	**X**	**X**

A-E = Relative Target Species Ranking by % Score and Relative Species Distribution within Project Area = Percent of all Blocks (38)

Bird/Bat Survey Results (22.11.07 and 28.1107.): The two initial bird/bat surveys were conducted by the Principle Officer NPR and the Terrestrial and Biodiversity Officer/DEC MNRE and were performed during early morning and late afternoon time periods respectively. The number of stations increased from 11 stations on 22.11.07 to 12 stations on 28.11.07 with the addition of another station in the far northeast corner of the project area. All stations waypoints coordinates were recorded and logged into the same GPS unit used for plant surveys for future reference and re-location. Full survey details are shown in Appendix K and are summarised below.

TABLE 10. Bird/bat survey general results

Survey Date	No. of Land Bird Species		No. of Sea Bird Species		No. of Bat Species		Total Observations
	Seen	Heard	Seen	Heard	Seen	Heard	
22.11.07 (morning)	9	11	-	-	1	-	20 bird species 1 bat species
28.11.07 (afternoon)	5	12	1	1	-	-	19 bird species
TOTALS	**14**	**23**	**1**	**1**	**1**	**-**	**40**

General Comments: The coordinator (Principal Officer NPR) of the bird/bat survey work also provided some general comments and observations with each datasheet and some of the important ones not already presented above are listed here.

- Twenty bird species were seen and or heard in the reserve: Banded Rail, Pacific Pigeon, Crimson-crowned Fruit-Dove, Many-coloured Fruit-Dove, White-rumped Swiftlet, Flat-billed Kingfisher, Polynesian Triller, Samoan Triller, Red-vented Bulbul, Samoan Fantail, Samoan Broadbill, Scarlet Robin, Samoan Whistler, Wattled Honeyeater, Cardinal Honeyeater, Polynesian Starling, Samoan Starling, Jungle Myna, Common Myna and the White-tailed tropic bird
- Only one species of flying fox was recorded in the reserve (*Pteropus tonganus*).
- Overall bird population density is slowly increasing after the devastation of the Mt Vaea Site by Cyclone Heta 2005.
- About 60 to 80 percent of species present in the Reserve are gradually increasing.
- The most frequently heard or seen birds are the two doves (Crimson crowned and the Multicoloured Fruit Dove) and the Wattle-honey eater at every station.
- The fruiting trees in this period of the year on Mt Vaea are Maali (*Termnalia richii*), Pulu Vao (*Funtumia elastica*), Pulu Mamoe (*Castilla elastica*), Ulu (*Artocarpus altilis*) and Mango (*Mangifera indica*).
- The flowering trees are Asitoa (*Syzygium inophylloides*) and Filofiloa (*Ixora samoensis*).
- Few of the birds that are seen in other times of the year like the Blue Crown Lory are seen or heard at this time of the year.
- The Samoan fantail was the most common bird species heard and seen throughout the afternoon counts.
- In comparison with the morning counts, song birds are frequently seen in mid morning to mid afternoon.
- The Polynesian Starling and Samoan Triller are heard more often in the afternoon than in the morning.

Reptile Survey Results: The trials to determine survey techniques using pitfall traps had only just begun at the time of finishing this report and heavy rains caused even more delays.

The basic approach thus far has been to test the pitfall traps (10 plastic buckets) buried around the gardens near the NPR office. Traps are checked twice daily and records are kept of captures, distance from nearest tree and % canopy overhead.

5. Survey Data Interpretation: The Mt. Vaea Project in its initial phase has been quite successful in establishing a platform for continued research and a significant database for overall biodiversity (both plant and animal) and of course the identification and assessment of the key invasive species within the reserve to date.

As can be seen the field surveys conducted thus far have already provided volumes of information and there are still other surveys remaining to be completed which will provide even more data. This presents a frequently overlooked but vitally important task of data management, analysis and interpretation. To this extent this consultant/coordinator has attempted to document and save all relevant project information in as many formats as possible for future use.

Initial results paint a poor picture of overall forest health with the severe impacts of present invasive species being very obvious throughout the whole project area and reserve. Maps using the survey data from both transects and observation blocks for each target species were generated using MapInfo and illustrate their distribution and relative importance (see attached figures B-I). The following general information can be gleaned from the project survey data sets and distribution maps:

- The whole project area has been severely impacted by both human related (e.g. agricultural and forestry) and natural calamities (e.g. cyclones, severe weather events, etc.) as well as invasive species.
- In all transects counted and measured (34/36) a total of 1,858 plants/stems were recorded and averaged 54.6 stems per transect with a low of 24 and a high of 114 stems measured.
- Within the transect blocks species diversity was generally low, with the total number of species recorded being 68 of the 78 total species recorded and/or observed and they ranged from a low of 3 to a high of 17 species recorded per transect.
- The total percentage (over every measured transect = 34/36) of invasive species abundance (ISA) of all species recorded (68/78) was very high at 62% with 57.6% being the top 5 target species alone.
- The total percentage of all invasive species (transect) by calculated dominance (ISD) was 60.6% with 59.29% being the top 5 target species alone.
- Invasive species also scored highly in the observation blocks (canopy 1&2) comprising a total of 42.3% of all the scores with 90% again being the top 5 target species alone.
- Even the 5 least impacted transect blocks ranged from 9.8-29.8% ISD and had one or more of the target species present.

Based on these survey results the top five IAS were defined on the basis of their importance within the project area and dominance amongst all the other invasive species present. The top 5 target species have been ranked according to their respective severity using data collected on abundance, dominance (transects) and presence and/or relative importance in the observation blocks (Tables 8 & 9).

5.1 Major Outcomes of the Mt. Vaea Restoration Project Phase I: The initial work conducted at the Mt. Vaea Reserve has provided most of the IS impact assessment information required for plants and has set the stage for future research and targets for further implementation. Some of the key outcomes of the project to date are:

- Established area maps with coordinates and waypoints for all transects, bird survey plots, reserve trails and the RLS tomb;
- Produced an inventoried checklist of key plant species both native and introduced within the project area and developed a database of invasive species which identifies their respective importance, abundance, dominance and distribution.
- Collected data and produced detailed maps of the distribution of the top 5 target species for future research and management.
- Gained knowledge and experience in field survey work and refined methodologies which can be used in Samoa (and elsewhere) in future.
- Gained knowledge and experience in GPS usage and mapping information software for future projects in Samoa.
- Established a core working group of researchers/advisors in Samoa and a network of technical expertise and support from within the region and beyond.
- Developed a 5 year plan for further research and management.
- Identified and documented "unique" areas within the reserve that will be important for future research and restoration efforts (e.g. areas with significant numbers of emerging seedlings of desired native species and/or with significant problematic species at the ground level for restoration efforts = *Ardessia elliptica*, *Cestrum nocturnum*, etc.).

5.2 Research Needs for the Mt. Vaea Restoration Project: In planning for the management strategies to be used for the next implementation phase an extensive internet search of relevant literature, websites, list servers, networks, and expert consultation was conducted (see key contacts appendix I). Unfortunately, little concrete information and/or experience was found and/or received especially pertaining to the project area top 5 target species. The control/management information search was conducted in as wide a spectrum of potential sources and details of these findings have been tabled (see attached spreadsheet = Control Methodology Options). Therefore, it will be imperative that extensive species specific control and forest restoration research be conducted within the reserve prior to the implementation of a complete management/removal program. Table 11 outlines these proposed research activities in their respective categories.

TABLE 11. Proposed research programs at the Mt Vaea Reserve			
Target species/theme	**Mechanical**	**Chemical**	**Combinations/Comments**
Albizia chinensis	▪ Efficacy of manual root destruction techniques. ▪ Efficacy of mutilation stumping. ▪ Frill and notching with chemical injection.	▪ Efficacy trials with trycloplyr herbicide. ▪ Efficacy trials with glyphosate herbicide. ▪ Efficacy Trials with 2,4,D herbicide.	▪ Injection, wound painting with frill notching.
Albizia falcataria	▪ Girdle debarking trials. ▪ Frill and notching with chemical injection.	▪ Efficacy trials with trycloplyr herbicide. ▪ Efficacy trials with glyphosate herbicide. ▪ Efficacy Trials with 2,4,D herbicide.	▪ Study location and extent of girdling required. ▪ Injection, wound painting with frill notching.
Castilla elastica	▪ Efficacy of manual root destruction techniques. ▪ Efficacy mutilation stumping	▪ Efficacy trials with trycloplyr herbicide. ▪ Efficacy trials with glyphosate herbicide. ▪ Efficacy Trials with 2,4,D herbicide.	▪ Injection, wound painting with frill notching.
Funtumia elastica	▪ Efficacy of manual root destruction techniques. ▪ Efficacy mutilation stumping	▪ Efficacy trials with trycloplyr herbicide. ▪ Efficacy trials with glyphosate herbicide. ▪ Efficacy Trials with 2,4,D herbicide.	▪ Injection, wound painting with frill notching.
Spathodea campanulata	▪ Efficacy of manual root destruction techniques. ▪ Efficacy mutilation stumping	▪ Efficacy trials with trycloplyr herbicide. ▪ Efficacy trials with glyphosate herbicide. ▪ Efficacy Trials with 2,4,D herbicide.	▪ Injection, wound painting with frill notching.
Native Species Recruitment	▪ Manual-planting vs. natural regeneration ▪ Spatial/distributional arrangements of natives	▪ Study levels of reinvasion by competitive ground species their control and ground preparation methods	▪
Restoration and Replanting	▪ Nursery Techniques Refinement ▪ Efficacy mutilation stumping and slashing of species such as *Cestrum sp.* and *Ardessia sp.*	▪ Efficacy trials with glyphosate herbicide on other IS which may hinder recruitment.	▪ Refer to draft report on artificial propagation methods of Samoan trees (Foliga and Blaffart 2007).

6. Management Plan Mt. Vaea Ecological Restoration Project Phase II (2008-13): The ecological restoration will be a monumental task and certainly a first of its kind for Samoa and should provide an excellent pilot demonstration for the rest of the Pacific Islands Region as well.

The 5-year management plan will largely be dependent on the funding and staff available and to this extent an estimated target figure of at least $270,000 USD (approx. $700,000 ST) over the period should be sufficient to cover most all of the costs involved. The bulk of this would by necessity be invested in the research required in years 1-3. However, it should also be noted that a project with this magnitude and level of difficulty it is most likely to require a much longer time frame especially to allow for the establishment of the desired native species.

The more substantive costs are foreseen to be in the areas of technical/management staff, labour and in materials and equipment required. For many of these costs a concerted effort should be placed on obtaining "in kind" support and the solicitation of local and overseas corporations for materials (e.g. chemicals, equipment, etc), goods and services (e.g. data support, media, transportation, etc.). The following matrix outlines the major activities, players involved, estimated resources required (adjusted 5% annually for inflation) and expected outcomes over the five year period (Table 12).

TABLE 12. Draft Workplan for the Mt Vaea Restoration Project (2008-2013)				
TIME FRAME	**Main Activities**	**Persons/Organizations Responsible**	**Expected Outcomes**	**Resources Required Estimated Costs (Samoan tala)**
Feb.-June, 2008 YEAR 1	• Seek additional funding for Project Phase II through appropriate donors. • Seek technical and financial support via appropriate corporate enterprises and services (e.g. Media, TV and Video Production Units, Monsanto, DOW Chemicals, etc.) • Seek approval and support for trial usage of suggested herbicides.	PC, CIPIP, MNRE, SPREP, JICA, PII, PILN, SNITT, MAF, GOS, etc.	• Sufficient funding ($600,000+) for the implementation all research and IAS management requirements for a 5 year (+) project phase. • Sources of technical, research, materials and equipment established. • Annual report produced.	• Concerned NGOs, individuals, GOS political will, technical and financial support in grant preparation. • Support from MAF and Registrar for pesticide importation and trial usage
July-July, 2009 YEAR 1	• Selection and/or recruitment of key staff and technical support including: Project Coordinator/Manager, field crew members (15-20 +), experienced volunteers AusAID, Peacecorps, JICA, Canada Fund, etc. • Design and establish long-term field research plots throughout the reserve. • Initiate field trials on control methods.	PC, CIPIP, MNRE, SPREP, JICA, PII, PILN, SNITT, MAF, GOS, etc.	• Key staff and technical support secured. • Long-term trials agreed, designed and positioned in strategic management zones within reserve. • Field trials on control methods established and data is being recorded • Annual report produced.	• Project Manager = $50,000/yr* • Field crew (15 men/$20/d/25 wks) = $37,500* • Equipment = $25,000 • Chemicals/Materials = $30,000* SUB-TOTAL = $142,500
Aug 09-Aug 2010 YEAR 2	• Continue field trials on control methods.	PC, CIPIP, MNRE, SPREP, JICA, PII, PILN, SNITT, MAF, GOS, etc.	• Data is collected accurately and efficiently and results begin to answer questions • Annual report produced. • Further research required is decided and refined.	• Project Manager = $52,500/yr • Field crew (10men x 40wks) = $42,100 • Chemicals/Materials = $31,500 SUB-TOTAL = $126,100
Sep.2010-Sep 011 YEAR 3	• Continue field trials on control methods.	PC, CIPIP, MNRE, SPREP, JICA, PII, PILN, SNITT, MAF, GOS, etc.	• Data is collected accurately and efficiently and results begin to answer questions. • Annual report produced. • Public awareness programs functioning. • Further research required is decided.	• Project Manager = $55,125/yr • Field crew (10men x 40wks) = $44,200 • Chemicals/Materials = $33,100 SUB-TOTAL = $132,425
		PC, CIPIP, MNRE, SPREP, JICA, PII, PILN, SNITT,	• Data is collected accurately and efficiently and results begin to answer questions.	

YEAR 4	• Implement proven control strategies identified during the field research.	MAF, GOS, etc.	• Annual report produced and public awareness is enhanced. • Further research required is decided and replanting/recruitment of native species begins.	• Project Manager = $57,890/yr • Field crew (10 men) = $46,400 • Chemicals/Materials = $20,000 SUB-TOTAL = $124,300
YEAR 5	Implement proven control strategies identified during the field research.	PC, CIPIP, MNRE, SPREP, JICA, PII, PILN, SNITT, MAF, GOS, etc.	• Data is collected accurately and efficiently and results begin to answer all management questions. • Both annual reports are produced. • Further research and actions required are decided and Mt. Vaea begins to restore. • Public awareness enhanced.	• Project Manager = $60,785/yr • Field crew (10 men) = $48,720 • Public awareness/Reporting=$ 10,000 • Chemicals/Materials = $10,000 SUB-TOTAL = $129,500
				ESTIMATED TOTAL $700,000

* = Increased at 5% per annum to take into account inflation; **PC =** Project Committee; **WP =** Work Plan; **CI =** Conservation International Pacific Islands Program; **TE =** Project Technical Expert; **MTVR =** Mt. Vaea Reserve; **JICA =** Japan International Cooperation Agency; **SPREP =** Secretariat of the Pacific Regional Environment Program; **MNRE =** Ministry of Natural Resources and Environment; **SNITT =** Samoa National Invasives Task Team; **PII =** Pacific Invasives Initiative

6.1 Suggested Implementation Approach: Ecological restoration work of this type has been done in very few places around the world and Samoa will most certainly be "breaking new ground" as far as Pacific Islands are concerned. As mentioned earlier in searching for specific information on control methodologies for the project areas worst invasive plants, very little was found however, some appropriate literature regarding restoration work was found based on experiences in Australia and are worthy of mention here. Some basic principles and useful guides to ecological/forest restoration work are as follows:

1. **Work from areas of native plants (good areas) towards weed infested areas (bad areas).** *Note: while the distribution of the top 5 target species appears very widespread there are some areas which are slightly less impacted and may be good starting points.*
2. **Make minimal disturbance to the area**. *Note: This will be very difficult in the Mt. Vaea Project area as steep slopes and large invasive trees will inevitably cause damage if trees are felled thus making chemical methods with slow plant death a much more attractive option of removal.*
3. **Let native plant regeneration dictate to rate of removal.** *Note: This remains an unknown for now but special attention should be given to reinvasion of other potentially serious invasives which may hamper native regeneration naturally. The degree of clearing and removal should be studied and observed closely and as a general suggestion/rule it is better to under-clear than to over-clear an area. Planned plantings may be the best option in many areas of the reserve.*

Other suggested approaches and guidelines for implementing the overall 5 year work-plan including proposed research are as follows:

- Remember that the implementation plan has targeted the top 5 invasive tree species as a start however, within the reserve area itself at least 17 (approx. 22%) invasive plant species were recorded which includes 8 trees, 5 shrubs, 2 herbs, and some vines and grasses. These additional species will need to be dealt with as well particularly those that may hinder native species recruitment and/or establishment. Generally speaking mechanical and chemical methods of control planned for the main target species should apply to these species as well and the degree of action taken will depend on levels of infestation, time and financial resources available at the time.
- Develop a zone based action plan to guide all the field crew(s) conducting the work throughout the 5 year period. For each year a block should be designated as a management zone starting from the best forest and moving toward the worst. An example would be as follows: (see proposed management zones on map in Figure B below).
    - Zone: Year 1 = 9.4 ha. Work area
    - Zone: Year 2 = 18.1 ha. Work area
    - Zone: Year 3 = 19.1 ha. Work area
    - Zone: Year 4 = 15.9 ha. Work area
    - Zone: Year 5 = 16.8 ha. Work area
- Locate and establish at least 5 permanent/long term survey plots (perhaps 1 in each management zone in easily accessible areas near trails) to be used for longer term research, assessments and monitoring.
- Be wary of heavy disturbance to fragile soils and maintain as much mulch and protection as possible in order to prevent potential serious sheet and rill erosion.

- Keep accurate records (daily) at all times in order be able to monitor and evaluate detailed management costs for future reference.
- Protect native species at all costs, know them well and understand the differences between your friends and your enemies.
- Be patient as the impact of control methods will take time as well as the restoration and regeneration of native species.
- The overall implementation of management strategies will be refined during an intensive 3 year research phase which will dictate to a large degree the specific techniques and methods used for invasive tree species removal.
- Caution must be taken in the removal of key (Top 5) invasive species especially in heavily infested blocks. Scattered removal of a percentage of trees (say 30%) will be better for the forest restoration in the long run than complete removal. Therefore some areas will need to be treated more than once over the 5-10 year cycle.

6.2 Suggested Restoration and Replanting Approach: Whistler, 2002 explains rainforest structure in Samoa as being influenced by a complex array of environmental and bio-geographical factors which include: soil, topography, elevation, and degree of disturbance. Based on topography Whistler further defines five categories of lowland rainforests as coastal forests, valley forests, lava flow forests, ridge forests, and slope forests with additional subdivisions or "associations" made using dominant species by genus e.g. *Diospyros* coastal forest.

Whistler, 2002 further suggests a complex of at least 35 major tree species representing at least 12 plant families in Samoan lowland forests ranging in elevation from 1-1,100m above sea level. Based on the results obtained from the transect blocks survey 24 of the major lowland forest tree species are found in various amounts in the Mt. Vaea Reserve (see Table 13 below).

TABLE 13. Important Samoan lowland tree species in the Mt Vaea reserve*

Samoan Name	English Name	Species Name	Presence in Reserve**	Propagation Methods***
'O'a	?	*Bischofia javanica*	D	-
Tamanu	?	*Callophyllum neo-ebundicum*	D	X
Moso'oi	Perfume Tree	*Cananga odorata*	D	X
Maali	?	*Canarium vitiense*	D	X
Anume	?	*Diospyros elliptica*	D	-
Au'auli	Samoan Ebony	*Diospyros samoensis*	D	X
Maota/Tufaso	?	*Dysoxylum samoensis*	C	X
A'amati'e	?	*Elaeocarpus floridanus*	D	-
Pua lulu	?	*Fagraea berteroana*	D	-
Aoa	Banyan	*Ficus obliqua*	C	-
Ifi	Polynesian Chestnut	*Inocarpus fagifer*	C	-
Lau fatu/Lau pata	?	*Macaranga stipulosa*	D	-
Atone	Samoan Nutmeg	*Myristica inutilis*	A	X
Atone 'ulu	?	*Myristica hypargyraea*	D	-
Afa	?	*Neonauclea forsteri*	D	X
Gasu	?	*Palaquim stehlinii*	A	X
Ala'a	?	*Planchonella garberi*	D	X
Mamalava	?	*Planchonella samoensis*	D	X
Tava	?	*Pometia pinnata*	A	X
Tavai	?	*Rhus taitensis*	D	-

TABLE 13. Important Samoan lowland tree species in the Mt Vaea reserve*				
Fana'io	?	*Sterculia fanaiho*	D	-
Asi Vai	?	*Syzygium dealatum*	D	-
Asi	?	*Syzygium inophylloides*	D	X
Malili	?	*Termnalia richii*	D	X
		24 Total Lowland Species	2/A, 3/C, 19/D	13 X

* = Species List based on Table 5.2 taken from Whistler 2002
** = Based on number of plants counted in transect survey blocks: A=31+ plants; B= 21-30 plants; C=11-20 plants; D= 0-10 plants
*** = Based information and data taken from the draft Propagation Manual (Foliga and Blaffart 2007) (X = propagation methods established)

As can be seen from the species listed above and the species recorded from the plant survey (see Appendix G) the Mt. Vaea Reserve is a complex of mature secondary, secondary and primary forest canopy and subcanopy species. A suitable replanting strategy should therefore, be based largely on this type of forest structure, maintaining as many of these species as possible while removing the undesirables. The following are some general suggestions for restoration work within the reserve:

- As soon as possible initiate nursery establishment and production of important species listed above focussing especially on species in short supply and/or with low numbers of seedlings recorded or observed throughout the reserve. *Note:* Some areas of the reserve were recorded as having considerable numbers of Tava *Pometia pinnata* scatted throughout the forest floor and would be a good source of planting material.
- In some areas of the reserve treatment of other scrub under story species will no doubt be necessary for better quicker restoration to take place. Research should target this area first in order to identify the best methods (mechanical or chemical) for controlling these problem species (e.g. *Cestrum nocturnum* and *Ardessia elliptica*). Take action against these species at the same time as removal of invasive tree species.
- Attempt as best as possible to emulate a more natural or "gap succession" process (as discussed by Whistler, 2002) meaning scattered and partial removal of canopy with replanting occurring simultaneously in each of these areas. Over removal will only cause more problems.
- Utilize shade tolerant species in heavily infested areas to allow for quicker recovery (refer to propagation manual for complete details).

6.3 Monitoring: Perhaps the most useful and important exercise will be the monitoring of both the research activities as well as the implementation of the prescribed work plan. It is suggested here that long-term monitoring utilize the permanent survey/research blocks to be established in each of the management zones. Additional monitoring blocks or stations can be established just outside the project area if time and finances permit to be used as "control" or "check" plots to provide comparative data and allow for more accurate monitoring of efficacy of IS removal and progress of natural native species recruitment and ecological restoration.

FIGURE B: SUGGESTED MANAGEMENT APPROACH FOR RESTORATION WORK

6.3 Proposed Materials/Equipment and Personnel for Phase II: The next project phase will require significant equipment and materials to conduct the appropriate research and implement the final management strategies that will be refined and further developed. Although much of the more important equipment can easily be purchased locally and/or overseas the more difficult task will be in importing some of the most appropriate herbicides for trial usage. This will require that the Ministry/CI Project Manager applying for special permits for importation and use in Samoa even if they are registered elsewhere. Investigations into the procedures and processes have been initiated through the Pesticide Registrar MAF and an appropriate form is attached in an appendix at the end of this document.

As indicated earlier the more substantive costs are foreseen to be in the areas of technical/management staff, labour and in materials (chemicals/adjuvants) and equipment required. The following Table 13 details these estimated costs adjusting at 5% per annum due to inflation where appropriate and indicates availability for purchase (local and/or overseas).

TABLE 14. Phase II: Proposed Equipment and Estimated Implementation Costs (2008-2013 indicative only)

Item/Expenditure	Quantity	Price/Unit ($ST tala)	Total ($ST tala)	Subtotal ($ST tala)	Purchased locally or from overseas
Equipment					
Chainsaws short bar	2 x 2,100	2,100	4,200	17,800	L
Chainsaws long bar	2 x 3,400	6,800	13,600		
Boots	15	450	6,750	6,750	L
Garmin GPSMAP60CSx	3	1,800	5,400	5,400	O
Digital Camera/Video	1	2,000	2,000	2,000	O
Overalls	15	225	3,375	3,375	L
RT Radios	5	400	2,000	2,000	O
Spades	20	55	1,100	1,100	L
Bush knives	48	25	1,200	1,200	L
Raincoats	15	90	1,350	1,350	L
Work Gloves	10 leather pairs	12	120	185	L
Protective Gloves	5 rubber pairs	13	65		
Files	48	18	864	864	L
Day back-packs	5	150	750	750	L
Long handle Axe	10	60	400	600	L
Spray paint cans	48	12	576	576	L
Flagging tape	24 rolls	12	288	288	O
First Aid Kit	2 boxes	250	500	500	O
Tomahawk Axe	10	25	250	250	L
Safety Goggles	10	8	80	80	L
Respiratory goggles	48	100	4,800	48	L
Knapsack Sprayers	5 x 20*L* capacity	300	1,500	1,500	L
Tree Injectors	5	200**	1,000	1,000	O
Paint Brushes	3”	15	150	150	L
			Subtotal Equipment	**$47,766**	**$47,766**
Chemicals (Herbicides & Adjuvants)*					
Garlon 4A (Trychlopyr)	25 x 20*L*=500*L*	2,000**	50,000	50,000**	O
Roundup (Glyphosate)	25 x 20*L*=500*L*	551	13,775	13,775	L
Gramoxone (Paraquat)	30 x 5*L*=150*L*	195	29,250	29,250	L
Banvine (2,4-D + Dicamba)	100 x 1*L*=100*L*	162	16,200	16,200	L
Adjuvants/Diesel oil	500*L*	20**	10,000	10,000	L
			Subtotal Chemicals	**$119,225**	**$119,225**

TABLE 14. Phase II: Proposed Equipment and Estimated Implementation Costs (2008-2013 indicative only)					
Item/Expenditure	**Quantity**	**Price/Unit ($ST tala)**	**Total ($ST tala)**	**Subtotal ($ST tala)**	**Purchased locally or from overseas**
Miscellaneous Materials					
Nursery bags	5,000	0.20	1,000	1,000	L
Root Hormone	1kg	***	3,000***	3,000	L
Shade Cloth	2x 50m rolls	300	600	600	O
Materials Repair shade house	***	***	5,000	5,000	L
Fertilizers	10x20kg bags	100	1,000	1,000	L
Fuel	2,000/yr	2,000/yr	10,000	10,000	L
			Subtotal Materials	**$20,600**	**$20,600**
Personnel*					
Project Manager Coordinator	1 full time	50,000/yr/adjusted*	276,300	276,300	
Labourers	10-15/yr/20/day	50,000/yr/adjusted*	218,920	218,920	
			Subtotal Personnel		**$495,220**
Awareness/Reporting					
Reporting costs	500/yr	500/yr	2,000	2,000	
Public Awareness	2,600/yr	2,600/yr	13,000	13,000	
			Subtotal Awareness/Reporting		**$15,000**
			ESTIMATED PROJECT COSTS 2008-2013	**$700,000 ST ($270,000 USD)**	

* = Increased by 5% per annum; **= Estimated importation and registration costs; *** = Estimated costs;
NB. Based on averaged exchange rates ANZ Bank January, 2008. 1 USD = $2.60 ST = Samoan tala

7. Conclusions and General Recommendations: Invasive alien species are recognized as one of the main causes of biodiversity erosion in island ecosystems. As a result of globalization, the number of naturalized introduced plants currently equals or even exceeds the number of native and endemic species in many tropical islands. Some of the naturalized plants have extended their distribution ranges and abundance with significant impacts on both species composition and ecosystem functions. The understanding of invasion patterns and processes is often a prerequisite for alien species management, endangered species conservation and habitat restoration thus this initial project phase. Samoa is certainly no exception here!!

The Mt. Vaea Project in its initial phase has been quite successful in establishing a platform for continued research and a significant database for overall biodiversity (both plant and animal) and of course the identification and assessment of the key invasive species within the reserve to date. This initial research and survey results paint a poor picture of overall forest health with the impacts of invasive species (both plant and animal) being evident and obvious throughout the whole project area. The ecological restoration of Mt. Vaea Reserve will be a long, difficult and expensive task but certainly achievable provided adequate resources are available for continued work. The initial work plan proposed in this report covers only a 5 year period at an estimated cost of $700,000ST and considering the scope work involved in the ecological restoration of Mt. Vaea a longer period with additional resources will most likely be required. Suggestions toward fostering corporate relationships to assist in technical and material expenses should be investigated as soon as possible. Possible donors will no doubt appreciate the benefits of such a "ground breaking" endeavour and it is sincerely hoped that many will want to participate in the projects future.

Lastly we owe this effort not only to our forest ecology or our future generations but also to the man who lies in rest near the summit of the reserve and whom scripted the eloquent words we all now so appreciate and endear…..

"Under the wide and starry sky
Dig the grave and let me lie.
Glad did I live and glad did I die
And I lay me down with a will.

This be the verse you grave for me:
Here he lies where he longs to be.
Home is the sailor home from the sea
And the hunter home from the hill."

R. L. Stevenson

8. Bibliography/Reference Materials Used

Bradley, Joan, 2002. Bringing Back the Bush *the Bradley Method of Bush Regeneration*. New Holland Publishers (Australia) Pty. Ltd. 111pp.

Cowie, R.H., 1999. Non-indigenous land and freshwater molluscs in the islands of the Pacific: conservation impacts and threats. Hawaii Biological Survey contribution number 1999-010. Department of Natural Sciences, Bishop Museum, 1525 Bernice Street, Honolulu, Hawaii 96817-2704 USA. 42pp.

Cowie, R.H. and Robinson, A.C. 2002. The Decline of Native Pacific Island Faunas: changes in status of the land snails of Samoa through the 20th century. Biology Conservation 110 (2003). Elsevier Science Ltd. pp. 55-65

Cowie, R. H. and Robinson, A.C. 2003. The Decline of Native Pacific Island Faunas: Changes in Status of the Land Snails of Samoa through the 20th Century. Biological Conservation 110 (2003) pp. 55-65.

Cowie, R.H., 2005. Alien Non-Marine Molluscs in the Islands of the Tropical and Subtropical Pacific A Review. From the Symposium "Non-Marine Alien Mollusk: The Future is a Foreign Ecosystem. Presented at the annual meeting of the Malacological Society 25-29 June, 2003 Ann Arbor, Michigan, USA. American Malacological Bulletin 20: 95-103. pp 95-103.

Critical Ecosystem Partnership Fund, September 2005. Ecosystem Profile Polynesia-Micronesia Biodiversity Hotspot. Final draft submitted to the CEPF Working Group. 138pp.

Foliga, T.S. and Blaffart, H. 2007 (revised). *DRAFT* Propagation Manual for Twenty Samoan Tree Species. ed. Atherton, J. 49pp.

Gill, B.J., 1993. The Land Retiles of Western Samoa. Journal of the Royal Society of New Zealand. Volume 23, Number 2. June 1993, pp 79-89.

Government of SAMOA/Division of Environment and Conservation/Ministry of Natural Resources, Environment, and Meteorology (MNRE) 2005. National Invasive Alien Species Implementation Action Plan (NIASIAP) January 2006 - December 2009. *Addressing* "Theme 6 Biosecurity" of the National Biodiversity Strategy and Action Plan (NBSAP) 2001. 29pp.

Lowe, S., Browne, M., Boudjelas, S., De Poorter, M. 2000. *100 of the World's Worst Invasive Alien Species A Selection from the Global Invasive Species Database.* Invasive Species Specialist Group (ISSG) from the Species Survival Commission (SSC) of the World Conservation Union (IUCN). 12pp.

Meyer J.-Y., Florence J., Mellado T., Martinez S. & Taputuarai R. 2007. Vegetation and Plant Invasions in the Island of Moorea, French Polynesia. Paper presented at the Pacific Science Congress in Okinawa July 2007. Abstract

National Trust New South Wales, 1999. The National Trust Bush Regenerators' Handbook. The National Trust of Australia (NSW). 48pp.

Rainforest Action Network. 2005. Species Extinction: *Rainforest Fact Sheet*. San Francisco, CA 94104 USA. rainforest@ran.org

Sax, D.F., Gaines, S.D., and Brown, J.H. December 2002. Species Invasions Exceed Extinctions on Islands Worldwide: A Comparative Study of Plants and Animals. The American Naturalist. Vol. 160, NO. 6. 766-783.

Skelton, P.A., Bell, L.J., Atonio, M., Trevor, A. 2000. The Status of the Coral Reefs and Marine Resources of Samoa. Government Report? 36pp.

Space,J.C., Flynn, T. 2002. Report to the Government of Samoa on Invasive Species of Environmental Concern. U.S.D.A. Forest Service Pacific Southwest Research Station Institute of Pacific Islands Forestry. Honolulu, Hawaii, USA. 77pp.

SPREP, 2000. Invasive Species in the Pacific: a technical review and draft regional strategy. Technically edited by Greg Sherley. Apia, Samoa.

Veitch, C.R. and Clout, M.N. (eds.), 2002. *Turning the Tide: the eradication of invasive species*. IUCN SSC Invasive Species Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. 414pp.

Watling, Dick, 2001, Birds of Fiji and Western Polynesia: including American Samoa, Niue, Samoa, Tokelau, Tonga, Tuvalu and Wallis-Futuna. Environmental Consultants Suva, Fiji. 272pp.

Wetterer, J.K., Vargo, D.L., 2003. Ants (Hymenoptera: Formicidae) of Samoa. Pacific Science (2003), vol. 57 no.4:409-419, University of Hawaii Press. 409-419pp.

Whistler, W. A. 1983. Weed Handbook of Western Polynesia. Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) 151pp.

Whistler, W. A. 1996. Samoan Herbal Medicine: *O La'au ma Vai Fofo o Samoa.* Isle Botanica, Honolulu.16pp

Whistler, W. A. 2000. Tropical Ornamentals: *A guide*. Timber Press, Inc. Portland, Oregon USA. 542pp.

Whistler, W. A. 2002. The Samoan Rainforest *A guide to the Vegetation of the Samoan Archipelago.* Isle Botanica, Honolulu. 168pp.

Whistler, W. A. 2004. Rainforest Trees of Samoa *A guide to the common lowland and foothill forest trees of the Samoan Archipelago.* Isle Botanica, Honolulu. 210 pp.

Wittenburg, R., Cock. M.J.W. (eds.), 2001. Invasive Alien Species: A Toolkit of Best Prevention and Management Practices. CAB International, Wallingford, Oxon, UK. 228pp.

9. WEBSITES USED:

ALIENS-L list server of the Invasive Species Specialist Group (ISSG) of the IUCN Species Survival Commission: aliens-l@indaba.iucn.org

Global Invasive Species Information Network: http://www.gisinetwork.org

The Global Invasive Species Program (GISP): http://www.gisp.org

The Global Invasive Species Database: http://www.issg.org/database/species/search

The CRC Weed Management for Australian Weeds: http://www.weeds.crc.org.au/index

The World Conservation Union (IUCN) Species Survival Commission (SSC): http://www.issg.org/links.html and www.iucnredlist.org

Pacific Island Ecosystems at Risk (PIER version 5): http://www.hear.org/pier/index.html

Pacific Regional Environment Programme (SPREP): http://www.sprep.org.ws

The Nature Conservancy (TNC): http://nature.org

Conservation International Biodiversity Hotspots: http://www.biodiversityhotspots.org

Pacific Islands Pest List Database (PLD): http://www.spc.int:8088/pld/index.jsp

Rainforest Action Network. San Francisco, CA 94104 USA. rainforest@ran.org

Hawaii Weeds UH/CTAHR. www.ctahr.hawaii.edu/forestry/Data/Weeds_Hawaii.asp

FIGURE B: DISTRIBUTION BY ABUNDANCE *Albizia chinensis*

FIGURE C: DISTRIBUTION BY ABUNDANCE *Albizia falcataria*

FIGURE D: DISTRIBUTION BY ABUNDANCE *Castilla elastica*

FIGURE E: DISTRIBUTION BY ABUNDANCE *Funtumia elastica*

FIGURE F: DISTRIBUTION BY ABUNDANCE *Spathodea campanulata*

FIGURE G: DISTRIBUTION BY ABUNDANCE TOP 5 TARGET SPECIES COMBINED

FIGURE H: DISTRIBUTION BY ABUNDANCE OF ALL INVASIVE TREE SPECIES COMBINED

FIGURE I: OVERALL DISTRIBUTION OF IS BY DOMINANCE

"Ecological Restoration of Mt Vaea Reserve"

TERMS OF REFERENCE FOR

PROJECT TECHNICAL EXPERT

The Technical Expert will be responsible for supervising the first phase of the Mt Vaea Restoration Project. He/She will work closely with relevant staff of the Division of Environment and Conservation (DEC) and Conservation International's Pacific Islands Program (CI-PIP) to ensure that all planning phase (phase 1) outputs are achieved and in particular that a five year project work plan outlining the detailed work schedules for the implementation phase over the following 5 years (phase 2), along with the methods of control to be trialed for each invasive weed and detailed project costings of all resources, equipment and materials required.

TASKS: The completion of the following planning phase tasks shall be coordinated by the Technical Expert.

- Survey and mapping of the distribution and abundance of key invasive species in the reserve area
- Literature research on appropriate techniques for the management of key invasive species in tropical environments;
- Trialing of appropriate invasive species management (ISM) techniques (if time permits);
- Baseline biodiversity survey of native species (birds, plants and other biota) and identification of the monitoring methodology to be used throughout the project;
- Identification of the research methodologies to be conducted;
- Outline of environmental awareness activities to be conducted;
- Preparation of a detailed 5 year project work plan outlining all the above elements including the work to be done, how it will be done and the resources needed to do it by year.

All necessary equipment (such as all survey gear and maps) will be provided to the technical expert to conduct the above tasks.

PROJECT COMMITTEE: A project committee will be formed with membership from DEC and CI, and possibly other partner organizations (e.g. JICA and SPREP), to provide guidance and support to the technical expert for project activities.

DELIVERABLES:

1. Consultants work plan. This report will outline how the technical expert will do the work and provide deadlines for each task, along with a list of any resources or inputs required by partners. The work plan will be presented to the Project Committee during the week of Sept 17-21.

2. Five year project work plan. This is the main deliverable of the consultancy and will outline the invasive species management work to be done in the implementation phase, how it will be done and the resources needed to do it by year. The final deadline for this work plan will be December 31, 2007.

TIME FRAME: This project planning phase will commence in September 2007 for 3 ½ to 4 months and is expected to be completed by the end of December 2007. The Technical Expert will be hired for a 40 day period during this timeframe but will be responsible for defining his/her workload during this time. If necessary, the technical expert may be hired again during the implementation phase to provide further technical support for the project.

WORKS WITH: Relevant staff of DEC, including the National Parks and Reserves Officer, JICA staff and Conservation International Staff and SNITT members. SPREP are also expected to provide technical support for this work. As noted a project committee will be formed to provide guidance to the Technical Expert and to monitor and support project activities.

RESPONSIBLE FOR: The consultant will be responsible for coordinating the work of all field survey team members.

RESPONSIBLE TO: The consultant will be responsible to the CI PIP Conservation Outcomes Manager and to the ACEO-DEC (MNRE) for communication on this work.

FUNDED BY: The position will be contracted to and funded by the Conservation International Pacific Islands Program.

APPENDIX B

MT. VAEA RESTORATION PROJECT SURVEY METHODOLOGIES

3rd DRAFT REVISED

SITE SELECTION: The total Mt. Vaea Reserve area is calculated at approximately 454 ac. 02r 0.87p or 183ha. An actual re-survey of the whole reserves boundaries is being planned and should be completed by the end of the planning phase. Initial project committee discussions suggested that the "project area" be redefined for ease of workload, manageability and best public exposure. The project area defined therefore focuses on the most heavily wooded area of the reserve inclusive of the public trails and excludes areas such as the adjacent old pasture land and the botanical garden. Actual project boundaries have been established using the base topographical map and the criteria mentioned above and now readjusted to accommodate the long trail which fell outside of the original boundary set therefore, the actual "project area" is now calculated as being a total of 78ha.

METHODOLOGY/APPROACH: It is proposed here that the designated area be further subdivided into working blocks (100m X 100m) each of 1ha in size and these working units be used for the establishment of survey transects to cover approximately 2.5% sampling area of each block. Transects will be established in every second block (50m x 10m in size=500m^2) starting from the blocks at the lowest elevation and moving to highest elevation and snaking in a south to north and then a north to south direction throughout the working area (approx. 39 one ha blocks in total). Each block will be numbered or coded accordingly (e.g. Transect 1 = plot 1; Transect 2 = plot 2; etc.) and specific details recorded for each data set or plant inventory (see Data Sheet below). Additional data components from additional work such as bird surveys, gastropods, control trial plots can be supper-imposed over the existing transects. Each transect will be established in approximately the center of each plot (e.g. 50m up and 25m inside each block) and laid out and marked according to the Whistler approach and follow as best as possible the contour of the slope in the area (snaking in an approximately south to north direction or north to south direction throughout the project area).

FIELD CREWS: Initially one team of 4-5 men will be required to establish each survey transect and record all data. An additional team may develop later if another GPS becomes available for transect data collection. GPS coordinates (e.g. waypoints) will be taken at the start and end of each transect line established.

DATA COLLECTION: Data will be collected on each transect using two recorders and two assessors. Each team of two will work on separate sides of the transect line (e.g. uphill and downhill side of the prevailing slope). Stems above 1 meter in height will be noted, species identified, and all stems greater than 5cm DBH will be recorded to the nearest decimal cm. measure (e.g. 17.6 cm).

TIMELINES: It is estimated that each transect will take 3-4 hours to complete or 2-3/day or 10-12/week. Therefore the entire working block (35 plots in total) should take approximately 4 weeks to complete assuming that some of the upper plots will be severe slopes and inaccessible for data collection.

Special Note: Until field tested there is no sure way of determining time required or ease and/or difficulty of the task. Therefore modifications may be necessary in order to expedite the survey process. These should be determined on the first field attempt at transect surveys on Monday 8.11.07.

Additional Surveys: Follow-up survey work [e.g. Bird Surveys, Gastropods (?), Reptiles, etc.] should utilize these same transect plots or subsets there of for the sake of consistency of project data. These additional surveys will be coordinated by Faleafaga Toni Tipamaa from the National Parks Office with the support of other technical advisors to be identified.

APPENDIX C

PLANT INVENTORY FIELD DATA SHEET Mt. VAEA RESERVE

RECORDER(s):_____
ASSESSORS: _____
DATE: _____ WEATHER:
_____
SITE/TRANSECT NO: _____ ELEVATION: _____m
BEARING: _____ GPS WAYPOINT #_____
SLOPE: _____
GPS START: S_____ W_____ Accuracy: +/- _____m
GPS END: S_____ W_____ Accuracy: +/- _____m
PHOTOPOINT NO.:_____
GROUND COVER:
_____
SEEDLINGS COVER (% TOTAL AREA):_____
EPIPHYTES PRESENT:
_____

SPECIES	STEM NO.	DBH (CM)	OTHER COMMENTS

APPENDIX D: TRANSECT DATA SPREADSHEET

TRANSECT	DATE	GPS Location	South	West	Accuracy +/-	GENERAL COMMENTS/INFORMATION
NO.	09.10.07	**Transect Start**	13.86508	171.76735	9m	**GPS Waypoint Number =**
T4		**Transect End**	13.86537	171.7674	?m	**ELEVATION:** 230mStart
Stem No.	**Species Name**	**Samoan Name**	**DBH (CM)**	**Tree Form**	**Plant Type**	**SLOPE ALONG:** +2%
1	*Castilla elastica*	Pulu Mamoe	13.8		INT/INV	**BEARING:** 181 degs (mag)
2	*Castilla elastica*	Pulu Mamoe	12.1		INT/INV	**ASSESSORS:** Setoa,Toni, Talie
3	*Castilla elastica*	Pulu Mamoe	22.1		INT/INV	Tone, Manu, Uiti
4	*Castilla elastica*	Pulu Mamoe	15.1	Forked	INT/INV	**RECORDERS:** Bonin & Moeumu
5	*Castilla elastica*	Pulu Mamoe	12.2	Forked	INT/INV	**WEATHER:** overcast
6	*Castilla elastica*	Pulu Mamoe	20.7	Forked	INT/INV	**PHOTO POINT COMPUTER: PPT3**
7	*Castilla elastica*	Pulu Mamoe	10.4		INT/INV	**GROUND COVER:** 70 % *Ardesia*
8	*Castilla elastica*	Pulu Mamoe	6.1		INT/INV	**SAPLINGS:** PV, Fuafua Auauli, Atone,
9	*Castilla elastica*	Pulu Mamoe	13.7		INT/INV	Niu Vao
10	*Castilla elastica*	Pulu Mamoe	22.6		INT/INV	**EPIPHYTES:**
11	*Castilla elastica*	Pulu Mamoe	6.1		INT/INV	**PLANT TYPE: INT=**Introduced**; INV=**Invasive**;**
12	*Castilla elastica*	Pulu Mamoe	13.7		INT/INV	**NAT=**Native
13	*Castilla elastica*	Pulu Mamoe	22.6		INT/INV	**GENERAL NOTES:**
14	*Castilla elastica*	Pulu Mamoe	6.1		INT/INV	Canopy comprised of PM, Sita, AF, AC
15	*Castilla elastica*	Pulu Mamoe	12.8		INT/INV	
16	*Castilla elastica*	Pulu Mamoe	10.6		INT/INV	Transect located near trail
17	*Castilla elastica*	Pulu Mamoe	6.3		INT/INV	
18	*Castilla elastica*	Pulu Mamoe	8		INT/INV	
19	*Castilla elastica*	Pulu Mamoe	5.9		INT/INV	
20	*Castilla elastica*	Pulu Mamoe	8.3		INT/INV	
21	*Castilla elastica*	Pulu Mamoe	14.6		INT/INV	
22	*Castilla elastica*	Pulu Mamoe	14.7		INT/INV	
23	*Castilla elastica*	Pulu Mamoe	6.8		INT/INV	
24	*Castilla elastica*	Pulu Mamoe	6.5		INT/INV	
25	*Castilla elastica*	Pulu Mamoe	5.9		INT/INV	
26	*Castilla elastica*	Pulu Mamoe	11.5		INT/INV	

27	*Castilla elastica*	Pulu Mamoe	5.7		INT/INV	
28	*Castilla elastica*	Pulu Mamoe	5.8		INT/INV	
29	*Castilla elastica*	Pulu Mamoe	8.4		INT/INV	
30	*Castilla elastica*	Pulu Mamoe	5.2		INT/INV	
31	*Castilla elastica*	Pulu Mamoe	6.7		INT/INV	
32	*Castilla elastica*	Pulu Mamoe	6.4		INT/INV	
33	*Castilla elastica*	Pulu Mamoe	6.3		INT/INV	
34	*Castilla elastica*	Pulu Mamoe	7.5		INT/INV	
35	*Castilla elastica*	Pulu Mamoe	11.6		INT/INV	
36	*Castilla elastica*	Pulu Mamoe	10.3		INT/INV	
37	*Castilla elastica*	Pulu Mamoe	6.7		INT/INV	
38	*Castilla elastica*	Pulu Mamoe	10.6		INT/INV	
39	*Castilla elastica*	Pulu Mamoe	9.8		INT/INV	
40	*Castilla elastica*	Pulu Mamoe	6.1		INT/INV	
41	*Castilla elastica*	Pulu Mamoe	8.4		INT/INV	
42	*Castilla elastica*	Pulu Mamoe	7.8		INT/INV	
43	*Albizia falcataria*	Tamaligi Pa'epa'e	39.6	Broaken	INT/INV	
44	*Balata sp.*	Maniuniu	8.8		NAT	
45	*Castilla elastica*	Pulu Mamoe	6.9		INT/INV	
46	*Castilla elastica*	Pulu Mamoe	47.6		INT/INV	
47	*Castilla elastica*	Pulu Mamoe	9.5		INT/INV	
48	*Balata sp.*	Maniuniu	11.5		NAT	
49	*Castilla elastica*	Pulu Mamoe	6.6		INT/INV	
50	*Balata sp.*	Maniuniu	6.2		NAT	
51	*Cedrella ordorata*	Sita	11.3	Forked	INT	
52	*Cedrella ordorata*	Sita	20.2	Forked	INT	
53	*Castilla elastica*	Pulu Mamoe	7		INT/INV	
54	*Castilla elastica*	Pulu Mamoe	9.4	Forked	INT/INV	
55	*Castilla elastica*	Pulu Mamoe	6.2	Forked	INT/INV	
56	*Kleinhovia hospita*	Fuafua	9.3	Forked	NAT	
57	*Kleinhovia hospita*	Fuafua	16.4	Forked	NAT	

58	*Cedrella ordorata*	Sita	9.9		INT	
59	*Cedrella ordorata*	Sita	21.4		INT	
60	*Cedrella ordorata*	Sita	8.6		INT	
61	*Castilla elastica*	Pulu Mamoe	8		INT/INV	
62	*Cedrella ordorata*	Sita	6.2		INT	
63	*Castilla elastica*	Pulu Mamoe	6.7		INT/INV	
64	*Castilla elastica*	Pulu Mamoe	13.8		INT/INV	
65	*Adenanthera pavonia*	Lopa	8.9		INT/INV	
66	*Castilla elastica*	Pulu Mamoe	5.1		INT/INV	
67	*Kleinhovia hospita*	Fuafua	50		NAT	

APPENDIX E: MT. VAEA PROJECT AREA MAP

---- = Reserve Public Trails **A, B, C = Observation Blocks** **1, 2, 3 = Transect Blocks** **___ = Initial Transect Location**

■ = Actual Bird Survey Sites *** * = Actual Transect Waypoints** **■ = RLS Tomb**

APPENDIX F: MT VAEA SURVEY PLOT DETAILS											
Plot No.	**Excursion Date**	**Start Location South**	**Start Location West**	**WP NO.**	**Accuracy**	**End Location South**	**End Location West**	**WP NO.**	**Accuracy**	**Plot Type**	**Elevation**
T1	8.10.07	13.86457	171.76648	#10	5m	13.86423	171.76651	#11	7m	Transect	202/211m
A	"									Observation	
T2	"	13.86244	171.76659	#12	5m	13.86203	171.76683	#13/#14?	6m	Transect	214/217m
B	9.10.07									Observation	
T3	"	13.86314	171.76736	?	6m	13.86336	171.76761	?	7m	Transect	191m
C	"									Observation	
T4	"	13.86508	171.76735	?	9m	13.86537	171.7674	?		Transect	230m
D	"									Observation	
T5	"	13.86675	171.76741	?	7m	13.86701	171.76773	?	6m	Transect	218m
E	10.10.07									Observation	
T6	"	13.86819	171.76831	#029	4m	13.86796	171.76813	?	6m	Transect	217m
F	"									Observation	
T7	"	13.8666	171.76817	#031	11m	13.86609	171.76811	#032	8m	Transect	244m
G	"									Observation	
T8	"	13.86471	171.76813		7m	13.86429	171.76803		6m	Transect	254m
T10	11.10.07	13.86105	171.76782	#038	6m	13.86143	171.76802	#039	7m	Transect	247m
H	"									Observation	
T11	"	13.86303	171.76805	#036	5m	13.86332	171.7683	#037	7m	Transect	305m
N	16.10.07									Observation	
T14	"	13.86687	171.769	#14	6m	13.86666	171.76862	?	10m	Transect	274m
M	"									Observation	
T13	"	13.86609	171.76917	#13	8m	13.86556	171.76906	?	7m	Transect	311m
P										Observation	
T16	"	13.86696	171.7701	#044	3m	13.86674	171.77049	?		Transect	291m
O	17.10.07									Observation	
T21	"	13.86696	171.77135	#047	5m	13.86683	171.77182	?	6m	Transect	285m
W	"									Observation	
T27	"	13.86685	171.77267	#048	6m	13.86687	171.77312	#048	2m	Transect	296m
BB	"									Observation	
T22	"	13.86791	171.77222	#049	6m	13.86778	171.77176	#050?	5m	Transect	261m
T15	"	13.86768	171.7699	#051	1m	13.8669	171.76947	#052	4m	Transect	228m
V	"									Observation	
CC	18.10.07									Observation	
T36	"	13.86947	171.77751	#053	2m	13.86919	171.7771	?	3m	Transect	351m
JJ	"									Observation	
T34	"	13.86774	171.7756	#054	3m	13.86804	171.77574	#055?	4m	Transect	351m

HH	"									Observation	
T28	"	13.86892	171.774	#055	2m	13.86872	171.77351	#056?	6m	Transect	275m
T29	22.10.07	13.86675	171.77377	#057?	7m	13.86676	171.77419	?	4m	Transect	318m
GG	"									Observation	
T33	"	13.86766	171.77478	#057	3m	13.86807	171.77483	?	8m	Transect	310m
II	"									Observation	
T35	"	13.86729	171.77567	#058	7m	13.86693	171.77551	#059	1m	Transect	382m
T32	"	13.8663	171.77481	#060	8m	13.8662	171.77444	#061	7m	Transect	369m
T20	12.11.07	13.86531	171.77101	#062	6m	13.86552	171.7713	#063		Transect	378m
U	"									Observation	
T23	"	13.86596	171.77171	#064	6m	13.86567	171.772	#065	8m	Transect	362m
FF	14.11.07									Observation	
T30	"	13.86529	171.77397	#066	6m	13.86508	171.77362	#067	6m	Transect	388m
DD	"									Observation	
AA	"									Observation	
T26	"	13.86506	171.77319	#068	6m	13.86523	171.77269	#069	7m	Transect	400m
X	"									Observation	
T17	15.11.07	X	X		X	X	X		X	Steep OBS	
T	"									Observation	
T24	"	13.86455	171.77174	#071	5m	13.86433	171.77211	#072	8m	Transect	449m
Z	"									Observation	
EE	"									Observation	
T31	"	13.86357	171.77356	#073	4m	13.86368	171.77397	#074	4m	Transect	495m
T25	"	X	X		X	X	X		X	Steep OBS	
T12	19.11.07	13.86382	171.76912	#077	7m	13.86338	171.7691	#078	6m	Transect	343m
L	"									Observation	
K										Observation	
T9	"	13.86278	171.76826	#079	5m	13.86245	171.76863	#080	3m	Transect	315m
I	"									Observation	
J	"									Observation	
T19	21.11.07	13.86366	171.77135	#082	3m	13.86334	171.77104	#083	5m	Transect	402m
Y	"									Observation	
Q	"									Observation	
T18	"	13.86279	171.77042	#084	7m	13.86251	171.77011	#085	5m	Transect	335m
S	"									Observation	
R	"									Observation	
RLS Tomb	21.11.07	13.86461	171.7706							Focal Point	432m
Bird S1	22.11.07	13.8674	171.76865	#086						Bird Station	236m
Bird S2	22.11.07	13.86735	171.77051	#88						Bird Station	235m

Bird S3	22.11.07	13.868	171.77208	#89						Bird Station	255m
Bird S4	22.11.07	13.86779	171.77368	#90						Bird Station	276m
Bird S5	22.11.07	13.86915	171.7752	#91						Bird Station	311m
Bird S6	22.11.07	13.86864	171.77724	#92						Bird Station	340m
Bird S7	22.11.07	13.86788	171.776	#93						Bird Station	379m
Bird S8	22.11.07	13.86625	171.77541	#94						Bird Station	383m
Bird S9	22.11.07	13.86561	171.77458	#95						Bird Station	399m
Bird S10	22.11.07	13.86491	171.77299	#96						Bird Station	410m
Bird S11	22.11.07	13.86468	171.77084	#97						Bird Station	430m
Bird S1	28.11.07	13.8674	171.76865	#086						Bird Station	236m
Bird S2	28.11.07	13.86735	171.77051	#88						Bird Station	235m
Bird S3	28.11.07	13.868	171.77208	#89						Bird Station	255m
Bird S4	28.11.07	13.86779	171.77368	#90						Bird Station	276m
Bird S5	28.11.07	13.86915	171.7752	#91						Bird Station	311m
Bird S6	28.11.07	13.86864	171.77724	#92						Bird Station	340m
Bird S7	28.11.07	13.86788	171.776	#93						Bird Station	379m
Bird S8	28.11.07	13.86625	171.77541	#94						Bird Station	383m
Bird S9	28.11.07	13.86561	171.77458	#95						Bird Station	399m
Bird S10	28.11.07	13.86491	171.77299	#96						Bird Station	410m
Bird S11	28.11.07	13.86468	171.77084	#97						Bird Station	430m
Bird S12	28.11.07	13.86336	171.76985	#98						Bird Station	394m

APPENDIX G CHECKLIST OBSERVED/RECORDED PLANT SPECIES MT. VAEA PROJECT AREA					
Species No.	**Samoan Name(s)**	**English Name(s)**	**Scientific Name**	**Plant Type**	**Plant Status***
1	Lopa	Red-bead Tree	*Adenanthera pavonia*	Tree	INT/INV
2	Laga'ali	?	*Aglaia samoensis*	Tree	NAT
3	Tamaligi Uliuli	Albizia	*Albizia chinensis*	Tree	INT/INV
4	Tamaligi Pa'epa'e	Albizia	*Albizia falcataria*	Tree	INT/INV
5	Toi	?	*Alphitonia ziziphoides*	Tree	NAT
6	Togovao	Shoebutton	*Ardessia elliptica*	Shrub	INT/INV
7	Ulu	Breadfruit	*Artocarpus altilis*	Tree	INT
8	Maniuniu	Palm (?)	*Balaka sp.*	Palm	NAT
9	Falaga	?	*Barringtonia samoensis*	Tree	NAT
10	O'a	?	*Bischofia javanica*	Tree	NAT
11	Tamanu	?	*Callophyllum neo-ebundicum*	Tree	NAT
12	Moso'oi	Perfume Tree	*Cananga odorata*	Tree	NAT
13	Maali	?	*Canarium vitiense*	Tree	NAT
14	Esi	Papaya	*Carica papaya*	Tree	INT
15	Pulu Mamoe	Mexican Rubber Tree	*Castilla elastica*	Tree	INT/INV
16	Sita	Ciga box cedar	*Cedrella odorata*	Tree	INT
17	Alii o le po/Teine o le Po	Night Cestrum	*Cestrum nocturnum*	Shrub	INT/INV
18	Tigamoni	Cinnamon	*Cinnamomum verum*	Tree	INT
19	?	?	*Citronella samoensis*	Tree	NAT
20	Losa Honolulu	Honolulu Rose	*Clerodendrum philippinum*	Shrub	INT/INV
21	Lau mamoe	Koster's Curse	*Clidemia hirta*	Herb	INT/INV
22	Niu Vao	Palm (?)	*Clinostigma samoense*	Palm	NAT
23	Kofe	Coffee	*Coffea arabica*	Tree	INT
24	Kotia	Laurel (?)	*Cordia alliadora*	Tree	INT/INV
25	Ti	?	*Cordyline fruticosa*	Herb	NAT (?)
26	Anoso Vao/Lau Ninii/Lau lilii	?	*Cryptocarya elegans*	Tree	NAT
27	Olioli	Tree Fern	*Cythea sp.*	Fern	NAT
28	Laugasese	?	*Davallia soilida*	Fern	NAT
29	?	Spotted Dumb Cane	*Dieffenbachia maculata*	Herb	INT/INV
30	Anume	?	*Diospyros elliptica*	Tree	NAT
31	Au'auli	Samoan Ebony	*Diospyros samoensis*	Tree	NAT
32	Maota /Tufaso (?)	?	*Dysoxylum samoensis*	Tree	NAT

33	A'amati'e	?	*Elaeocarpus floridanus*	Tree	NAT
34	Siapo Atua/Sapatua/Siapatua	Blue-marble Tree	*Elaeocarpus grandis*	Tree	INT/INV
35	?	?	*Erythrospermum acuminatissimum*	Tree	NAT
36	Pua Lulu		*Fagraea berteroana*	Tree	NAT
37	Mati		*Ficus godeffroyi*	Tree	NAT
38	Aoa	Banyan	*Ficus obliqua*	Tree	NAT
39	Filimoto	?	*Flacourtia rukam*	Tree	NAT
40	Pulu Vao	African Rubber Tree	*Funtumia elastica*	Tree	INT/INV
41	Fau	Beach Hibiscus	*Hibiscus tiliaceus*	Tree	NAT
42	?	?	*Hedycaraya denticulata*	Tree	NAT
43	Laufao	Heliconia	*Heliconia laufao*	Tree	NAT
44	Vaepaa	Heliconia	*Heliconia sp.*	Tree	NAT
45	Ifi	Polynesian Chestnut	*Inocarpus fagifer*	Tree	INT
46	Filofiloa	?	*Ixora samoensis*	Tree	NAT
47	Fu'afu'a	?	*Kleinhovia hospita*	Tree	NAT
48	Latana	Lantana	*Lantana camara*	Shrub	INT/INV
49	Papaono	?	*Litsea samoensis*	Tree	NAT
50	Lau Pata	?	*Macaranga harveyana*	Tree	NAT
51	Lau Fatu/Lau Pata	?	*Macaranga stipulosa*	Tree	NAT
52	Mago	Mango	*Mangifera indica*	Tree	INT
53	Fuesaina	Mile-a-minute	*Mikania micrantha*	Vine	INT/INV
54	Nonu	Indian Mulberry	*Morinda citrifolia*	Tree	INT
55	Tupe/Fuainu (?)	?	*Mucuna gigantea*	Vine	NAT
56	Fai (taemanu)	Wild banana	*Musa. Sp*	Tree	NAT?
57	Atone	Samoan Nutmeg	*Myristica inutilis*	Tree	NAT
58	Atone/Atone ulu	?	*Myristica hypargyraea*	Tree	NAT
59	Afa	?	*Neonauclea forsteri*	Tree	NAT
60	Tootoo valea	Fire Spike	*Odontonema tubiforme*	Shrub	INT/INV
61	Gasu	?	*Palaquim stehlinii*	Tree	NAT
62	Vao Lima	Sour grass/T-grass	*Paspalum conjugatum*	Grass	INT/INV
63	Ava'avaaitu		*Piper graeffei*	Vine	NAT
64	Soga		*Pipturus argenteus*	Tree	NAT
65	Ala'a	?	*Planchonella garberi*	Tree	NAT
66	Mamalava	?	*Planchonella samoensis*	Tree	NAT

67	Tava	?	*Pometia pinnata*	Tree	NAT
68	Vi Vao	?	*Reynoldsia lanutoensis*	Tree	NAT
69	Tavai	?	*Rhus taitensis*	Tree	NAT
70	Faapasi/Tulipe	African Tulip-Tree	*Spathodea campanulata*	Tree	INT/INV
71	Fana'io	?	*Sterculia fanaiho*	Tree	NAT
72	Mahoki (?)	Mahogany	*Swietenia macrophylla*	Tree	INT
73	Asi Vai	?	*Syzygium dealatum*	Tree	NAT
74	Asitoa/Asi	?	*Syzygium inophylloides*	Tree	NAT
75	Malili		*Termnalia richii*	Tree	NAT
76	Koko	Cocoa	*Theobroma cacao*	Tree	INT
77	Tuna (?)	?	*Toona sureni*	Tree	INT
78	Avapui/Fana Povi (?)	Shampoo Ginger	*Zingiber zerumbet*	Herb	NAT

2 = Fern Species	**4 = Vine/Grass Species**	**11 = Shrubs/Herb Species**	**61 = Trees/Palm Species**	**78 = Total Species**

APPENDIX H Key Equipment/Materials Purchased from Overseas (CI PIP)			
NO. of Units	Description	Unit Value NZ $	Total Value NZ $
1	Garmin GPSMAP60CSx	888.00	888.00
1	MC- 126 Compass	36.00	36.00
1	Suunto Clinometer with Percent. & Degree	235.00	235.00
2	Yamayo Open Reel 50m Tape	85.00	170.00
2	Yamayo 3/10 Diameter Tape	42.00	84.00
10	Bio Flagging Tape/yellow	7.00	70.00
10	Bio Flagging Tape/yellow	7.00	70.00
1	TT Transfer Costs	20.00	20.00
1	Freight and Insurance	260.00	260.00
		TOTAL NZ $	**1833.00**

APPENDIX I. KEY PROJECT CONTACTS FOR INFORMATION/CONSULTATIONS			
Name	**Organization**	**Topic Area**	**Email**
Pat Billy	Invasive Plant Specialist, The Nature Conservancy of Hawaii (TNC)	Identification/Biology Control Methods	pbily@tnc.org
Anne Marie La Rosa	Forest Health Coordinator Institute of Pacific Islands Forestry, USDA Forest Service	Identification/Biology Control Methods	alarosa@fs.fed.us
Jean-Yves Meyer	*Délégation à la Recherche, Tahiti, French Polynésie*	Identification/Biology Control Methods	jean-yves.meyer@recherche.gov.pf
Jim Space	Pacific Island Ecosystems at Risk (PIER)	Identification/Biology Control Methods	Jim_Space@rocketmail.com
Barry A. Rice	Invasive Species Specialist Invasive Species Team	Identification/Biology Control Methods	bamrice@ucdavis.edu
Losalini N. Leweniqila	Koronivia Agriculture Station, Fiji	Control Methods *Spathodea campanulata.*	losalini.leweniqila@govnet.gov.fj
Paul Van Ryzin	RC&D Coordinator, USDA-Natural Resources Conservation Service, American Samoa	Control Methods *A.f.*	paul.vanryzin@pb.usda.gov
J. B. Friday	University of Hawaii	Identification/Biology	jbfriday@hawaii.edu
Siaifoi Faaumu	National Parks American Samoa	Control Methods *A.f.*	siaifoi@yahoo.com
Athena Pratt	Soil Conservationist USDA-NRCS American Samoa	Control Methods *A.c.* Control Methods *S.c.*	Athena.Pratt@pb.usda.gov
Mick Jeffery	Natural Resources Manager Christmas Island National Park Parks Australia Department of Environment & Water Resources	Control Methods *Castilla elastica;* Control Methods *Spathodea .campanulata.*	Mick.Jeffery@environment.gov.au
Mr. Faumuina Pati Liu	ACEO DEC/MNRE	Research/Control/ Management/Planning	Pati.liu@mnre.gov.ws
Mr. James Atherton	Conservation Outcomes Manager CI PIP	Research/Control/ Management/Planning	j.atherton@conservation.org
Mr. Faleafaga Toni Tipamaa	Principal National Parks and Reserves Officer/MNRE	Research/Control/ Management/Planning	nationalparks@lesamoa.net toni.tipamaa@mnre.gov.ws
Mr. Hitofumi Abe	JICA Chief Advisor Enhancing Management Capacity Project National Parks and Reserves/MNRE	Research/Control/ Management/Planning	hitofumi.abe@samoaonline.ws
Mr. Suemalo Talie Foliga	Senior National Parks and Reserves Officer/MNRE	Research/Control/ Management/Planning	tfoliga@yahoo.com
Dr. Jill Key	PILN Coordinator located at SPREP	Research/Control/ Management/Planning	JillK@sprep.org
Dr. Alan Tye	Invasive Species Officer SPREP	Research/Control/ Management/Planning	alant@sprep.org
Mr. Warea Orapa	Weed Management Officer, Plant Protection Service, Secretariat of the Pacific Community	Identification/Biology Control Methods	WareaO@spc.int
Mr. Afele Faiilagi	Principal Terrestrial and Biodiversity Officer/DEC MNRE	Research/Control/ Management/Planning	afele.faiilagi@mnre.gov.ws
Ms. Moeumu Uili	Terrestrial and Biodiversity Officer/DEC MNRE	Research/Control/ Management/Planning	Moeumu.uili@mnre.gov.ws
Mr. Setoa Apo	Senior Research Officer /Forestry Division	Research/Control/ Management/Planning	jungletoa@yahoo.com
Mr. Tone Simanu	Research Officer/Forestry Division	Research/Control/ Management/Planning	entole@yahoo.com
Mr. Joe Reti Jnr.	Draftsman Officer/Forestry Division	Research/Control/ Management/Planning	?
Dr. Joel Miles	Palau Goverment	Identification/Biology Control Methods	jmiles@palau-oerc.net

Mr. Petania Tuala	Survey/Mapping Division MNRE	Mapping Information	petania.tuala@mnre.gov.ws
Dr. Art Whistler	USP Fiji	Identification/Biology	whistler@hawaii.edu
Mr. Tavita Togia	National Parks American Samoa	Control Methods *Albizia .falcataria.*	Tavita_Togia@nps.gov

APPENDIX J. APPLICATION FOR REGISTRATION OF A PESTICIDE

1) Product Name: _____

2) Name and Address of Applicant: _____
_____

3) Active Ingredient(s) and Concentration: _____
(g / Litre or g / kg) _____
_____
_____

4) Formulation: _____
_____

5) WHO Hazard Class: IA IB II III Not Classified
(Circle the appropriate class)

6) Proof of Overseas Registrations: New Zealand Reg. No.: _____
Australian Reg. No.: _____
Fijian Reg. No.: _____

7) Container Type: _____

8) Name and Address of Formulator/ Manufacturer: _____
_____
_____

9) Signed: _____ Date: _____

Attachments:
- Summary of intended use patterns in Samoa
- A statement of the Need-to-use
- Evidence of Overseas Registration Certificates (refer to N0. 6)
- Ten (10) copies of the proposed label
- Material Safety Data Sheet (MSDS)

APPENDIX K. BIRD SURVEY RESULTS: 22/11/07

	Station No.	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	Remarks
	Date	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	22/11/07	
	Time	7.00am	7.25am	7.40am	7.50am	8.05am	8.20am	8.40am	9.00am	9.10am	7.20am	9.30am	
	Waypoint	86	88	89	90	91	92	93	94	95	96	97	
	Coordinates S (dec. degrees)	S 13 86 740	S 13 86 735	S 13 86 800	S 13 86 779	S 13 86 915	S 13 86 864	S 13 86 788	S 13 86 625	S 13 86 561	S 13 86 491	S 13 86 468	
	Coordinates W (dec. degrees)	W 171 76 865	W 171 77051	W 171 77208	W 171 77368	W 171 77521	W 171 7724	W 171 77600	W 171 77 541	W 171 77 458	W 171 77 299	W 171 77 084	
	Elevation (m)	236m	235m	255m	276m	311m	340m	379m	383m	399m	410m	430m	
	Weather	cloudy	sunny	partly sunny	cloudy	cloudy	partly cloudy	sunny/windy	sunny	sunny	sunny	sunny	
	Observation	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	
Bird Species (English name)	**Observed (% of all stations)**												
Eastern Reef Heron	**0**												
Australian Grey Duck	**0**												
Banded Rail	**9.1**	s											
Purple Swamphen	**0**												
Pacific Pigeon	**0**		h										1 Pacific pigeon heard
White-throated Pigeon	**0**												
Tooth-billed Pigeon	**0**												
Crimson-crowned Fruit-Dove	**27.3**	h/s	h	h	h	h	h	h	h	h	hs	hs	Frequently heard at site
Many-coloured Fruit-Dove	**9.1**	h	h		h	h	h	h	h	h	hs	h	Frequently heard at site
Friendly Ground-Dove	**0**												
Blue-crowned Lory	**0**												
Barn Owl	**0**												
White-rumped	**36.4**	h	s				s			s		hs	

	Station No.	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	Remarks
Swiftlet													
Flat-billed Kingfisher	**27.3**	h/s	h	s	h							hs	
Polynesian Triller	**9.1**	s	h	h	h		h		h	h		h	
Samoan Triller	**0**			h	h	h	h			h			
Red-vented Bulbul	**36.4**	hs	hs	hs		h		h			h	hs	
Island Thrush	**0**												
Samoan Fantail	**0**	h	h	hs	h	h	h		h		h	h	
Samoan Broadbill	**0**			h					h	h			
Scarlet Robin	**0**			h			h						
Samoan Whistler	**18.2**	h	h	h	h	h	h		h	hs	hs	h	
Samoan White-eye	**0**												
Mao	**0**												
Wattled Honeyeater	**72.7**	hs	hs	hs	h	h	h	hs	s	hs	hs	hs	
Cardinal Honeyeater	**27.3**	h	h	h	h	h	h	h	h	hs	s	hs	
Samoan (Red-headed) Parrotfinch	**0**												
Polynesian Starling	**18.2**		hs		hs	h							
Samoan Starling	**54.5**	hs	hs	hs	hs	h		h		h	hs	hs	
Jungle Myna	**45.4**	hs	hs							hs	hs	hs	
Common Myna	**63.6**	hs	hs	hs	hs	hs			hs	h	h	hs	
Samoan Moorhen	**0**												
Jungle Fowl	**0**												
Longtail Cuckoo	**0**												
Feral Pigeon	**0**												
Tongan Flying Fox	**9.1**					s							1 Fruit Bat seen
Samoan Flying Fox	**0**												

Key: h = heard; s = seen; hs = heard and seen

APPENDIX K. BIRD SURVEY RESULTS (CONT'D): 28/11/07

	Station No.	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
	Date	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07	28/11/07
	Time	1100am	1120	1140	1200	1220	1240	1.00pm	1.10pm	1.20pm	1.30pm	1.40pm	2.00pm
	Waypoint	86	88	89	90	91	92	93	94	95	96	97	98
	Coordinates S (dec. degrees)	S 13 86 740	S 13 86 735	S 13 86 800	S 13 86 779	S 13 86 915	S 13 86 864	S 13 86 788	S 13 86 625	S 13 86 561	S 13 86 491	S 13 86 468	13,86,33.6
	Coordinates W (dec. degrees)	W 171 76 865	W 171 77051	W 171 77208	W 171 77368	W 171 77521	W 171 77240	W 171 77600	W 171 77 541	W 171 77 458	W 171 77 299	W 171 77 084	171,76,985
	Elevation (m)	236m	235m	255m	276m	311m	340m	379m	383m	399m	410m	432m	394m
	Weather	sunny	sunny	sunny	sunny	sunny	sunny	sunny	sunny	sunny	sunny	sunny	sunny
	Observation	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S	H/S
Bird Species (English name)	**Observed (% of all stations)**												
Eastern Reef Heron	**0**												
Australian Grey Duck	**0**												
Banded Rail	**8.3**	s											
Purple Swamphen	**0**												
Pacific Pigeon	**0**												
White-throated Pigeon	**0**						h						
Tooth-billed Pigeon	**0**												
Crimson-crowned Fruit-Dove	**0**	h	h	h	h	h	h	h	h	h	h	h	h
Many-coloured Fruit-Dove	**0**	h	h	h	h	h	h	h	h				
Friendly Ground-Dove	**0**												
Blue-crowned Lory	**0**												
Barn Owl	**0**												
White-rumped Swiftlet	**50**	s	hs		hs		hs				s	s	

	Station No.	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Flat-billed Kingfisher	**0**												
Polynesian Triller	**8.3**	h	h	h	hs	h	h	h				h	
Samoan Triller	**25**			h	hs	hs	hs						
Red-vented Bulbul	**25**	h	h	h	hs	h	hs	hs	h	h			
Island Thrush	**0**												
Samoan Fantail	**58.3**	hs	hs	hs	hs	hs	hs	hs	h		h	h	
Samoan Broadbill	**0**								h			h	h
Scarlet Robin	**0**												
Samoan Whistler	**50**	hs	h	hs	h	hs	hs	hs	h		h	hs	h
Samoan White-eye	**0**												
Mao	**0**												
Wattled Honeyeater	**58.3**	hs	hs	hs	hs	hs	hs	hs	h	h	h	h	h
Cardinal Honeyeater	**41.7**	h	hs	h	hs	hs	h	hs	h		h	h	hs
Samoan (Red-headed) Parrotfinch	**0**												
Polynesian Starling	**8.3**				h	hs	h	h					
Samoan Starling	**25**	h	h	h	hs	hs	hs	h		h	h	h	
Jungle Myna	**25**	hs	hs			h	hs	h	h	h	h	h	h
Common Myna	**25**			hs	hs	h	hs	h		h	h	h	
Samoan Moorhen	**0**												
Jungle Fowl	**0**												
Longtail Cuckoo	**0**												
Feral Pigeon	**0**												
Tongan Flying Fox	**0**												
Samoan Flying Fox	**0**												

Key: h = heard; s = seen; hs = heard and seen