



Appendix C

Terrestrial Ecology Characterisation - Mine Area to Markham River

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Purpose of EIS

The EIS has been prepared by, for and on behalf of Wafi Mining Limited and Newcrest PNG 2 Limited (together the "**WGJV Participants**"), being the participants in the Wafi-Golpu Joint Venture ("**WGJV**") and the registered holders of exploration licences EL 440 and EL1105, for the sole purpose of an application (the "**Permit Application**") by them for environmental approval under the Environment Act 2000 (the "**Act**") for the proposed construction, operation and (ultimately) closure of an underground copper-gold mine and associated ore processing, concentrate transport and handling, power generation, water and tailings management, and related support facilities and services (the "**Project**") in Morobe Province, Independent State of Papua New Guinea. The EIS was prepared with input from consultants engaged by the WGJV Participants and/or their related bodies corporate ("**Consultants**").

The Permit Application is to be lodged with the Conservation and Environment Protection Authority ("**CEPA**"), Independent State of Papua New Guinea.

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Development of Project subject to Approvals, Further Studies and Market and Operating Conditions

Any future development of the Project is subject to further studies, completion of statutory processes, receipt of all necessary or desirable Papua New Guinea Government and WGJV Participant approvals, and market and operating conditions.

Engineering design and other studies are continuing and aspects of the proposed Project design and timetable may change.

NEWCREST MINING LIMITED DISCLAIMER

Newcrest Mining Limited ("**Newcrest**") is the ultimate holding company of Newcrest PNG 2 Limited and any reference below to "Newcrest" or the "Company" includes both Newcrest Mining Limited and Newcrest PNG 2 Limited.

Forward Looking Statements

The EIS includes forward looking statements. Forward looking statements can generally be identified by the use of words such as "may", "will", "expect", "intend", "plan", "estimate", "anticipate", "continue", "outlook" and "guidance", or other similar words and may include, without limitation, statements regarding plans, strategies and objectives of management, anticipated production or construction commencement dates and expected costs or production outputs. The Company continues to distinguish between outlook and guidance. Guidance statements relate to the current financial year. Outlook statements relate to years subsequent to the current financial year.

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As an Australian Company with securities listed on the Australian Securities Exchange (ASX), Newcrest is subject to Australian disclosure requirements and standards, including the requirements of the Corporations Act 2001 and the ASX. Investors should note that it is a requirement of the ASX listing rules that the reporting of Ore Reserves and Mineral Resources in Australia comply with the 2012 Edition of the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (the JORC Code) and that Newcrest's Ore Reserve and Mineral Resource estimates comply with the JORC Code.

Competent Person's Statement

The information in the EIS that relates to Golpu Ore Reserves is based on information compiled by the Competent Person, Mr Pasqualino Manca, who is a member of The Australasian Institute of Mining and Metallurgy. Mr Pasqualino Manca, is a full-time employee of Newcrest Mining Limited or its relevant subsidiaries, holds options and/or shares in Newcrest Mining Limited and is entitled to participate in Newcrest's executive equity long term incentive plan, details of which are included in Newcrest's 2017 Remuneration Report. Ore Reserve growth is one of the performance measures under recent long term incentive plans. Mr Pasqualino Manca has sufficient experience which is relevant to the styles of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the JORC Code 2012. Mr Pasqualino Manca consents to the inclusion of material of the matters based on his information in the form and context in which it appears.

HARMONY GOLD MINING COMPANY LIMITED DISCLAIMER

Harmony Gold Mining Company Limited ("**Harmony**") is the ultimate holding company of Wafi Mining Limited and any reference below to "Harmony" or the "Company" includes both Harmony Gold Mining Company Limited and Wafi Mining Limited.

Forward Looking Statements

These materials contain forward-looking statements within the meaning of the safe harbor provided by Section 21E of the Securities Exchange Act of 1934, as amended, and Section 27A of the Securities Act of 1933, as amended, with respect to our financial condition, results of operations, business strategies, operating efficiencies, competitive positions, growth opportunities for existing services, plans and objectives of management, markets for stock and other matters. These include all statements other than statements of historical fact, including, without limitation, any statements preceded by, followed by, or that include the words "targets", "believes", "expects", "aims", "intends", "will", "may", "anticipates", "would", "should", "could", "estimates", "forecast", "predict", "continue" or similar expressions or the negative thereof.

These forward-looking statements, including, among others, those relating to our future business prospects, revenues and income, wherever they may occur in this EIS and the exhibits to this EIS, are essentially estimates reflecting the best judgment of our senior management and involve a number of risks and uncertainties that could cause actual results to differ materially from those suggested by the forward-looking statements. As a consequence, these forward-looking statements should be considered in light of various important factors, including those set forth in these materials. Important factors that could cause actual results to differ materially from estimates or projections contained in the forward-looking statements include, without limitation: overall economic and business conditions in South Africa, Papua New Guinea, Australia and elsewhere, estimates of future earnings, and the sensitivity of earnings to the gold and other metals prices, estimates of future gold and other metals production and sales, estimates of future cash costs, estimates of future cash flows, and the sensitivity of cash flows to the gold and other metals prices, statements regarding future debt repayments, estimates of future capital expenditures, the success of our business strategy, development activities and other initiatives, estimates of reserves statements regarding future exploration results and the replacement of reserves, the ability to achieve anticipated efficiencies and other cost savings in connection with past and future acquisitions, fluctuations in the market price of gold, the occurrence of hazards associated with underground and surface gold mining, the occurrence of labour disruptions, power cost increases as well as power stoppages, fluctuations and usage constraints, supply chain shortages and increases in the prices of production imports, availability, terms and deployment of capital, changes in government regulation, particularly mining rights and environmental regulation, fluctuations in exchange rates, the adequacy of the Group's insurance coverage and socio-economic or political instability in South Africa and Papua New Guinea and other countries in which we operate.

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Competent Person's Statement

The Wafi-Golpu Joint Venture is an unincorporated joint venture between a wholly-owned subsidiary of Harmony Gold Mining Company Limited and a wholly-owned subsidiary of Newcrest Mining Limited.

The information in the EIS that relates to Golpu Ore Reserves is based on information compiled by the Competent Person, Mr Pasqualino Manca, who is a member of The Australasian Institute of Mining and Metallurgy. Mr Pasqualino Manca, is a full-time employee of Newcrest Mining Limited or its relevant subsidiaries, holds options and/ or shares in Newcrest Mining Limited and is entitled to participate in Newcrest's executive equity long term incentive plan, details of which are included in Newcrest's 2017 Remuneration Report. Ore Reserve growth is one of the performance measures under recent long term incentive plans. Mr Pasqualino Manca has sufficient experience which is relevant to the styles of mineralisation and type of deposit under consideration and to the activity which he is undertaking to qualify as a Competent Person as defined in the JORC Code 2012. Mr Pasqualino Manca consents to the inclusion of material of the matters based on his information in the form and context in which it appears.

TERRESTRIAL FLORA AND FAUNA BASELINE ASSESSMENT MINE AREA TO MARKAM RIVER

WAFI-GOLPU PROJECT

Prepared for
Advisian (part of the WorleyParsons Group)

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Client: Advisian (part of the WorleyParsons Group)

Project Title: Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project

Project Author/s: Dr Penn Lloyd, David Stanton, David Fell and Terry Reis

Project Summary: This technical report presents the results of an assessment of the baseline terrestrial ecology (vegetation communities and flora and fauna species) of an approximately 40 km long (north-south) and 10 km wide area in the lower Watut River valley including the Mine Area and a section of the Infrastructure Corridor between the Mine Area and the Highlands Highway (referred to as the Mine Access Road and Northern Access Road section) in the Morobe Province of the Independent State of Papua New Guinea.

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EXECUTIVE SUMMARY

Purpose of the report

Wafi Mining Limited and Newcrest PNG 2 Limited (the WGJV Participants) are equal participants in the Wafi-Golpu Joint Venture (the WGJV). The WGJV Participants are currently investigating the feasibility of constructing, operating and (ultimately) closing an underground copper-gold mine and associated ore processing, concentrate transport and handling, power generation, water and tailings management, and related support facilities and services (hereafter the "Wafi-Golpu Project" or "Project").

The proposed underground copper-gold mine will be located beneath Mt Golpu, approximately 300 kilometres (km) north-northwest of Port Moresby and 65 km southwest of Lae in the Morobe Province of the Independent State of Papua New Guinea (PNG).

The WGJV has commissioned a range of studies to inform the Project's Feasibility Study Update and to prepare an Environmental Impact Statement (EIS). This report has been prepared for Advisian (part of the WorleyParsons Group) to describe the baseline terrestrial biodiversity of an approximately 40 km long (north-south) and 10 km wide area in the lower Watut River valley including the Mine Area and a section of the Infrastructure Corridor between the Mine Area and the Highlands Highway (referred to as the Mine Access Road and Northern Access Road section), hereafter "the study area". Terrestrial biodiversity assessed within the study area included vegetation communities, flora species and vertebrate fauna species.

Study approach

The study combined a desktop review of International Union for Conservation of Nature (IUCN) and other biodiversity databases, terrestrial ecology studies previously conducted within the study area and relevant literature on the terrestrial biodiversity of the Morobe Province with a series of three field surveys undertaken by between two and four ecologists between April and September 2015. The combined survey effort of the current and previous surveys totalled 57 days split across five different survey events between 2010 and 2015. These surveys covered a range of seasons, locations and habitat types within the study area, and represent a substantial survey effort.

Vegetation communities

The study area is located within a local area vegetated with large tracts of intact and relatively unmodified primary lowland rainforest vegetation communities. The alluvial plain of the Watut River valley is dominated by a mosaic of Large to Medium Crowned Forest, Mixed Swamp Forest and Swamp Woodland together with Swamp Grassland. The adjoining hills are vegetated with Medium Crowned Forest and Small Crowned Forest and scattered patches of Kunai Grassland. Disturbance and degradation of these habitats is largely related to clearing for subsistence agriculture and is limited to the vicinity of village settlements, particularly along the Watut River. The Large to Medium Crowned Forest on alluvial plains and fans vegetation community was assessed as meeting the IUCN guidelines for recognition as a vulnerable ecosystem, mostly due to the recent impacts of commercial logging of this vegetation community across PNG.

Terrestrial flora

The flora surveys and herbarium records identified 885 flora species within the study area, including 63 fern species, eight species of conifer and allies, two species of dipterocarp and 812 species of flowering plant. The following nine threatened or near threatened flora species have been confirmed as occurring within the study area:

- *Diospyros lolinopsis* (IUCN: Critically Endangered). IUCN status requires reassessment in light of recent records that significantly increase the area of occurrence of the species; meets 'Vulnerable' status under IUCN guidelines.
- *Intsia bijuga* (Kwila; IUCN: Vulnerable).
- *Pterocarpus indicus* (New Guinea Rosewood; IUCN: Vulnerable).
- *Myristica buchneriana* (IUCN: Vulnerable)
- *Myristica globosa* (IUCN: lower risk - Near Threatened)
- *Aglaia sexipetala* (IUCN: lower risk - Near Threatened)
- *Flindersia amboinensis* (IUCN: lower risk - Near Threatened)
- *Cycas apoa* (IUCN: Near Threatened)
- *Cycas schumanniana* (IUCN: Near Threatened)

Of a total of 84 introduced plant species recorded in the study area, 20 are considered to pose a specific risk to natural environmental values as invasive weed species, particularly in areas of disturbance.

Terrestrial fauna

The fauna surveys recorded 262 terrestrial vertebrate fauna species within the study area, comprising 44 mammal species, 170 bird species, 33 reptile species and 15 amphibian (frog) species. The 44 mammal species included 18 species of non-volant (non-flying) mammal and 26 species of flying mammal (bats). The rich diversity of birds, including several threatened, near threatened or otherwise noteworthy, forest-dependent species typically found only in relatively large, undisturbed tracts of primary forest, indicates that forested habitats across the study area are in good condition for supporting bird diversity typical of intact, primary forest. The following four threatened or near threatened terrestrial fauna species have been confirmed as occurring within or close to the study area:

- Papuan Eagle (*Harpyopsis novaeguineae*; IUCN: Vulnerable). The study area occurs within the home range of at least one resident breeding pair that inhabits primary rainforest in the study area.
- New Guinea Pademelon (*Thylogale browni*; IUCN: Vulnerable). This species was recorded as a captive in a local village and may occur at low density in remote, higher elevation forest adjoining the study area.
- Gurney's Eagle (*Aquila gurneyi*; IUCN: Near Threatened). At least one breeding pair appears to be resident in primary rainforest in the study area.
- Blue-Black Kingfisher (*Todiramphus nigrocyaneus*; IUCN: Near Threatened). This species is resident within alluvial forest close to mixed swamp forest with Sago Palm, including in the Markham Gap Basin. While this species has a wide distribution across New Guinea, it is inexplicably rare throughout its range, being known from only a few scattered records, with an isolated population in the study area.

Intact primary alluvial and hill forest supports the greatest terrestrial fauna diversity within the study area. While large areas of this rainforest remain relatively undisturbed in a structural sense, more accessible areas that are closer to access roads and village settlements experience greater hunting pressure that has resulted in the local loss of highly prized species that are sensitive to hunting pressure. The Markham Gap Basin is an area of especially high terrestrial biodiversity value within the study area, supporting a complex mosaic of intact and little disturbed rainforest and swampy habitats that exhibit a high degree of functional interconnectivity, a combination considered to be unique within the local region. Furthermore, the area experiences lower hunting pressure due to its relative remoteness and all the threatened, near-threatened or otherwise noteworthy terrestrial fauna species that are known to occur in the study area are known or are likely to occur within or adjoining the Markham Gap Basin.

International Finance Corporation (IFC) critical habitat

Using a conservative assessment approach, critical habitat in accordance with IFC guidelines was identified in association with forest supporting the tree *Diospyros lolinopsis* that is listed as Critically Endangered under the IUCN Red List; however, this species' IUCN status requires reassessment in light of recent records that significantly increase the area of occurrence of the species such that the species meets 'Vulnerable' status under IUCN guidelines, in which case its habitat would not be identified as critical habitat under the IFC guidelines. Due to the broad extent of occurrence of the species, this critical habitat is characterised as Tier 2 critical habitat, as opposed to Tier 1 critical habitat that has a very restricted extent of occurrence.

TERRESTRIAL FLORA AND FAUNA
BASELINE ASSESSMENT - MINE AREA TO MARKHAM RIVER

WAFI-GOLPU PROJECT

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Table of Terms and Abbreviations

Term/Abbreviation	Explanation
ASL	above sea level
BAAM	Biodiversity Assessment and Management Pty Ltd
°C	degrees Celsius
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
E	FIM code for: non-vegetation, including lakes and large rivers, and areas dominated by landuse
EIS	environmental impact statement
FIMS	Forest Inventory Mapping System
FSW	FIMS code for: Mixed Swamp Forest vegetation community
G	FIMS code for: Grassland vegetation community
GISD	Global Invasive Species Database
GRI	FIMS code for: grassland and herbland riverine successions dominated by grass
ha	hectares
HM/HS	FIMS code for: Medium Crowned Forest/ Small Crowned Forest on foothills vegetation community
IFC	International Finance Corporation
ILG	Incorporated Land Group
IUCN	International Union for Conservation of Nature
km	kilometre
km^2	square kilometres
m	metres
m^2	square metres
mm	millimetres
O	FIMS code for: non-vegetation and areas dominated by landuse
PIER	Pacific Island Ecosystems at Risk Database
PL	FIMS code for: Large to Medium Crowned Forest on plains and fans vegetation community
PNG	Independent State of Papua New Guinea
PNGFRI	Papua New Guinea Forest Research Institute
Project Area	The land that is the subject of the proposed Project activities and Project facilities, being: • The Mine Area • The Infrastructure Corridor • The Coastal Area
Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River study area	An approximately 40 km long (north-south) and 10 km wide area in the lower Watut River valley including the Mine Area and a section of the Infrastructure Corridor between the Mine Area and the Highlands Highway (referred to as the Mine Access Road and Northern Access Road section)

Term/Abbreviation	Explanation
W	FIMS code for: Woodland vegetation community
WGJV	Wafi-Golpu Joint Venture
WSW	FIMS code for: Swamp Woodland vegetation community
WWF	World Wildlife Fund

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Wafi Mining Limited and Newcrest PNG 2 Limited (the WGJV Participants) are equal participants in the Wafi-Golpu Joint Venture (the WGJV). The WGJV Participants are currently investigating the feasibility of constructing, operating and (ultimately) closing an underground copper-gold mine and associated ore processing, concentrate transport and handling, power generation, water and tailings management, and related support facilities and services (hereafter the "Wafi-Golpu Project" or "Project").

The proposed underground copper-gold mine will be located beneath Mt Golpu, approximately 300 kilometres (km) north-northwest of Port Moresby and 65km southwest of Lae in the Morobe Province of the Independent State of Papua New Guinea (PNG).

Geographically, the Project occupies a mine to port footprint that extends from the Mine Area to the Coastal Area with an Infrastructure Corridor that links the two areas. Together these discrete areas make up the proposed Project Area:

- **Mine Area**. The area encompassing the proposed block cave mine, underground access declines and nearby infrastructure, including a portal terrace and waste rock dump supporting each of the Watut and Nambonga declines, the Watut Process Plant, power generation facilities, laydown areas, water treatment facilities, quarries, wastewater discharge and raw water make-up pipelines, raw water dam, sediment control structures, roads and accommodation facilities for the construction and operations workforces.
- **Infrastructure Corridor**. The area encompassing the proposed Project infrastructure linking the Mine Area and the Coastal Area, being corridors for pipelines and roads and associated laydown areas. The proposed concentrate pipeline, terrestrial tailings pipeline and fuel pipeline will connect the Mine Area to the Coastal Area. A proposed Mine Access Road and Northern Access Road will connect the Mine Area to the Highlands Highway. New single-lane bridges are proposed over the Markham, Watut and Bavaga rivers. Laydown areas will be located at key staging areas.
- **Coastal Area**. The Coastal Area includes the proposed Port Facilities Area and the proposed Outfall Area:
  - Port Facilities Area. Located at, or in proximity to, the Port of Lae, with a site adjacent to Berth 6 (also known as Tanker Berth) nominated as the preferred option. The proposed facilities will include the concentrate filtration plant and materials handling, storage, ship loading facilities and filtrate discharge pipeline.
  - Outfall Area. Located approximately six kilometres east of the port. The proposed facilities will include the Outfall System comprising the mix/de-aeration tank and associated facilities, seawater intake pipelines and subsea outfall pipelines, pipeline laydown area, choke station, access track and parking turnaround area.

The WGJV has commissioned a range of studies to inform the Project's Feasibility Study Update and to prepare an Environmental Impact Statement (EIS).

This report describes the findings of the Terrestrial Flora and Fauna Baseline Assessment – Mine Area to Markham River study. The study area for this report includes the Mine Area and a section of the Infrastructure Corridor between the Mine Area and the Highlands Highway and is described in more detail in **Section 1.2** below. The remainder of the Project Area is subject to a separate terrestrial flora and fauna baseline report prepared by others.

Future development of the Project remains subject to ongoing deep orebody drilling and definition (after underground access has been achieved), technical studies, completion of statutory permitting processes and securing Government and WGJV Participants' approvals.

Engineering design and other studies, including environmental studies, are continuing and there is potential that aspects of the proposed Project design, layout and timetable may change.

1.2 STUDY AREA DESCRIPTION

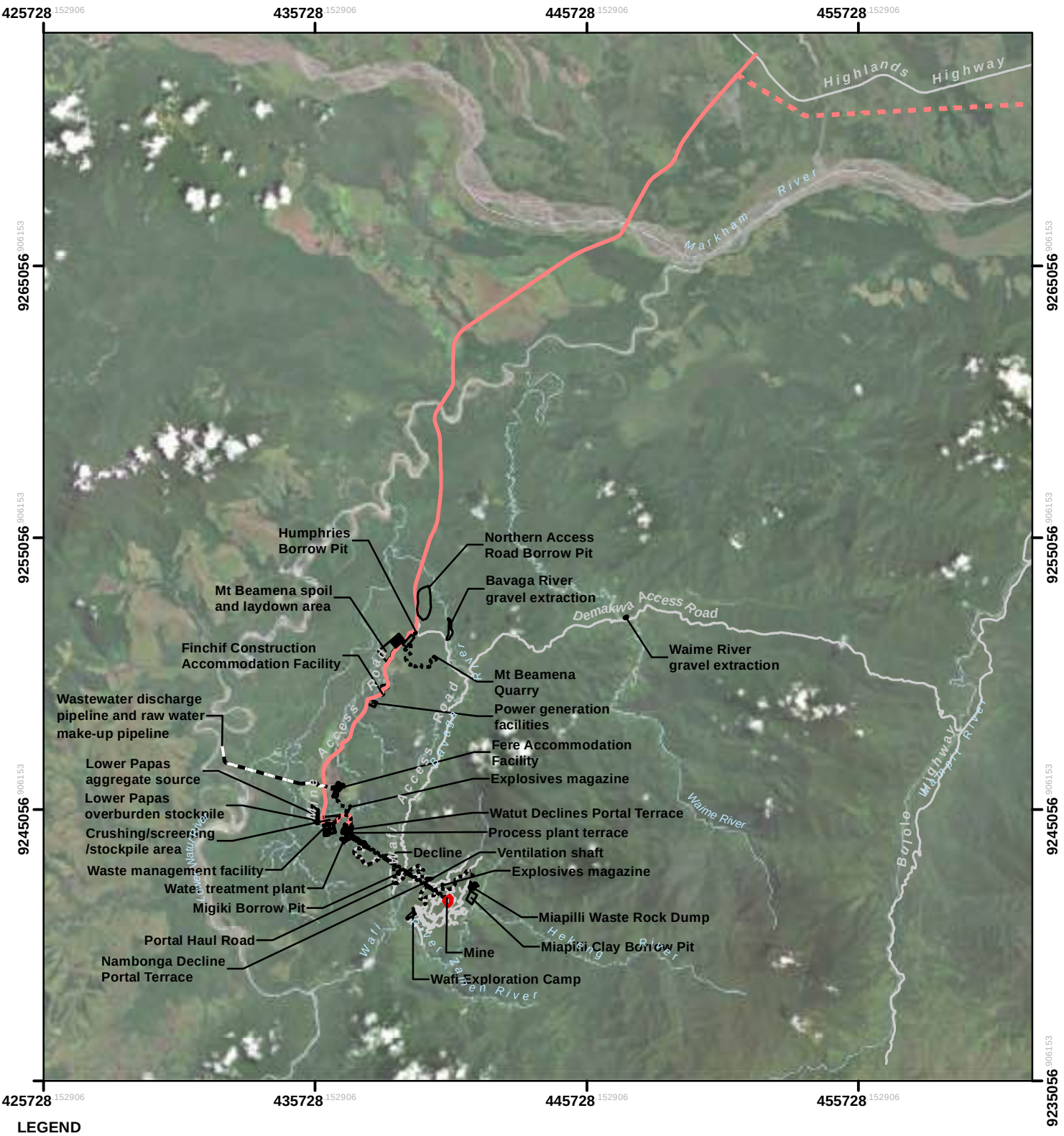
The study area for this report covers an approximately 40 km long (north-south) and 10 km wide area in the lower Watut River valley including the Mine Area and a section of the Infrastructure Corridor between the Mine Area and the Highlands Highway (referred to as the Mine Access Road and Northern Access Road section) (see **Figure 1.1**). This study area is bounded in the west by the meandering channel of the lower Watut River but extends to the western alluvial plain of the lower Watut River from the point that the Infrastructure Corridor crosses the Watut River. It is bounded in the east by the existing entrance road to Wafi Camp from Damakwa via Bavaga. It is bounded to the south by the Wafi River to its confluence with the Watut River and stretches north to the Markham River, together with a portion of the Infrastructure Corridor extending north of the Markham River to the Highlands Highway near Zifasing village.

Photo 1.1. Aerial view from just west of the Finchif Fly Camp looking south over the lower Watut River alluvial plain, with the Watut Valley Road visible at left and the Watut River visible in the top right.

Photo 1.2. Aerial view from Wafi Camp looking south over the Wafi River valley, illustrating a typical steep, forested valley in the study area.

With mean annual rainfall at Wafi Camp of approximately 2,500 mm, ranging from 1,200 mm to 3,440 mm (BMT WBM 2018), the study area is located in one of the drier areas of rainforest in New Guinea (Pratt 1982). The majority of the study area is vegetated with lowland rainforest, ranging from Large Crowned Forest, Mixed Swamp Forest and Swamp Woodland on alluvial floodplains (**Photo 1.1**) to Small Crowned Forest and Medium Crowned Forest on slopes and ridges (**Photo 1.2**).

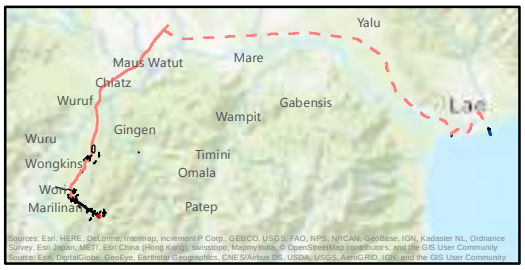
Small, villages are scattered widely on the Watut River alluvial plain and foothill river valleys. The inhabitants of these villages derive most of their food needs from a combination of swidden, or slash and burn, agriculture, the growing of cash crops in more permanent gardens on richer alluvial soils, and fishing and hunting of wild animals in their natural habitats. Swidden agriculture has likely been practiced in the local area for thousands of years (Bowman *et al.* 1990) and is a system that involves alternating clearance of small plots of forest and a short cultivation period with a long fallow period during which forest regrows and soils recover their nutrients. Consequently, forest disturbance is greater in close proximity to villages.



LEGEND

- Existing road network
- Waterways
- Infrastructure corridor (study area)
- Infrastructure corridor (outside of study area)
- Other infrastructure
- Access road
- Waste water discharge pipeline
- Twin declines
- Orebody

0 1 2 3 4
Kilometres
1:200,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55



Drawn By: KM Reviewed by: PL/WB Date: 23/03/2018

Figure:	**1.1**
Title:	Study area (Mine Area and Infrastructure Corridor through to its junction with the Highlands Highway)
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

BAAM ECOLOGICAL CONSULTANTS

1.3 STUDY OBJECTIVES

The principal aim of this study is to describe the baseline terrestrial ecological values in the study area, in particular the vegetation communities and flora and fauna species.

Specific objectives of the study are to:

- Describe the existing baseline terrestrial ecological values and sensitive environmental areas relating to terrestrial flora and fauna for the study area as appropriate for an EIS, including characterisation of vegetation communities (type and condition) and their spatial distribution in the study area, and provide lists of species identified and with the potential to occur in the study area (for each disturbance footprint) with particular focus on species with conservation significance.
- If required, collect or source additional information and data required to complete the baseline assessment.
- Identify any threatened, near-threatened or otherwise noteworthy species and vegetation communities (e.g., listed by the International Union for Conservation of Nature (IUCN) or nationally protected) likely to be present within the study area.
- For species of conservation significance, characterise their conservation status and ecology including locality, distribution, habitat, breeding, recruitment, feeding and movement requirements and seasonal aspects and availability of habitat (including type and distribution), and provide a map of habitats and locations where species of conservation significance were identified.
- Identify any areas of 'critical habitat' in accordance with International Finance Corporation (IFC) *Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management* (IFC 2012a, 2012b).
- Describe the baseline conditions for weed and invasive species in the study area.

1.4 LEGISLATIVE AND REGULATORY OVERVIEW

1.4.1 National legislation

The 1975 *National Constitution* of PNG declares as its fourth National Goal and Directive Principle the objective of conserving the country's natural resources and environment for the collective benefit of society and of future generations. The following PNG environmental legislation can be considered key national mechanisms for achieving this goal.

Environment Act 2000: *The Environment Act (2000)*, which repeals the Environmental Planning Act 1978, is the primary environmental legislation in PNG. The Act provides for protection of the environment in accordance with the fourth National Goal and Directive Principle (National Resources and Environment) of the PNG Constitution as well as regulating the environmental impacts imposed by development activities. The principal objective of the Act is to protect the environment from harm and in doing so, safeguard the life-supporting capacity of air, water, soil and ecosystems for present and future generations. It also pertains to preservation of PNG traditional social structures. The approval process for projects that are required to submit detailed biological, social and cultural assessments (as an EIS) setting out the implications of the development proposal is subject to approval by a 'Director of Environment' duly appointed for the purposes of this Act.

The National Parks Act 1982: *The National Parks Act 1982 a*nd National Parks Regulation 1984 relate to the conservation, management and development of sites, areas and buildings with particular significance whether of biological, topographical, geological, historical, scientific or social importance. National parks, reserves and sanctuaries are managed under this Act by the Director of National Parks for the protection of flora and fauna.

Conservation Areas Act 1978: Conservation and management of sites, areas and buildings of environmental and national cultural inheritance may also be enacted under the *Conservation Areas Act 1978.* This law relates to matters of national interest. A National Conservation Council advises the Minister on relevant matters, including criteria for recommendations on conservation areas, and development proposals affecting or in the vicinity of a conservation area or proposed conservation area. Conservation areas are managed by a Conservation Area Management Committee that reflects the interests of local landowners and the Provincial Government, Local-level Government or Local-level Government Authority.

Fauna (Protection and Control) Act 1966: The *Fauna (Protection and Control) Act 1966* allows for the systematic protection and management of PNG's fauna allowing for the establishment of Wildlife Management Areas. Activities in these areas relate strictly to the management of fauna unlike the Conservation Areas which may relate to protection of a range of cultural and natural resources.

PNG International Trade (Fauna & Flora) Act 1979: PNG became a signatory in 1976 to the international intergovernmental agreement CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). This agreement is designed to regulate international trade in threatened species in order to prevent over-exploitation, and lists in its Appendices relevant species recommended for protection. The PNG *International Trade (Fauna & Flora) Act 1979* and associated Regulations implements this commitment through the Management authority and the Scientific authority and by controlling and regulating the trade, possession, transport, exportation and importation of regulated species.

The Forestry Act 1991: The *Forestry Act 1991* relates to the management, development and protection of forest resources and environments as a renewable asset for succeeding generations whilst contributing to the Nation's economic growth, employment creation, and processing of forest resources. Scientific study and research into forest resources is encouraged to contribute to a sound ecological balance. Under the Act, Government land may be dedicated as a National Forest, and trees or members of any species or class of trees may be declared as reserved trees. The PNG Forest Authority is responsible for implementation of the Act, for providing advice to the Minister on forest policies and legislation, and for the preparation and review of the National Forest Plan. Each Provincial Government is responsible for preparation of a Provincial Forest Plan. The Act entitles the State (the Forest Authority) to enter into Forest Management Agreements with landowners and for the National Forest Board to recommend to the Minister on appropriate logging companies, and timber permits and licenses.

Land tenure: In PNG, almost all land (97%) is privately owned by local kinship groups (clans) under traditional land tenure systems, and with respect for customary land rights guaranteed under the National Constitution (Holzknecht 1994). The *Land Groups Incorporation Act 1974* recognises customary land-holding groups (legally identified as incorporated land groups, ILGs) and establishes local community control over land and resources. The ILG process proceeds via consultation among members and consultation and cooperation with incorporated land groups in the same community. Resources tend to be owned by groups but some rights are held by individuals, such as ownership of economic or other valuable trees (Holzknecht 1994).

Less than 2.8% of PNG has formal protected area status, and 80% of the protected areas comprise only three sites on the mainland with most of the others being small, fragmented and poorly managed. Wildlife Management Areas (i.e. provincial parks and local parks) are managed by the National Parks Board under local Land Use Management Plans for the management of specific wildlife and to prevent over-exploitation.

1.4.2 International agreements

Papua New Guinea is a signatory to a number of international conventions and treaties associated with the conservation of terrestrial biodiversity. These include:

- the *Convention on Biological Diversity*, dedicated to promoting sustainable development through the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources;
- the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), which aims to ensure international trade in specimens of wild animals and plants does not threaten their survival;
- the *Ramsar Convention on Wetlands of International Importance* (Ramsar convention), which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources;
- the *International Plant Protection Convention* (IPPC), which aims to secure coordinated, effective action to prevent and control the introduction and spread of pests of plants and plant products; and
- the *Convention on Conservation of Nature in the South Pacific* (APIA Convention), a partnership among nations in the Oceania region dedicated to taking action for the conservation, utilisation and development of the natural resources of the South Pacific region through careful planning and management for the benefit of present and future generations; however, the operation of this convention has been suspended since 2006.

CITES identifies two categories of species affected by trade:

- species listed under Appendix I of CITES as species threatened with extinction which are or may be affected by trade; and
- species listed under Appendix II of CITES as species which, although not necessarily now threatened with extinction, may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilisation incompatible with their survival.

PNG currently has two wetlands listed under the Ramsar Convention, Lake Kutubu in Southern Highlands (4924 ha, 06º25'S 143º20'E) and Tonda Wildlife Management Area in Western Province (590 000 ha, 08º45'S 141º23'E; Ramsar Convention Secretariat 2014).

1.4.3 International Finance Corporation (IFC)

The International Finance Corporation (IFC) has developed eight Environmental and Social Performance Standards that define IFC clients' responsibilities for managing the environmental and social risks of projects receiving financing from the IFC (IFC 2012a). The IFC performance standards on social and environmental responsibility also support the Equator Principles (EPs), a credit risk management framework for determining, assessing and managing environmental and social risk in project finance transactions to fund the development and construction of major infrastructure and industrial projects. IFC *Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management* (IFC Performance Standard 6) recognises three different types of biodiversity habitats (see **Section 1.5.4**).

1.5 CONVENTIONS USED

1.5.1 Global conservation status

The conservation status of a species is an indicator of how likely the species is to become extinct in the near future. Species at higher risk of extinction are said to have a higher conservation status. The IUCN is the world's principal authority on the conservation status of species. The IUCN Red List of Threatened Species is the world's most comprehensive information source on the global

conservation status of wild species and their links to livelihoods. The IUCN Red List uses standardised criteria to evaluate the extinction risk of species and subspecies (collectively called taxa), recognising seven extinction risk categories, as summarised in **Table 1.2** below.

The IUCN Red List may also categorise a taxon as either Not Evaluated, when it has not yet been evaluated against the criteria listed in **Table 1.2**, or Data Deficient, when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. Data Deficient is therefore not a category of threat. Species listed as Critically Endangered, Endangered or Vulnerable are collectively referred to as threatened species.

Table 1.2. IUCN Red List categories of risk of extinction (IUCN 2012).

Category	Explanation
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range.
Critically Endangered (CR)	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild (probability of extinction in the wild is at least 50% within 10 years or three generations).
Endangered (EN)	A taxon is Endangered when it is facing a very high risk of extinction in the wild (probability of extinction in the wild is at least 20% within 20 years or five generations).
Vulnerable (VU)	A taxon is Vulnerable when it is facing a high risk of extinction in the wild (probability of extinction in the wild is at least 10% within 100 years).
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.
Least Concern (LC)	A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

1.5.2 National conservation status

The PNG *Fauna (Protection & Control) Act 1966* (Fauna Act) recognises two categories of conservation status for fauna species:

- Protected (P): species that are declared protected; and
- Restricted (R): species that are not declared protected but are restricted for trade because of international market demand and traditional utilisation within PNG.

1.5.3 Conservation significant species

In the context of the EIS process in Papua New Guinea, species of conservation significance for the purpose of this assessment are considered to include:

- species of international conservation significance, listed as threatened (critically endangered, endangered or vulnerable) or near threatened in the IUCN Red List;
- species of international conservation significance, listed under Appendix I of CITES as species threatened with extinction that are, or may be, affected by trade;
- species of national conservation significance, listed under the PNG *Fauna (Protection & Control) Act 1966* (Fauna Act) as protected or restricted; and
- new or undescribed species known only from the study area.

1.5.4 IFC habitat types and critical habitat assessment criteria

The IFC Performance Standard 6 classifies habitats as (IFC 2012b,c):

- **Modified habitat**: areas that may contain a large proportion of plant and/or animal species of non-native origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition.
- **Natural habitat**: areas composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition.
- **Critical habitat**: areas with high biodiversity value that satisfy one or more of the following criteria:
  - Criterion 1: habitat of significant importance to species listed as Critically Endangered or Endangered on the IUCN Red List of Threatened Species;
  - Criterion 2: habitat of significant importance to endemic and/or restricted-range species;
  - Criterion 3: habitat supporting globally significant concentrations of migratory species and/or congregatory species (e.g. cave-dwelling bats);
  - Criterion 4: highly threatened and/or unique ecosystems; and/or
  - Criterion 5: areas associated with key evolutionary processes.

IFC Guidance Note 6 (IFC 2012c) recognises gradients in critical habitat, and makes a distinction between Tier 1 and Tier 2 critical habitat for each of Criteria 1 through 3, as outlined in **Table 1.3** below.

Table 1.3. Summary of criteria for categorising Tier 1 and Tier 2 critical habitat (IFC 2012c).

Criteria	Tier 1 critical habitat characteristics	Tier 2 critical habitat characteristics
Criterion 1: Critically Endangered (CR) and Endangered (EN) species	Habitat required to sustain ≥ 10 percent of the global population of a CR or EN species where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species. Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.	Habitat that supports the regular occurrence of a single individual of an IUCN Red-listed CR species and/or habitat containing regionally-important concentrations of an IUCN Red-listed EN species where that habitat could be considered a discrete management unit for that species. Habitat of significant importance to CR or EN species that are wide-ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species. As appropriate, habitat containing nationally/regionally-important concentrations of an EN, CR or equivalent national/regional listing.
Criterion 2: Endemic[1] and Restricted-range[2] species	Habitat known to sustain ≥ 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species (e.g. a single-site endemic).	Habitat known to sustain ≥ 1 percent but < 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment.

Criteria	Tier 1 critical habitat characteristics	Tier 2 critical habitat characteristics
Criterion 3: Migratory and Congregatory species	Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 95 percent of the global population of a migratory or congregatory species at any point of the species' life-cycle where that habitat could be considered a discrete management unit for that species.	Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent but < 95 percent of the global population of a migratory or congregatory species at any point of the species' life-cycle and where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment. For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for identifying Wetlands of International Importance. For species with large but clumped distributions, a provisional threshold is set at ≥5 percent of the global population for both terrestrial and marine species. Source sites that contribute ≥ 1 percent of the global population of recruits.

[1] An endemic species has ≥ 95 percent of its global range inside the country or region of analysis.
[2] A restricted-range species is defined as: (a) for terrestrial vertebrates: a species with an extent of occurrence of 50,000 km^2 or less; or (b) for terrestrial plants: an endemic species.

IFC Guidance Note 6 defines a highly threatened or unique ecosystem as one that: (1) is at risk of significantly decreasing in area or quality e.g. is losing a high percentage of its area each year; (2) has a small spatial extent; and/or (3) contains unique assemblages of species including assemblages or concentrations of biome-restricted species (IFC 2012c). It further outlines that ecosystems are typically classified and mapped at specific scales with a focus on vegetation structure and composition, land cover, and key abiotic factors, and that the prioritisation of highly threatened or unique ecosystems should employ similar factors to those used for the IUCN Red List of Threatened Species, including long-term trend, rarity, ecological condition, and threat (IFC 2012c). The IUCN Commission on Ecosystem Management has developed guidelines for the application of IUCN Red List of Ecosystems Categories and Criteria to assess the extinction risk and conservation status of ecosystems (Rodriguez *et al.* 2015, Bland *et al*. 2017). The development of the IUCN guidelines was informed by, and is therefore very similar to, an empirical guideline for the assessment of threatened ecological communities in Australia (TSSC 2013). The latter guideline is considered to have greater relevance to the data available to the present study; therefore, it informed the assessment of the extinction risk of vegetation communities present within the study area. This guideline assesses the risk of extinction of vegetation communities on the basis of one or more of six different criteria, as outlined in **Table 1.4** below. In accordance with Rodriguez *et al.* (2015) and Bland *et al*. (2017), the highest category obtained by any of the assessed criteria will be the overall status of the ecosystem. The extinction risk categories of Critically Endangered and Endangered are considered in this assessment to be aligned with IFC critical habitat Criterion 4, as this is consistent with the both the definition of a highly threatened ecosystem under IFC Guidance Note 6 and the categories used for IFC critical habitat Criterion 1.

Table 1.4. Summary of criteria for assessing the extinction risk of vegetation communities (reproduced from TSSC 2013).

	Extinction risk category		
Criterion	**Critically Endangered**	**Endangered**	**Vulnerable**
1) Its decline in geographic distribution is any of:	very severe[1]	severe[2]	substantial[3]
a) Decline relative to the longer-term (beyond 50 years ago e.g. since 1750); or,	≥90%	≥70%	≥50%
b) Decline relative to the shorter-term (past 50 years).	≥80%	≥50%	≥30%
2) Its geographic distribution is:	very restricted[4]	restricted[5]	limited[6]
and the nature of its distribution makes it likely that the action of a threatening process could cause it to be lost in:	the immediate future[7]	the near future[8]	the medium-term future[9]
3) For a population of a native species that is likely to play a major role in the community, there is a:	very severe decline[10]	severe decline[11]	substantial decline[12]
to the extent that restoration of the community is not likely to be possible in:	the immediate future[7]	the near future[8]	the medium-term future[9]
4) The reduction in its integrity across most of its geographic distribution is:	very severe[13]	severe[14]	substantial[15]
as indicated by degradation of the community or its habitat, or disruption of important community processes, that is:	very severe[13]	severe[14]	substantial[15]
5) Its rate of continuing detrimental change is:	very severe	severe	substantial
as indicated by: (a) rate of continuing decline in its geographic distribution, or a population of a native species that is believed to play a major role in the community, that is:	very severe[1,10]	severe[2,11]	serious[3,12]
or (b) intensification, across most of its geographic distribution, in degradation, or disruption of important community processes, that is:	very severe[13]	severe[14]	serious[15]
6) A quantitative analysis shows that its probability of extinction, or extreme degradation over all of its geographic distribution, is:	at least 50% in the immediate future[7]	at least 20% in the near future[8]	at least 10% in the medium-term future[9]

[1] An estimated decline of at least 80% over the last 50 years or at least 90% since 1750.
[2] An estimated decline of at least 50% over the last 50 years or at least 70% since 1750.
[3] An estimated decline of at least 30% over the last 50 years or at least 50% since 1750.
[4] Very restricted means: a total area of occupancy of less than 10 km^2 (1,000 ha); or a total extent of occurrence less than 100 km^2 (10,000 ha); or an average patch size of less than 0.1 km^2 (10 ha).
[5] Restricted means: a total area of occupancy of less than 100 km^2 (10,000 ha); or a total extent of occurrence less than 1,000 km^2 (100,000 ha); or an average patch size of less than 1 km^2 (100 ha).
[6] Limited means: a total area of occupancy of less than 1,000 km^2 (100,000 ha); or a total extent of occurrence less than 10,000 km^2 (1,000,000 ha).
[7] Immediate future means: the next 10 years, or 3 generations of any long-lived or key species believed to play a major role in sustaining the community, whichever is the longer, up to a maximum of 60 years.
[8] Near future means: the next 20 years, or 5 generations of any long-lived or key species believed to play a major role in sustaining the community, whichever is the longer, up to a maximum of 100 years.
[9] Medium-term future means: the next 50 years, or 10 generations of any long-lived or key species believed to play a major role in sustaining the community, whichever is the longer, up to a maximum of 100 years.
[10] An estimated population decline of at least 80% over the last 10 years or 3 generations, whichever is longer.
[11] An estimated population decline of at least 50% over the last 10 years or 3 generations, whichever is longer.
[12] An estimated population decline of at least 20% over the last 10 years or 3 generations, whichever is longer.
[13] Restoration is unlikely within the immediate future, even with positive human intervention.
[14] Restoration is unlikely within the near future, even with positive human intervention.
[15] Restoration is unlikely within the medium-term future, even with positive human intervention.

1.5.5 Taxonomy and nomenclature

The following authorities have been followed with respect to the taxonomy (classification, identification and nomenclature of currently recognised species) and common names of species within the main terrestrial vertebrate fauna groups:

- **Mammals**: The IUCN Red List nomenclature (IUCN 2015).
- **Birds**: The International Ornithologists' Committee/Union (IOC) checklist of world bird species (Gill and Donsker 2017).
- **Herpetofauna** (reptiles and frogs): The IUCN Red List nomenclature (IUCN 2015), modified by recent taxonomic revisions, including Oliver *et al.* (2015).

1.5.6 Likelihood of occurrence

The likelihood of occurrence in the study area of species of conservation significance was assessed through integration of the following sources of information:

- database search results and the results of any previous surveys of the study area that identify whether there are records of the species in the study area or nearby;
- review of the published literature pertaining to the known distributions and habitat requirements of the species; and
- field survey and habitat assessment results and professional experience.

Based on the above, the criteria and categories used in the likelihood of occurrence assessment are summarised in **Table 1.5.**

Table 1.5. Criteria and categories used to assign likelihood of occurrence of species in the study area.

Likelihood of occurrence in the study area	Explanation
Known	The species was detected during field assessment, or is known from past surveys in the study area and is not now considered locally extinct.
Likely	A medium to high probability (40% or greater probability of occurrence) that the species occurs in the study area or visits the study area because suitable habitat occurs, the study area is within the known distribution of the species, there are records of the species in the vicinity of the study area, and the species is not now considered locally extinct.
Potential	Either: (a) there are no past records of the species in the vicinity of the study area but suitable habitat occurs and there is insufficient information on the distribution of the species (e.g. it is naturally rare and difficult to detect, or there has been insufficient survey effort) to categorise the species as likely or unlikely to occur; or (b) there are past records of the species in the vicinity of the study area but habitat in the study area is marginal or spatially limited meaning that the species' presence on the study area would be transitory at best.
Unlikely	A low probability (less than 40% probability of occurrence) that the species occurs in the study area because suitable habitat does not occur, the study area is outside the known distribution of the species, there are no records of the species in the local region despite adequate survey effort, the species is considered locally extinct, or the species has not been observed despite sufficient spatial and temporal survey effort for detecting the species.

2.0 TERRESTRIAL FLORA METHODS

2.1 DESKTOP ASSESSMENT

The purpose of the desktop assessment was to undertake literature searches, searches of IUCN and other biodiversity databases, and review of previously conducted terrestrial ecology studies for the Project and any other available studies for the local area to:

- summarise all existing terrestrial flora information for the study area and surrounds; and
- identify data gaps in the previous surveys in order to inform the planning and scope of the current field surveys.

The gap analysis included evaluation of the need for targeted searches of conservation-significant species identified as potentially occurring in the study area, in the context of the extent to which regional data are available and the current understanding of the distribution range of conservation-significant species. The desktop assessment included a review of the following literature and databases:

- International databases including the IUCN Red List of Threatened Plants (IUCN 2015).
- International conservation assessments undertaken by non-government organisations, including the World Wildlife Fund (WWF).
- National databases including the PNG Plants Database (Conn *et al.* 2006), spatially referenced records of PNG plants records held by the Queensland Herbarium (Queensland Herbarium 2015), Lae Herbarium and PNGs Forest Inventory Mapping System (FIMS) (Hammermaster and Saunders 1995).
- Descriptive texts relevant to flora and landscape, including Paijmans (1975), Paijmans (1976), Whitmore (1984), Conn (1995), and Womersly (1978).
- Academic research papers relevant to floristic taxonomy and botanical survey, both in the study area and the broader PNG environs.
- Previous floristic assessments undertaken for the Project including Booyong Forest Science (2011a, 2011b and 2013).

2.2 CLASSIFICATION OF VEGETATION COMMUNITIES

A hierarchical approach is applied to the classification of habitats, land and associated vegetation within this report. The different classification categories are defined as:

- **Broadest scale (global):**– Terrestrial ecoregions. Ecoregions define distinct ecosystems that share broadly similar environmental conditions and natural communities (Wikramanayake 2002). Ecoregions are defined at 1:1 000 000 scale.
- **National / regional scale:**– Forest Inventory Mapping System (FIMS) vegetation types. Vegetation is described with reference to the national scale vegetation mapping produced at 1:250 000 scale by Hammermaster and Saunders (1995). Provides context to the finer scale vegetation community mapping undertaken in this study.
- **Local scale:**– Vegetation community mapping. Vegetation mapping produced specifically for the purpose of this study at a scale of 1:50 000. A vegetation community is best described as a unit of vegetation that demonstrates similarities in both structure and floristic composition. Vegetation communities are used to describe fine scale variation in floristic composition that may not be apparent at broader scale (global and national) mapping such as FIMS.

For the purpose of regional consistency, the field characterisation of vegetation and description of vegetation communities is based on the classification of Paijmans (1976), which provides the basic framework for vegetation assessment within PNG and recognises distinctive forest types based on geographic distribution and environment. The major subdivisions of relevance to this assessment are:

- Lowland freshwater swamps;
- Lowland alluvial plains and fans; and
- Foothills and mountains below 1,000 m ASL.

These forest types are further subdivided into a number of distinctive and consistently recognised vegetation types.

2.3 CLASSIFICATION OF VEGETATION CONDITION

A specific descriptor of vegetation condition has been applied which recognises different categories of vegetation condition based on the structural integrity of vegetation communities. The different categories of vegetation condition were then related to the IFC Performance Standard 6 habitat classifications. The condition classification specifically aims to identify those habitats that have been subject to minimal human intervention, thus demonstrating a high degree of 'intactness'. Additional categories identify varying levels of disturbance ranging from partial clearing or thinning of natural vegetation to complete clearing and/or vegetation dominated by planted gardens or invasive exotic species. The classification of vegetation condition used in this assessment is described in **Table 2.1.**

Table 2.1. Habitat condition categories applied to vegetation communities.

Condition category	Description of condition	IFC Performance Standard 6
1 (Intact)	The vegetation community exists in unmodified condition. No structural disturbance of canopy, sub-canopy or ground cover layers is evident. Some selective harvesting of poles or timber species may have occurred although this is minor in nature and has not compromised structural integrity of the vegetation community.	Natural Habitat
2 (Moderately disturbed)	The vegetation community has been subject to structural modification, resulting in a general reduction in forest stature and complexity. A sub-set of the original floristic diversity is retained within the habitat and small vestiges of unmodified habitat may remain. Habitats within this condition category are generally derived from severe thinning and harvesting of forest products.	Natural Habitat
3 (Degraded)	Secondary forest composed of native pioneer species in which the structure and floristic assemblage of the original forest has been destroyed through prior complete clearing or long term continuous disturbances. Condition Category 3 also includes modified habitats composed of native species that have had long term stability through regular intervention by man (e.g. Kunai Grassland that represents rainforest transformed to grassland through a long history of regular burning).	Modified Habitat
4 (Highly modified)	Modified habitats generally comprising a mix of native and exotic food plants, garden plants and also weeds. Includes maintained and abandoned garden areas with large areas of the latter occupied by the invasive pest plants such as *Piper aduncum.*	Modified Habitat

2.4 FIELD SURVEY

2.4.1 Survey timing and team

Three phases of field survey were undertaken during 2015:

- an initial survey phase over 15 field days between 24 March and 7 April 2015 that focused on the study area as a whole;
- a follow-up survey over five field days from 16 to 20 July 2015 that focused on infrastructure areas and a potential Northern Access Road alignment along the western boundary of the Markham Gap Basin; and
- a survey over five field days from 24 to 28 September 2015 that focused on a revised alignment of the Northern Access Road.

The first two field surveys were conducted by a specialist botanist (David Fell) and landscape ecologist (David Stanton), whereas the third survey was conducted by David Stanton with David Fell providing assistance with later identification of plant specimens. Additional field assistance during all surveys was provided by WGJV staff, in particular Tei Ans, who assisted the flora survey team throughout the survey duration. Field access was gained by a combination of vehicle, foot traverse and helicopter for inaccessible locations.

2.4.2 Survey site selection

Satellite imagery was reviewed prior to field survey to target representative habitats contained within project footprint areas. This provided a preliminary understanding of field conditions and provided an opportunity to select sites suitable for on ground survey. The imagery review allowed a suite of representative survey sites to be selected for inspection to ensure the field survey:

- targeted a representative range of habitats within the project area;
- sampled those communities that were useful as providing reference condition for disturbed communities (i.e. best type examples); and
- directed detailed sampling towards those communities that might be critical to a range of ecologically significant species or those with particular conservation significance.

Selection of field survey sites also considered the proposed infrastructure layout to ensure areas of potential impact were adequately described and categorised. Due to the considerable length (approximately 25 km) and inaccessible nature of potential routes for the Northern Access Road, sampling on some sections of the potential alignment was limited to several locations where representative habitats could be accessed. Floristic sampling focused on intact habitats (Condition Category 1) as these possessed the greatest likelihood of hosting significant biodiversity values. Representative survey sites were also placed within degraded and highly modified habitats to aid habitat description and identify significant weed species.

2.4.3 Aerial reconnaissance and field assessment

Prior to on ground assessment, a helicopter fly-over of the project site was undertaken to refine survey site selection and provide an aerial overview to assist vegetation community mapping. At each field survey site examined on the ground, core field information collected included location, landform and geological features, vegetation height and structure as well as forest basal area and species composition. A Garmin GPS 60 (Geographic Positioning System) was used to accurately record coordinates for site locations (WGS 84).

Field survey sites were stratified into two levels of survey intensity: secondary (detailed); and quaternary (descriptive) sites. Secondary sites were completed as a comprehensive collection and identification of all canopy species recorded in a plot-less sweep of a basal area gauge recorded from a fixed central point. A floristic inventory was undertaken within each secondary survey location, with botanical vouchers of fertile material (flowers and fruits) collected comprehensively throughout all structural layers within the general site vicinity to assist species identification and assessment of floristic diversity. Quaternary sites involved recording forest structure supplemented with a search for IUCN listed flora species and any plants with fertile material for collection. In general, each secondary survey site took two to three hours to complete whereas each quaternary site took from 10 to 30 minutes to complete.

The collection of fertile material of species within canopy, sub-canopy and shrub layers is broadly consistent with survey procedures of Takeuchi (2002). The collection of non-fertile vouchers was restricted to potential IUCN species or those species where vegetative material may be particularly diagnostic, although the confidence in regard to positive identification of these vouchers to genus and species level is considered to be low. Voucher specimens were labelled, treated with 70% ethanol and submitted to the PNG National Herbarium in Lae. Duplicate samples were imported under Australian Department of Agriculture Permit to Import Quarantine Material under the *Quarantine Act 1908* Section 13(2AA) for submission to the Queensland Herbarium for identification.

3.0 TERRESTRIAL FAUNA METHODS

3.1 DESKTOP ASSESSMENT

The purpose of the desktop assessment was to undertake literature searches, database searches of IUCN and other biodiversity databases such as that of the Bishop Museum, and review previous terrestrial ecology studies for the broader Project and any other available studies for the local area to:

- summarise all existing terrestrial vertebrate fauna information for the study area and surrounds; and
- identify data gaps in the previous surveys in order to inform the planning and scope of the current field surveys.

The gap analysis included evaluation of the need for targeted searches of conservation-significant species identified as potentially occurring in the study area, in the context of the extent to which regional data are available and the current understanding of the distribution range of conservation-significant species.

3.2 FIELD SURVEY

3.2.1 Survey timing and team

Two terrestrial fauna field surveys were undertaken during 2015. The first field survey was undertaken over 21 days from 24 March to 13 April 2015 by a team of two experienced fauna ecologists, Terry Reis and Dr Penn Lloyd. This survey focused on the whole of the study area and involved the following phases:

- A reconnaissance of the study area via a guided driven tour of the proposed Project infrastructure sites, together with a half-hour overflight of the study area via helicopter on 24 March.
- Observational ground surveys of hill forest in the Watut Declines Portal Terrace area (1 day), accessed via road, and alluvial forest on two sites along a potential Northern Access Road alignment (Waime River and Chiatz; 2 days), accessed via helicopter, on 25 to 27 March.
- A general fauna trapping and observational survey centred on hill forest in the Watut Declines Portal Terrace area and Kunai Grassland in the Finchif area over four nights and four days 28th March to 1st April.
- A general fauna trapping and observational survey centred on alluvial and swamp forest at the southern end of the proposed Northern Access Road alignment over four nights and four days 2 to 6 April.
- A mist-netting and observational survey to confirm the identity of a potential new species of scrubwren reported by a previous survey of the study area (Woxvold and Aplin 2013) over six days 8 to 13 April, which surveyed areas of hill forest in the upper Buvu Creek catchment and the Watut Declines Portal Terrace area, and alluvial forest at the entrance to the Watut Declines Portal Terrace area.

The second survey focused on a revised alignment for the Northern Access Road and was undertaken over five days (24-28 September 2015) by Dr Penn Lloyd. This survey involved the following phases:

- A reconnaissance of a revised alignment for the Northern Access Road via a quarter-hour overflight of the study area via helicopter on 24 September, as well as during later helicopter overflights.

- Observational ground surveys (during daylight hours) at five different locations along the revised alignment for the Northern Access Road, accessed via helicopter, on 24-28 September.

The field surveys were conducted with the support of WGJV staff and local residents, particularly Alan Levi, Tei Ans, Manase Yangueng, David Bola and Jerry Mugu, with field activities coordinated by David Bola and Inoya Haguna.

3.2.2 Survey site selection

The selection of survey sites aimed to:

- provide a survey of sites representative of the different fauna habitat types within the study area;
- provide a survey of fauna habitats within or as close as possible to areas that may be directly or indirectly impacted by the Project; and
- fill gaps in previous survey coverage of the study area, particularly in relation to revised Project infrastructure designs.

3.2.3 Bird surveys

Birds were surveyed by walking slowly along survey trails that followed existing road tracks or forest interior walking trails to maximise the detectability of birds with minimal noise disturbance. Extra time was spent in the vicinity of flowering or fruiting trees that are particularly attractive to foraging birds. Birds were identified through visual observation using high-quality Swarovsky and Leica binoculars or by the characteristic calls of different species. Call recognition in the field was assisted through the use of a digital call library of most birds with potential to occur in the study area loaded on an iPhone 5. The call library included calls sourced from xeno-canto, an online repository of bird call recordings from around the world. To facilitate the detectability of shy, cryptic or rare species, call playback of calls of these species was undertaken using a portable speaker blue-toothed to the iPhone 5. Bird surveys were conducted primarily within the first four hours of sunrise, when bird activity is greatest, but also opportunistically at intervals throughout the day. Nocturnal birds were targeted during night-time spotlighting surveys (see **Section 3.2.7**). A cumulative species list was maintained for each hour of survey effort.

The targeted survey for *Sericornis* scrubwrens in the third week of the first survey combined observational surveys with mist-netting in likely habitat areas. The mist-netting first targeted the location (upper Buvu Creek catchment) where two scrubwrens were observed during a previous survey of the study area. Once scrubwrens had been observed and subsequently captured at this location, other sites in hill and alluvial forest in the Watut Declines Portal Terrace area were targeted, particularly the location where a scrubwren was heard but not seen in an earlier phase of the general fauna survey. At each site, a total of seven mist-nets, each 9-12 m long and 3 m high, were set up, supported by cut tree saplings anchored with strings. Once unfurled, nets were checked at intervals of half an hour to an hour to remove any trapped birds. Trapped birds were removed and placed individually in cloth bags until they were measured, weighed, photographed and released.

3.2.4 Herpetofauna (frogs and reptiles) ground searches

Reptiles were surveyed through active searching during the warmer parts of the day when reptile activity is greatest, and opportunistically whenever reptile movement was detected while undertaking other survey activities. Active searching focused particularly on sunlit patches of leaf litter, hunting trail edges and lower tree trunks that attract sun-bathing reptiles. Nocturnal reptiles were surveyed during night-time spotlighting surveys (see **Section 3.2.7**). Wherever possible, multiple photographs were taken of all reptiles seen and captured to facilitate identification.

Frogs were surveyed during night-time nocturnal surveys (see **Section 3.2.7**), focused particularly on walking along fast-flowing mountain creeks and the vicinity of standing pools of water in alluvial forest and grassland swamps.

3.2.5 Small-mammal trapping surveys

Metal box traps were deployed to survey for small mammals (rodents and marsupials to the size of bandicoots) at three locations in different habitat types: in hill forest at the Watut Declines Portal Terrace, in Kunai Grassland in the Finchif area, and in alluvial and adjoining foot-slope forest at the southern end of the proposed Northern Access Road. A total of between 25 and 50 Elliott type 'A' traps and between nine and 18 Elliott type 'B' traps were installed over four consecutive nights at each survey site. Traps were placed on the ground or on fallen tree trunks, in locations close to tree hollows, burrows or ground cover (**Photo 3.1**), approximately 10-20 m apart, and baited with slices of uncooked sweet potato. Traps were cleared each morning.

Photo 3.1. Elliott B small mammal trap set near tree hollow.

Photo 3.2. AnaBat bat detector setup in the field.

3.2.6 Camera trapping surveys

Five remote cameras were deployed during each of the two general fauna trapping surveys, over a period of three nights in hill forest at the Watut Declines Portal Terrace area, and a period of four nights in alluvial forest at the southern end of the proposed Northern Access Road. A single camera was also deployed for seven nights in the upper Buvu Creek catchment. The cameras were set in locations where terrestrial mammal and/or bird activity was likely to be greatest, namely in the vicinity of burrows or tree trunk hollows, and on visible animal trails or along likely animal movement corridors. Remote cameras provide an effective survey method for rare and retiring animals, particularly nocturnal mammals and terrestrial birds (Rowcliffe *et al*. 2008, Paull *et al*. 2012). Each camera was tied to a sturdy tree trunk approximately 1-1.5m from the ground, and directed at a point on the ground 2-3m from the camera at which a small amount of rice and/or sliced sweet potato was scattered as bait. The remote cameras comprised three RECONYX HyperFire HC500 cameras (set to high motion detector sensitivity) and two Faunatech Trail Cam KG-680 cameras (set to medium motion detector sensitivity). The cameras were set for 24-hour operation, and set to take three photos at 1-second intervals per trigger, with a 15-second quiet period before being able to respond to additional triggers.

3.2.7 Spotlighting surveys

Night-time spotlighting surveys involved a combination of driving and walking surveys. Driving surveys involved driving slowly (10-30 km/hr) along dirt tracks traversing the study area, searching for animals (particularly reptiles) on the road in the headlights, as well as scanning roadside tree trunks and canopy vegetation on either side of the vehicle with high-powered torches for reflected eye-shine of arboreal mammals, reptiles and birds. Whenever an animal was detected, the vehicle was stopped to investigate the sighting. Walking surveys involved 3-5 team members walking

slowly along vehicle tracks and interior forest hunting trails, searching the ground, tree trunks, understorey and canopy vegetation for the reflected eye-shine of mammals, reptiles, frogs and birds. Spotlighting surveys also included walking up and down fast-flowing mountain streams searching for frogs at the water's edge and along the adjoining banks, and along the edges of alluvial swamps to search for frogs that inhabit standing waters. Frog calls were recorded, and detailed photographs taken wherever possible, to assist identification.

During the walking surveys, birds and frogs were identified from characteristic calls, and call playback of nocturnal bird calls was undertaken in an effort to stimulate responses from the targeted species.

3.2.8 Anabat survey for echo-locating bats

Microbats find their way around at night and locate their prey (typically insects) through echolocation, producing high-frequency calls that are sent out either through the mouth or nostrils. The calls bounce back from surrounding objects and are picked up as echoes by the bat's often enlarged, sensitive ears. Ultrasound detectors, commonly called bat detectors, are used to listen to and record the calls of echo-locating bat species. Echo-locating bats were surveyed using three Anabat II detectors and associated ZCAIM units. Two units, each enclosed within a waterproof housing (**Photo 3.2**), were deployed overnight at different locations to record microbat calls throughout the night, ensuring sampling of peak nocturnal activity periods. A third, handheld unit was used during nocturnal spotlighting surveys to survey for microbat calls during both walking surveys and driving surveys, and to survey bats feeding on insects attracted to the floodlights around Wafi Camp. Stationary Anabat detectors were deployed overnight for a total of 13 nights.

Using appropriate computer software, recorded microbat calls can be viewed as a graphic signature of frequency against time. The shape and duration of the call, and the upper and lower frequencies, all provide information that can be used to distinguish different species by comparing the recorded calls to calls in reference libraries, i.e. libraries of calls recorded from trapped individuals of different species. The Anabat recordings of echolocating bats were sent to Dr Kyle Armstrong (University of Adelaide; South Australian Museum; President, Australian Bat Society, Inc.) for identification and analysis.

3.2.9 Significant ecological features

The field survey also focused on recording the presence of significant ecological features, including:

- **Caves and karst** that might provide roosting and maternity sites for significant concentrations of cave-dwelling bats.
- **Waterbird nesting colonies**, where egrets, herons and other waterbirds gather together to nest.
- **Megapode nest mounds**. Two species of megapode bird occur in the study area, Collared Brush-Turkey (*Talegalla jobiensis*) and New Guinea Scrubfowl (*Megapodius decollatus*). The males of these species construct large mounds of leaf-litter and other decomposing vegetation mixed with loose soil in which females lay an egg every few days. Incubation of the eggs then occurs through the heat generated by the decomposing vegetation. Megapode eggs are large, weighing up to 200 g each and include a large proportion of nutritious yolk. Females may lay between 28 and 50 eggs each year (Coles 1937, Baltin 1969). The mounds are maintained and used by the birds over many years (Jones 1990, Marchant and Higgins 1993). This combination of features means that megapode eggs are valued by local communities as an important source of food, with community members visiting mounds regularly to harvest freshly-laid eggs (Woxvold and Aplin 2013).
- **Display sites for lekking birds-of-paradise**. Mature males of many birds-of-paradise species have long, elaborately shaped and/or brightly coloured feather plumes that enhance their attractiveness to females during the displays the males perform for females during the breeding season (Frith and Beehler 1998). The males usually perform their displays at favoured or

actively maintained display sites, with the males of some species aggregating together in a communal display site called a lek. The elaborate plumes of male birds-of-paradise are prized by local communities for addition to traditional head-dresses used during ceremonial occasions (Sillitoe 1988). As such, hunters develop a detailed knowledge of the locations of birds-of-paradise display sites, particularly the traditional sites of lekking species, where they focus their hunting effort.

3.2.10 Incidental observations

During the survey, fauna observations were continuous and included species records obtained outside the systematic methods of the survey.

3.2.11 General survey considerations

Survey tracks, the locations of survey sites and the locations of all observations of conservation significantspecies and ecological features were recorded via hand-held Garmin GPS.

The daytime weather throughout the March-April 2015 survey period was partly cloudy to fine, with occasional rainfall in the early morning and late afternoon, meaning that very little survey time was lost to inclement weather. There were also regular rain showers during the night, particularly in the first two weeks of the survey, which provided suitable survey conditions for surveying frogs and reptiles at night. The weather throughout the September 2015 survey was partly cloudy to fine, with brief light rainfall on one morning. The study area had received very little rainfall in the two months preceding the September survey, and less than a few millimetres of rainfall occurred during the survey period itself. These prevailing dry conditions were associated with a strong El Nino climate event being experienced across PNG at the time of the survey.

4.0 TERRESTRIAL FLORA RESULTS AND DISCUSSION

4.1 OVERVIEW OF PAPUA NEW GUINEA'S TERRESTRIAL FLORA

At a global level, the ecology of PNG is described in relation to ecoregions which are defined as large areas of land containing a distinct assemblage of natural communities and species with boundaries that approximate the original extent of natural communities prior to major landuse change or disturbance (DEC 2010). The study area falls entirely within the 'Northern Papua New Guinea Lowland Rain and Freshwater Swamp Forest Ecoregion (Terrestrial Ecoregion 123)' as defined by Wikramanyake *et al.* (2002) with the conservation status of natural vegetation within the ecoregion classified as 'Critical – Endangered' (Wikramanyake *et al.* 2002). In addition, the lower Watut River area encompassing the majority of the study area is regarded as a centre of plant biodiversity and endemism described by Davis (1995) as:

> 'A little-known area of lowland swamp and rainforests with populations of the endemic root parasite *Langsdorffia papuana*[1], a genus otherwise known only from Madagascar and Central and South America'.

Papua New Guinea is covered by 28.2 million hectares of rainforest that forms 80% of the country's natural forest estate, and hosts some of the most biologically diverse forests in the world (Davis, 1995). It is one of 17 megadiverse countries in which over 70% of the earth's species occur (Conservation International 2012), and one of the most floristically diverse regions in the world. Conservative estimates are in excess of 15,000 to 20,000 species for the island (Davis 1995; Womersly 1978) with an estimated 2,000 species of orchids alone (Papua New Guinea National Assessment Report 2006) and a high level (60-80%) of species endemism in plants (Johns 1993, Davis 1995). It is estimated that 6% of the world's flora species occur in PNG (DEC 2010). Nevertheless, floristically PNG remains one of the most inadequately surveyed nations in Malesia (south-east Asia, northern Australia across to the western Pacific islands), meaning that floristic knowledge of the country is substantially incomplete (Takeuchi and Golman 2001, Takeuchi 2003).

The poorly surveyed nature of PNG is a result of previous floristic surveys that have been largely 'expedition based' or concentrated on collection within a single locality within a constrained time period (Takeuchi 2003). The uneven distribution of these expedition localities across the landscape has resulted in many areas within the country which are largely unexplored. Lowland habitats are generally under-sampled and, as a general rule, the density of floristic sampling increases with altitude and decreases from east to west across the cordillera (Takeuchi 2001, 2003). Due to uncomfortable survey conditions and health risks, lowland habitats are extremely poorly sampled relative to other areas within PNG despite being the most threatened habitats due to a concentration of anthropogenic activity. There are few surveys from which floristic information relating to the study area, and lowland habitats in general, can be directly drawn, and only a limited number of studies which are considered relevant, with these requiring considerable extrapolation of survey results. A floristic survey of the Josephstaal Forest Management Area (Takeuchi 2000), 250km north of the study area, provides one of the few insights into the floristic composition of lowland forests in the region. Further information on flora distributions can be obtained from herbarium collection records sourced from a range of collectors and held within the Lae National Herbarium and the Queensland Herbarium in Brisbane.

PNG forests tend to have moderate to high biodiversity with endemism increasing with altitude (Miller *et al.* 1994b). Takeuchi and Golman (2001) note that whilst certain mountainous areas are hotspots for floristic endemism, incomplete data means that it is impossible to identify low level centres of endemism. Regional studies do however indicate the lowland-montane ecotone (600 to 1,000m altitude) attains the highest floristic development (Takeuchi and Golman 2001) with lowland habitats possessing a less abundant floristic composition, although this may in part be due historical sampling biases.

[1] Geesink 1972 reports collections of *Langsdorffia papuana* at 1,500m elevation in *Nothofagus* dominated forest.

It should also be noted that whilst northern PNG environments are considered a stronghold of Melanesian endemism (Balgooy *et al.* 1996), the number of geographically restricted species recorded for New Guinea vegetation on a whole is relatively low, particularly in montane forest formations. This is thought to be due to climatic conditions during the Pleistocene epoch (1.6 million to 10,000 years ago) that suppressed treelines to as low as 2,000 – 2,300m elevation as little as 12,000 years before present (Powell and Hope 1976). Thus, montane forest is a relatively recent forest formation that has originated from upslope migration of the treeline from lower elevation forests types. The implication is that the floristic composition of the montane forest massif is likely to be relatively uniform and comparable across broad areas on the New Guinea cordillera. Greater scope for regional endemism exists in lower elevation forest habitats which have been subject to a much greater period of stability. Hence the collection of fertile botanical specimens in the relatively poorly surveyed study area is likely to be highly productive and considerably increase floristic knowledge of PNG habitats more broadly.

4.2 SURVEY COVERAGE OF THE STUDY AREA

4.2.1 Previous surveys

The study area has been the subject of four previous terrestrial flora assessments since 2011. Booyong Forest Science conducted an initial two stages of flora survey in 2011 (Booyong Forest Science 2011a and 2011b), which involved a floristic assessment of the broader Project exploration area as well as proposed Tailings Storage Facility options within the Markham Gap Basin, respectively. The Markham Gap Basin does not appear on any topographic map, but refers to an approximately 3,200 ha (32 km^2) alluvial basin surrounded by steep hills and ridges except for an approximate 1.2 km-wide gap at its western end through which drainage flows out of the basin in a westerly direction to the Watut River. The Markham Gap Basin Tailings Storage Facility options are no longer applicable to the current Project footprint. The 2011 assessments included mapping and description of major floristic formations, assessment of forest condition as well as assessment of conservation significant (IUCN listed) species. The floristic surveys utilised the following assessment methods:

- Level 1: Survey sites comprising unbounded plots (generally 400 to 500 m^2) in which main vascular plants were recorded in up to six physiognomic strata.
- Level 2 Sites: Rapid visual assessment of vegetation focusing primarily on canopy trees; and
- Level 3 Sites: Searches for IUCN listed species and fertile specimens undertaken at each major change in floristic structure.

A follow up field survey was completed by Booyong Forest Science in June 2012 (Booyong Forest Science 2013), which focused on the Watut Valley Road and Watut Declines Portal Terrace areas and covered many of the areas subject to the 2015 assessment described in this report. It should be noted that neither the location and number of survey sites nor the extent of survey was identified in the 2011 or 2013 survey reports, meaning that it was difficult to gauge the spatial distribution of survey sites, conservation significant species or the comprehensiveness of the 2011 and 2012 survey efforts. It is also noted that, whilst a species list incorporating 378 identified species was compiled, no reference was made to fertile plant collections or specimen submissions to relevant herbaria.

The PNG Forest Research Institute completed a forest resource inventory of the Watut Valley Road alignment between Bavaga and Watut Declines Portal Terrace area (PNGFRI 2011). The survey included calculations of merchantable timber volumes, identified to species level, along 13.5 km of access road in Mixed Hill Forest prior to construction, with assessment completed 20 m either side of the proposed road centreline. Two total species enumeration plots were conducted in the Bavaga and Babauf areas, which recorded all tree and other plants species within a 10 m by 50 m assessment plot. A total of 90 and 100 flora species were recorded within the two individual plots. The report also included an assessment of plants of traditional value to local villagers and identified the submission of 80 fertile plant specimens to the PNG National Herbarium in Lae.

Whilst the findings of the Booyong Forest Science (2011a, 2011b, 2013) survey reports have been considered in this report, the comprehensive floristic assessment undertaken by PNGFRI (2011) provided considerable insight into floristic assemblages and general floristic diversity in the study area and this study was drawn on extensively to inform floristic assessments in the current survey.

4.2.2 2015 surveys

During the initial survey in March 2015, 41 floristic sites including 26 secondary sites and 15 quaternary sites were assessed across a range of vegetation communities within the study area. An additional three secondary survey sites and seven quaternary sites were performed in the second stage of the field assessment in July 2015, and a further eight secondary and 30 quaternary survey sites were completed during the September 2015 survey of the revised Northern Access Road alignment. The location of floristic survey sites is shown in **Figure 4.1** and details of the survey sites are provided in **Appendix A**. The surveys, which included structured botanical collection, culminated in the submission of 310 fertile plant specimens to the PNG National Herbarium, Lae and the Queensland Herbarium, Brisbane. A schedule of collections and identifications (where possible) is provided in the flora species list in **Appendix B**. The number of fertile plant specimens collected during each survey period through 2015 decreased between March and September (205 fertile samples in March, 105 in July, 15 in September). This likely reflects the influence of the El Nino drought on plant flowering and suggests the most productive sampling period occurs immediately after the wet season.

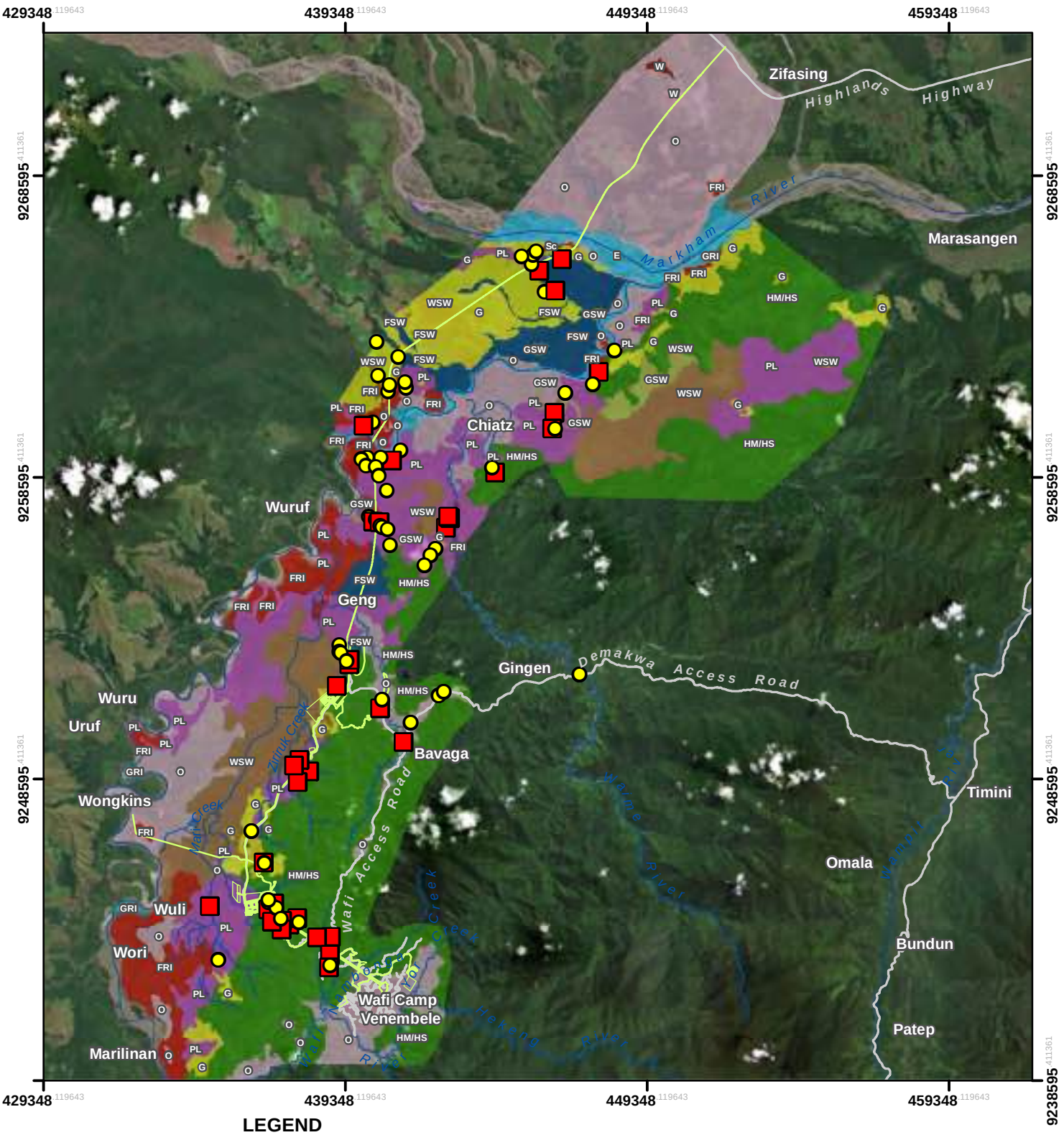
4.3 VEGETATION COMMUNITIES AND MAPPING

The study area is located within a local area vegetated with large tracts of contiguous and relatively unmodified primary rainforest vegetation communities. **Table 4.1** provides a summary of vegetation communities identified in the study area. These vegetation communities are described on the basis of the vegetation community classification system of Paijmans (1976), grouped into FIMS vegetation communities following the classification system adopted by Hammermaster and Saunders (1995) for FIMS. The classification system of Hammermaster and Saunders (1995) differs slightly from that of Paijmans (1976) in having a greater focus on classifying vegetation communities on the basis of forestry resources for forestry inventory mapping. The area subject to ground-truthed mapping of vegetation communities (see **Figure 4.1**) covers an area of approximately 327 km^2, extending from east of the entrance road to Wafi Camp westward to west of the Watut River, also extending northwards from the Wafi River to the Markham River to cover a broad corridor surrounding the proposed Mine Area and the Infrastructure Corridor through to its junction with the Highlands Highway. It is important to note that vegetation communities are mapped at a scale of 1:50 000 on the basis of the Hammermaster and Saunders (1995) vegetation community classification system used by FIMS; however, the ground-truthed mapping differs from the original FIMS mapping that was undertaken at a much broader scale of 1:250 000 by Hammermaster and Saunders (1995). Structural and floristic descriptions of vegetation communities sampled in the field survey are presented in **Sections 4.3.1** to **4.3.8**. The conservation status of vegetation communities is assessed in **Section 4.4** and vegetation community condition is assessed in **Section 4.5**.

Table 4.1. Vegetation communities (VC) occurring within the study area, together with their Forest Inventory Mapping System (FIMS) classifications (Hammermaster and Saunders 1995).

VC code	Vegetation community description[1]	FIMS equivalent[2]	FIMS description
Natural Vegetation Communities / Naturally Bare Areas			
4	Mixed alluvium forest	PL: Low altitude forest on plains and fans - below 1000m:	Large to Medium Crowned Forest
4a	Mixed alluvium forest (heavily disturbed)		
5	Mixed hill forest	HM/HS: Low altitude forest on uplands below 1000m.	Medium Crowned Forest/ Small Crowned Forest
5a	Mixed hill forest (heavily disturbed)		
6a	*Saccharum/Imperata* grassland (foothills)	G: Grassland and herbland	Grassland
6b	*Saccharum/Imperata* grassland (alluvial plains)		
6e	Woodland (with *Nauclea orientalis, Melaleuca leucadendra*)	W: Woodland	Woodland
7	Mixed swamp forest	FSW: Swamp forest	Mixed Swamp Forest
8	*Saccharum/Phragmites* grass swampland/Pandan swamp woodland mosaic	GSW: Grassland and herbland	Swamp Grassland
9	Sago swamp woodland	WSW: Woodland	Swamp Woodland
11	Seral forest (pioneer vegetation communities) with *Planchonia papuana* and *Nauclea orientalis.*	FRI: Secondary floodplain successions	Riverine mixed successions
12	Scrub (with dominant *Mallotus* sp.)	Sc: Scrub	Scrub
W	Watercourse	E: Non-vegetation and areas dominated by landuse	Lakes and larger rivers
RA	River alluvium/ gravel bar	GRI: Grassland and herbland	Riverine successions dominated by grass
Modified Vegetation Communities / Areas Devoid of Vegetation			
4r	Secondary forest (regrowth from mixed alluvium forest)	O: Non-vegetation and areas dominated by landuse	Non-vegetation and areas dominated by landuse (e.g. agriculture, silviculture, housing, roads and other infrastructure)
5r	Secondary forest (regrowth from mixed hill forest)		
6c	Mixed native / exotic grasslands and shrublands of uncertain origin		
6d	Mixed native / exotic grasslands and shrublands degraded through cattle grazing, typically with emergent *Samanea saman* (Raintree)		
10	Mixed regrowth / exotic regrowth		
C	Mixed regrowth / exotic regrowth		
CO	Older cultivated areas		
CD	Other disturbed areas		
Plantation	Plantation		

[1] Description derived from Paijmans (1976), applied to natural vegetation communities only.
[2] Classification derived from Hammermaster and Saunders (1995).



LEGEND

Proposed infrastructure footprint

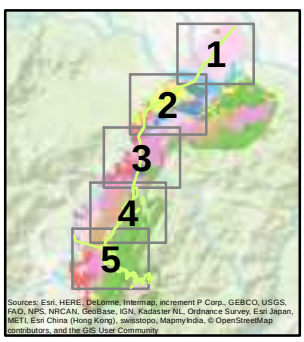
Flora Survey Points

Quaternary

Secondary

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GRI - Riverine successions dominated by grass
- GSW - Swamp Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- Sc - Scrub
- W - Woodland
- WSW - Swamp Woodland



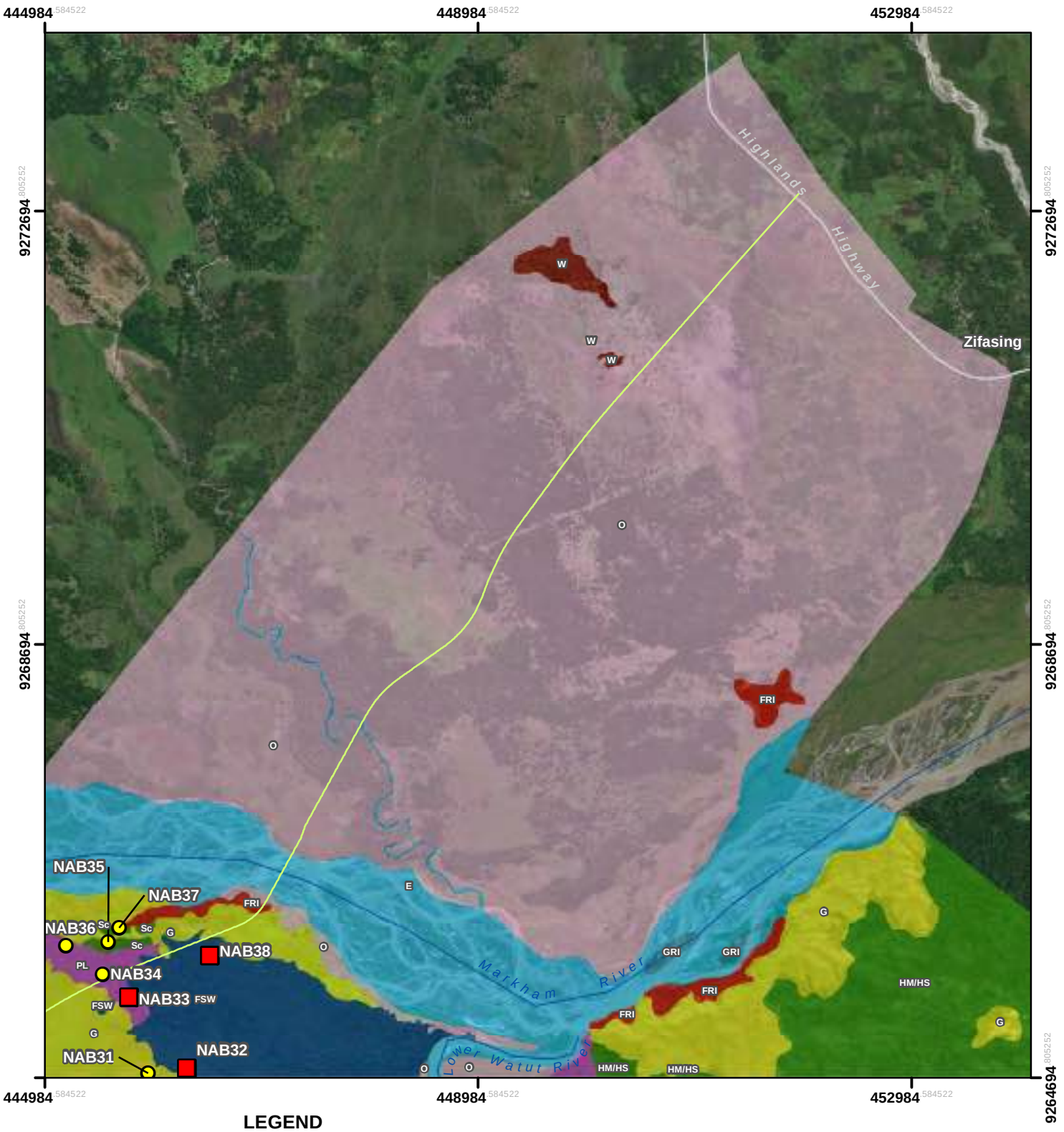
0 1 2 3 4
Kilometres
1:180,000 at A4

Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**4.1.**
Title:	Flora Survey Sites and Vegetation Communities - Overview map
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS



LEGEND

Proposed infrastructure footprint

Flora Survey Points

Quaternary Secondary

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GRI - Riverine successions dominated by grass
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- Sc - Scrub
- W - Woodland

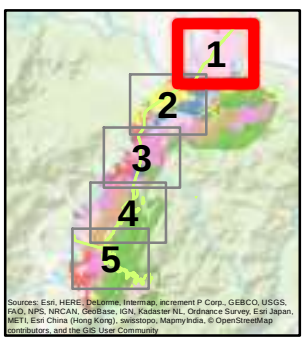


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Figure:	**4.1.a Map 1 of 5**
Title:	Flora Survey Sites and Vegetation Communities
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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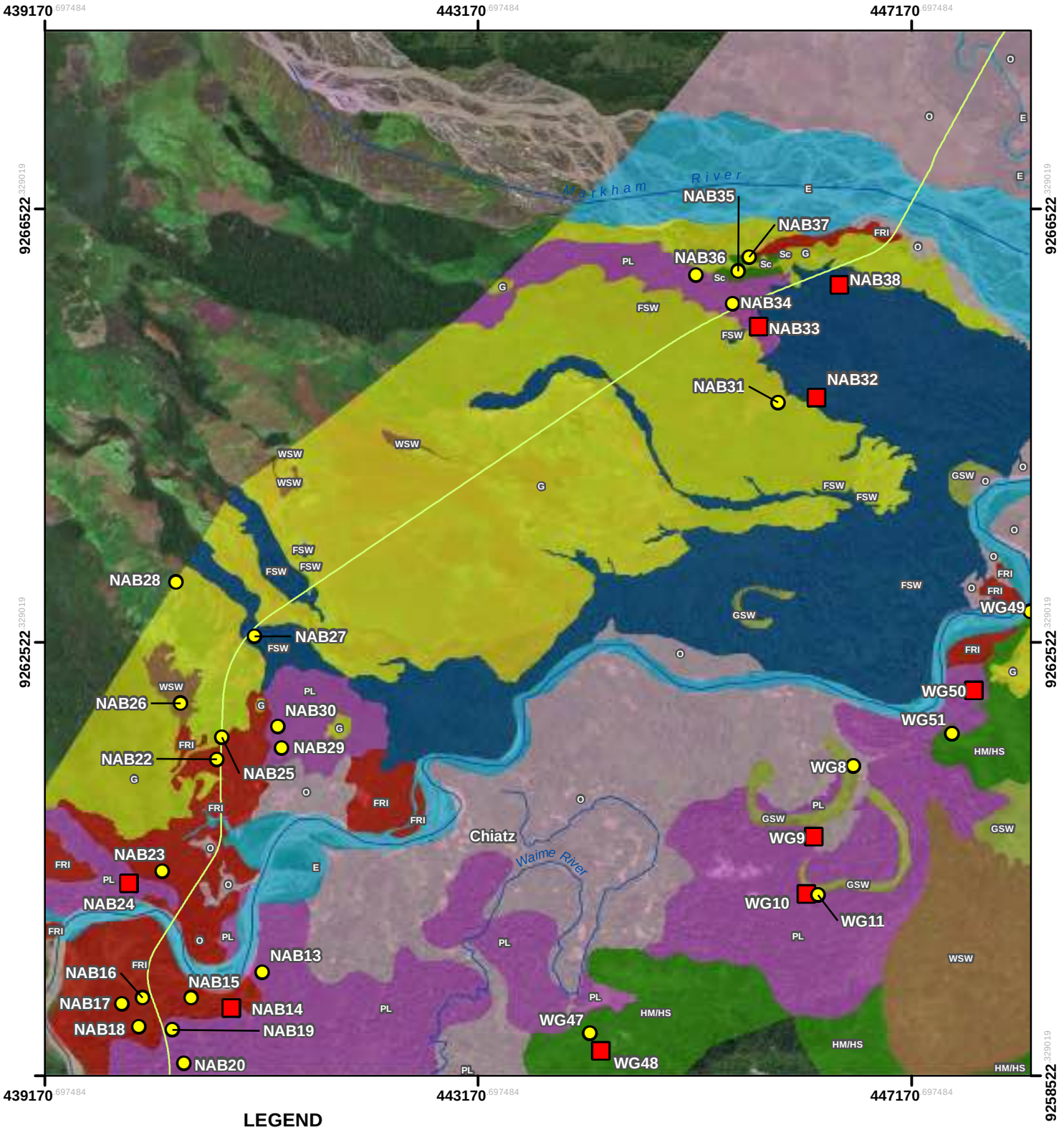

LEGEND

Proposed infrastructure footprint

Flora Survey Points

Quaternary

Secondary

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GSW - Swamp Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- Sc - Scrub
- WSW - Swamp Woodland

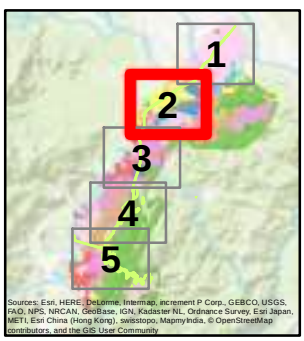

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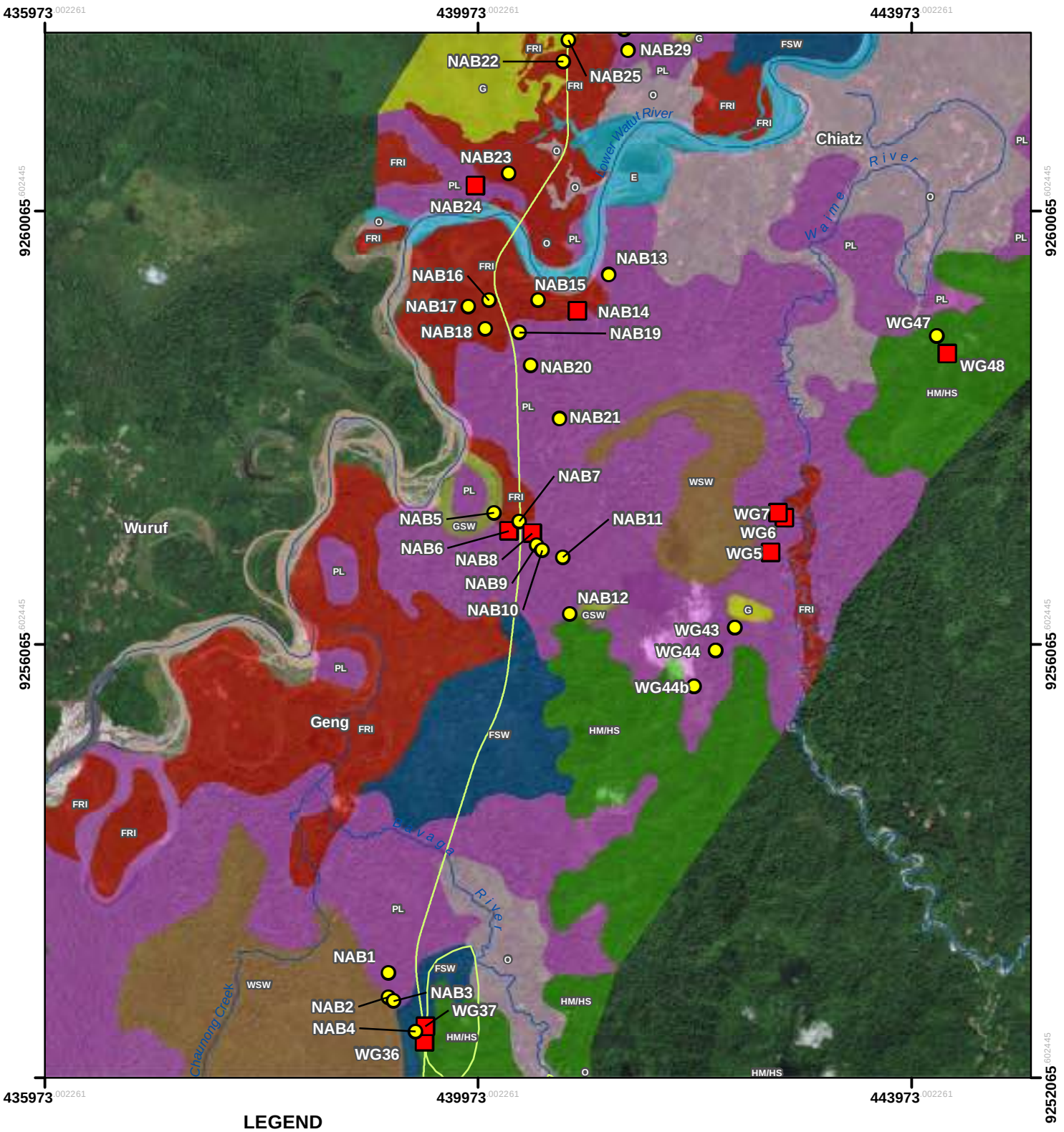
Figure:	**4.1.b Map 2 of 5**
Title:	Flora Survey Sites and Vegetation Communities
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS



LEGEND

Proposed infrastructure footprint

Flora Survey Points

Quaternary

Secondary

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GSW - Swamp Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- WSW - Swamp Woodland

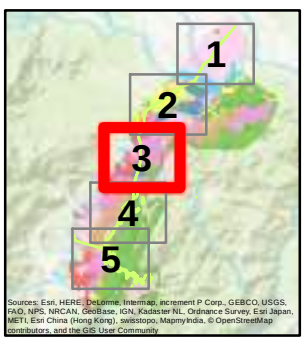


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Figure:	**4.1.c Map 3 of 5**
Title:	Flora Survey Sites and Vegetation Communities
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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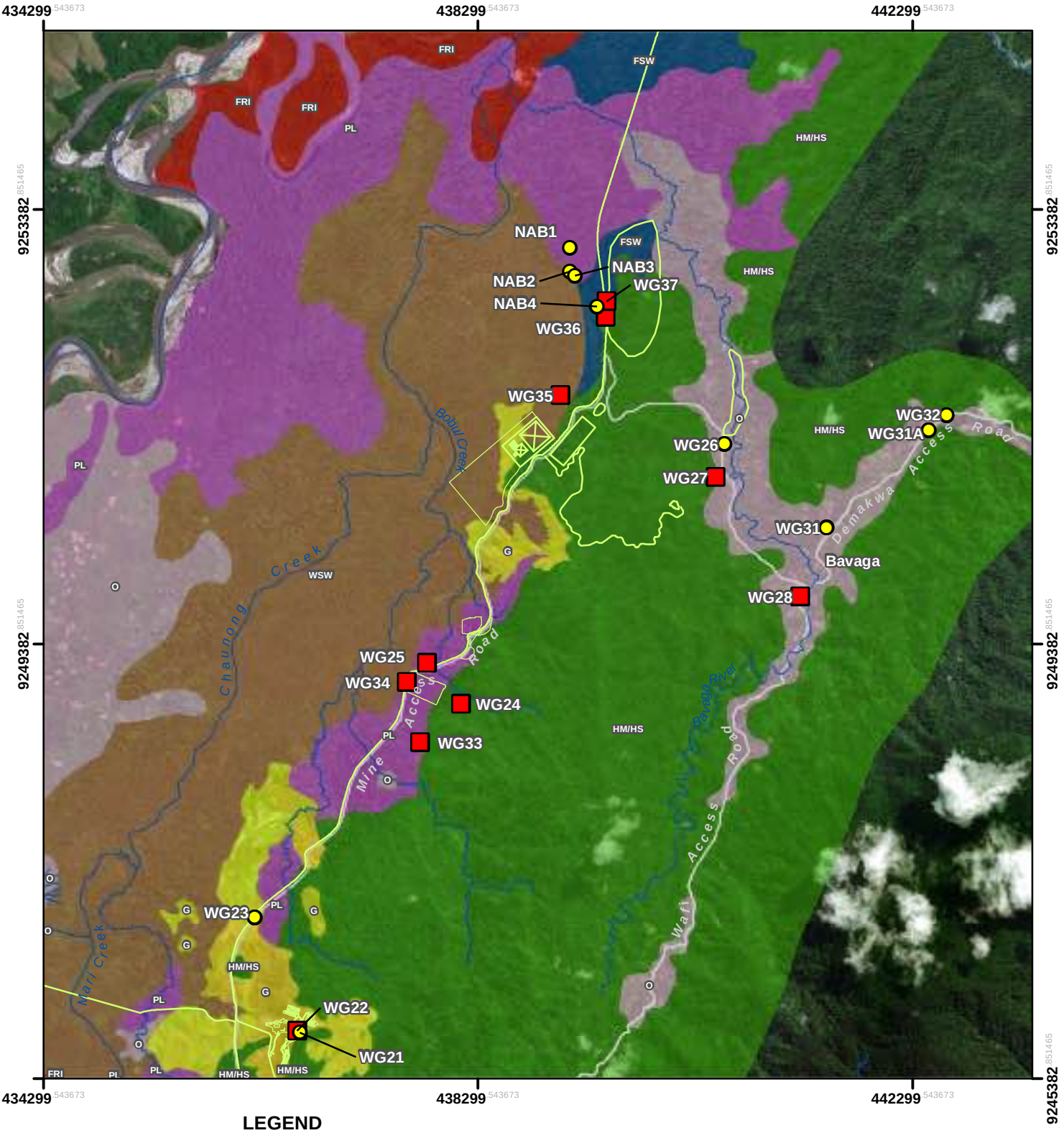

LEGEND

Proposed infrastructure footprint

Flora Survey Points

Quaternary Secondary

FIMS Vegetation Communities

- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- WSW - Swamp Woodland

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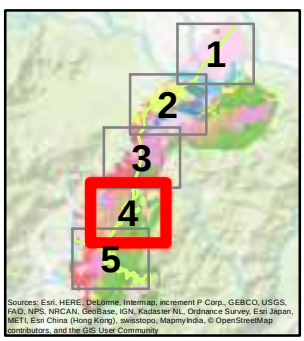
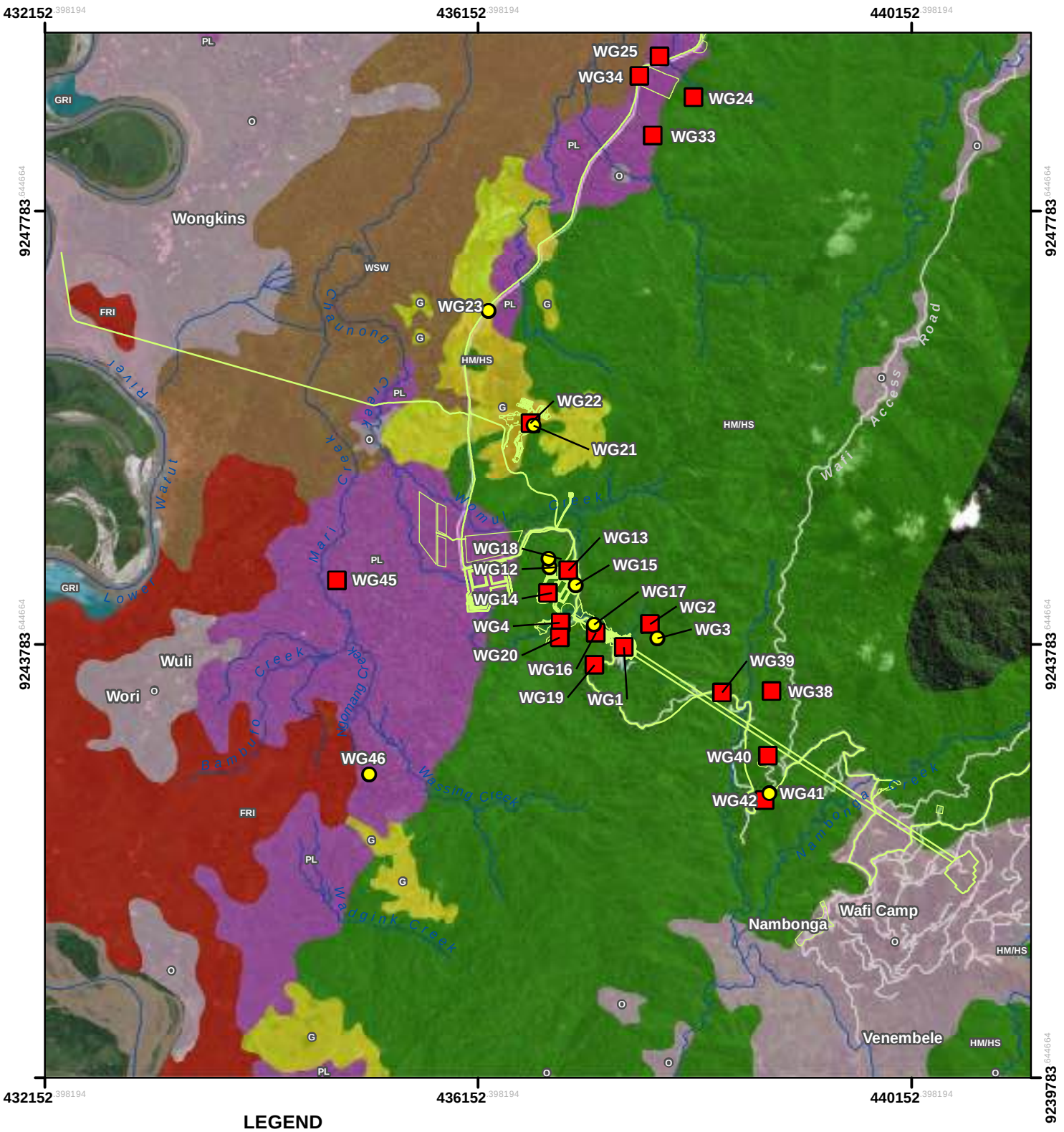


Figure:	**4.1.d Map 4 of 5**
Title:	Flora Survey Sites and Vegetation Communities
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS



LEGEND

Proposed infrastructure footprint

Flora Survey Points

Quaternary

Secondary

FIMS Vegetation Communities

- FRI - Secondary floodplain successions
- G - Grassland
- GRI - Riverine successions dominated by grass
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- WSW - Swamp Woodland

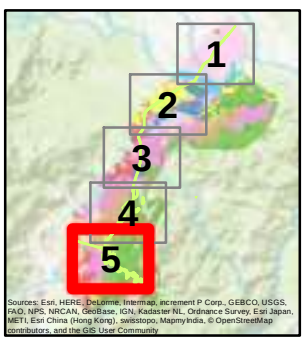


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Figure:	**4.1.e Map 5 of 5**
Title:	Flora Survey Sites and Vegetation Communities
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS

4.3.1 ***Large to Medium Crowned Forest on plains and fans (VC 4, VC 4a; FIMS PL)***

Vegetation survey sites: WG5, WG6, WG7, WG9, WG10, WG25, WG23, NAB1, NAB2, NAB6, NAB8, NAB9, NAB10, NAB14, NAB19, NAB33 (see **Figure 4.1**).

Extensive tracts of Large to Medium Crowned Forest (**Photos 4.1** and **4.2**) occur on the broad alluvial plain of the lower Watut River, dispersed within complexes of Swamp Forest and grassland. This vegetation community was comprehensively surveyed at a number of locations, including three detailed survey sites along a potential alignment of the Northern Access Road, five detailed survey sites on the proposed Northern Access Road alignment, and several detailed survey sites in alluvial plain forests fringing foot-slope habitats in the Finchif area (**Figure 4.1**). Canopy trees (T1 structural layer) are almost universally strongly buttressed with typical canopy heights ranging from 35m to 55m in undisturbed habitats. *Octomeles sumatrana* (Erima) is typically the tallest tree, dominating in some areas. Other prominent canopy species include *Dracontomelum dao* (New Guinea Walnut), *Pometia pinnata* (Taun), *Pterocymbium beccarii*, *Celtis latifolia, Aglaia cucullata, Terminalia complanata, Vitex cofassus* (Garamut), *Alstonia scholaris* (Milky Pine), *Flacourtia zippelii, Polyalthia oblongifolia, Ficus* spp., *Tristiropsis acutangula, Wrightia laevis, Antiaris toxicaria*, *Pterocarpus indicus* (New Guinea Rosewood) and occasional *Intsia bijuga* (Kwila). Kwila generally occurs at the interface between alluvial and foot-slope forests and is not common through the general forest mosaic. Canopy gaps are usually filled by pioneer species including *Artocarpus altilis* (Breadfruit), *Anthocephalis chinensis, Macaranga aleuritoides* and *Ficus* spp. including *Ficus nodosa*.

The sub-canopy is typically divided into two to three tree layers with *Pimeleodendron amboinicum, Myristica* spp., *Mangifera minor, Gnetum gnemon, Gnetom latifolia, Ficus* spp, *Arenga microcarpa, Diospyros* sp., *Aglaia sapindina, Garcinia* sp., *Caryota rhumphiana, Pandanus* sp., *Licuala lauterbachii, Hydriastele costata, Semecarpus* sp, *Chisocheton ceramicus* and *Horsfieldia irya* generally abundant. Climbing palms including *Korthalsia* sp. and *Calamus* spp. are also prominent in most localities.

Understorey and groundcover species include *Haplostichanthus longirostris, Sclerolaena* sp., *Alpinia* spp., *Leea novoguineensis, Macaranga* spp., *Korthalsia* sp., *Alocasia nicolsonii, Archidendron glabrum, Donax canniformis, Pneumatopteris sogerensis, Calamus* spp., *Araliaceae* sp., *Breynia cernua, Phaleria macrocarpa, Allophyllus cobbe, Voacanga grandiflora, Zizyphus* sp., *Syzygium* sp., *Piper* spp., *Barringtonia* sp., *Polyalthia* sp., *Flagellaria indica, Pycnarrhena novoguineensis, Licuala lauterbachii, Pleomele angustifolia* and *Dioscorea sp.* Hemi-epiphytes including *Rhaphidophora* sp., *Freycinetia* spp*., Scindapsus* sp., *Epipremnum pinnatum* and *Asplenium* sp. are common throughout all structural layers as are thick woody lianas representing the genera *Smilax, Cissus, Mucuna* and *Combretum*.

Photo 4.1. Typical structure of Large to Medium Crowned Forest on plains at site WGS10.

Photo 4.2. Large to Medium Crowned Forest on the banks of the Waime River.

The forest canopy is largely undisturbed over extensive areas, with only scattered canopy gaps caused by tree-fall and establishment of small garden areas in some localities. Closer to road edges, portable sawmilling operations are selectively logging some canopy trees, focusing in particular on valuable timber species including Kwila, New Guinea Walnut and Taun. These selective logging practices, while having some impact on forest structural integrity, favour retention of the original canopy structure over a predominant proportion of the forest.

Variations mapped within this forest type relate largely to disturbance regime. Where the habitat is heavily disturbed through clearing but retains a proportion of the original canopy structure, it was mapped as vegetation type 4a (FIMS PL). Where the habitat comprises regrowth from former clearing, it was mapped as vegetation type 4r (FIMS O, see **Section 4.3.11**). Such regrowth forests are of more limited ecological value and have been classified as modified habitat under the IFC criteria. Constituent species are generally fast growing pioneer species including *Artocarpus altilis* (Breadfruit), *Commersonia* sp*., Mallotus peltatus*, *Anthocephalus chinensis, Macaranga aleuritoides* and *Ficus* spp., and the shrub layers may be infused with woody weeds including *Piper aduncum* (Bamboo Piper) and *Leucaena leucocephala* (Leucaena) with a canopy covered by sprawling vines such as the native *Meremia peltata* (Meremia) and *Thunbergia grandifolia.*

4.3.2 Medium Crowned Forest/ Small Crowned Forest on foothills (VC 5, VC 5a; FIMS HM/HS)

Vegetation survey sites: WG1, WG2, WG3, WG4, WG13, WG14, WG16, WG19, WG20, WG24, WG27, WG28, WG32, WG36, WG38, WG39, WG40, WG42, NAB12 (**Figure 4.1**).

Vegetation Community 5 exists as a mosaic of two forest structural types, these being 1) Medium Crowned Forest (FIMS category HM, **Photo 4.3**); and 2) Small Crowned Forest (FIMS category HS, **Photo 4.4**). The two forest types have not been differentiated in this assessment due to the complexity of the habitat mosaic, coupled with the relatively low resolution of available imagery which made differentiation based on crown structure extremely difficult. This forest type is the most extensive habitat in the study area, occupying all locations from footslopes fringing the eastern margins of the Watut River alluvial plain and extending eastwards through the mountains surrounding Wafi Camp (**Figure 4.1**).

Photo 4.3. Typical structure of Medium Crowned Forest (HM) on foothills at site WG36.

Photo 4.4. Tall Small Crowned Forest (HS) on ridgelines, dominated by dipterocarp trees.

Small Crowned Forest typically occupies ridgelines and drier habitats where its dominant canopy constituents are the dipterocarp species *Hopea iriana* and *Anisoptera thurifera* (Anisoptera). This is a structurally simple forest with a limited number of canopy species with un-buttressed boles ranging in height from 30m to 45m. Associated canopy species include Kwila, *Gmelina moluccana* (White Beech), *Ficus nodosa, Syzygium sp.* and *Anthocephalus chinensis* in some localities. A low sub-canopy merges with shrub layers and includes *Protium macgregorii, Maniltoa psylogyne, Litsea guppyi, Celtis latifolia, Euroschinus papuana, Celtis latifolia, Pittosporum pullifolium, Commersonia*

bartramia, Pavetta pachychlada, Psychotria fitzalanii, Ficus copiosa, Jagera sp*., Diospyros ferrea* var*. buxifolia, Sterculia schumanniana, Aglaia subminutiflora,* Decaspermum *fruiticosum* and *Cycas apoa* (DGF WG92)*.* Ground and low shrub layers are variable forming a vine / fern thicket in some drier locations formed with *Blechnum* sp*., Nephrolepis* sp*., Cissus* sp*., Alpinia* spp*., Smilax* sp*., Dianella ensifolia* and *Hoya susuella*.

In moister locations along lower footslopes and gully lines, the dipterocarps become less prominent and the forest transitions into Medium Crowned Forest in which vines are prominent (dominantly mesophyll) with a more diverse mix of canopy species dominated by Taun, Kwila, New Guinea Rosewood, *Homalium foetidum, Maniltoa psylogyne, Syzygium buettnerianum, Celtis latifolia, Polyalthia longifolia, Tristiropsis acutangula, Spondias cytherea, Garuga floribunda, Pterocymbium beccarii, Eleaocarpus sphaericus, Diospyros papuana, Chrysophyllum roxburghii, Firmiana papuana, Endospermum molluccanum, Vitex coffassus* and *Pimelodendron amboinicum.*

Sub-canopy and shrub layers merge with species including *Myristica globosa, Myristica buchneriana, Protium macgregorii, Garcinia dulcis, Garcinia latissima, Diospyros crebripilis, Sterculia schummanniana, Phaleria coccinea, Phaleria octandra, Versteegia cauliflorus, Alectryon ferrugineum, Psychotria cf. beccarii* var*. beccarii, Siphonodon celastrineus, Ficus nodosa, Ficus wassa, Ochrosia coccinea, Macaranga quadriglandulosa, Memecylon hepaticum, Aglaia sexipetala, Microcos grandiflora, Archidendron glabrum, Pittosporum pullifolium, Harpullia ramiflora, Pavetta pachyclada, Cerbera floribunda, Myristica fatua, Calycacanthus magnusianus, Arenga microcarpa, Licuala lauterbachii, Melicope denhamii, Ptychosperma vestitum* with *Leea novoguineensis, Pangium edule, Syzygium gonatanthum* and *Leucosyke australis* occupying moister locations adjacent to drainage lines. Ground covers and hemi-epiphytes vary in composition dependent on topographic position although species include *Alocasia magnifica, Epipremnum amplissimum, Amorphophalus paeoniifolius, Scleria lithosperma, Asplenium adiantoides, Microlepia speluncae, Pothos rumphii, Pothos hellwigii, Angiopterus evecta, Dianella ensifolia, Alocasia nicolsonii, Nephrolepis biserrata, Nephrolepsis hirsutula* and *Selaginella* sp*.*

Disturbed localities within this forest type are commonly dominated by *Anthocephalis chinensis, Protium macgregorii, Commersonia bartramia, Artocarpus altilis, Macaranga involucrata* and *Melicope elleryana.*

4.3.3 Grassland (VC 6a, VC 6b; FIMS G)

Vegetation survey sites: WG22, WG23, NAB25, NAB31, NAB35 (**Figure 4.1**).

Extensive native grassland habitats (**Photos 4.5** and **4.6**) occur on the foot-slopes of the Watut River valley (VC 6a, mapped as FIMS G), extending onto the alluvial plain in some localities (VC 6b, mapped as FIMS G) (**Figure 4.1**). These grassland habitats, referred to throughout broader PNG as Kunai Grassland due to the general dominance of *Imperata cylindrica* (Kunai), are anthropogenic, having developed as a consequence of a long history of human use of fire for clearing and hunting. Paijmans (1976) recognises native grasslands as either representing fire dis-climax communities or, in the case of Kunai Grassland, indicating historical clearing for cultivation. Despite a history that originates from human activity, this vegetation community is dominated by native grass species and is widely distributed within a mosaic of natural lowland vegetation types, and should be considered a component of the natural vegetation mosaic.

The Kunai Grassland surveyed was dominated by *Polytocca macrophylla* with *Themeda triandra* (Kangaroo Grass) co-dominant and Kunai and *Eulalia trispicata* subdominant. Other species included the grasses *Mnesithea rottboelliodes* (Cane Grass) and *Sarga* sp. (DGF WG142), and a diverse array of sedges and forbs (herbaceous (not woody) flowering plants other than grasses) including *Fimbristylis littoralis, Fimbristylis* sp. (DGF WG129), *Cyperus brevifolius, Scleria lithosperma, Crotalaria sessiliflora, Euphorbia bifida, Phyllanthus amarus, Phyllanthus* sp. (DGF WG144), *Mitrasacme pygmaea, Pycnospora lutescens, Polygala longifolia, Polygala triflora, Polygala chinensis, Uraria* sp. (DGF WG126a), *Mukia sp*. (DGF WG127), *Osbeckia chinensis* and *Evolvulus alsinoide*. In alluvial areas, the robust grass *Polytocha macrophylla* becomes prominent

and a sparse, low, open shrub layer dominated *Antidesma ghaesembilla* is generally present as well as scattered emergents of *Albizia procera*. The reed *Phragmites vallatorius,* often in association with the sprawling fern *Stenochlaena palustris* and sedges*,* frequently occupies swampier depressions.

Photo 4.5. Kunai grassland at the location of survey site WG23.

Photo 4.6. Aerial view of Kunai Grassland on the Watut River Valley foot-slopes.

4.3.4 Woodland (VC 6e; FIMS W)

Only small areas of natural woodland are mapped in the northern portion of the survey area in the vicinity of the proposed Northern Access Road alignment. Whilst surveyed from helicopter only, it was apparent that the habitat is dominated by *Nauclea orientalis* and *Melaleuca leucadendra* over a ground cover of native grass species, predominantly *Imperata cylindrica*. These woodland habitats form scattered patches amongst the broader expanse of grassland degraded through cattle grazing, the latter characterised as VC 6d and mapped as FIMS O (see **Section 4.3.11**).

Photo 4.7 Woodland (VC 6e, FIMS W) dominated by *Nauclea orientalis* in the north-western portion of the study area, south of the Highlands Highway.

Photo 4.8 Degraded grassland habitats (VC 6d, FIMS O) with patches of low forest dominated by the exotic raintree (*Samanea saman*) in the north-western portion of the study area, south of the Highlands Highway.

4.3.5 Mixed Swamp Forest (VC 7 – FIMS FSW)

Vegetation survey sites: WG37, NAB3, NAB4, NAB27, NAB32, NAB38 (**Figure 4.1**).

Mixed Swamp Forest covers extensive areas of the Watut and Markham River floodplains, often forming a transitional community between the well-developed Large Crowned Forest (FIMS PL) and the permanently wet Swamp Woodlands (FIMS WSW, see **Section 4.3.7**) dominated by *Metroxylon sagu* (Sago Palm) (**Figure 4.1**). Mixed Swamp Forest was sampled at location WG37 where it merged to the south into Sago Swamp Woodland (FIMS WSW) and directly abutted Medium Crowned Forest (FIMS HM) on foot-slopes to the east. Further sites (NAB 27, 32, 38) were surveyed on the proposed Northern Access Road alignment, where Mixed Swamp Forest formed broad bands in drainage depressions, separated by expanses of Kunai Grassland (FIMS G). This swamp forest / grassland mosaic was particularly well formed west of the Watut River where it occupied broad alluvial landforms deposited at the confluence of the Watut and Markam Rivers.

The characteristic feature of Mixed Swamp Forest is the semi-permanently wet nature of the forest floor which results in the reduction of floristic complexity of the shrub and ground cover layers, whilst retaining the tall forest stature of well-developed rainforest (**Photo 4.9**). The swampy nature of the habitat affords some buffer from fire, meaning the boundaries are considerably more stable than Large Crowned Forest (FIMS PL) that is prone to boundary retreat when subjected to regular burning of adjoining grassland. Typical canopy heights in most localities ranges from 30m to 45m, with dominant canopy trees comprising *Terminalia impediens, Neonauclea* sp*., Eleaocarpus* sp*.*, *Ficus* sp*.,* Kwila in better drained localities, *Alstonia scholaris* (Milky Pine), *Anthocephalus chinensis, Inocarpus fagifer,* New Guinea Walnut and New Guinea Rosewood*.* Strong buttressing was apparent in many canopy trees although was not as well developed as in Large to Medium Crowned Forest (FIMS PL).

Photo 4.9. Mixed Swamp Forest at location of survey site WG37.

Photo 4.10. Swamp Grassland with dominant *Phragmites vallatorius* fringing an oxbow lake.

The sub-canopy of Mixed Swamp Forest was characterised by a relatively simple suite of species including *Buchanania macrocarpa, Myristica* spp*., Horsfieldia subtiiis, Melicope elleryana, Licuala lauterbarchii, Caryota rumphiana, Hydriastele costata, Horsfieldia hellwigii, Pandanus* sp*.* and *Kingiodendron novoguinensis*. Sago Palm forms a dense sub-canopy layer in the majority of locations, occasionally reaching canopy height. Shrub and ground layers are relatively sparse, typified by a mix of *Haplostichanthus longirostris, Leea novoguineensis, Asplenium sp.* (both on ground and in trees), *Calamus holrungii, Alpinia* spp*., Selaginella* sp*., Freycinettia* sp*.* and *Nephrolepis* sp., and the broad-leaved herb *Donax canniformis*.

4.3.6 Swamp Grassland (VC 8; FIMS G)

Vegetation survey sites: WG8, WG11, NAB5 (**Figure 4.1**).

Across the floodplain of the Watut River, numerous oxbow lakes and wetlands have been formed and isolated due to the ongoing migration of the river's broad meanders (**Photo 4.10**). These swamplands form a mosaic of open wetlands, swamp grasslands and *Pandanus* forests although access difficulties prevented comprehensive sampling. With increasing saturation, woodland and

forest habitats are replaced by shrubs and ground cover is dominated by forbs and swamp tolerant grasses including *Phragmites vallatorius, Leersia hexandra* and the sprawling fern *Stenochlaena palustris*. Emergent trees and shrubs may occur, typified by *Timonius timon* and *Nauclea orientalis* and parts of the mosaic may be dominated by *Pandanus* forest fringed by areas of Sago Palm.

4.3.7 Swamp Woodland (VC 9; FIMS WSW)

Vegetation survey sites: WG34, WG35, NAB26, NAB32 (**Figure 4.1**).

Permanently saturated areas on the Watut River floodplain are generally occupied by extensive woodlands and forests dominated by Sago Palm (**Figure 4.1**, **Photos 4.11** and **4.12**). Typical structural characteristics are a dense monotypic sub-canopy of Sago with heights ranging from 11m to 17m, a mid-dense canopy occupied by *Terminalia impediens*, *Alstonia scholaris* (Milky Pine), *Nauclea orientalis*, *Bischofia javanica, Vitex cofassus* (Garamut), *Horsefieldia* spp*., Cananga odorata, Pimeleodendron amboinicum, Hydriastele costata* and *Campnosperma brevipetiolatum*. In some locations, the upper canopy is dominated by *Timonius timon* reaching canopy heights of 25m. Ground layers were not intensively sampled but they are floristically simple, comprising a narrow suite of forbs and shrubs including *Heliconia* sp. *Alpinia* sp., *Leea novoguinensis, Vitex* sp., *Ficus wassa*, *Ficus* spp. and *Calamus* sp.

Photo 4.11. Swamp Woodland emergent trees above a dense sub-canopy of Sago Palm at survey site WG34.

Photo 4.12. Swamp Woodland visible as a grey wash of sparsely-leaved emergent tree crowns above a dense sub-canopy of Sago Palm.

4.3.8 Seral Forest (pioneer vegetation communities) with Planchonia papuana and Nauclea orientalis (VC 11; FIMS FRI)

Vegetation survey sites: NAB22, NAB23 (**Figure 4.1**).

Broad areas of Seral Forest occur on the western margins of the Watut River in the vicinity of the proposed Northern Access Road alignment. This vegetation community has a low dense canopy ranging in height from 15 to 25 m dominated by *Nauclea orientalis* and *Planchonia papuana* (**Photos 4.13** and **4.14**). The sub-canopy layer is dominated by *Morinda citrifolia, Gnetum gnemon, Intsia bijuga, Carallia brachiata, Leea novoguineensis, Alstonia scholaris, Commersonia bartramiana* and *Caryota rumphiana* interspersed with a variably dense thicket of shrub and vine species, most typically *Ptychosperma macarthurii, Arenga macrocarpa, Flagellaria indica, Calamus* spp*., Alpinia* spp*.* and *Merremia peltata.* Gaps in this forest are typically occupied by thickets of the invasive weeds *Piper aduncum* and *Leucaena leucocephala* that may be extensive in former garden areas. This habitat is a floristically and structurally simple forest formation that represents an intermediate stage in the development of more complex Large Crowned Forest habitats.

Photo 4.13. Margins of Seral Forest (VC 11, FIMS FRI) adjacent to Kunai Grassland at survey site NAB22 with emergents of *Planchonia papuana* and *Nauclea orientalis*.

Photo 4.14. Dense thickets of *Calamus* spp. and *Ptychosperma macarthurii* in Seral Forest at survey site NAB22.

4.3.9 Scrub (VC 12; FIMS Sc)

Scrub occurs in small patches on the proposed Northern Access Road alignment immediately south of the Markham River where it is associated with a hill ridgeline of Kunai Grassland (**Photos 4.15** and **4.16**). The habitat represents a transitional vegetation type that forms a fringe between regularly burned Kunai Grassland and rainforest and is floristically and structurally very simple. The low canopy is uneven and ranges in height from 3 to 7 m and is dominated by *Mallotus* sp. with *Morinda citrifolia, Macaranga involucrata* and *Ficus* sp. sub-dominant. The understory is sparse, dominated by thin wiry lianes with a groundcover of ferns, predominantly *Blechnum* sp.

Photo 4.15. Margins of Scrub (VC 12, FIMS Sc) adjacent to Kunai Grassland on a hill at flora survey site NAB35 immediately south of the Markham River.

Photo 4.16. The cycad *Cycas shumanniana* (IUCN: Near Threatened) was common along the ecotone between Scrub and Kunai Grassland at NAB35.

4.3.10 Watercourses and gravel bars (VC W, VC RA; FIMS E, GRI)

Review of satellite imagery at various dates of capture reveal the dynamic nature of the Watut River with regular meander shifts as the river migrates across its floodplain. The rapidly evolving channel planform has created a continuum of fluvial features in seral stages ranging from bare river braids to point bars occupied by grasslands and developing shrublands (**Figure 4.1**, **Photos 4.17** and **4.18**). Dense swards of *Saccharum robustum* typify many of these features, interspersed with areas of *Phragmites vallatorius, Stenochlaena palustris* and developing shrublands and low forests of *Artocarpus altilis, Commersonia bartramia, Voacanga grandifolia, Anthocephalus chinensis* and

Mallotus sp. With regular flooding and continuous migration of river channels, these seral communities are regularly being reclaimed in the natural process of riverine erosion and deposition, with few examples holding sufficient long term stability to develop more complex floristic and structural features.

Photo 4.17. Watut River showing continuum of seral stages from point bars to developing grassland and shrubland on meandering river channel.

Photo 4.18. Markham River braids partially stabilised by *Saccharum robustum* below the Watut confluence.

4.3.11 Secondary habitats, villages and cultivated areas (VC 4r, VC 5r, VC 6c, VC 6d, VC 10, VC C, VC CO, VC CD, VC Plantation; FIMS O)

Regrowth forests are most abundant in the vicinity of villages and other settled areas representing regrowth from total clearing or untended gardens (**Figure 4.1**, **Photos 4.19** and **4.20**). Areas derived from regrowth of primary forest typically comprise a limited number of colonising species with even canopy heights. Next to the access roads and in other disturbed locations, secondary forests are comprised primarily of *Anthocephalus chinensis* with sprawling mats of the smothering native vine *Merremia peltata.* Other secondary tree species may include *Protium macgregorii, Ficus* spp*., Commersonia bartramia, Macaranga* sp., *Homolanthus* sp*.,* and *Alphitonia oblata.*

Photo 4.19. Cultivated garden areas at Bavaga Village.

Photo 4.20. Mosaic of gardens and regrowth surrounding Bavaga Village.

Overgrown garden areas support a complex mix of native and introduced food resource plants grown in a permaculture (sustainable and self-sufficient) system. Where sampled at Bavaga Village, canopy heights of retained emergent *Octomeles sumatrana* (Erima) trees attained 45 m, similar to natural forest areas with a mixed lower canopy of *Artocarpus camansi* (Breadnut), *Pometia pinnata* (Taun), *Cocos nucifera* (Coconut), *Anthocephalus chinensis*, *Metroxylon sagu* (Sago Palm) and the food tree *Terminalia kaernbachii* (Ngalonka). Sub-canopy and shrub layers are often

dominated by Cocao (*Theobroma cacao*), *Cynometra sp*., Papaya (*Carica papaya*), Banana (*Musa sp.*), Coffee (*Coffea arabica*), Taro (*Alocasia sp.*) and *Glyricidia sepium*. The canopy is typically extremely uneven with large canopy gaps providing light for food resource trees. Numerous weeds may also be present including *Setaria palmifolia* (Palm Grass), *Saccharum robustum* (Robust Cane), *Ipomoea quamoclit* (Cupids Flower), Cassava (*Cassava manihot* and *Manihot esculenta*), Snake Weed (*Stachytarpheta jamaicensis* and *S. cayenesis*), *Mimosa pudica* (Sensitive Weed), *Pueraria phaseoloides* (Tropical Kudzu), *Mimosa diplotricha* (Giant Sensitive Weed), *Piper aduncum* (Bamboo Piper) and thickets of (*Bambusa* spp*.* (bamboo)*, Leucaena leucocephala* (Leucaena) and *Muntingia calabura* (Jamaican Cherry).

On the northern side of the Markham River crossing on the proposed route of the Northern Access Road (**Figure 4.1**), alluvial areas comprise grassland with dense pockets of forest dominated by the exotic and invasive *Samanea saman* (Raintree).

4.4 THREATENED VEGETATION COMMUNITIES

The study area lies within what the World Wildlife Fund (WWF) has characterised as a Critical – Endangered Ecoregion (Terrestrial Ecoregion 123). However, this WWF classification is based on an assessment of perceived threats into the future, assuming: a) chronic threats due to low level activities such as subsistence agriculture; and b) catastrophic threats from large scale commercial operations such as logging and plantation development. Furthermore, the current status of the Northern New Guinea Lowland Rainforest ecosystem was recently described as 'relatively undisturbed' (Wikramanayake 2002). Assessment of the conservation status of vegetation communities using the more rigorously quantitative method outlined in **Section 1.5.4** requires information on historical rates of clearing of vegetation communities.

There are a number of publications that deal with deforestation and degradation of rainforest within Papua New Guinea. Initial analyses were based on the Forest Inventory Mapping System (FIMS; Hammermaster and Saunders 1995), a comprehensive national forest mapping database that used air photo interpretation to map different forest types at a relatively coarse scale (1:100 000), and an update to FIMS that included mapping and statistics of land use change and areas logged between 1975 and 1996 (McAlpine and Quigley 1998). Using the FIMS mapping, the Food and Agriculture Organisation of the United Nations (FAO) estimated a constant rate of forest loss of 0.5% per year between 1990 and 2010, and provided summary statistics of the change in the areas of different forest types between 1975 and 1996 that identified an 11.8% reduction in lowland forest on alluvial plains and fans, 4.3% reduction in lowland forest on uplands and 43.7% reduction in swamp forest (FAO 2005, 2010).

Shearman *et al.* (2008, 2009) undertook vegetation boundary mapping throughout PNG at a much finer spatial scale than the FIMS mapping, using high resolution stereo - aerial photography (1972) and high resolution satellite imagery captured between 2000 and 2014. Based on this higher resolution mapping Shearman *et al.* (2008, 2009) calculated rates of forest change (clearing and degradation) over the period 1972 to 2002 that are considerably greater than the estimates of FAO (2005, 2010), particularly in commercially accessible forests. Degradation refers to the conversion of primary forest to secondary forest by commercial logging, and was included in estimates of forest change since the nature of commercial logging predisposes such forest to increased risk of fire and intensified subsistence agriculture that converts logged over forest to other forms of landuse over an extended period of time. The annual rate of change in overall forest extent rose from 0.4 percent per year (%/yr) in 1972–1973 to 1.4 %/yr in 2001–2002, peaking in 1997–1998 at 1.8 %/yr. Within commercially accessible forests, the estimated rate of forest change rose from 0.7 %/yr to 1.4 %/yr over the 1980s before dramatic increases in commercial logging over the 1990s increased the rate of change to a high of 3.4 %/yr in 1997–1998, before decreasing to 2.6 %/yr in 2001–2002 (Shearman *et al.* 2008, 2009). Overall, 48.2% of this forest change was due to commercial logging, 45.6% was related to subsistence agriculture, 4.4% was due to forest fires, 1.2% was due to plantations, and just 0.6% was due to mining (Shearman *et al.* 2008, 2009). Over the 12 years from 2002 to 2014, the rate of forest change decreased: 4.1% of overall rainforest area was either cleared or logged, representing an annual rate of deforestation/degradation of approximately 0.35%

but the annual rate of change was estimated at 0.49% in 2014; and within commercially accessible forest, 7.27% of forest was cleared or logged, representing an annual rate of deforestation/degradation of approximately 0.63% since 2002 (Bryan *et al.* 2015).

Shearman *et al.* (2009) noted the FAO assessments are based on: (a) data that are at too coarse a spatial scale to detect fine-scale change due to subsistence agriculture and agricultural expansion; and (b) linear extrapolation of forest clearing rates measured between two points of image capture (1975 and 1996) with linear projection of this rate post 1996. In an opinion paper that had a particular focus on forest carbon stocks, Filer *et al*. (2009) criticised the Shearman *et al*. (2008, 2009) estimates of forest change as being over-estimated. However, Filer *et al*. (2009) did not provide new, evidence-based estimates of forest change relevant to assessment of vegetation community integrity and Shearman *et al*. (2010) comprehensively rebutted the criticisms. Consequently, the estimated rates of forest change of Shearman *et al.* (2008, 2009) and Bryan *et al*. (2015) remain the most up-to-date estimates to assess the status of vegetation communities against.

The projected forest clearing rates in Shearman *et al.* (2008, 2009) and Bryan *et al*. (2015) were used as a basis to assess the conservation status (at national level) of the principal forest types present in the study area. To do so, three ecological subdivisions were identified, these being:

1. **Floodplain Forest**, which includes the FIMS units of Large to Medium Crowned Forest (PL), Open Crowned Forest (PO) and Small Crowned Forest (PS). The physiognomic distinction between the three FIMS units is arbitrary and not consistently mappable (P. Shearman pers. comm. June 2015), which is why they were combined for this exercise.
2. **Mixed Hill Forest**, which includes Medium Crowned Forest (HM) and Small Crowned Forest (HS) on uplands (hills).
3. **Swamp Forest**, which includes Mixed Swamp Forest (FSW) and Swamp Woodland (WSW).

Floodplain Forest: This is the most restricted of the three forest groupings occurring on riverine flood plains and low angle alluvial fans throughout lowland portions of Papua New Guinea. Based on FIMS mapping, floodplain forest (excluding Swamp Forest) occupied 3,260,800 ha or 12% of PNG's national forest estate in 1972. Floodplain forest hosts the most abundant timber resource of all forest types with reported commercial timber volumes of between 30 and 40 m^3/ha compared to Medium Crown Forest with reported commercial volumes of 25 m^3/ha (Bryan 2011). Soil types are typically well to imperfectly drained alluvial soils that rarely if ever flood (Paijmans 1975). Due to the lowland location and well drained nature of the soils, all Floodplain Forest is assumed to be accessible to commercial logging operations across its national extent. Based on the estimated annual rates of forest change for forests accessible to commercial logging (from Shearman *et al.* 2009 and Bryan *et al*. 2015, summarised in **Table 4.2**), Floodplain Forest is calculated to have undergone a 41.9% reduction in its extent over the 45 year period between 1972 and 2017 as indicated in **Table 4.2**.

The reduction in extent of Floodplain Forest is considered 'substantial', having exceeded 30% but less than 50% over the past 50 years, placing it within an extinction risk category of 'Vulnerable' in accordance with **Criterion 1b** of **Table 1.4**. As the processes of forest degradation and clearing are inextricably linked, the estimated detrimental change to the community has exceeded 30% over the past 50 years, which also qualifies it for 'Vulnerable' status under **Criterion 5b** of **Table 1.4**. Based on the original extent of this forest provided in FAO (2010) and the annual rates of deforestation and degradation summarised in **Table 4.2**, an estimated 1,909,000 ha of Floodplain Forest remains in PNG at a national level in 2017. It should be noted that this remaining area of occupancy is substantially greater than the threshold of less than 100,000 ha for qualification for 'Vulnerable' status under **Criterion 2** of **Table 1.4**. Therefore, the assessment of 'Vulnerable' status is a conservative assessment based on the rate of decline over the past 50 years.

Table 4.2. Percentage of forest remaining for periods from 1972 to present based on clearing rates of Shearman *et al.* (2008) and Bryan *et al*. (2015).

Forest formation	Period	Annual rate of deforestation and degradation (%)	Percentage of 1972 or 1975 extent remaining
Floodplain Forest*	1972 - 1980	0.5	96.1
	1981 - 1983	0.75	93.9
	1984 - 1990	1.25	86.0
	1991 - 1995	2.0	77.7
	1996 - 1998	3.0	71.0
	1999 to 2002	2.62	73.1
	2003-2014	0.63	59.2
	2015-2017	0.63	58.1
Mixed Hill Forest**	1975 - 1980	0.5	97.5
	1981 - 1983	0.6	95.8
	1984 - 1990	0.75	90.9
	1991 - 1995	1.0	86.4
	1996 - 1998	1.5	82.6
	1999 to 2002	1.2	83.8
	2003-2013	0.35	75.5
	2014-2017	0.49	74.4

*Rates of clearing for forest accessible to commercial logging derived from Shearman *et al.* (2009) and Bryan *et al.* (2015).
**Rates of clearing for all forests derived from Shearman *et al.* (2008) and Bryan *et al.* (2015).

Mixed Hill Forest: Lowland rainforest on footslopes is the most abundant forest type throughout PNG with 1975 estimates of 17,946,800 ha (FAO 2010) or 59% of the nation's forest estate excluding swamp forests. Shearman *et al.* (2008) estimated approximately 42% of lowland rainforest is accessible to commercial logging through amenable geomorphology and slope characteristics (<25% slope), in rough agreement with McAlpine and Quigley (1998) who estimated 53% of forest on lowland hills has no physical constraint to logging. Whilst inaccessibility excludes the degradation of forest from commercial logging operations, they often remain subject to disturbance through clearing for subsistence agriculture and hence should not be considered entirely secure. Application of average clearing rates for all forest types in PNG based on calculations of Shearman *et al.* (2009) and Bryan *et al*. (2015) estimates that 74.4 % of the 1975 extent of mixed hill forest remains in 2017 (see **Table 4.2**). This means that the mixed hill forest formation does not meet the threshold of ≥30% loss over the past 50 years for recognition as a threatened vegetation community (based on **Criteria 1b** and **5b** of **Table 1.4**). Furthermore, it still has an estimated area of occurrence across PNG of approximately 13.3 million hectares.

Swamp Forest: It was difficult to provide any meaningful assessment of the conservation status of swamp forest types, including Mixed Swamp Forest (FSW) and Swamp Woodland (WSW), as there is limited and contradictory information on the rate of clearing for these habitats. FAO (2010) reported 1,267,300 ha of swamp forest in PNG in 1996, a 43.7% reduction since 1975, whereas Shearman *et al.* (2008) mapped 3,409,018 ha of swamp forest at a national level in 2002, and noted that swamp forests are difficult to access and largely undisturbed. PNG has not experienced the broad-scale draining and clearing of swamps for agriculture that has occurred in many other tropical countries, although extensive areas of swamp forest have recently been drained and cleared in West New-Britain for oil palm production (P. Shearman, personal communication, June 2015). Whilst there are additional threats other than direct clearing, such as sedimentation, it is unlikely that swamp forests have degraded to the extent that they would meet the thresholds of either Endangered or Vulnerable risk status and hence are not considered to be threatened based on current evidence.

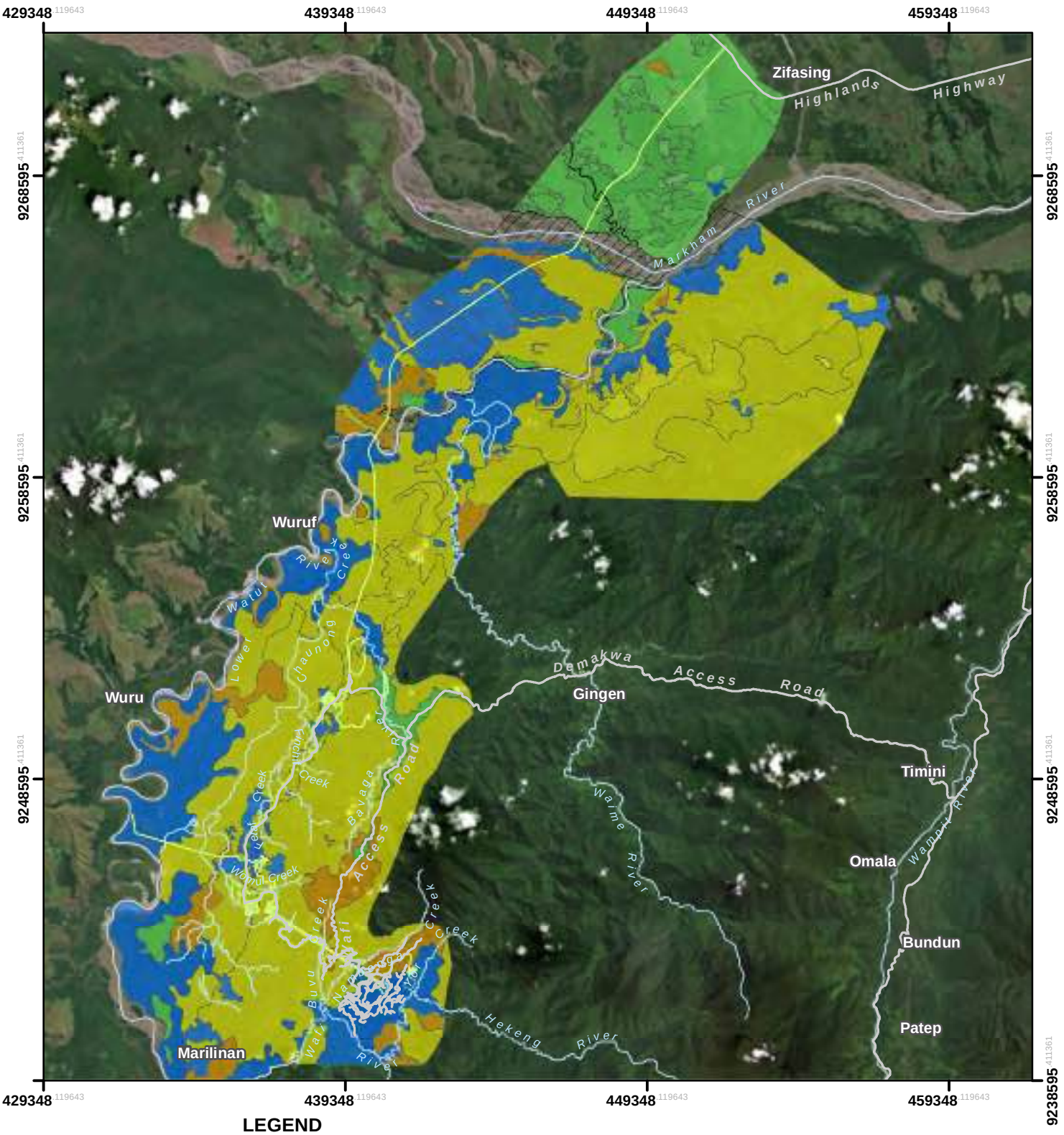
As a concluding statement, lowland forests in the study area are generally well preserved examples of their type with intrinsically high conservation value. The forests of the Watut River alluvial plain and surrounding foot-slopes appear to have been protected from broad scale logging due to their geographical isolation. It is notable that the recent construction of new access roads has already contributed to localised disturbance through the influx of portable logging and milling operations in alluvial forest adjacent to access roads. Nevertheless, this type of selective logging causes

substantially less degradation than commercial logging practices, and the small tree-fall disturbance areas can be expected to rapidly regrow to secondary forest in the absence of additional sources of disturbance.

4.5 VEGETATION CONDITION AND MAPPING

The framework for assessment of vegetation condition has been detailed in **Section 2.3**. The mapping of each of the four vegetation condition categories across the study area is shown in **Figure 4.2**. The critical factor influencing vegetation condition is distance from villages and associated access roads and pathways. The following points are notable:

1. The most intensively utilised areas occur around Bavaga and on the alluvial plain immediately adjacent to the Watut River where village and garden areas are concentrated. Cultivated areas that surround these villages invariably have the lowest condition value category (4: highly modified) on account of the lack of any resemblance to natural habitats. Highly modified habitats typically include an abundance of invasive weeds. Other small pockets of highly modified condition occur adjacent to the access road from Bavaga to Wafi Camp.
2. Further removed from village areas, extensive portions of the Watut River alluvial plain are occupied by a regenerating mix of secondary shrubs and trees mixed with native grasses (typically *Saccharum robustum)* and both woody and herbaceous weeds. Many of these areas have been subject to historical cultivation and are in the process of regenerating to simple secondary growth forests. These areas, which also include some abandoned garden areas in foot-slope locations, have been classified as degraded (condition category 3).
3. Extensive tracts of intact and relatively undisturbed (condition category 1) Medium / Small Crowned Forest occur in foot-slope locations extending across extensive areas of the Watut River alluvial plain with a well preserved mosaic of Large Crowned Forest (PL), Mixed Swamp Forest (FSW) and Swamp Woodland (WSW). The preservation of these habitats is largely the result of historically poor access, coupled with an abundance of arable land close to established village areas. With further development of access routes and movement of population into these areas, the footprint of native anthropogenic disturbance will undoubtedly change. This will initially occur through the thinning of native forests for timber resources and expansion of small scale gardening expanding the area of partially modified forest that has been assigned a moderately disturbed condition (condition category 2).
4. This assessment has assigned a degraded condition (condition category 3) to native anthropogenic grassland habitat (Kunai Grassland). Although this habitat type has a well-developed and diverse native flora assemblage that is likely to have been stable for up to several thousand years, it is the product of regular burning practices (i.e. human intervention) that transformed what was likely to have been rainforest into grassland.
5. The condition classification has not taken into account areas of dieback previously noted across Swamp Woodlands of the Watut River floodplain (noted in Booyong Forest Science 2013). This dieback was considered likely to have been the result of changes in sedimentation regime resulting from soil disturbance and erosion in the upper catchment of the Watut River (Booyong Forest Science 2013). The footprint of the dieback is not clearly evident in available imagery, limiting the ability to confidently map its boundaries.



LEGEND

- Proposed infrastructure footprint

Vegetation Condition

- Intact (category 1)
- Moderately disturbed (category 2)
- Degraded (category 3)
- Highly modified (category 4)
- Not Classified

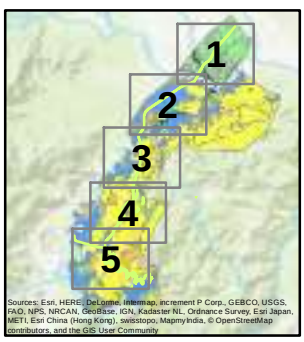


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Figure:	**4.2**
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Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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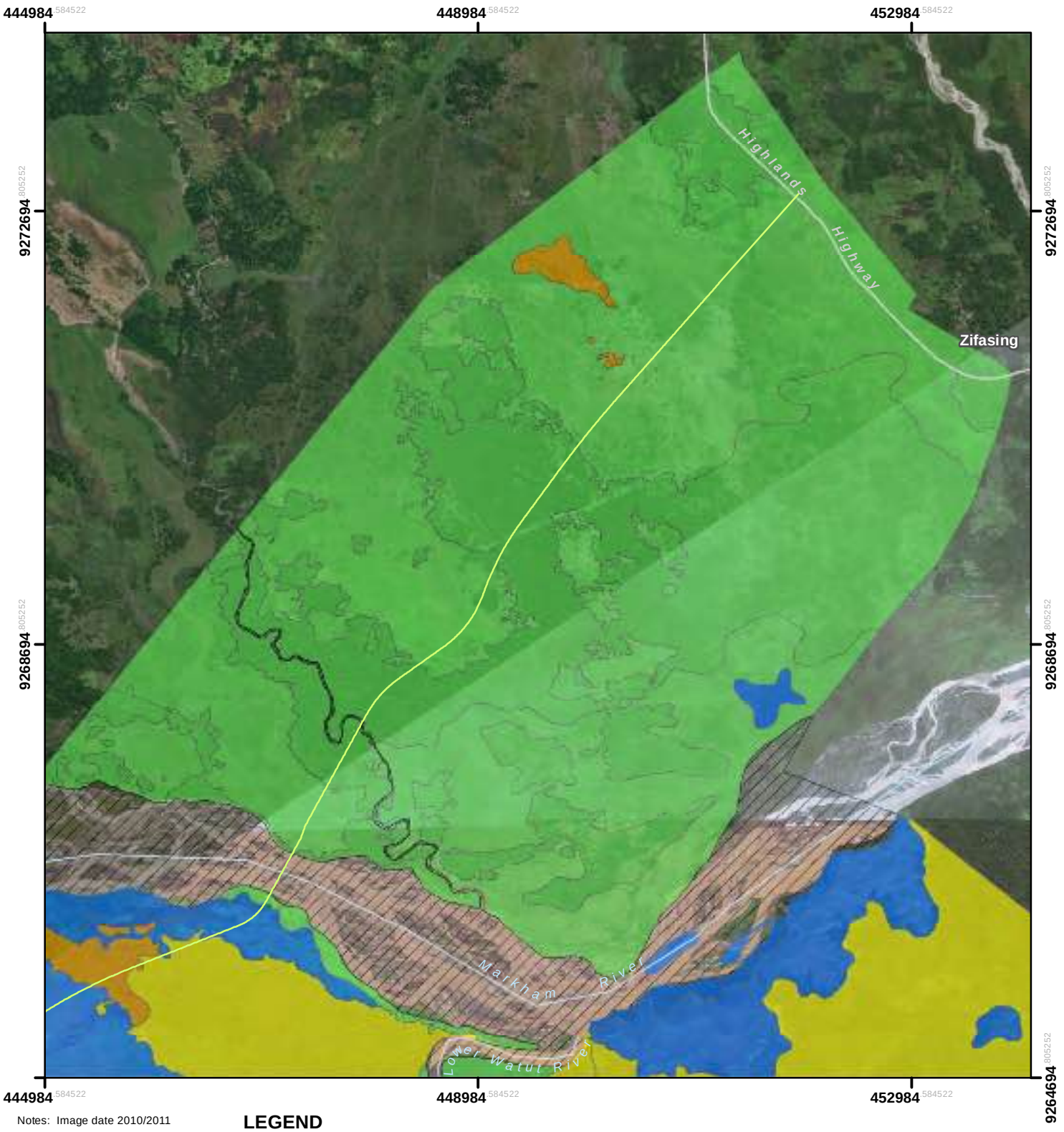

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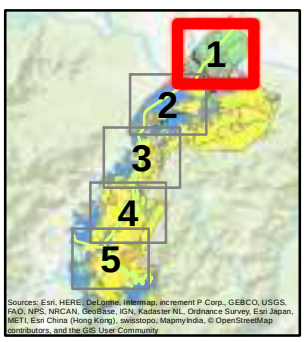

LEGEND

Proposed infrastructure footprint

Vegetation Condition

- Intact (category 1)
- Moderately disturbed (category 2)
- Degraded (category 3)
- Highly modified (category 4)
- Not Classified

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1:50,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**4.2.a Map 1 of 5**
Title:	Vegetation Condition within the study area
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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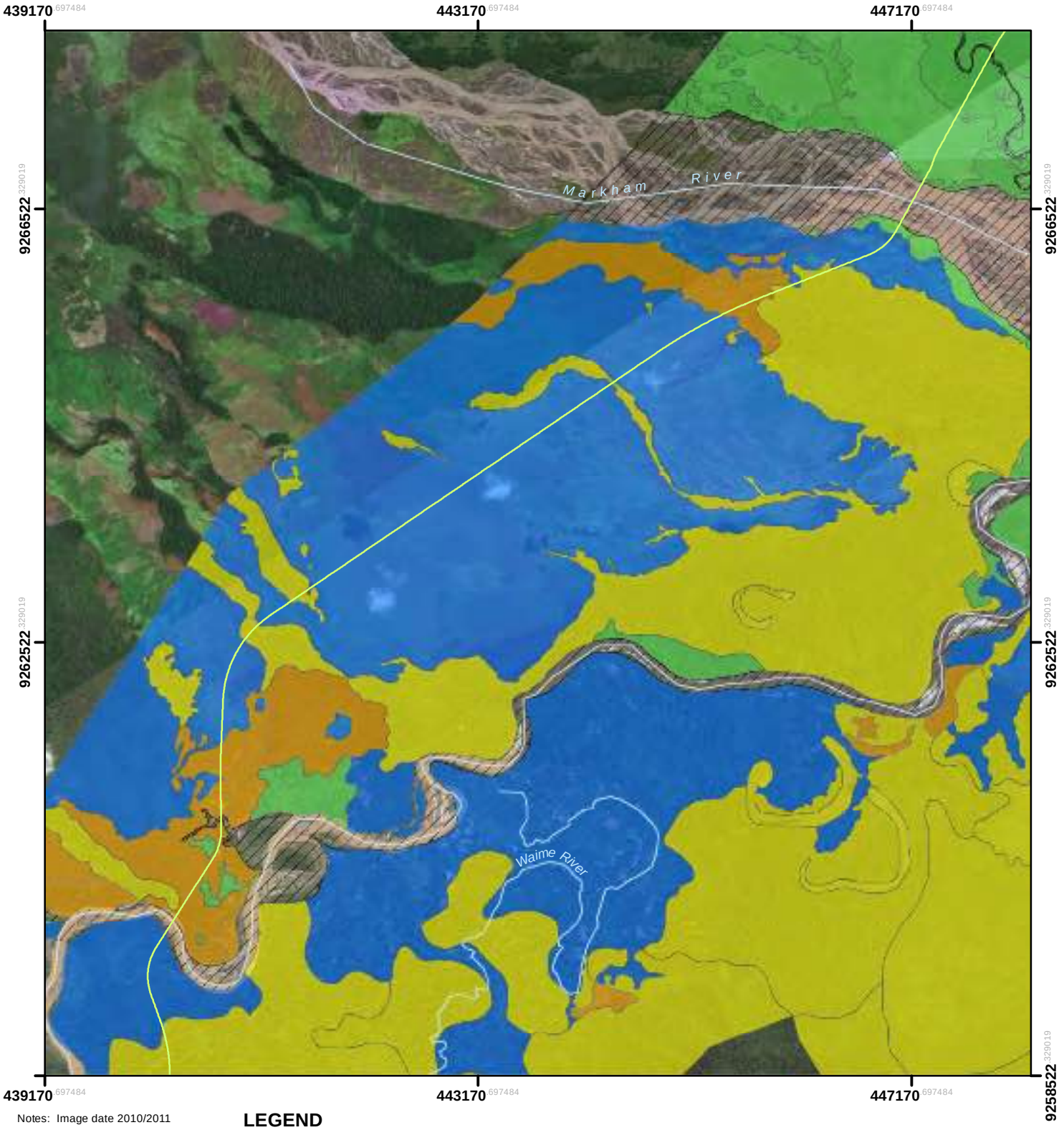

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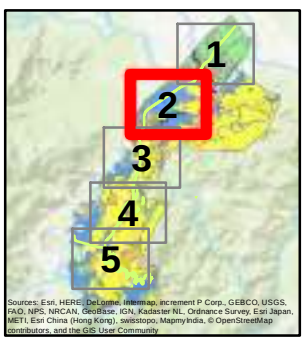

LEGEND

Proposed infrastructure footprint

Vegetation Condition

- Intact (category 1)
- Moderately disturbed (category 2)
- Degraded (category 3)
- Highly modified (category 4)
- Not Classified

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Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**4.2.b Map 2 of 5**
Title:	Vegetation Condition within the study area
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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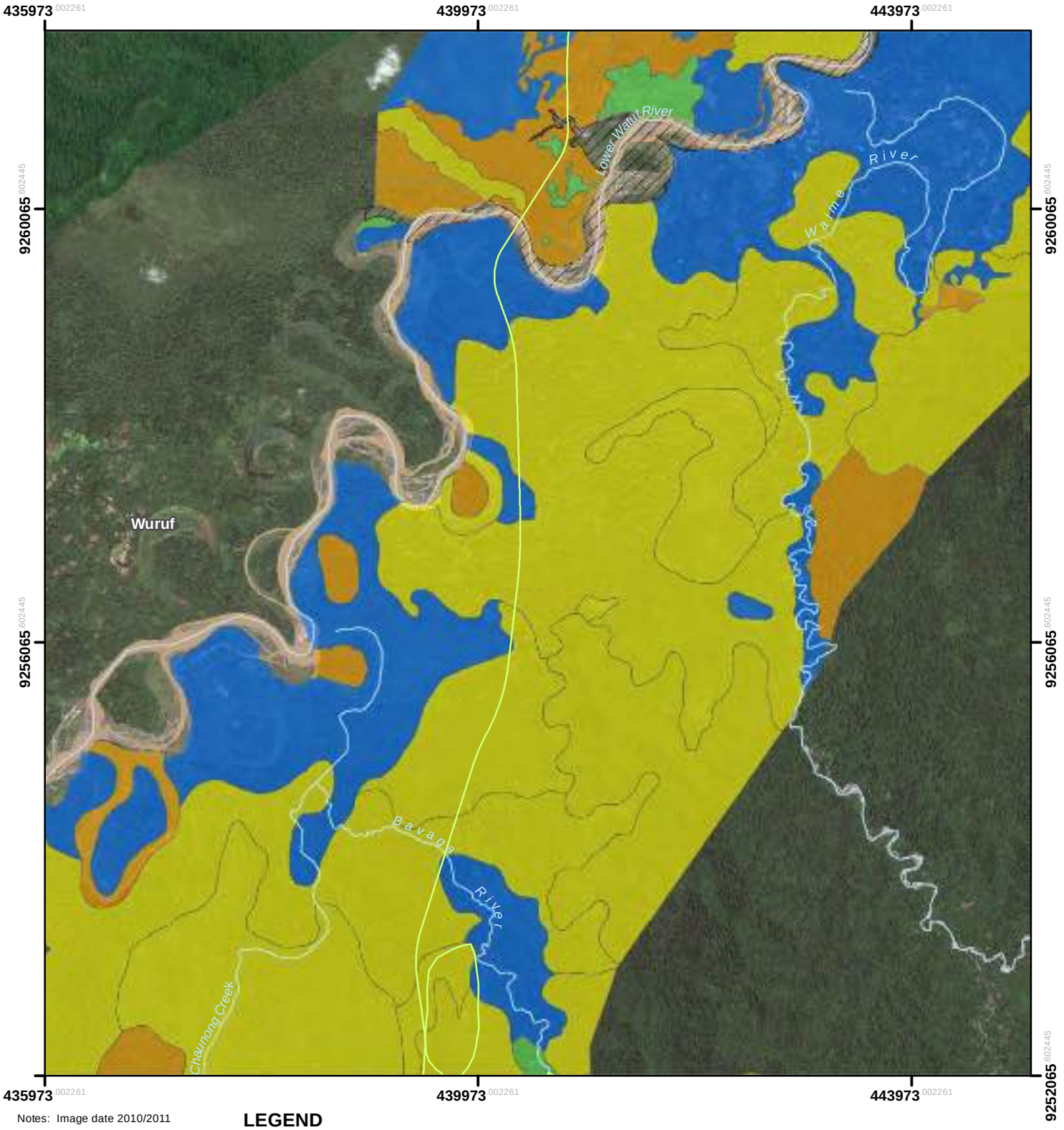

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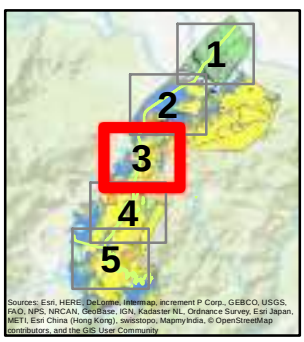

LEGEND

Proposed infrastructure footprint

Vegetation Condition

- Intact (category 1)
- Moderately disturbed (category 2)
- Degraded (category 3)
- Highly modified (category 4)
- Not Classified

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Kilometres
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Figure:	**4.2.c Map 3 of 5**
Title:	Vegetation Condition within the study area
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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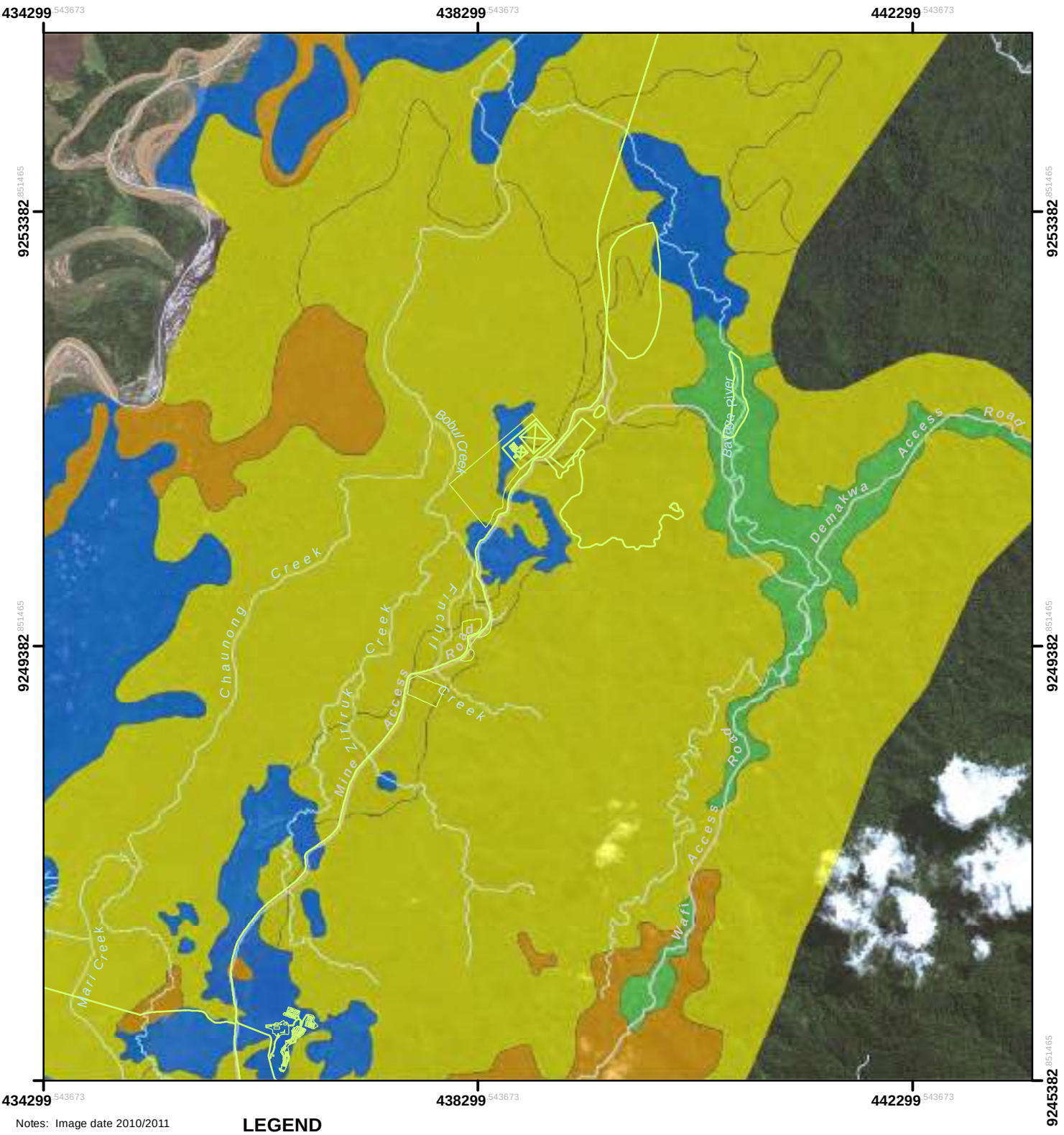

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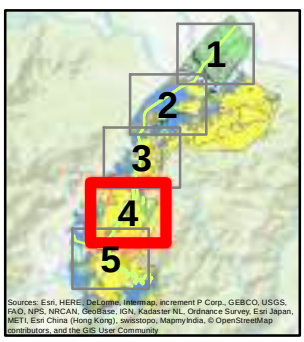

LEGEND

Proposed infrastructure footprint

Vegetation Condition

- Intact (category 1)
- Moderately disturbed (category 2)
- Degraded (category 3)
- Highly modified (category 4)

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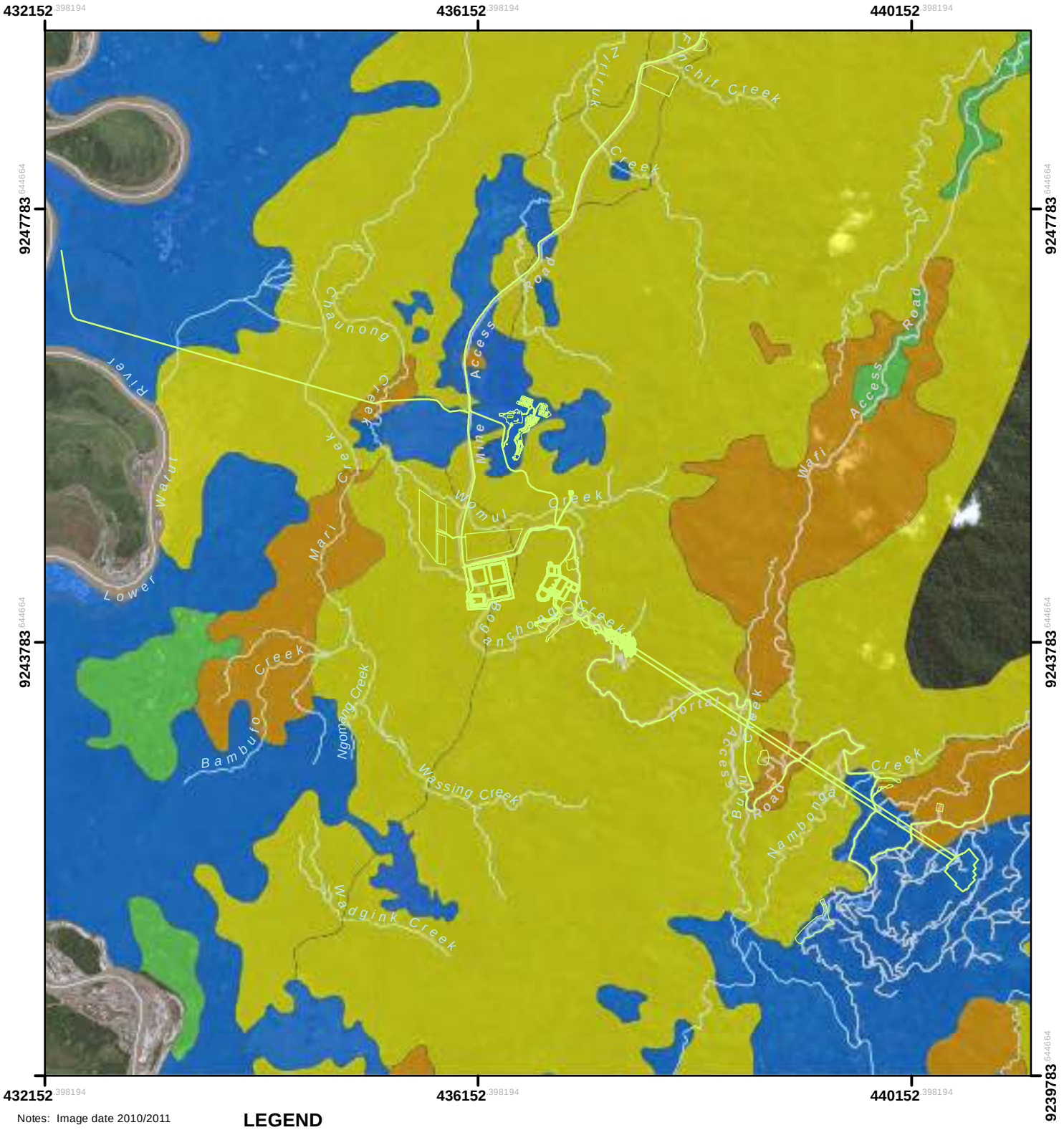
Figure:	**4.2.d Map 4 of 5**
Title:	Vegetation Condition within the study area
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS



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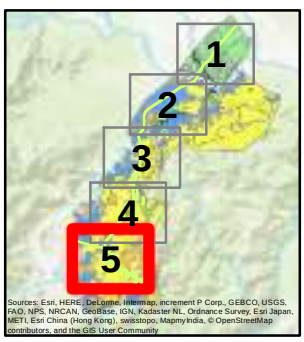

LEGEND

Proposed infrastructure footprint

Vegetation Condition

- Intact (category 1)
- Moderately disturbed (category 2)
- Degraded (category 3)
- Highly modified (category 4)

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Kilometres
1:50,000 at A4
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Figure:	**4.2.e Map 5 of 5**
Title:	Vegetation Condition within the study area
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 4-2 Habitat Condition map series 20180322.mxdDate: 22/03/2018 2:56:22 PM

4.6 FLORA SPECIES OVERVIEW

Floristic studies detailed by Takeuchi (2000) within lowland rainforests (below 400 m) of the Josephstaal Forest Management Agreement Area, approximately 250km north of the study area, identified 139 families, 445 genera and 730 distinct morphospecies with an unaccounted proportion of the flora considered undocumented. Due to similarities in the altitudinal range of the study area with the Josephstaal Forest Management Agreement Area, it could be expected that comprehensive floristic surveys in the study area would identify similar numbers of flora species, although species composition might vary due to the geographic distance between sites.

As previously noted in **Section 4.1**, single expeditionary-based surveys generally lead to incomplete samples of the flora of a study area due to the relatively limited number of species that are fertile during any survey period (Takeuchi 2003). Full botanical inventories of the habitats in the study area would take many months involving extended seasonal surveys to comprehensively collect fertile vegetative material. Takeuchi and Golman (2001) make reference to the poorly collected nature of flora in PNG and it is likely that in the advent of detailed botanical inventory studies within the study area over a range of seasons, a number of species new to science would likely be identified. Furthermore, it is likely that many species would not be positively identified due to a lack of fertile material for the purpose. Flora surveys of the study area have included the following studies conducted between 2010 and 2015:

- Booyong Forest Science (2011a): Botanical survey for an unspecified period in December 2010. No reference to the collection of fertile specimens or submission to herbaria.
- Booyong Forest Science (2011b): Botanical survey in the Markham Gap Basin for an unspecified period in December 2010. No reference to the collection of fertile specimens or submission to herbaria.
- PNG Forest Research Institute (2011): Combined survey period of 18 days between February and April 2011. A total of 80 fertile plant specimens submitted to the PNG National Herbarium, Lae, did not include specimens of plants identified as threatened species by the IUCN Red List.
- Booyong Forest Science (2013): Botanical survey for an unspecified period in June 2012. No reference to collection of fertile specimens or submission to herbaria.
- Current surveys (2015):
    - 14 days of survey in late March 2015. A total of 205 fertile plant specimens lodged with the Queensland Herbarium, Brisbane, with duplicates of most taxa also lodged with the PNG National Herbarium, Lae.
    - Five days of survey associated with a potential Northern Access Road alignment in July 2015 with 105 specimens lodged with the PNG National Herbarium, Lae.
    - Five days of survey associated with the proposed Northern Access Road alignment in September 2015. Twenty-four fertile specimens retained at WGJV.

Combined survey results, incorporating the results of previous surveys and previous botanical collections contained in herbarium records (Queensland Herbarium 2015), have identified 885 flora species within the study area, including 63 fern species, eight species of conifer and allies, two species of dipterocarp and 812 species of flowering plant. In total 385 fertile plant specimens have been submitted to relevant herbaria across the four dedicated field surveys undertaken for the Project. A full survey species list including information from all sources that were accessed is provided in **Appendix B**. It should be noted that the recorded plant species list includes a considerable number of species that have not been verified through herbarium submission. It should also be noted that the species list would represent only a minor subset of the species present within the study area.

4.7 CONSERVATION SIGNIFICANT SPECIES

Although there are conventions that PNG is a signatory to, such as the International Plant Protection Convention and Convention on Biological Diversity, there is no formalised system within PNG legislation dealing specifically with the protection of threatened or significant plant species. Nor has any structured national system applying conservation status to flora species been devised or applied. The recognition of threatened species in this report is based on information provided in the IUCN Red List of Threatened Species (IUCN 2017a). It should be stressed that this system has no legislative or legal significance within PNG other than to provide guidance to the relative conservation significance and/or rarity of any given plant species at a particular location. Reference to the IUCN database indicates 143 plant species within PNG listed as threatened (Vulnerable, Endangered, or Critically Endangered), 34 listed as Near Threatened and a further 36 species listed as Data Deficient. **Table 4.3** provides information relevant to threatened and near threatened species that, on the basis of field survey and floristic review, are either *known* to occur based on the results of field survey or previous studies, or are considered *likely* or *possible* to occur based on known distributions and habitat preferences or previous survey records. Only one flora species listed as Data Deficient by the IUCN Red List (*Aglaia cucullata*) has been recorded within the study area (**Appendix B**).

Due to the paucity of botanical collections in PNG, it is necessary to assess all listed species for likelihood of occurrence within the study area. A full list of threatened species for PNG, as per the IUCN Red List, is provided in **Appendix C**. Without more extensive botanical inventory beyond the Project scope, it is not possible to exclude the potential for the occurrence of many of these species from within the study area. In total:

- Nine threatened or near threatened flora species have been confirmed to occur in the study area through submission of fertile specimens to relevant herbaria. This includes one species listed as Critically Endangered, three species listed as Vulnerable and five species listed as Near Threatened under the IUCN Red List (**Table 4.3**). The locations where these species were recorded during the detailed secondary and quaternary flora site assessments during the 2015 surveys are shown in **Figure 4.3**. It is important to note that the detailed flora site assessments covered only a small percentage of the study area; therefore, the locations of the conservation significant species shown in **Figure 4.3** do not represent the total distribution of these species across the study area. For example, Kwila occurs commonly in most areas of Medium Crowned Forest and Small Crowned Forest on hillslopes and as scattered trees in most areas of Large Crowned Forest on alluvial plains.
- A further eight threatened or near threatened species of flora have been reported to occur in the study area although have not been verified through collection and submission of fertile material. This includes one species listed Critically Endangered, two listed Endangered, one listed Vulnerable and four species listed Near Threatened under the IUCN Red List (**Table 4.3**). The precise locations of these records remain unknown as they were not specifically identified in previous reports that recorded their occurrence in the study area, and:
- A further 25 species are considered to possibly occur based on habitat and geographic distribution including one listed Critically Endangered, one listed as Endangered, 16 listed Vulnerable and seven species listed Near Threatened under the IUCN Red List (**Table 4.3**).

In addition to the IUCN species list, 263 taxa are listed in CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) Appendices 1 and 2 for PNG (UNEP – WMC, 2015). The species presently listed for PNG include five species of *Cyathea*, 10 species of *Cycas*, five taxa in the fern family Dicksoniaceae, four pitcher plants (genus *Nepenthes*), and 149 species of orchid. Listing on CITES of orchids is, however, incomplete (as noted in the database explanatory notes) and export of all orchids collected from the wild was banned by the PNG Department of Environment and Conservation in 1990 (Vantomme *et al.* 2002). Miller *et al.* (1994a) also listed *Euphorbia* spp. as protected under CITES.

Table 4.3. Conservation significant flora species known and likely to occur within the project area and their threat status under the IUCN Red List.

Species	Record source	IUCN*	Habitat and distribution	Comments on records and likelihood of occurrence
Species confirmed to occur in the study area – recorded in 2015 surveys				
Diospyros lolinopsis (**Photo 4.21**)	Recorded in current survey and also reported in Booyong (2013) and PNGFRI (2011)	CR	The IUCN assessment undertaken by Eddowes (1998a) suggests that the only recorded occurrences of this tree are at Usino near the Bigei River and in the Adelbert Mountains at approximately 400m elevation, both in Madang Province (Queensland Herbarium 2015). Information provided by the Lae Herbarium indicates a much greater geographic distribution with 8 records in 5 locations in Madang and Milne Bay Provinces at altitudes ranging from 50 m to 650 m ASL.	A common species in the sub-canopy and occasionally canopy in Medium Crowned Forest, particularly from the proposed location of the Northern Access Road borrow pit to just north of the Chiatz area, with good evidence of seed dispersal and seedling recruitment (**Photos 4.29** and **4.30**). Most commonly associated with ridgelines where it shares dominance with *Intsia bijuga* although is occasionally found on outwash and alluvial plains at the base of hillslopes. A single specimen was also recorded in the Buvu Creek valley but it appeared to be rare in this area. The species was verified with voucher specimens lodged to the Queensland Herbarium (DGF WG183) and a subsequent fertile specimen with mature fruit lodged with the Lae Herbarium (DGF WG290, 291). The species was also recorded in the Bavaga area during timber assessments undertaken by PNGFRI (2011) and reported to be common on hillslopes (Booyong 2013) although voucher specimens were not lodged during these surveys.
Intsia bijuga (Kwila)	Recorded in all surveys.	VU	A pan-tropical species of lowland rainforest distributed throughout south-east Asia and Melanesia which produces one of the most valuable timbers of South East Asia (World Conservation Monitoring Centre 1998a).	Recorded during survey in Medium Crowned Forest and Small Crowned Forest on hillslopes. The species is extremely common forming dense stands in some forested areas. Scattered specimens also located in Large Crowned Forest on the Watut River alluvial plain.
Pterocarpus indicus (New Guinea Rosewood) (**Photo 4.22**)	Recorded in all surveys.	VU	A widespread tree found in lowland primary and some secondary forest, mainly along tidal creeks and rocky shores (Eddowes 1998b).	Scattered trees found within Medium Crowned Forest on footslopes, Large Crowned Forest on the Watut River alluvial plain and also Mixed Swamp Forest.
Flindersia amboinensis (**Photo 4.23**)	Recorded in 2015 only	LR – NT	A large tree with widespread but sporadic occurrence within lowland and sub-montane rainforest throughout PNG (Eddowes 1998c).	A scattered tree on footslopes located in Medium Crowned Forest in the Buvu Creek valley as well as several specimens located in the vicinity of the proposed Northern Access Road borrow pit.
Myristica buchneriana (**Photo 4.24**)	Recorded in 2015 only	VU	Tree of primary rainforest frequently found on ridge tops between 300 m and 1,300 m (Eddowes 1998d).	The species was collected during field surveys in Medium Crowned Forest near the Finchif Fly Camp. Scattered herbarium records throughout lowland and sub-montane forest, mostly in northern PNG. Identity confirmed through submission of fertile voucher specimen the PNG National Herbarium (DGF WG151).
Myristica globosa (**Photo 4.25**)	Recorded in 2015 only	LR – NT	Occurs in rainforest up to 1,200 m (Eddowes 1998e).	The species was collected during field survey in Medium Crowned Forest at Site WG36 in the vicinity of the proposed Northern Access Road borrow pit. Identity confirmed through submission of a fertile specimen to the Lae Herbarium (DGF WG182, 208).
Aglaia sexipetala (**Photo 4.26**)	Recorded in 2015 only	LR – NT	Small sub-canopy tree occurring in lowland rainforest. Cosmopolitan species known from Indonesia, Irian Jaya, Malaysia and Papua New Guinea.	Recorded in disturbed Large Crowned Forest on the margins of Waime River. Species identity confirmed through submission of a fertile specimen to PNG National Herbarium in Lae (DGF WG196).

Species	Record source	IUCN*	Habitat and distribution	Comments on records and likelihood of occurrence
Cycas schumanniana (Cites Listing) (**Photo 4.27**)	Recorded in current survey and Booyong (2011b)	NT	A grassland species of cycad growing to 2 m high (RBGSYD 2012b). It is endemic to PNG occurring on the northern side of the island along the foothills of the Bismarck range, predominantly in the valleys of the Markham and Ramu Rivers, and extending south from Lae along the Bulolo river as far as Wau and Madang. Recorded from low to high elevations, up to 1,600 m ASL (Hill 2010c).	The species was recorded on a low ridgeline adjacent to the Markham River on the proposed Northern Access Road alignment. Scattered small individual plants were associated with frequently burnt Kunai Grassland on the ridgeline but the species was more abundant on the ecotone between the Kunai Grassland and adjoining Scrub that afforded the species some protection from the frequent burning. The species was reported to be occasional on ridges in hill forest in the Markham Gap Basin (Booyong 2011b).
Cycas apoa (Cites Listing) (**Photo 4.28**)	Recorded in 2015 only	NT	A forest cycad growing to heights of 4-7 m (RBGSYD, 2012a). Known from northern coastal New Guinea, from the Huon Peninsula west to at least the Mamberamo River in Indonesian New Guinea. This species is scattered in closed mesophyll forest in wet lowland areas, most typically on low ridges (Hill 2010d).	Associated with Medium Crowned Forest on hillslopes in a large number of localities. Found on the far eastern limits of the known geographical range of the species. Verified with voucher specimen lodged with the Queensland Herbarium (DGF WG19).
Species recorded in previous surveys				
Halfordia papuana	Booyong (2011b)	CR	This tree is scattered in submontane and montane rainforest between 1,200 m and 2,700 m with some collections as low as 250 m. Mostly confined to the Bulolo/Wau region in Morobe Province although several specimens recorded in the East Sepik Province (Conn *et al.* 2006) and Lae Herbarium collections for the West Sepik, Chimbu, Central Highlands, Eastern Highlands, Enga and Southern Highlands provinces (M. Lovave pers. comm.).	The species was identified in Swamp Forest in the Markham Gap Basin area in Booyong (2011b). Identification was tentative based on a single seedling only. Collection location appears contrary to the species' preferred habitat, which is sub-montane rainforest. Whilst occurrence of the species cannot be discounted, the majority of the study area provides sub-optimal habitat and the species is unlikely to be present in significant populations.
Diospyros insularis	Reported in Booyong (2013)	EN	A tree of primary lowland rainforest. Found in only a few localities in the Solomon Islands and New Ireland of the Bismarck Archipelago (Eddowes 1998f). Lae Herbarium holds specimens for the island provinces of Milne Bay, West New Britain and East New Britain (M Lovave pers. comm.) and the species has not been previously recorded from the mainland provinces.	Reported to be common on ridges and occasional on plains in Booyong (2013) although the identification has not been confirmed through submission of fertile herbarium specimen. Considered unlikely to occur in the in the study area based on herbarium collections that suggest it does not occur on mainland PNG.
Flindersia pimenteliana	Reported in PNGFRI (2011)	EN	A large tree found mainly in lower montane rainforest or in foothill rainforest. In PNG, the species is widespread but uncommon and sporadic. Fifty collections throughout the Central, Morobe, Milne Bay Provinces and Papua (Indonesia). Collections in the Lae district (Eddowes 1998g). Lae Herbarium retains 17 collections from the Morobe, Milne Bay, Madang, Eastern Highlands, Northern and Western Provinces (M. Lovave pers. comm.).	Recorded by PNGFRI (2011) within a total species enumeration plot in the Babauf Forest area although identification was not confirmed with herbarium voucher specimen. Several herbarium specimens have been collected with 50km of the study area (Queensland Herbarium 2015). The species has potential to occur in the study area although, based on lack of records during recent intensive field survey, it is unlikely to be common.
Archidendron forbesii	Reported in Booyong (2013)	VU	A late secondary tree scattered in lowland rainforest. Reported to be confined to the Central province (Eddowes 1998h). Lae Herbarium holds a single record for the species near Sogeri in the Central Province (M. Lovave pers. comm.)	Reported in Booyong (2013) to be occasional on ridge forests and alluvial plains. Record would represent a significant range extension for the species, which was not confirmed through the submission of a fertile herbarium specimen. Two fertile specimens of *Archidendron* from 2015 surveys submitted to the Queensland and Lae Herbariawere identified as *Archidendron glabrum.* Based on herbarium collection records, it is considered unlikely that the species occurs in the study area.

Species	Record source	IUCN*	Habitat and distribution	Comments on records and likelihood of occurrence
Cycas campestris (Cites Listing)	Reported in Booyong (2013)	NT	All collections from the Central Province, mostly in the vicinity of Port Moresby (Hill 2010a).	Reported to be occasional on ridges and rare on alluvial plains (Booyong 2013). Record would represent a significant range extension for the species. Not confirmed through submission of fertile herbarium specimen. Based on known distribution range, species is considered unlikely to occur.
Cycas scratchleyana (Cites Listing)	Reported in Booyong (2011a, 2011b, 2013)	NT	All current herbarium collections are from the Western, Gulf, Central, Milne Bay Provinces plus Irian Jaya in coastal rainforest to hills (Hill 2010b). The plant is considered to be widespread within its known range, occurring from near-coastal sites to foothills (5 m to 900 m ASL).	Reported to be common in hill forest on ridges and occasional on flats. Not confirmed through submission of fertile herbarium specimen. Based on known distribution range, species is considered unlikely to occur, and most likely a mis-identification of *C. apoa*.
Aglaia silvestris	Booyong (2013)	LR – NT	A widespread, variable species of various habitat types, occurring up to 2,100 m. Cosmopolitan species with widespread, scattered distribution throughout Papua New Guinea (Pannel 1998b).	Reported in Booyong (2013) to be common on ridges and occasional on alluvial plains. Also, reported in PNGFRI as a tree in the Bavaga Forest Area. Since the presence of the species has not been confirmed through submission of a fertile herbarium specimen, it is assessed as having potential to occur.
Aglaia euryanthera	Booyong (2013)	LR - NT	A small tree found in many forest habitats up to 2,100 m (Pannel 1998c). Known to occur in PNG, Australia and Irian Jaya. Six collections throughout PNG (Conn *et al.* 2006).	Reported in PNGFRI (2011) as *Aglaia cf. euranthera* within a total species enumeration plot in the Babauf Forest area. Since the presence of the species has not been confirmed through submission of a fertile herbarium specimen, it is assessed as having potential to occur.
Species considered to have potential to occur although not recorded in surveys				
Helicia subcordata		CR	Tall forest tree in primary forest found only once near Wagau in the Morobe province in mid-montane forest at 1,350 m (Eddowes 1998l).	Possible in Medium Crowned Forest and Small Crowned Forest.
Calophyllum morobense		EN	Occurs in lowland rainforest on alluvial soils. Endemic to Morobe Province (Eddowes 1998i) with records in the Lae district (Queensland Herbarium 2015).	Possible in Large Crowned Forest of the Watut River alluvial plain.
Aglaia flavescens		VU	A small tree confined to the island of New Guinea (Pannel 1998d). So far it is known from only four localities all within the Milne Bay, Madang and Morobe Provinces (Conn *et al.*2006).	Possible in Medium Crowned Forest and Small Crowned Forest as well as Large Crowned Forest of the Watut River alluvial plain.
Aglaia lepiorrhachis		VU	Sub-canopy tree of lowland forest. Endemic to PNG. 8 Collections from the Madang and Morobe Province.	Possible in Medium Crowned Forest and Small Crowned Forest as well as Large Crowned Forest of the Watut River alluvial plain.
Polyscias prolifera		VU	The IUCN considers the species to be known from only two collections in the Kuper Range (World Conservation Monitoring Centre 1998b) within the Morobe district. Conn *et al.* (2006) however also notes records from disturbed lowland forest in Morobe district; lowland rainforest in the Manus District; a single record from Mt Lululua in the East New Britain Subdistrict; Pomio from within montane *Nothofagus* forest plus a collection from within 50 km of the study area.	Possible in Medium Crowned Forest and Small Crowned Forest on hillslopes.
Calophyllum robustum		VU	This uncommon tree is found in lowland rainforest. Known from the Morobe district and near Ioma in the Northern district. However, the distribution limits of this taxon are unclear (Eddowes 1998j).	Possible in Medium Crowned Forest and Small Crowned Forest as well as Large Crowned Forest of the Watut River alluvial plain.

Species	Record source	IUCN*	Habitat and distribution	Comments on records and likelihood of occurrence
Gluta papuana		VU	This tree grows in seasonally inundated forest along rivers, in freshwater swamps and on well-drained soils up to 50 m ASL (Eddowes 1998k). Endemic to New Guinea, it occurs in Gulf, Western and Morobe Provinces with 8 collections throughout its range (Conn *et al.* 2006).	Possible in Large Crowned Forest and Mixed Swamp Forest of the Watut River alluvial plain.
Aglaia brassii		VU	This understorey tree is fairly common in lowland primary and secondary forest up to 500 m (Pannel 1998h).	Possible in all rainforest habitats in the study area.
Aglaia cremea		VU	Scattered collections through Irian Jaya, West Sepik, Central Highlands to Morobe Province. It grows in secondary forest and hill forest (Pannel 1998i).	Possible in all primary and regrowth rainforest habitats in the study area.
Cupaniopsis bullata		VU	A small tree found in secondary vegetation. Collections from Morobe and Central Province; known only from the type collection (World Conservation Monitoring Centre 1998c).	Possible in all primary and regrowth rainforest habitats in the study area.
Guioa unguiculata		VU	A small tree known only from four collections in the Central Highlands and Morobe Province (World Conservation Monitoring Centre 1998d).	Possible in all forested habitats in the study area, based on general distribution.
Horsfieldia clavata		VU	A shrub or small tree from tall lowland forest on well-drained soils. Although locally common, has been collected only three times in the Northern Province and Morobe Province (World Conservation Monitoring Centre1998e).	Possible in all primary and regrowth rainforest habitats in the study area.
Mammea papyracea		VU	A small tree, known only from the type collection, found in Buso, south of Lae in the Morobe district. (Stevens 1998).	Possible in all rainforest habitats in the study area.
Mangifera altissima		VU	A timber species of lowland evergreen forest (World Conservation Monitoring Centre 1998f). Scattered collections from Morobe and Northern provinces as well as New Britain and Solomon Islands (Conn *et al.* 2006).	Possible in all rainforest habitats in the study area.
Myristica pygmaea		VU	A small tree, endemic to Morobe Province, where it has been collected twice (World Conservation Monitoring Centre 1998g).	Possible in all rainforest habitats in the study area.
Myristica schlechteri		VU	The only specimen of this understorey tree was collected in 1908 in forest near Pema, Morobe Province (World Conservation Monitoring Centre 1998h).	Possible in all rainforest habitats in the study area.
Myristica sinclairii		VU	A total of five collections have been gathered from Morobe Province as an understory in Castanopsis forest (World Conservation Monitoring Centre 1998i).	Possible in Small Crowned Forest although habitats in study area not entirely consistent.
Adinandra forbesii		LR – NT	A tree scattered in monsoon forest, savannah woodland and lower montane forest up to 1,200 m (Eddowes 1998m). Morobe, Western Highlands, Eastern Highlands, Southern Highlands, Western, Gulf, Central, Northern & New Britain (Conn *et al.* 2006).	Possible in all rainforest habitats in the study area.
Aglaia flavida		LR – NT	A rainforest tree with six collections in the Morobe Province, Milne Bay and Bouganville (Panell 1998j)	Possible in all rainforest habitats in the study area.
Aglaia lepidopetala		LR – NT	Understory tree in rainforest. Widespread species with collections in the Morobe district (Pannel 1998k).	Possible in all rainforest habitats in the study area.
Aglaia rimosa		LR – NT	Secondary forest along streams, mostly in coastal or sub-coastal areas (Pannel 1998f).	Possible in Medium Crowned Forest and Small Crowned Forest along watercourses

Species	Record source	IUCN*	Habitat and distribution	Comments on records and likelihood of occurrence
Aglaia subcuprea		LR – NT	A tree of primary and secondary forest up to 2,570 m, often in periodically inundated areas. Restricted to Morobe – Milne Bay Area (Pannel 1998g).	Possible in Medium Crowned Forest and Small Crowned Forest.
Eucalyptopsis papuana		LR – NT	Occurs in a small patch on Woodlark Island, in the headwaters of the Watut River in the Morobe Province and in the Western and East Sepik Provinces (Eddowes 1998n).	Possible in Medium Crowned Forest and Small Crowned Forest.
Podocarpus rumphii		LR – NT	*Podocarpus rumphii* is a constituent of lowland to lower montane tropical rainforests, where it can be locally common. Widespread specific throughout Asia and the Pacific (Farjon A. 2013) with records from Irian Jaya and Gulf, Eastern Highlands and Milne Bay Provinces of PNG (Conn *et al.* 2006).	Possible in all rainforest habitats in the study area.

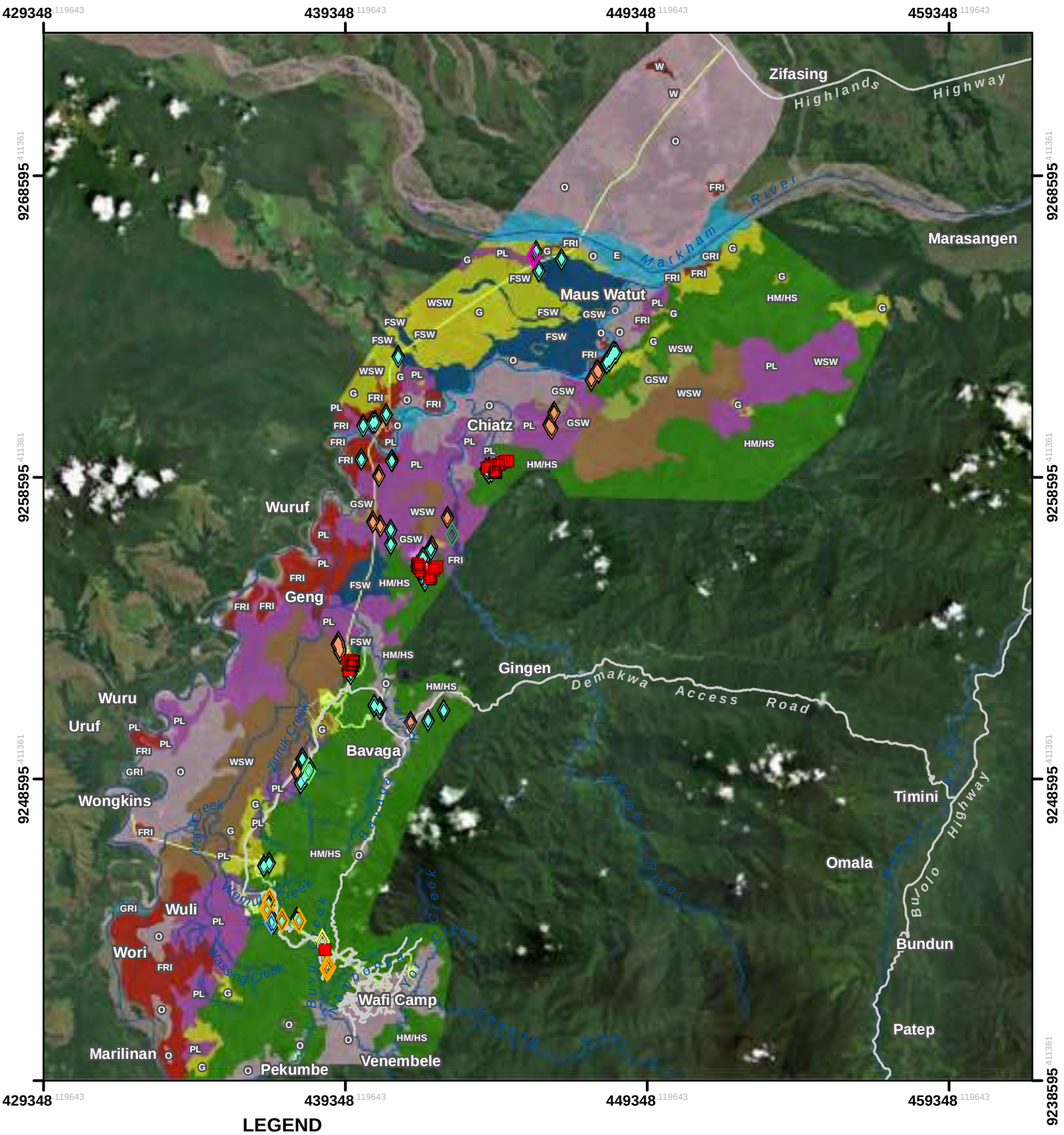
* Extinction risk status under the IUCN Red List (IUCN): CR = Critically Endangered (facing an extremely high risk of extinction in the wild in the immediate future); EN = Endangered (facing a very high risk of extinction in the wild in the near future); VU = Vulnerable (facing a high risk of extinction in the wild in the medium-term future); LR- NT = Lower Risk – Near Threatened.

Photo 4.21. Fruit and leaves of *Diospyros lolinopsis* (IUCN: Critically Endangered).

Photo 4.22. Winged seed of New Guinea Rosewood (*Pterocarpus indicus)* (IUCN: Vulnerable).

Photo 4.23. Fertile seed capsule from *Flindersia amboinensis* (IUCN: Near Threatened).

Photo 4.24. Fruiting specimen of *Myristica buchneriana* (IUCN: Vulnerable).



LEGEND

Proposed infrastructure footprint

Priority Flora Species

- Critically Endangered, *Diospyros lolinopsis*
- Near Threatened, *Aglaia sexipetala*
- Near Threatened, *Cycas schumanniana*
- Near Threatened, *Cycas*
- Near Threatened, *Eucalyptopsis papuana*
- Near Threatened, *Flindersia amboinensis*
- Near Threatened, *Myristica globosa*
- Vulnerable, *Intsia bijuga*
- Vulnerable, *Myristica buchneriana*
- Vulnerable, *Pterocarpus indicus*

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GRI - Riverine successions dominated by grass
- GSW - Swamp Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- Sc - Scrub
- W - Woodland
- WSW - Swamp Woodland

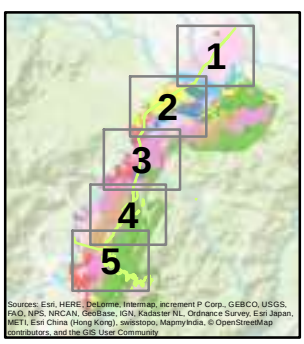


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Figure:	**4.3**
Title:	Flora species of conservation significance encountered on field surveys - Overview map
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

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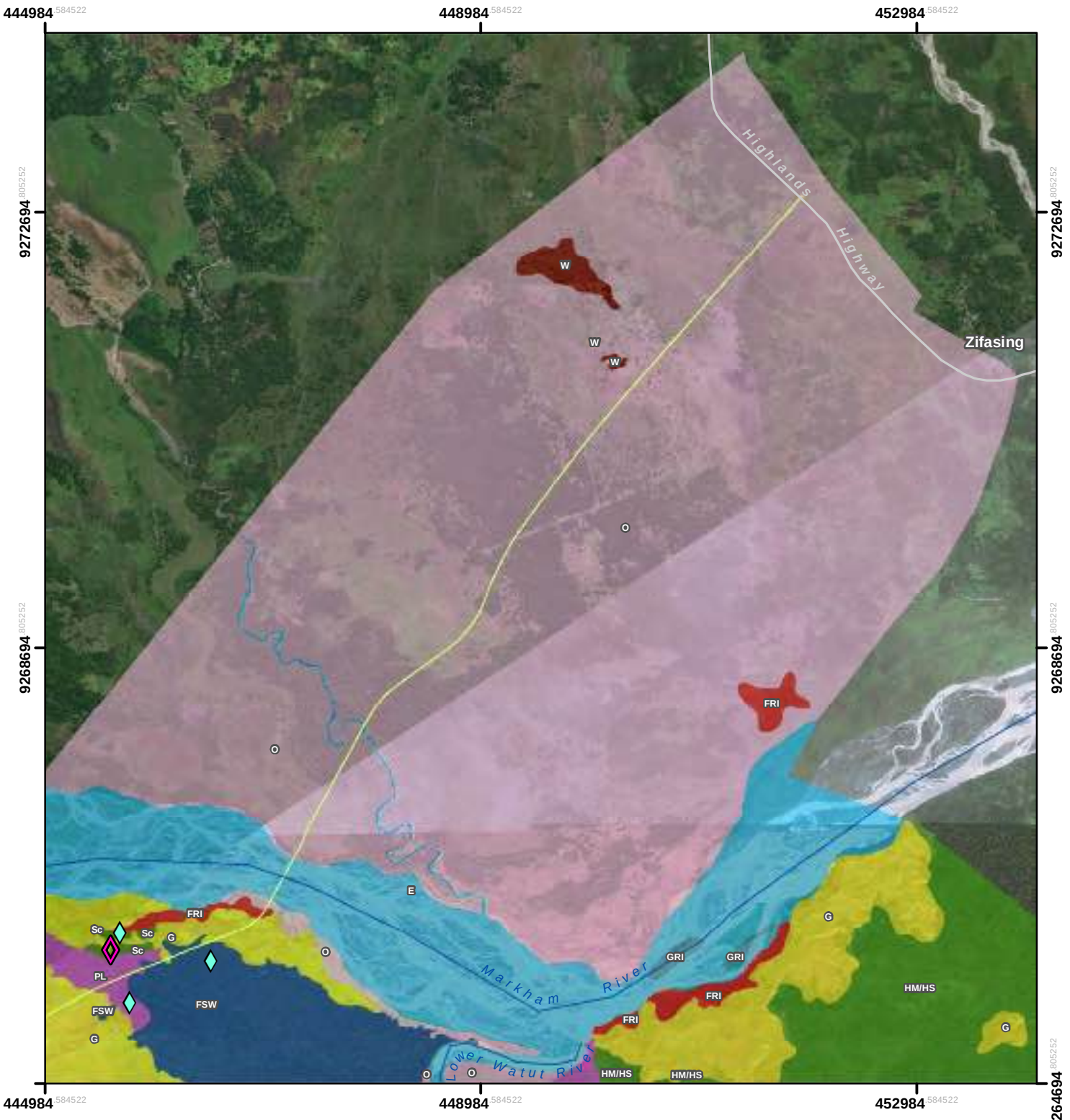

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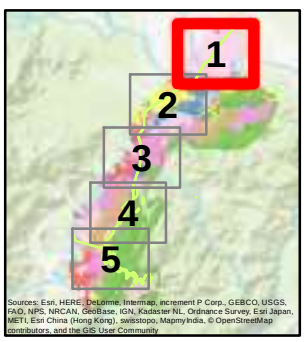

LEGEND

Proposed infrastructure footprint

Priority Flora Species

- Near Threatened, *Cycas schumanniana*
- Vulnerable, *Intsia bijuga*

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GRI - Riverine successions dominated by grass
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- Sc - Scrub
- W - Woodland

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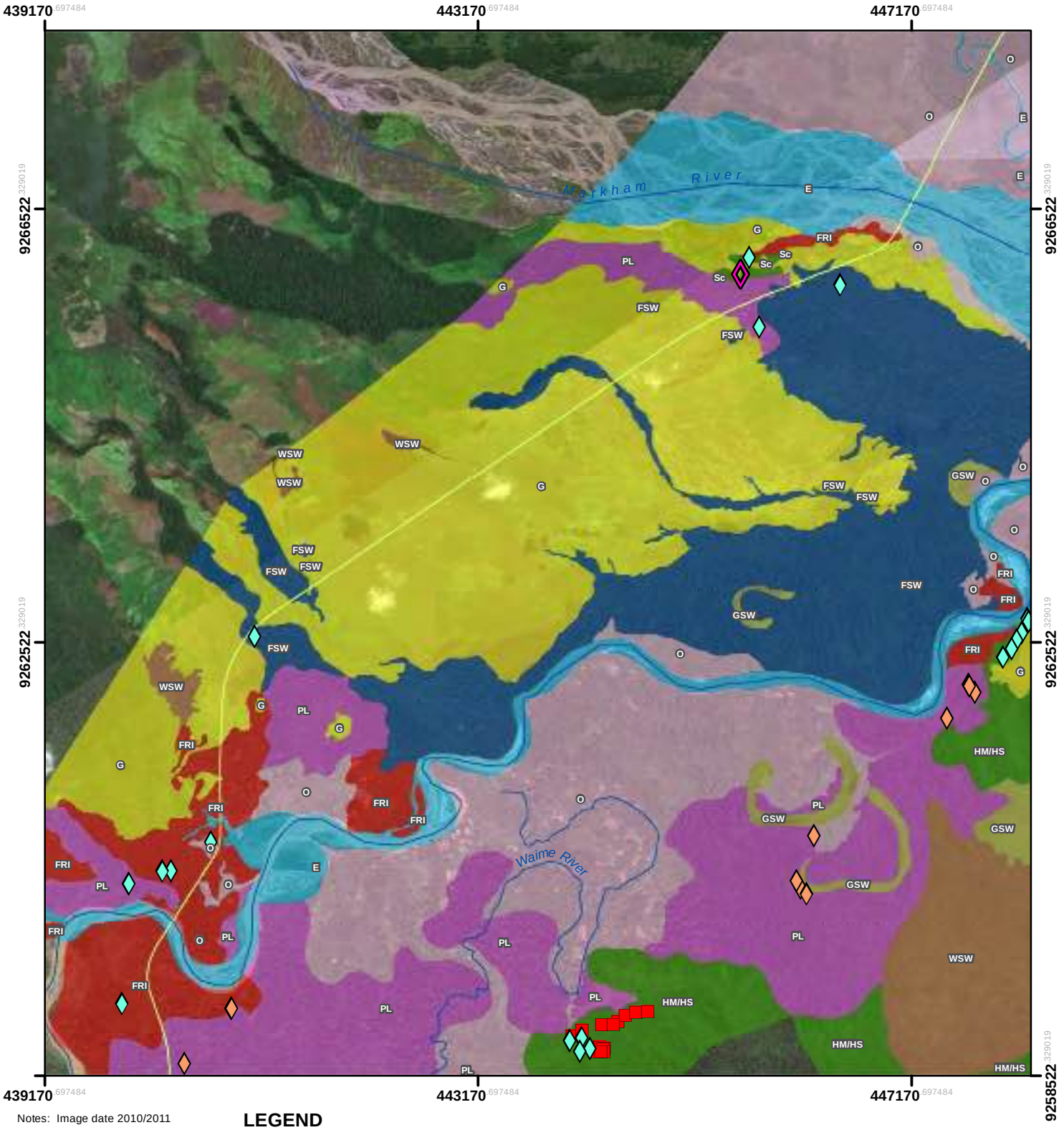
Figure:	**4.3.a Map 1 of 5**
Title:	Flora species of conservation significance encountered on field surveys
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

BAAM ECOLOGICAL CONSULTANTS

Drawn By: KM Reviewed by: PL Date: 22/03/2018

Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 4-3 Locations of significant flora species 20180322.mxd



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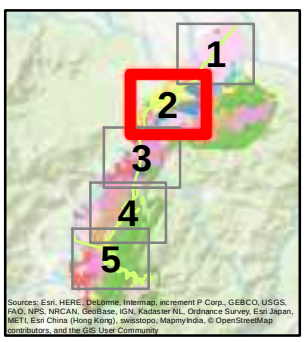

LEGEND

Proposed infrastructure footprint

Priority Flora Species

- Critically Endangered, *Diospyros lolinopsis*
- Near Threatened, *Cycas schumanniana*
- Vulnerable, *Intsia bijuga*
- Vulnerable, *Pterocarpus indicus*

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GSW - Swamp Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- Sc - Scrub
- WSW - Swamp Woodland

0 0.5 1 1.5 2
Kilometres
1:50,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

N W E S

Drawn By: KM Reviewed by: PL Date: 22/03/2018

Figure:	**4.3.b Map 2 of 5**
Title:	Flora species of conservation significance encountered on field surveys
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

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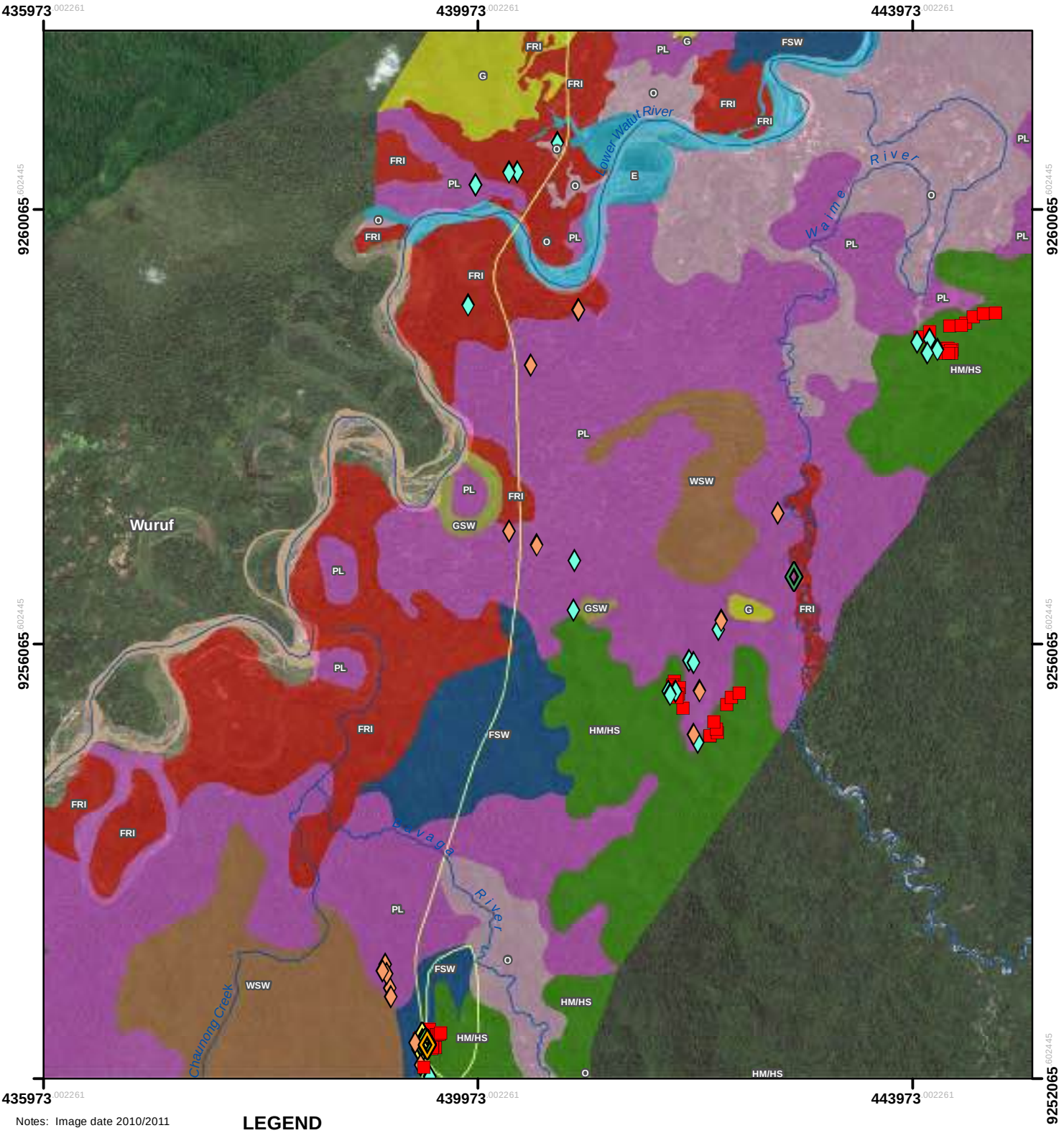
Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 4-3 Locations of significant flora species 20180322.mxd



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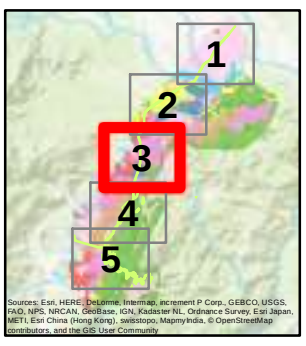


LEGEND

Proposed infrastructure footprint

Priority Flora Species

- Critically Endangered, *Diospyros lolinopsis*
- Near Threatened, *Aglaia sexipetala*
- Near Threatened, *Cycas apoa*
- Near Threatened, *Eucalyptopsis papuana*
- Near Threatened, *Flindersia amboinensis*
- Near Threatened, *Myristica globosa*
- Vulnerable, *Intsia bijuga*
- Vulnerable, *Pterocarpus indicus*

FIMS Vegetation Communities

- E - Lakes and larger rivers
- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- GSW - Swamp Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- WSW - Swamp Woodland

0 0.5 1 1.5 2
Kilometres
1:50,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

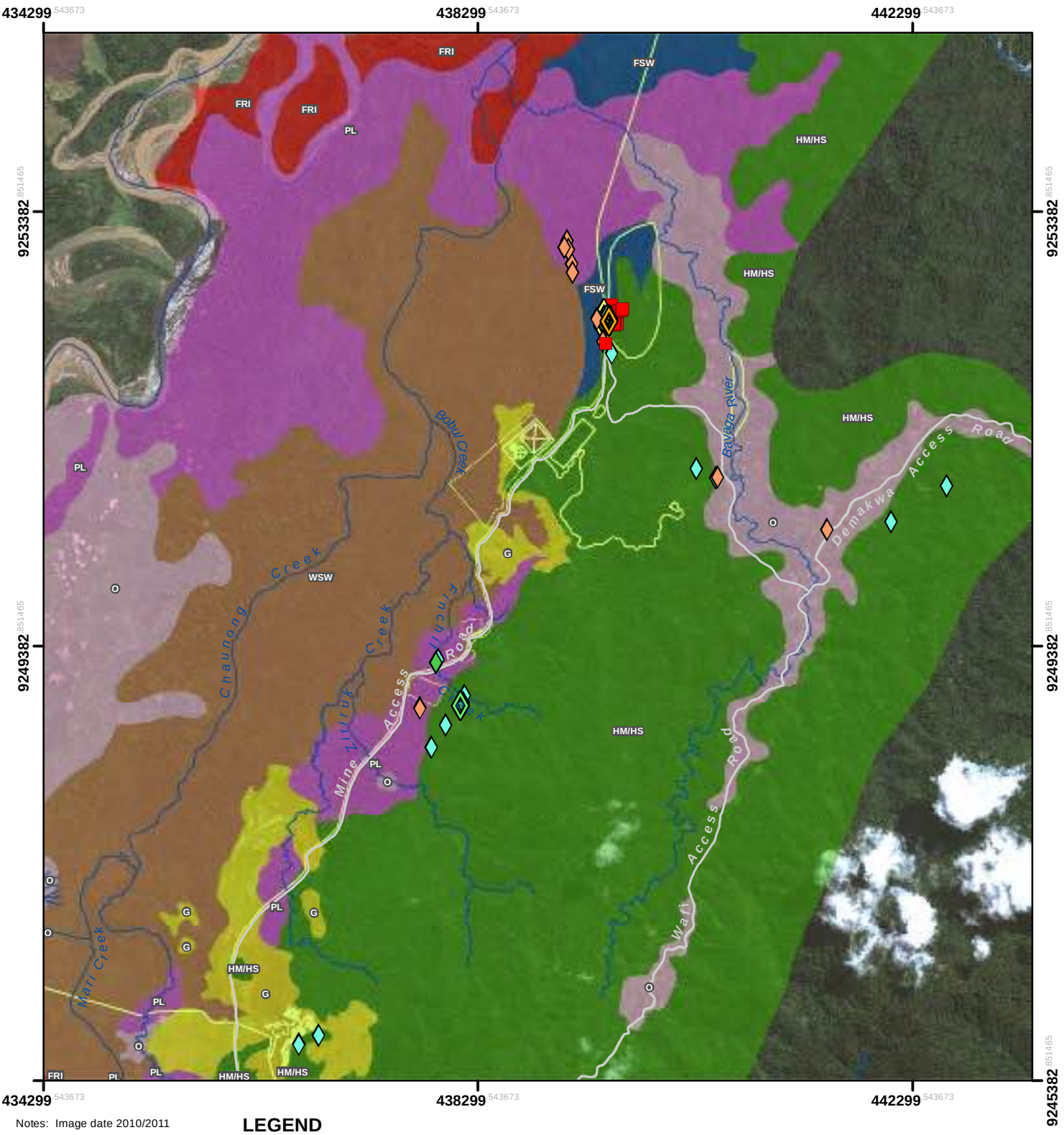
N W E S

Figure:	**4.3.c Map 3 of 5**
Title:	Flora species of conservation significance encountered on field surveys
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

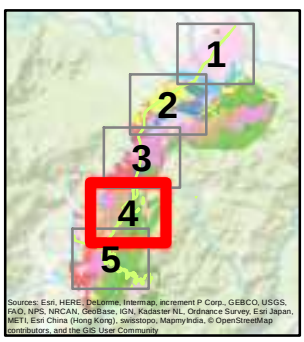
BAAM ECOLOGICAL CONSULTANTS

Drawn By: KM Reviewed by: PL Date: 22/03/2018

Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 4-3 Locations of significant flora species 20180322.mxd



Notes: Image date 2010/2011



LEGEND

Proposed infrastructure footprint

Priority Flora Species

- Critically Endangered, *Diospyros lolinopsis*
- Near Threatened, *Cycas apoa*
- Near Threatened, *Eucalyptopsis papuana*
- Near Threatened, *Flindersia amboinensis*
- Near Threatened, *Myristica globosa*
- Vulnerable, *Intsia bijuga*
- Vulnerable, *Myristica buchneriana*
- Vulnerable, *Pterocarpus indicus*

FIMS Vegetation Communities

- FRI - Secondary floodplain successions
- FSW - Mixed Swamp Forest
- G - Grassland
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- WSW - Swamp Woodland

0 0.5 1 1.5 2
Kilometres
1:50,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

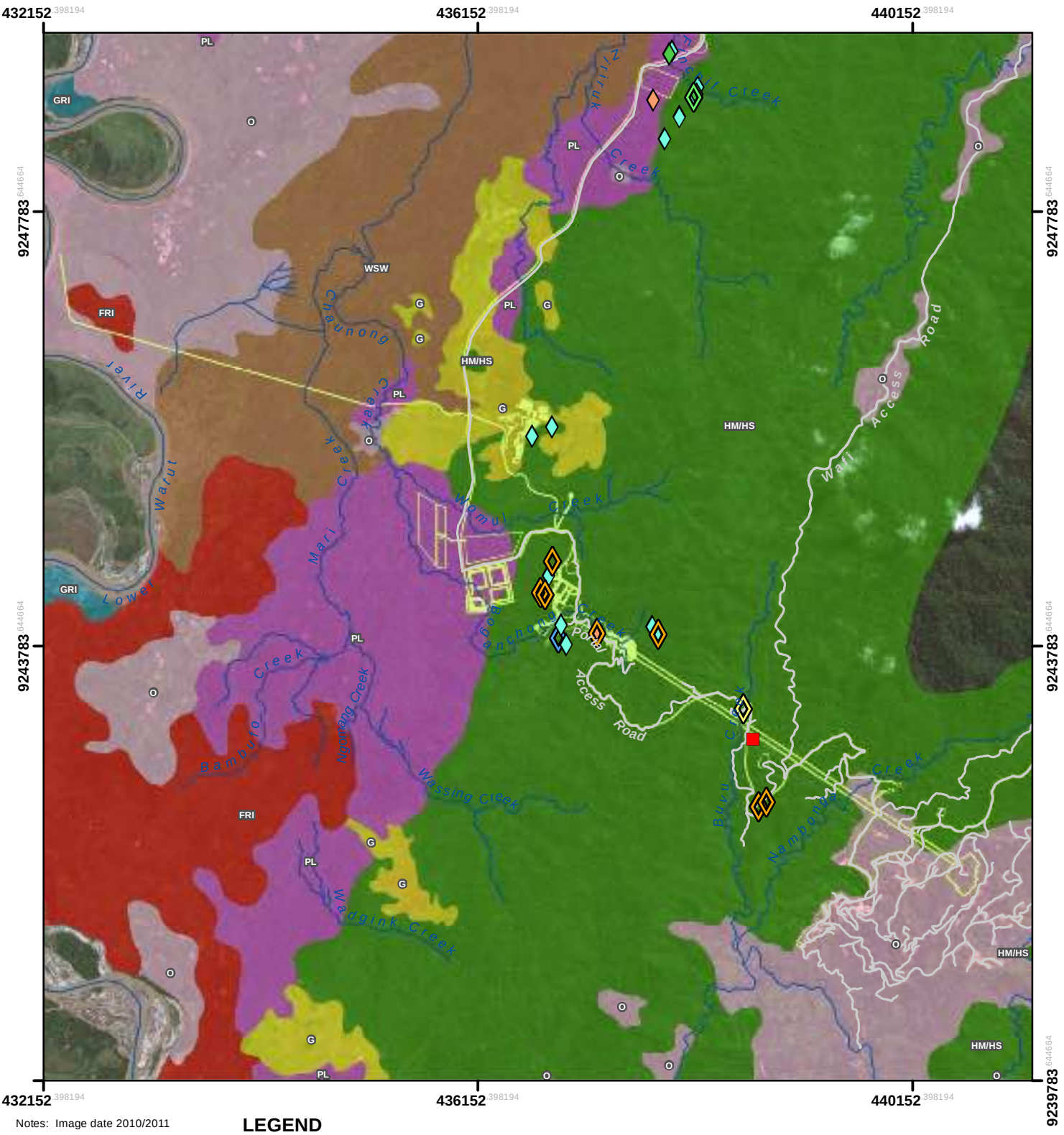
N W E S

Drawn By: KM Reviewed by: PL Date: 22/03/2018

Figure:	**4.3.d Map 4 of 5**
Title:	Flora species of conservation significance encountered on field surveys
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

BAAM ECOLOGICAL CONSULTANTS

Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 4-3 Locations of significant flora species 20180322.mxd



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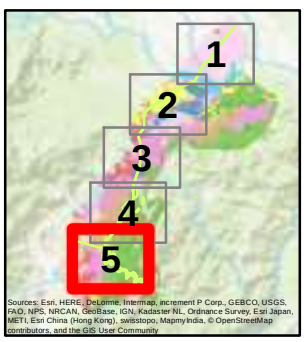

LEGEND

Proposed infrastructure footprint

Priority Flora Species

- Critically Endangered, *Diospyros lolinopsis*
- Near Threatened, *Cycas apoa*
- Near Threatened, *Eucalyptopsis papuana*
- Near Threatened, *Flindersia amboinensis*
- Near Threatened, *Myristica globosa*
- Vulnerable, *Intsia bijuga*
- Vulnerable, *Myristica buchneriana*
- Vulnerable, *Pterocarpus indicus*

FIMS Vegetation Communities

- FRI - Secondary floodplain successions
- G - Grassland
- GRI - Riverine successions dominated by grass
- HM/HS - Medium Crowned Forest/Small Crowned Forest
- O - Other non-vegetation and areas dominated by land use
- PL - Large to Medium Crowned Forest
- WSW - Swamp Woodland

0 0.5 1 1.5 2
Kilometres
1:50,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

N W E S

Drawn By: KM Reviewed by: PL Date: 22/03/2018

Figure:	**4.3.e Map 5 of 5**
Title:	Flora species of conservation significance encountered on field surveys
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

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Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 4-3 Locations of significant flora species 20180322.mxd

Photo 4.25. Fruiting specimen of *Myristica globosa* (IUCN: Near Threatened).

Photo 4.26. Fruiting specimen of *Aglaia sexipetala* (IUCN: Near Threatened).

Photo 4.27. Recently burnt foliage and seeds of *Cycas schumanniana* (IUCN: Near Threatened) in a scrub/grassland ecotone at survey site NAB35.

Photo 4.28. Fertile specimen of *Cycas apoa* (IUCN: Near Threatened) in Medium Crowned Forest on a hillslope at survey site WG18.

4.7.1 Additional clarifications in regard to conservation significant species

Several conservation significant species were recorded as present within the study area in previous reports (Booyong 2013, PNGFRI 2011), yet their occurrence within the study area would appear contrary to previously known distributions. This includes the Critically Endangered tree *Halfordia papuana*, and the Endangered tree *Diospyros insularis*. The identified presence of *Halfordia papuana* in Booyong Forest Science (2011b) has been considered with caution since the species identification was based on a single seedling found in lowland Swamp Forest, contrary to its preferred lower montane forest habitat (Conn *et al.* 2006) and no voucher specimen was collected. Published information suggests *Diospyros insularis* is restricted to island provinces of PNG (Eddowes 1998b) and its identified presence in the study area is again treated with caution.

For *Diospyros lolinopsis,* the assessment of 'Critically Endangered' undertaken by Eddowes (1998a) is based on information that considered the species to be known only from two populations, located at Usino near the Bigei River (E. E. Henty NGF28009, 17 Aug 1966, Queensland Herbarium) and the Adelbert Mountains at approximately 400m elevation (T. Platts-Mills TPM120 and J. Waikabu, Mar 1997, PNG National Herbarium), both in Madang Province. Information provided by the Lae Herbarium (M. Lovave pers. comm., June 2015) identifies the following additional records for the species held by the Lae Herbarium:

- D.Foreman *et al.* NGF 45875 at 170 m ASL, Amiaba River, Usino, Madang.

- D.Foreman *et al.* NGF 45894 at 170 m ASL, Amiaba River, Usino, Madang.
- D.Foreman *et al.* NGF 45914 at 170 m ASL, Amiaba River, Usino, Madang.
- N.M.U Clunie LAE 63524 at 60 m ASL, Sapi catchment, Gogol Valley, Madang.
- Tim Platt-Mills TPM120 at 650 m ASL, Salemben village, Adelbert Mountains, Madang.
- B. Conn *et al.* 5122 at 100 m ASL, Wanang River, secondary rainforest research Plot.
- E.E. Henty NGF 27026 at 460 m ASL, Bamba near West Point, Rossel Island, Milne Bay.
- Oliver Paul LAE 87543 at 650 m ASL, West Suau, Milne Bay.

In combination, these herbarium records and the results of the present survey confirm the occurrence of the species in at least six general locations that span up to 1,000 km across three different provinces in PNG. It is apparent that the extinction risk status of *Diospyros lolinopsis* requires re-assessment to consider this more up-to-date information. Whilst re-assignment of extinction risk status is at the discretion of IUCN authorities, comparison of the currently known distribution with IUCN criteria (IUCN 2012) suggests that, at worst, the species should be considered 'Vulnerable' under Criterion B2 of IUCN (2012), i.e. conservatively the species is known from between 6 and 10 locations and the species' extent of occurrence (the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known sites of present occurrence of the species) is greater than 5,000 km^2.

Photo 4.29. Scat of Dwarf Cassowary containing the large seeds of *Diospyros lolinopsis* (IUCN: Critically Endangered).

Photo 4.30. Seedlings of *Diospyros lolinopsis* (IUCN: Critically Endangered) germinating beneath a parent tree.

4.8 EXOTIC FLORA SPECIES

A total of 84 different introduced or exotic flora species have been recorded in the study area by the various flora surveys. Whilst some exotic species transported into new environments may fail to survive, a percentage are able to expand the area they infest and negatively impact the economy, human health or ecology of a region and are termed invasive (Global Invasive Species Database 2011). Deleterious effects of exotic species may include direct displacement of native species through out-competing, smothering of canopy or ground layers, prevention or deflection of natural regeneration and impacts to agriculture productivity.

Table 4.4 details 20 exotic species recorded during the field survey that are considered to pose a specific risk to natural environmental values particularly following disturbance. The assessment relies heavily upon assessments and information provided within the Global Invasive Species Database (2015) and the Pacific Island Ecosystems at Risk Database (PIER 2013) coupled with field observation. It does not include exotic garden food plants unless these spread readily into natural environments, nor a number of introduced species which are considered widespread and of

low invasive potential. The weeds are listed in order of assessed risk to natural habitat values (PIER 2013) with three species listed in the '100 worst invasive alien species' (Global Invasive Species Database 2011) assigned the highest risk of impact to natural habitat values.

In cultivated portions of the study area, introduced species are a common part of the landscape and are associated with an ongoing disturbance regime for gardening. The majority of these weeds are widespread herbaceous species and, although capable of rapid invasion to disturbed areas, are not considered highly invasive or a threat to native vegetation. Highly invasive weeds such as Bamboo Piper (*Piper aduncum*) (Hartemink 2010) and Siam Weed (*Chromolaena odorata*) are prevalent along disturbed roadsides, garden areas and other sites of disturbance. In the case of Bamboo Piper, this shrubby weed dominates large areas of hillslope where former garden areas have been abandoned.

Highly invasive weeds are more prevalent in foothill and lowland habitats throughout the infrastructure corridor with infestations of Siam Weed, Giant Sensitive Weed (*Mimosa diplotricha*), Leucaena (*Leucaena leucocephala*) and Tropical Kudzu (*Pueraria phaseoloides*) commonly observed, particularly along infrastructure corridors and tracks associated with mineral exploration. Some authorities (e.g. Csurhes 2008) consider Tropical Kudzu to be native to PNG given that it has been traded as a food source throughout Indonesia, PNG and the Pacific for hundreds of years. Its establishment as a problematic weed species tends to require cultivation at the broad scale, suggesting that its use in rehabilitation would be undesirable. Further determination of weed control priorities at the project scale requires consideration of the potential significance of the impact of each weed present, the existing and future disturbance impacts to the local environment, and the feasibility of control.

Table 4.4. Exotic species recorded during the survey and potential risks posed to garden and native habitats.

Species	Common name	Life form	Location and habitats recorded	Risk[2]	Major habitats at risk	Registered on GISD[3]
Chromoleana odorata	Siam Weed	Herb	Garden areas near Bavaga and relatively widespread along roadsides as well as the Wafi Camp.	High (28)	Disturbed habitats, riparian areas and savannah swamps and grasslands. This weed is a serious threat to garden productivity.	Yes, as one of world's 100 most invasive pests
Pueraria lobata	Tropical Kudzu	Vine	Found smothering gardens and on disturbed roadside margins where it may spread into intact habitats.	High (24)	Considered a native species in PNG which naturalises in disturbed areas potentially smothering gardens and areas of natural regeneration. Likely to become problematic only if cultivated on a large scale (e.g. used in rehabilitation).	Yes (listed as *Pueraria montana var. lobata*), as one of world's 100 most invasive pests
Mimosa diplotricha	Giant Sensitive Weed	Herb	Disturbed roadside margins and garden areas throughout the study area.	High (24)	Highly invasive coloniser of disturbed habitats and garden areas, wet areas and riparian areas. Most aggressive in lowland areas where it poses threat to gardens and natural wetland habitats on the Watut River alluvial plain. Grows most aggressively in lowland habitats.	Yes

[2] From PIER (2013): Risk scores >6 indicate a high risk of ecological / agricultural damage, and higher scores indicate a greater degree of risk of such damage.
[3] From Global Invasive Species Database (2015).

Species	Common name	Life form	Location and habitats recorded	Risk[2]	Major habitats at risk	Registered on GISD[3]
Solanum torvum	Devils Fig	Shrub	Most abundant in degraded habitats and garden areas along roadsides and on river flats.	High (24)	Potential serious pest in lowland areas, particularly riparian fringes and wet savannah habitats where it has the potential to out-compete and displace native vegetation.	No
Bidens pilosa	Cobblers Pegs	Herb	Recorded from disturbed garden areas, access tracks and cleared easements throughout the study area.	High (23)	Mostly garden areas and disturbed margins of access tracks and roads.	Yes
Piper aduncum	Bamboo Piper	Shrub	Pervasive pest of all cleared areas forming emerald green thickets on abandoned garden areas	High (18)	Disturbed garden areas and cleared easements. Has the potential to colonise recently disturbed areas and prevent natural regenerative processes as well as impact agricultural production.	Yes
Ricinus communis	Castor Bean	Shrub	Recorded on the banks of the Markham River.	High (21)	Riparian habitats including river gravel bars and garden areas on alluvial soils.	Yes
Mimosa pudica	Sensitive Weed	Herb	All disturbed areas, particularly along roadsides, cleared areas and gardens	High (18)	Disturbed areas, garden areas and grassland/ savannah habitat where disturbance has occurred. May also invade moist margins of wetland savannahs (e.g. habitats of the Watut River alluvial plain).	Yes
Megathyrsus maximus	Guinea Grass	Grass	Common on disturbed easements and roadsides in the study area	High (17)	Rapidly occupies and tends to dominate disturbed habitats where it smothers native regeneration	Yes (listed as *Urochloa maximum*)
Leucaena leucocephala	Leucaena	Shrub	Prominent in lowland habitats, particularly garden areas and disturbed track margins throughout the study area. Favoured as a building material.	High (15)	Potential serious pest in garden areas although may occupy natural savannah habitats and grassland areas where there is disturbance and a vector for spread. Alluvial plain habitats of the Watut and Markham valleys are considered high risk habitats.	Yes, as one of world's 100 most invasive pests
Ipomoea quamoclit	Cupid's Flower	Herb - Vine	Noted in disturbed garden habitats where it was smothering disturbed riparian vegetation	High (14)	Has potential to invade early successional stages of tropical rainforest and compete with native vine species	No
Mutingia calabura	Jamaican cherry	Tree	Common in disturbed habitats including abandoned garden areas and disturbed roadside margins and degraded riparian fringes.	High (12)	Fast growing tree which seeds profusely with fruit spread by birds. Has potential to smother regenerating rainforest habitats preventing natural succession.	No
Thunbergia c.f. *grandifolia*	Thunbergia	Vine	Associated with disturbed garden areas smothering intact forest along cleared margins. Not strongly established in the landscape at present	High (11)	Primary and secondary forests being smothered from disturbed margins.	Yes
Senna alata	Candle Bush	Shrub	Associated with overgrown gardens and adjacent to roadsides and access tracks spreading into the understory of secondary growth forests.	High (10)	Potential to spread into disturbed margins of regenerating forest and deflect establishment of native shrubs. Most aggressive in lowland areas.	No

Species	Common name	Life form	Location and habitats recorded	Risk[2]	Major habitats at risk	Registered on GISD[3]
Clittoria ternatea	Butterfly Pea	Vine	Associated with disturbed track margins and occurring throughout overgrown gardens spreading into the groundcover of secondary growth forests.	High (9)	Potential to spread into disturbed margins of regenerating forest and deflect establishment of native groundcovers. Most aggressive in lowland areas.	No
Manihot glaziovii	Ceara Rubber	Shrub	Growing in older cultivated areas as a dense shrub where it was competing with Cassava.	High (8)	High potential to be a serious pest in garden areas and a risk to productivity.	No
Stachytarpheta jamaicensis, S. cayennenis	Snakeweeds	Herb	*S. cayennenis is* relatively common in disturbed areas and easements. *Stachytarpheta jamaicensis* occurs on roadsides and in garden areas particularly on alluvial soils,	NA*	Mostly an inhabitant of disturbed areas around villages, gardens and access tracks. May invade natural riparian areas (gravel beds and stream banks), wetlands and grasslands where there is a vector for spread (e.g. vehicles, pigs).	No
Macroptilium atropurpureum	Siratro	Herb	Generally associated with overgrown gardens where it forms a robust groundcover spreading into the understory of secondary growth forests and throughout disturbed grasslands.	NA*	Potential to spread into ground layers of gardens and regenerating forest and prevent establishment of native ground covers.	No
Hyptis capitata	Knob weed	Herb	Associated with overgrown gardens throughout the study area.	NA*	Potential to spread into ground layers of gardens and regenerating forest and prevent establishment of native ground covers. Most aggressive in lowland areas.	No
Urena lobata	Chinese burr	Herb	Associated with disturbed track margins and garden areas throughout the study area where it occupies overgrown gardens spreading into the groundcover of secondary growth forests.	NA*	Potential to spread into disturbed margins of regenerating forest and deflect establishment of native groundcovers. Most aggressive in lowland areas.	No

* NA: indicates that a risk assessment for the species has not been prepared for the Pacific Islands.

4.9 CRITICAL FLORA HABITAT

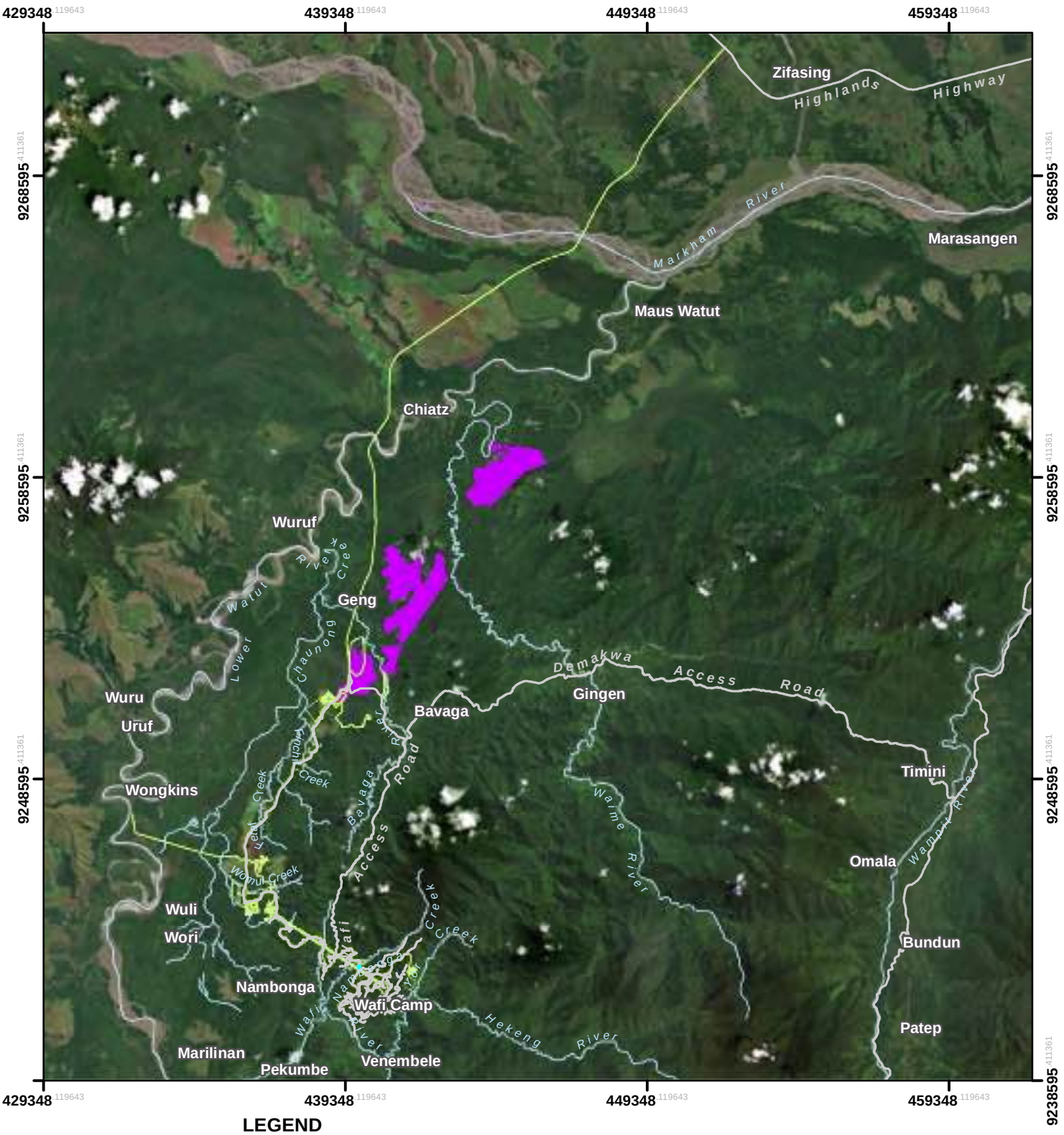
One type of critical habitat associated with terrestrial flora and vegetation communities was assessed as occurring within the study area in accordance with IFC Performance Standard 6 guidelines, namely habitat of significant importance to a species (*Diospyros lolinopsis*) listed as Critically Endangered on the IUCN Red List of Threatened Species (meeting Criterion 1 of IFC Performance Standard 6). The distribution of this critical habitat across the study area is shown in **Figure 4.4**.

Areas of foot-slope forest in which *Diospyros lolinopsis* was found to occur relatively commonly have been mapped as critical habitat for this species on the basis that (1) significant populations of this species occur in these habitat areas; and (2) the species is listed Critically Endangered under the IUCN Red List. However, as discussed in greater detail under **Section 4.7**, re-evaluation of the IUCN extinction risk status of *Diospyros lolinopsis* to take into account recent records of the species in several widely spaced locations is likely to find that the species no longer meets IUCN criteria for listing as either Critically Endangered or Endangered, in which case the habitat for the species will no longer meet the criteria for recognition as IFC critical habitat. Therefore, it should be noted that recognition of critical habitat for this species in this assessment has taken a conservative approach

to the interpretation of IFC critical habitat guidelines, i.e. significant habitat for the species is identified as critical habitat due to its current status on the IUCN Red List. Due to the broad extent of occurrence of the species, this critical habitat is characterised as Tier 2 critical habitat.

It is important to note that the mapping of critical habitat for *Diospyros lolinopsis* is restricted to surveyed areas only based on presence/ absence of the species as recorded in field surveys, which focused on the vicinity of proposed Project infrastructure areas. Thus the mapping of critical habitat for the species includes areas of forest where the species was observed to form a prominent component of the canopy or sub-canopy. The mapping also incorporates information provided by villagers in the Chiatz area that footslopes between Chiatz and Mt Beamana provide the predominant habitat for *Diospyros lolinopsis* in the local area; it therefore includes all Medium Crowned Forest in footslope situations between Mt Beamana and Chiatz. The area in the Buvu Creek catchment where a single specimen of *Diospyros lolinopsis* was recorded has not been identified as critical habitat as the species appeared to be rare in this area; therefore, the habitat here is not of 'significant importance' to the species. This does not exclude the potential for critical habitat for *Diospyros lolinopsis* occurring in adjacent habitats that have not been surveyed. Previous surveys reported *Diospyros lolinopsis* to be relatively common in Medium Crowned Forest fringing the Markham Gap Basin (Booyong Forest Science 2011b) and to be common on ridges in Medium Crowned Forest in areas surveyed along the route of the Watut Valley Road and forest between Finchif and the Watut Declines Portal Terrace (Booyong Forest Science 2011a, 2013), but did not map the locations of the populations, so it has not been possible to extend the mapping of critical habitat for the species to areas surveyed by Booyong Forest Science. More thorough assessment of the extent of critical habitat across the local region would require more extensive targeted field survey outside proposed Project infrastructure areas that is beyond the scope of this assessment.

Besides *Diospyros lolinopsis*, three other flora species listed as either Critically Endangered or Endangered under the IUCN Red List, namely *Flindersia pimenteliana* (IUCN: Endangered), *Diospyros insularis* (IUCN: Endangered) and *Halfordia papuana* (IUCN: Critically Endangered), have been previously reported to occur in the study area (Booyong 2013, PNGFRI 2011). While its presence was not confirmed in the 2015 surveys, *Flindersia pimenteliana* is expected to occur in the study area as reported by PNGFRI (2011) since the study area falls within the known range for the species and several voucher specimens have previously been collected within 50km of the study area (Queensland Herbarium 2015). Similarly, *Halfordia papuana* has previously been recorded in the Morobe Province although its preferred habitat of lower montane rainforest does not occur in the study area and the species is therefore unlikely to be common. As neither *Flindersia pimenteliana* nor *Halfordia papuana* were recorded within or closely adjoining the proposed Project footprint despite intensive survey effort, habitats within the Project footprint are not considered to represent critical habitat in relation to the ongoing persistence of these species in the local region. Consequently, critical habitat has not been mapped for these species. Similarly, as the presence of *Diospyros insularis* has not been confirmed through a voucher specimen and the study area is outside the species' known range (see **Section 4.7.1**), no critical habitat for this species is considered to occur within or immediately adjoining the Project footprint area.



LEGEND

- Proposed infrastructure footprint
- Waterways

Critical Flora Habitat

- Significant habitat for *Diospyros lolinopsis* (IUCN: critically endangered)

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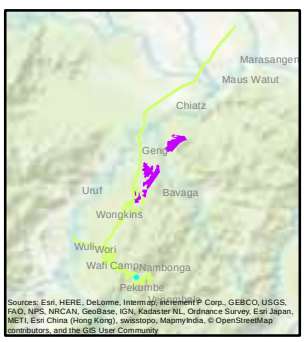
Kilometres
1:180,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55



Drawn By: KM Reviewed by: PL Date: 22/03/2018

Figure:	**4.4**
Title:	Critical flora habitat within the study area
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

BAAM ECOLOGICAL CONSULTANTS

5.0 TERRESTRIAL FAUNA RESULTS AND DISCUSSION

5.1 OVERVIEW OF PAPUA NEW GUINEA'S TERRESTRIAL VERTEBRATE FAUNA

New Guinea is the world's largest tropical island. Vegetated mostly with rainforest, it supports the third largest expanse of tropical forest after the rainforests of the Amazon and Congo (Brooks *et al.* 2006). Its tropical location coupled with the island's diverse topography, with elevations ranging from sea level to over 5,000m, diverse habitat types and complex geological history have resulted in an extraordinarily rich biodiversity; while it occupies less than 1% of the global land area, 5-7% of the world's biodiversity is found on the island (Austin 2006). In 1975, forest covered 330,650 km^2, approximately 70% of the total land area of 464,100 km^2 of PNG, with the remaining 30% also containing substantial areas of primary and secondary forest, but in a mosaic with village agriculture and grasslands (Bellamy and McAlpine 1995, Faith *et al.* 2001).

The mammal fauna of PNG includes at least 245 recognised species, nearly 40% of which are bats (IUCN 2015). The New Guinea mammal fauna has affinities with that of Australia due to a period of contact between the two land masses that ended in the early Miocene about 25 million years ago, and includes groups such as the monotremes (represented by echidnas in the family Tachyglossidae), eight families of marsupials, rodents and six families of bats (Flannery 1995). The bats are divided into two main groups, the family Pteropodidae that live on a diet of fruit, nectar and flowers and have well developed eyes to find their way around at night using vision, and several families of bats (generally termed micro-bats) that are primarily insectivorous and use sophisticated echo-location to find their way around and forage.

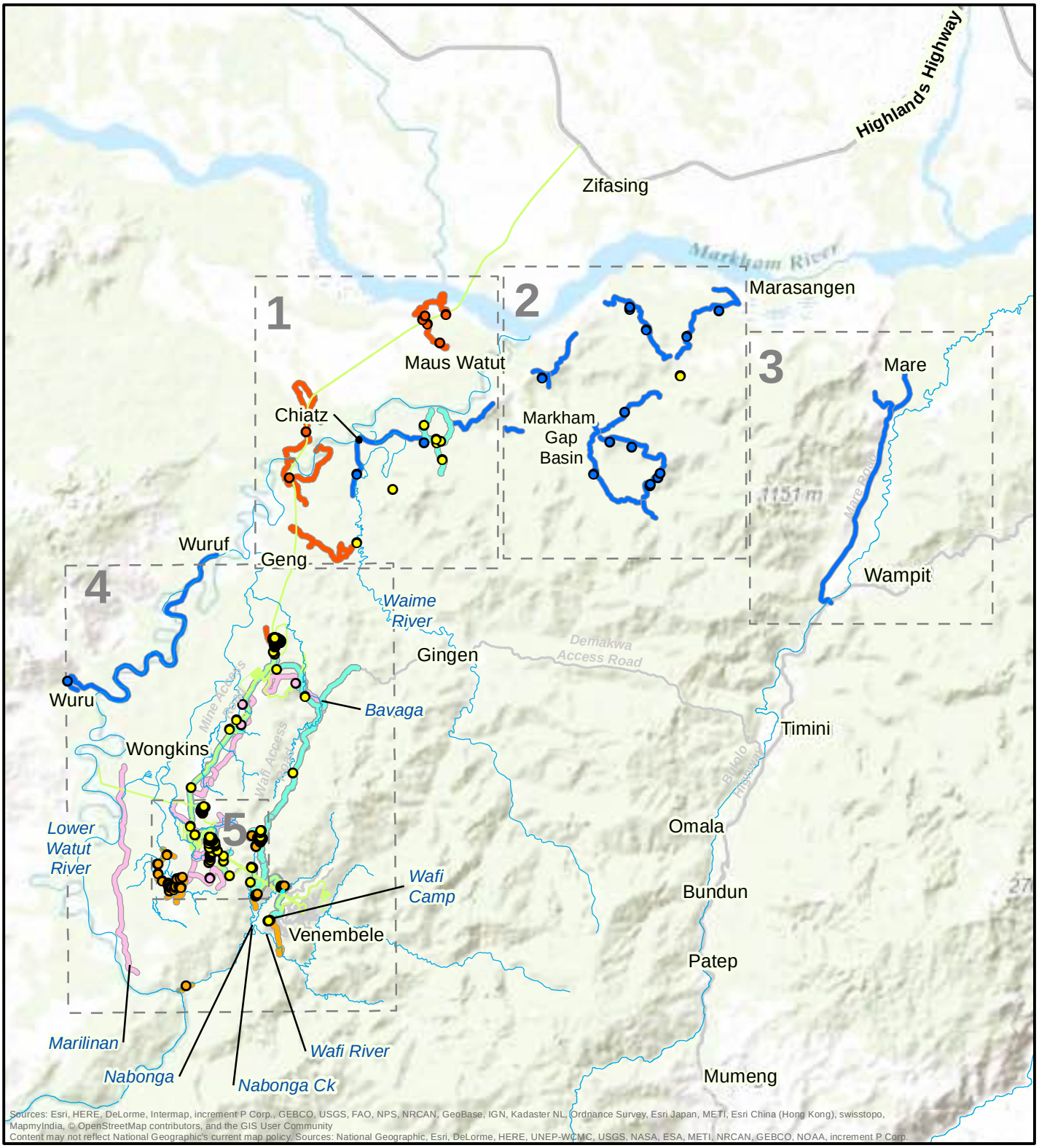
A total of 744 bird species have been recorded for PNG, of which 113 are breeding endemics to PNG and 43 species are globally threatened (BirdLife International 2017a). BirdLife International considers the most important places for habitat-based conservation of birds to be Endemic Bird Areas, which are regions of the world where the distributions of two or more restricted-range species (species that occupy ranges smaller than 50,000 km^2) overlap (BirdLife International 2017b). The study area does not fall within the range of any Endemic Bird Area, meaning that the local region is not located within a priority area for the habitat-based conservation of birds.

The herpetofauna (reptiles and amphibians) of the Papuan region, which comprises New Guinea, the Admiralty and Bismarck Archipelagos and the Solomon Islands, is considered to be extremely diverse but remains relatively poorly surveyed and described, with the geographic ranges of known species often poorly understood and hundreds of species likely still to be discovered or formally named (Allison 1993, Kraus 2010a, 2010b). In 2011, the herpetofauna of the Papuan region comprised 424 reptile species (266 lizard, 138 snake, 18 turtle and two crocodile species) and 408 frog species (Allison and Kraus 2011), but these totals have since expanded with increasing taxonomic work and field survey. For example, recent expeditions to previously unstudied localities have described many new species of frogs (e.g. Günther and Richards 2011, Günther *et al.* 2012, Kraus 2010a, 2010b, 2012, 2013a, 2013b, Kraus and Allison 2009).

5.2 SURVEY COVERAGE OF THE STUDY AREA

5.2.1 Previous surveys and the 2015 survey

The study area has been the subject of several terrestrial fauna assessments since 2010. Prior to the initiation of fauna field surveys within the study area, Woxvold (2010) reviewed information available on the terrestrial fauna of the region and developed a comprehensive list of species known to occur or that potentially occur in the vicinity of the study area based on current knowledge of species distributions. This list of species with potential to occur in the study area, amended to include the results of database searches undertaken for the present study, is presented in **Appendix D**. Three terrestrial vertebrate fauna surveys have previously been undertaken within or in close proximity to the study area, as summarised in **Table 5.1** below. The approximate locations of survey tracks and sites from previous surveys, as well as the 2015 survey sites and tracks, are shown in **Figure 5.1**.



Reviewed by: PL Date: 22/03/2018 Drawn By: KM

LEGEND

- Proposed infrastructure footprint
- Waterways

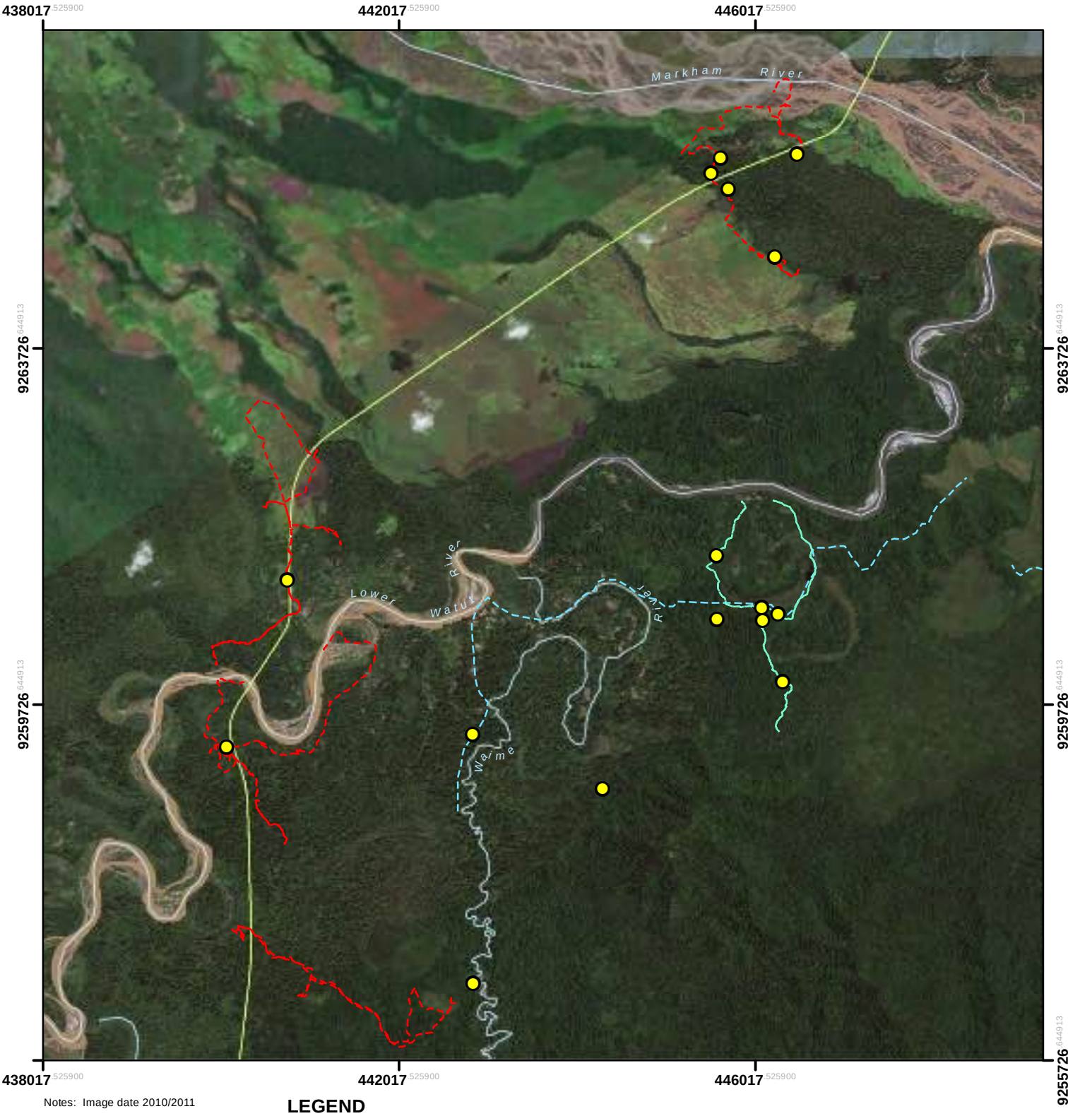
Survey Locations (Year):	Survey tracks (Year):
2015 (September)	2015 (September)
2015 (March-April)	2015 (March-April)
2012	2012
2011	2011
2010	2010

0 5 10
Kilometres
1:225,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**5.1**
Title:	Location of fauna survey sites (2010-2015) - Overview
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

BAAM ECOLOGICAL CONSULTANTS

Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-1 Location of fauna survey sites (2010-2015) Overview 20180322.mxdDate: 22/03/2018 4



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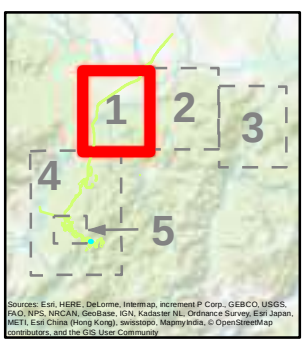

LEGEND

- Proposed infrastructure footprint
- Waterways

Survey Type:

- Bat detector
- Camera
- Mist net
- Box trap
- Survey location

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

0 0.5 1 1.5 2
Kilometres
1:60,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**5.1.a Map 1 of 5**
Title:	Location of fauna survey sites (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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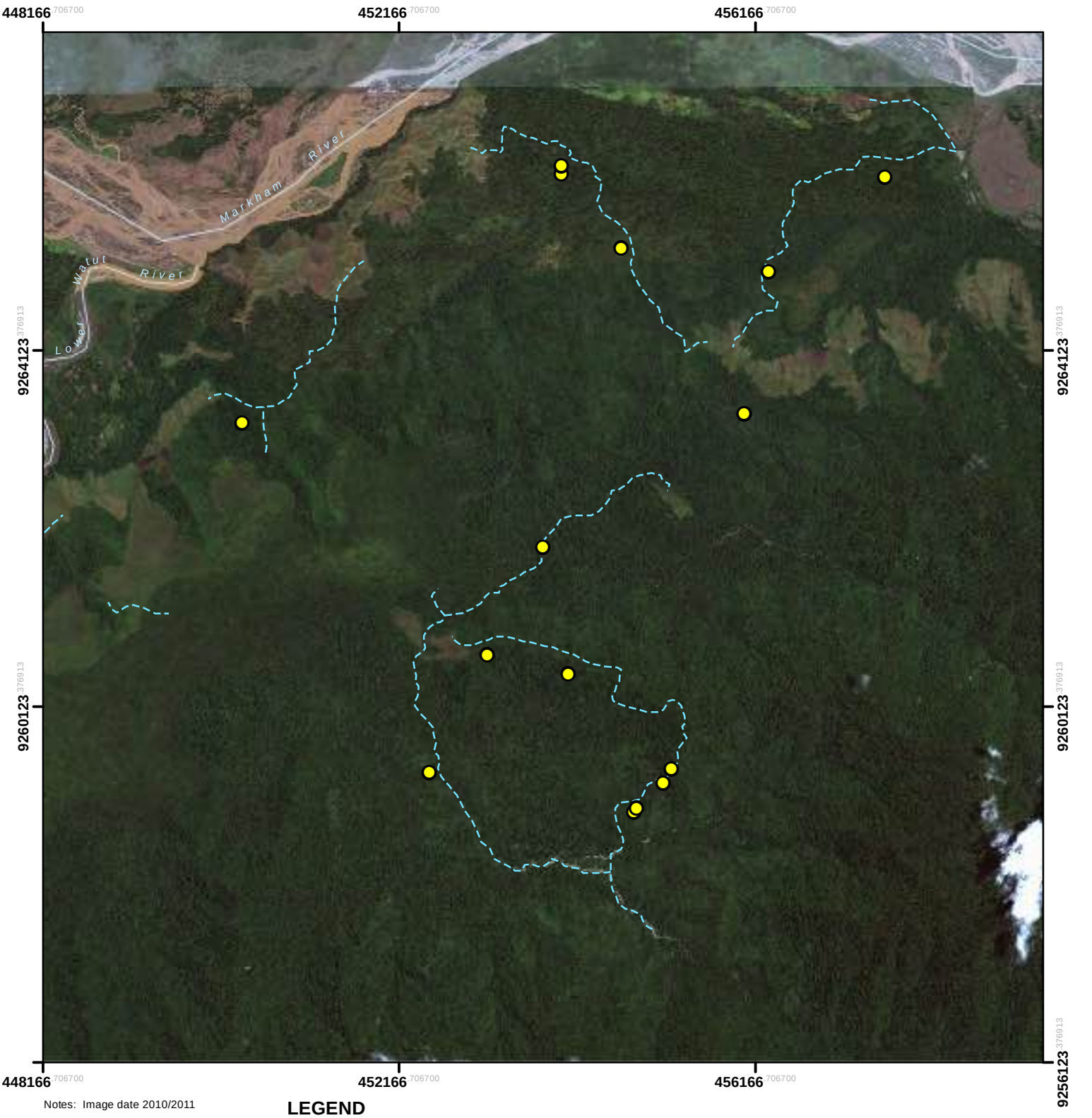
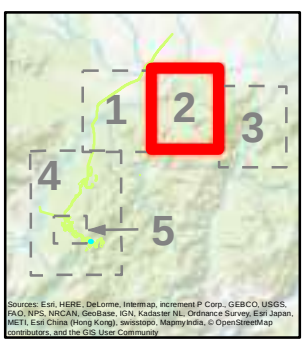


Notes: Image date 2010/2011



LEGEND

- Proposed infrastructure footprint
- Waterways

Survey Type:

- Bat detector
- Camera
- Mist net
- Box trap
- Survey location

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

0 0.5 1 1.5 2
Kilometres
1:60,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

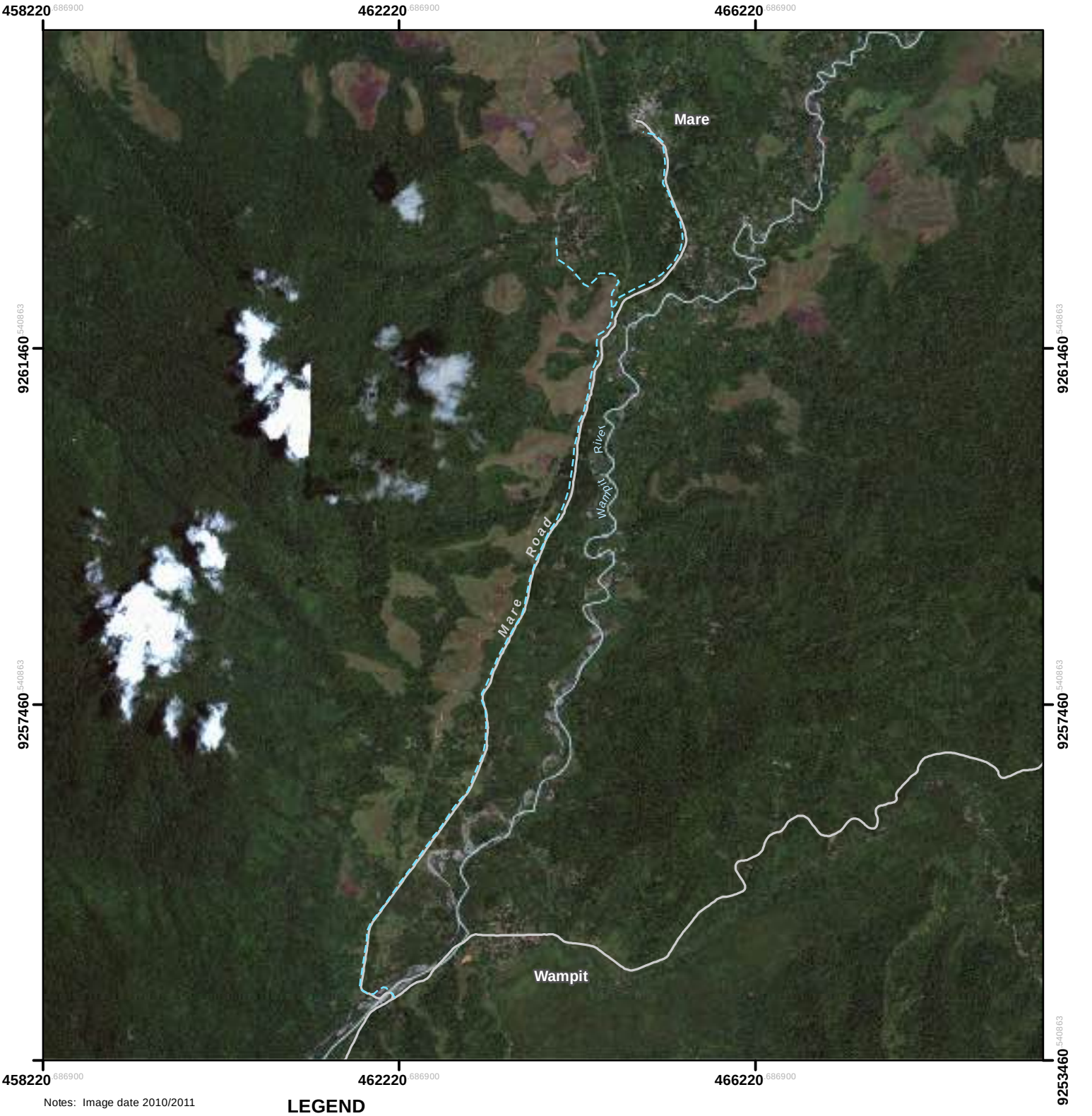
N W E S

Figure:	**5.1.b Map 2 of 5**
Title:	Location of fauna survey sites (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

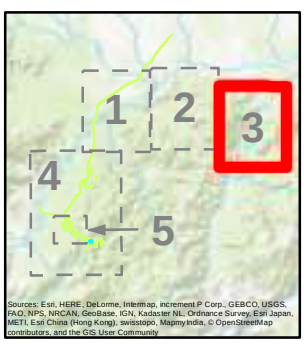
Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS

G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-1 Location of fauna survey sites (2010-2015) Detailed Maps 20180322.mxdDate: 22/03/2018 4:04:30 PM



Notes: Image date 2010/2011



LEGEND

- Proposed infrastructure footprint
- Waterways

Survey Type:

- Bat detector
- Camera
- Mist net
- Box trap
- Survey location

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

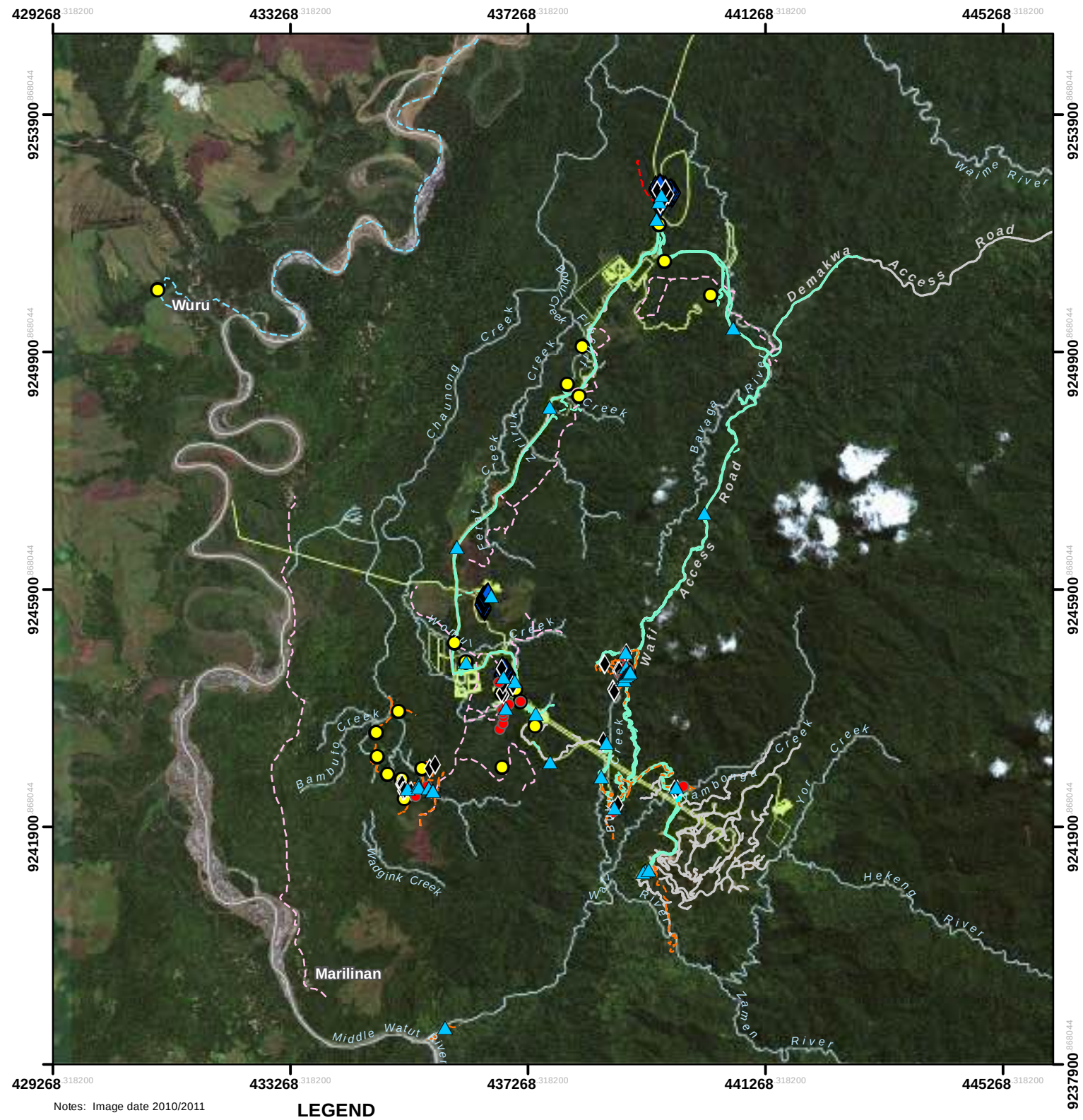
0 0.5 1 1.5 2
Kilometres
1:60,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**5.1.c Map 3 of 5**
Title:	Location of fauna survey sites (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

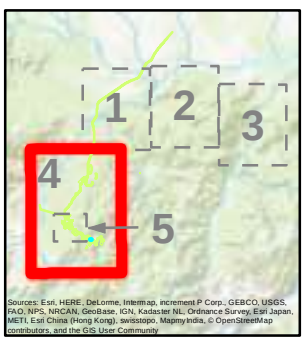
Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS

G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-1 Location of fauna survey sites (2010-2015) Detailed Maps 20180322.mxdDate: 22/03/2018 4:04:30 PM



Notes: Image date 2010/2011



LEGEND

- Proposed infrastructure footprint
- Waterways

Survey Type:

- Bat detector
- Camera
- Mist net
- Box trap
- Survey location

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

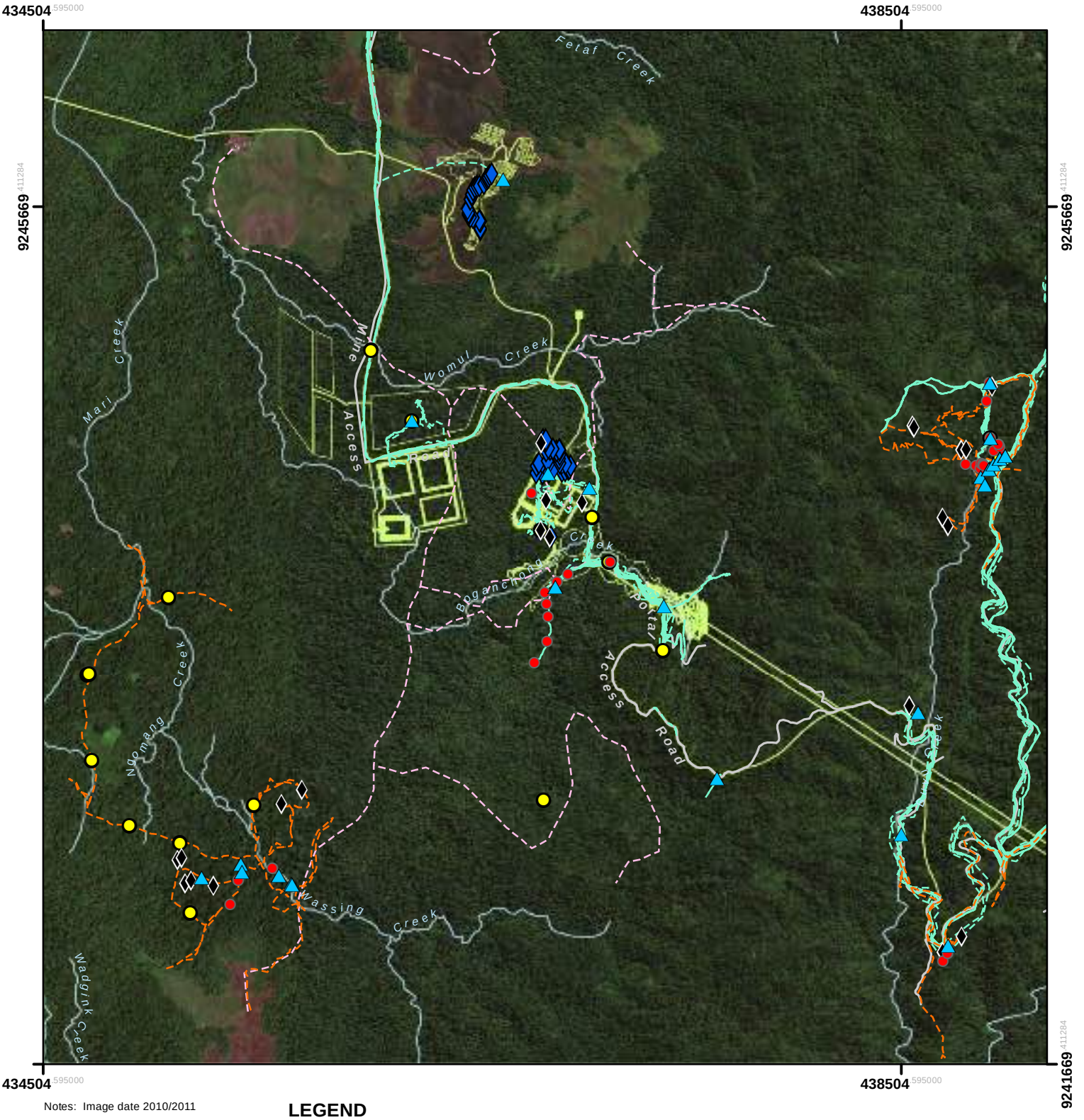
0 0.5 1 1.5 2
Kilometres
1:90,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**5.1.d Map 4 of 5**
Title:	Location of fauna survey sites (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

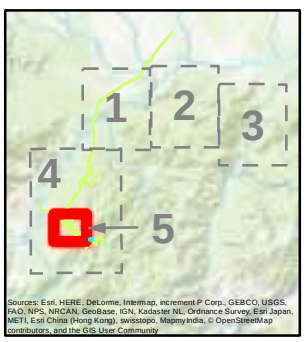
Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS

G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-1 Location of fauna survey sites (2010-2015) Detailed Maps 20180322.mxdDate: 22/03/2018 4:04:30 PM



Notes: Image date 2010/2011



LEGEND

- Proposed infrastructure footprint
- Waterways

Survey Type:

- Bat detector
- Camera
- Mist net
- Box trap
- Survey location

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

0 0.25 0.5 0.75 1
Kilometres
1:25,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

N W E S

Figure:	**5.1.e Map 5 of 5**
Title:	Location of fauna survey sites (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS

G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-1 Location of fauna survey sites (2010-2015) Detailed Maps 20180322.mxdDate: 22/03/2018 4:01:25 PM

Table 5.1. Summary of survey effort and coverage of the study area.

Survey timing	Locations	Survey techniques and effort
23 November to 4 December 2010 (Woxvold 2011)	Eastern foothills and lowland alluvial plain of the lower Watut River valley, including a proposed road corridor from Bavaga village to the Timini-Wafi road and the area around the proposed Watut Declines Portal Terrace.	• Personnel: 1 fauna ecologist • Daytime observational surveys (59 hours over 10 days) • Night-time spotlighting surveys and frog call recordings (2 hours over 2 nights) • Community interviews (3: Bavaga, Wonkins, Woli and Majim villagers) • Incidental observations (10 days)
14 to 26 November 2011 (Woxvold 2012)	Foothills and lowland alluvial plains of the lower Watut River and Markham River valleys, focused on the Markham Gap Basin near the confluence of the Watut and Markham Rivers.	• Personnel: 1 fauna ecologist • Daytime observational surveys on foot (70.75 hours over 11 days) • Boat survey along the Watut River (2.5 hours) • Community interviews (3: Uruf, Chiatz and Mare villages) • Incidental observations (10 days)
17 to 29 May 2012 (Woxvold and Aplin 2013)	Hill forest in the Venembele, Wafi Camp, Buvu Creek valley areas, and foothills and Watut alluvial plain in the vicinity of the Watut Declines Portal Terrace.	• Personnel: 2 fauna ecologists • Daytime observational surveys on foot (69.5 hours over 13 days) • Night-time spotlighting surveys (38.25 hours over 2 nights) • Mist-netting (555 net-metre-hours; 26 net nights) • Small mammal trapping (383 trap nights) • Camera trapping (1164.5 camera hours; 52 camera nights) • Micro-bat recordings (19 detector nights) • Community interviews (2: Venembele and Pekumbe villages) • Incidental observations (10 days)
24 March to 14 April 2015 (this study)	Hill forest in the Watut Declines Portal Terrace area, Wafi Camp and Buvu Creek catchment, and foothills and alluvial forest on the Watut plain from the vicinity of the entrance to the Watut Declines Portal Terrace area north to the vicinity of Chiatz village, as well as around Bavaga village.	• Personnel: 2 fauna ecologists • Daytime observational surveys on foot (94.5 hours over 21 days) • Night-time spotlighting surveys (7.5 hours over 4 nights) • Mist-netting (2,344 net-metre-hours) • Small mammal trapping (290 trap nights) • Camera trapping (960 camera hours; 40 camera nights) • Micro-bat recordings (12 detector nights) • Incidental observations (22 days)
24 to 29 September 2015 (this study)	Alluvial forest and grassland along a revised Mine Access Road and Northern Access Road alignment across the lower Watut and Markham River plains.	• Personnel: one fauna ecologist • Daytime observational surveys on foot (29 hours over 5 days) • Incidental observations (5 days)

The combined total of 57 days split across five different survey events between 2010 and 2015 and covering a range of locations and habitat types within the study area, including areas both within and adjoining the current Project area, represents a substantial survey effort.

The previous surveys of the study area in 2010, 2011 and 2012 utilised similar field survey methods to the 2015 survey, with some differences. The 2012 survey had a particular focus on sampling the bat fauna with the use of mist nets deployed overnight. This technique was highly effective in capturing fruit- and blossom-feeding species in the family Pteropodidae. Both the 2012 and March-April 2015 surveys included extensive survey for echo-locating micro-bats through Anabat recording of high-frequency bat calls, spotlighting surveys at night (targeting nocturnal frogs, reptiles, birds and mammals), mist-netting of birds and small-mammal trapping surveys. Community interviews, which were included only in previous surveys, were facilitated by community members employed as WGJV Village Liaison Officers, and typically followed the following method (Woxvold 2011, 2012, Woxvold and Aplin 2013):

- Following an introduction and explanation for the visit, the ecologist interacted with a group of local residents of each village (including men, women and children) and looked at pictures of animals in a booklet prepared specifically for the surveys. The prepared booklet contained images of recognisable species that are (a) of conservation significance and/or (b) likely to be of some use to local residents for dietary and/or customary purposes, if present. Residents were asked about the presence, distribution, status, local language name and importance of each species to the local community. Images of birds in Beehler *et al.* (1986) were then shown, the more distinguishable mammals having been covered in the prepared booklet.
- A short walk was taken around the village environs while accompanied by local villagers. This gave additional opportunities to record the local names of birds heard vocalising, and to record the presence of any pets and/or hunting trophies retained in each village.
- After the scheduled village interviews, small numbers of local residents, mostly men with extensive hunting experience (but sometimes also children), accompanied the team during ground surveys. This provided a significant body of further information on the habits and local abundance of particular animal species, and on local procurement methods for each species.
- Care was taken when interpreting results from the interviews due to the large number of people giving opinions (sometimes 20 or more people in attendance), conflicting opinions and presence of dominant personalities. As photos and images from field guides can lead to misunderstandings over the species being discussed, resulting in false information, the most reliable information was deemed to involve trophies viewed in villages, distinctive and commonly hunted species (e.g. cassowaries, megapodes), bird vocalisations heard together in the field for which the local informant could provide an accurate description, and independent corroborations involving multiple independent sources.

5.2.2 Seasonality considerations

Located at latitude 7° south of the equator, the study area experiences a humid, tropical climate. There is limited seasonal variation in temperature through the year, with maximum daily temperatures typically ranging from 28 °C to 33 ºC and overnight temperatures between 25 °C and 28 ºC (Coffey Environments 2011). Mean annual rainfall at Wafi Camp (1990-2014) was approximately 2,500 mm and ranged between 1,200 mm and 3,440 mm, with an annual coefficient of variation of 17% (BMT WBM 2018). The relatively low coefficient of variation means that there is relatively limited variation in rainfall amount between years. During the period from 1990-2014, the majority of rainfall occurred between October and May (see **Figure 5.2**).

Despite the absence of strong seasonality in climate in lowland rainforest, the bird community in particular may still display some seasonality in the relative abundance and occurrence of species, which is largely influenced by seasonal patterns of flowering and fruiting plants (Bell 1982b, Beehler *et al.* 1995). The combined surveys of the study area have covered the late 'dry' season (September), early 'wet' season (November-December) and late 'wet'/early 'dry' season (March-May). They have therefore covered a good range in seasonal conditions across four different years in order to provide adequate survey of potential annual and seasonal variation in fauna species occurrence.

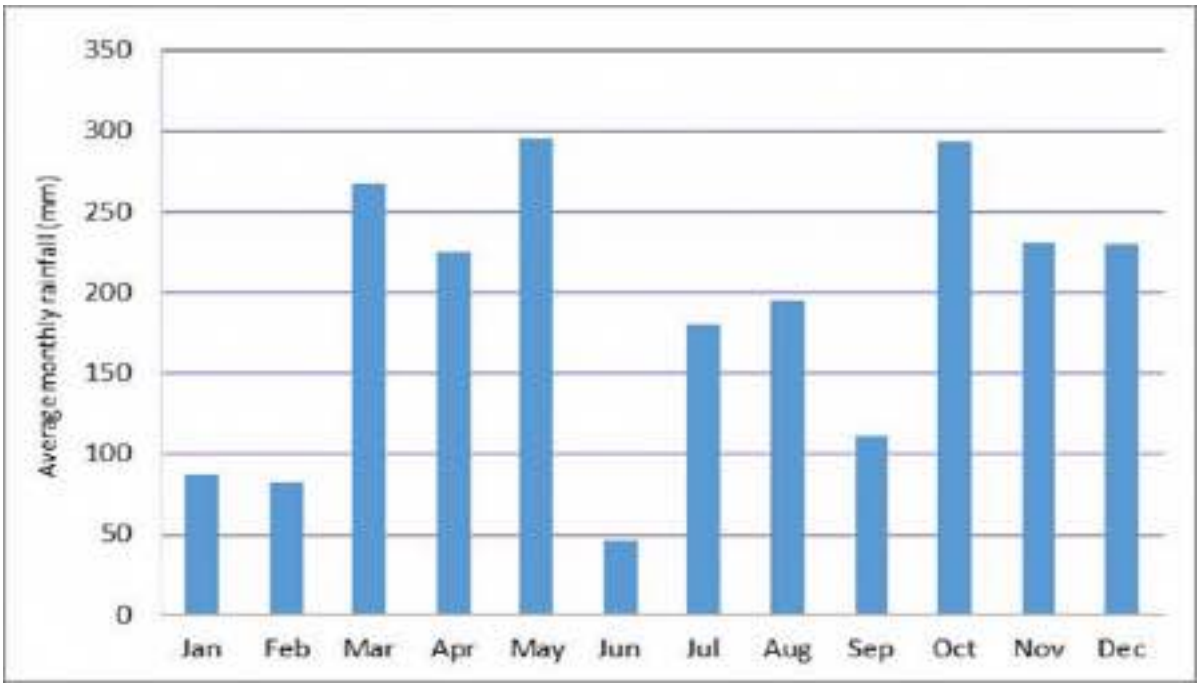


Figure 5.2. Mean monthly rainfall at Wafi Camp for the period 1990-2014 (reproduced from BMT WBM 2018).

5.3 GENERAL FAUNA OVERVIEW

A total of 262 terrestrial vertebrate fauna species have been recorded within the study area during the five surveys conducted over the period 2010 to 2015, comprising 44 mammal species, 170 bird species, 33 reptile species and 15 amphibian (frog) species (**Table 5.2, Appendix E**). The number of species recorded in each survey increased from 98 to 194 between 2010 and March-April 2015 as survey effort increased with each survey. The March-April 2015 survey recorded a total of 47 species not recorded in previous surveys, including three mammal species, 31 bird species, 12 reptile species and one amphibian species. The September 2015 survey recorded an additional four species (all birds) not previously recorded in the study area.

Table 5.2. Total number of terrestrial vertebrate fauna species recorded within the study area during each of four surveys.

Fauna group	2010	2011	2012	2015 (March-April)	2015 (September)	Total
Mammals	2	7	37	24	2	44
Birds	91	106	101	139	96	170
Reptiles	1	7	15	20	5	33
Amphibians (frogs)	4	4	13	11	0	15

5.3.1 Mammals

The 44 mammal species recorded in the study area include 18 species of non-volant (non-flying) mammals and 26 species of flying mammals (bats).

Non-volant mammals

The box-trapping surveys of 2012 and 2015 captured 28 individuals of five different rodent species over the two survey events, with a relatively low overall capture rate of 4.2 animals per 100 trap-nights (see **Appendix E**). Capture rates were higher in hill forest than in alluvial forest or Kunai Grassland. Lowland Paramelomys (*Paramelomys platyops*) and Black-tailed Melomys (*Melomys*

rufescens) were the most-commonly trapped species, with only single individuals of three different rat species trapped. The remote camera surveys of 2012 and 2015 photographed at least five different native mammal species, with bandicoots, including the Common Echymipera (*Echymipera kalubu*, **Photo 5.1**), being the most commonly photographed species (see **Appendix E**). The remote camera survey results together with the relative abundance of bandicoot diggings observed in both hill forest and alluvial forest in 2012 and 2015 suggests that bandicoots are relatively abundant throughout the study area (Woxvold and Aplin 2013, this study).

During night-time spotlighting surveys of 2012 and 2015, a total of at least five non-volant mammals were observed, including a Sugar Glider (*Petaurus breviceps*) that was heard calling in 2012, several Giant White-tailed Rats (*Uromys* sp. *caudimaculatus* group) in both surveys, and an Eastern Common Cuscus (*Phalanger intercastellanus*, **Photo 5.2**) that was seen and photographed in 2015. The introduced Water Buffalo (*Bubalus bubalis*) was observed in Kunai Grassland and alluvial forest north of the Markham Gap Basin in 2011 and may be restricted to the far northern portion of the study area (Woxvold 2012). Signs (tracks and diggings) of feral pigs (*Sus scrofa*) were found commonly in both alluvial and hill forest, and the tracks of Water Rat (*Hydromys chrysogater*) were observed on the banks of Waime River in 2015. Several cats (*Felis catus*) seen hunting at night at locations several kilometres from the closest settlements in 2015 suggests the presence of feral animals.

A further five mammal species were not directly recorded in the field, but were identified as likely to occur on the basis of reliable accounts of local informants, captive animals in villages or hunting trophies. These included Raffray's Bandicoot (*Peroryctes raffrayana*), Ground Cuscus (*Phalanger gymnotis*), Common Spotted Cuscus (*Spilocuscus maculatus*), White-striped Dorcopsis (*Dorcopsis hageni*) and New Guinea Pademelon (*Thylogale browni*).

Photo 5.1. Common Echymipera (*Echymipera kalubu*) trapped by a local hunter.

Photo 5.2. Eastern Common Cuscus (*Phalanger intercastellanus*) in alluvial forest.

Bats

The total of 26 species of bats recorded in the study area comprises 10 species of fruit-, nectar- and blossom-eating bats in the family Pteropodidae and 16 species of smaller, echo-locating bats. A total of 241 individuals of eight species of pteropodid bats were captured in mist nets during the 2012 surveys (**Appendix E**), with two additional species observed during spotlighting surveys, namely Giant Flying Fox (*Pteropus neohibernicus*, **Photo 5.3**) and Moluccan Naked-backed Fruit Bat (*Dobsonia moluccensis*). No echo-locating bats were caught in the mist nets, despite their obvious local abundance. Pteropodid bats rely on their large eyes and excellent vision to find their way around at night, which makes them susceptible to capture in nets, whereas echo-locating bats are generally able to detect and avoid mist nets. While the taxonomic identity of two of the captured pteropodids is not fully resolved, none of the pteropodid bats are considered to be threatened or near threatened species by the IUCN, and all are probably widespread and abundant (Woxvold and Aplin 2013). At most mist-netting sites, more than 80% of pteropodid bat

captures were of the Common Blossom Bat (*Syconycteris* cf. *australis*) (Woxvold and Aplin 2013). Hundreds of Giant Flying Foxes were observed flying over alluvial forest at dusk during the 2015 survey. This species congregates to roost in alluvial forest on the Watut River alluvial plain, but the roost sites continually shift as they are targeted by local hunters.

Photo 5.3. A Giant Flying-Fox (*Pteropus neohibernicus*) kept as a pet at Mare (from Woxvold and Aplin 2013).

Photo 5.4. Common Tube-nosed Bat (*Nyctimene* sp. '*albiventer*' group) in alluvial forest.

The bat detector surveys recorded a total of 15 different call types in 2012 (including 4 not detected in 2015) and 11 different call types in 2015 (including 3 not detected in 2012), resulting in a total of 18 different call types that were attributable to 16 different species (**Appendix E**). Some call types could not be definitively assigned to species due to the overlap in call-type characteristics among some species and/or the lack of reference calls for certain species (see **Appendix F** for details). However, these unidentified call types are unlikely to represent any species listed as threatened or near threatened under the IUCN Red List, as no such species had potential to occur in the study area (see **Section 5.5**). The call-type accumulation curve for the 2012 and 2015 surveys, which plots the cumulative total of echo-locating bat call types recorded over each bat detector recording session of the surveys, shows an asymptote was reached after 12 recording sessions of survey effort (**Figure 5.3**). This suggests there was sufficient survey effort to record most rare echo-locating bat species within the study area. Slightly more call types were recorded in alluvial forest than in hill forest, despite the greater survey effort in hill forest.

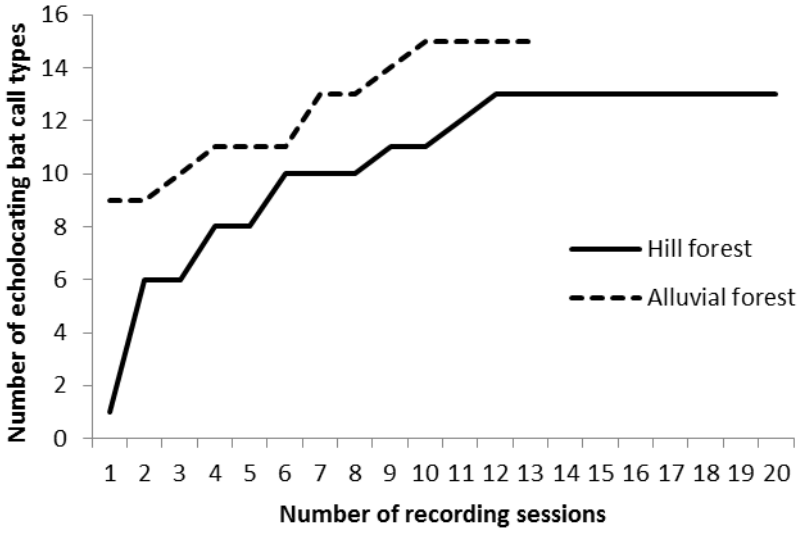


Figure 5.3. Call-type accumulation curve for the 2012 and 2015 bat detector surveys in each of hill forest and alluvial forest habitat types.

No caves were located in the study area during any of the four terrestrial fauna surveys, and none were known to local residents surveyed during the community interviews of 2010 to 2012 (Woxvold 2011, 2012, Woxvold and Aplin 2013). Nonetheless, several of the bat species recorded within the study area are known to roost only in caves or prefer to roost in caves, so their presence confirms that there must be substantial caves located outside the study area in the wider, local region (Woxvold and Aplin 2013). Furthermore, at least seven of the microbat species detected almost certainly require caves to roost in when breeding (Woxvold and Aplin 2013). However, the nightly foraging ranges of bat species can extend many kilometres from their roost sites (Bernard and Fenton 1983, Fenton and Rautenbach 1986), and even up to 25 km for Common Rousette Bat (*Rousettus amplexicaudatus*: Boonsong and McNeely 1977 cited in Woxvold and Aplin 2013), a species captured in the study area.

Two conservation significant mammal species listed as threatened species under the IUCN Red List were identified within the study area as captive animals in local villages: Goodfellow's Tree Kangaroo (*Dendrolagus goodfellowi*; IUCN: Endangered); and New Guinea Pademelon (*Thylogale browni*; IUCN: Vulnerable). These species are discussed further in **Section 5.5.1**.

5.3.2 Birds

There is a high diversity of birds in the study area, with a total of 171 species recorded over the five surveys 2010 to 2015. Species richness was similar in both hill forest and alluvial forest types, with 118 species recorded in hill forest and 115 species recorded in alluvial forest. Substantially fewer species were recorded in watercourse/wetland (30 species) and Kunai Grassland (19 species) habitat types.

The species accumulation curve for the 2015 surveys, which plots the cumulative total of bird species recorded over each day of the survey, suggests an asymptote was reached after around 17 days of survey effort during the first 23 days encompassing the March-April survey (**Figure 5.4**). Between days 13 and 23, five additional species were recorded, and between days 17 and 23 only two additional species were recorded. Over the additional five days of the September 2015 survey (days 24 to 29 in **Figure 5.4**) an additional nine species (all associated with wetland or disturbed/grassland habitats) were recorded, including four species not previously recorded in the study area. These data indicate that there was sufficient survey effort to record most rare and/or cryptic species within the 2015 study area. The additional 30 days of survey effort over three years in the 2010-2012 surveys, which surveyed additional portions of the study area, recorded an additional 18 bird species including five wetland/grassland species and four other species identified only provisionally.

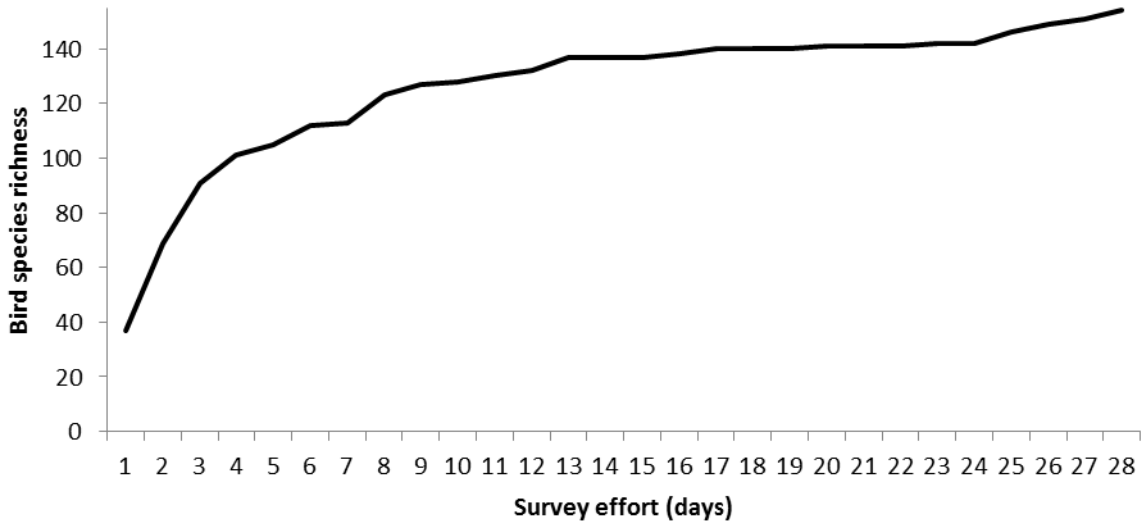


Figure 5.4. Species accumulation curve for the 2015 bird surveys.

A total of 61 individuals of 24 different bird species were captured during the mist-netting surveys in 2012 (13 birds) and March-April 2015 (48 birds, **Photos 5.5** to **5.7**); these did not include any species not also detected by sight or their calls during the diurnal observational surveys (**Appendix E**). The spot-lighting surveys in 2010, 2012 and March-April 2015 identified eight species of nocturnal bird, including four species of owl, two species of frogmouth and two species of nightjar. Four bird-of-paradise species were recorded in the study area: Raggiana Bird-of-Paradise (*Paradisaea raggiana*); King Bird-of-Paradise (*Cicinnurus regius*); Crinkle-collared Manucode (*Manucodia chalybatus*); and Glossy-mantled Manucode (*Manucodia ater*). Both Raggiana and King Bird-of-Paradise were common species in both hill and alluvial forests, whereas the single observations of the two manucode species suggest they are uncommon in the study area.

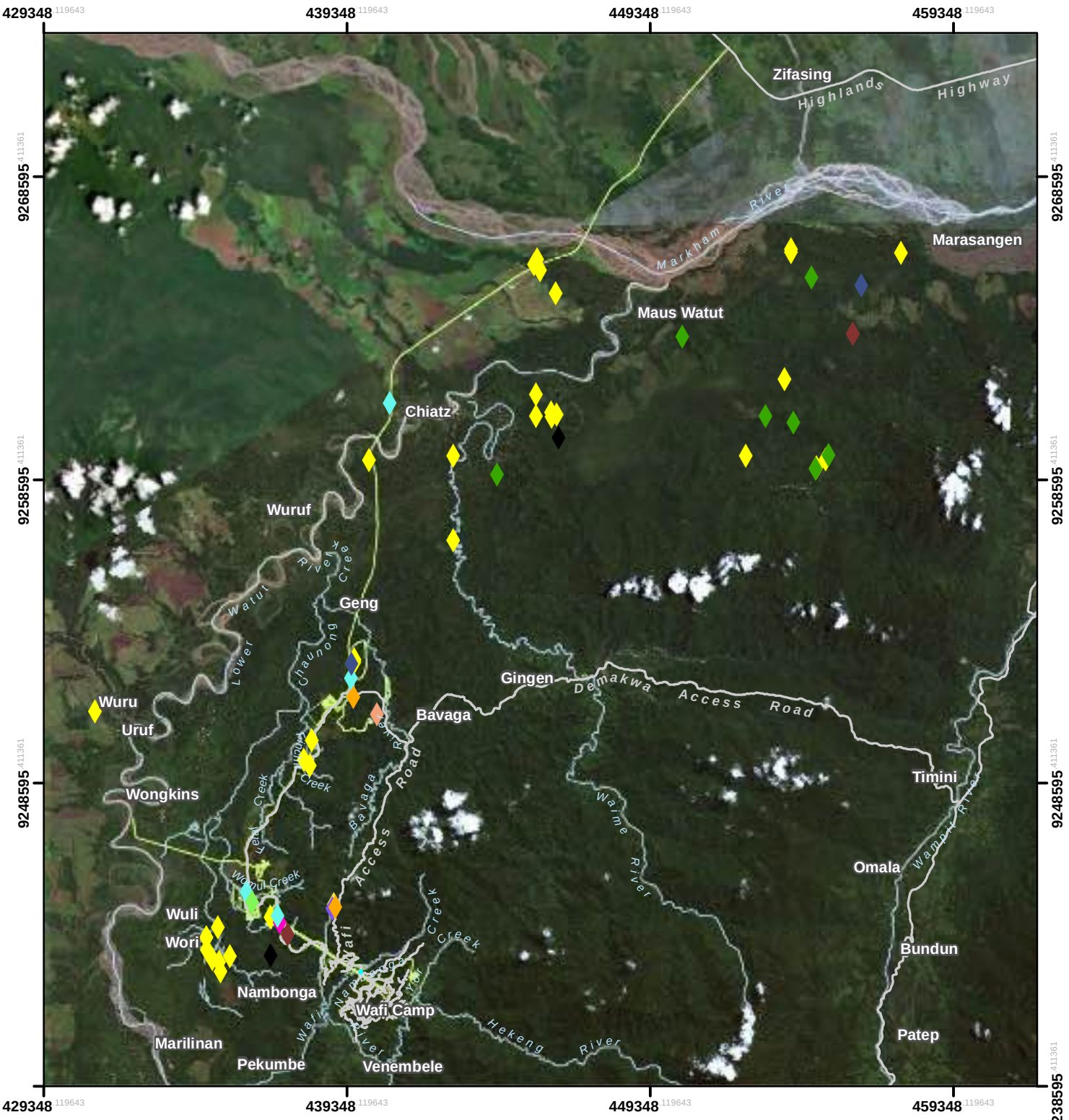
Photo 5.5. A Hook-billed Kingfisher (*Melidora macrorrhina*) mist-netted in hill forest.

Photo 5.6. A male Frilled Monarch (*Arses telescopthalmus*) mist-netted in alluvial forest.

Photo 5.7. A male Black Sunbird (*Leptocoma aspasia*).

Photo 5.8. Eggs of Collared Brushturkey (left) and New Guinea Scrubfowl (right) taken from nest mounds.

Three conservation significant bird species listed as threatened or near threatened species under the IUCN Red List were identified within the study area: Papuan Eagle (*Harpyopsis novaeguineae*; IUCN: Vulnerable); Gurney's Eagle (*Aquila gurneyi*; IUCN: Near Threatened) and Blue-Black Kingfisher (*Todiramphus nigrocyaneus*; IUCN: Near Threatened). Dwarf Cassowary (*Casuarius bennetti*) was also recorded within the study area; while this species was considered Near Threatened by the IUCN prior to 2016, a recent re-evaluation of its conservation status has determined that hunting may not be driving a significant decline as was previously thought and many uninhabited areas remain where this species is believed to be doing well, meaning that the species is now listed Least Concern under the IUCN Red List (BirdLife International 2016a). The locations of records of these species are shown in **Figure 5.5**. These species are discussed further in **Section 5.5.1**. A further eight conservation significant species declared protected under the PNG Fauna Act were recorded within the study area, and are discussed further in **Section 5.5.2**. One further notably rare species that is endemic to New Guinea was recorded within the study area, Papuan Hawk-Owl (*Uroglaux dimorpha*). This species is discussed further in **Section 5.5.4**.



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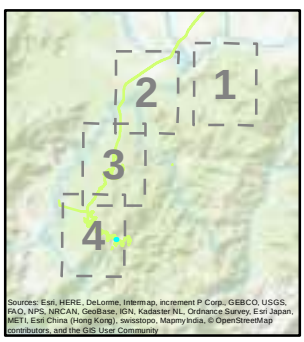


LEGEND

- Proposed infrastructure footprint
- Waterways

Significant ecological features

- Blue-black Kingfisher
- Dwarf Cassowary
- Dwarf Cassowary (sign)
- Gurney's Eagle
- Metallic Starling nesting colony
- Pale-billed Scrubwren (heard)
- Pale-billed Scrubwren (sighting & capture)
- Papuan Eagle
- Papuan Hawk-Owl
- Raggiana Bird-of-Paradise display site
- Scrubwren sp. (2012)
- Megapode nest mound

0 1 2 3 4
Kilometres
1:180,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

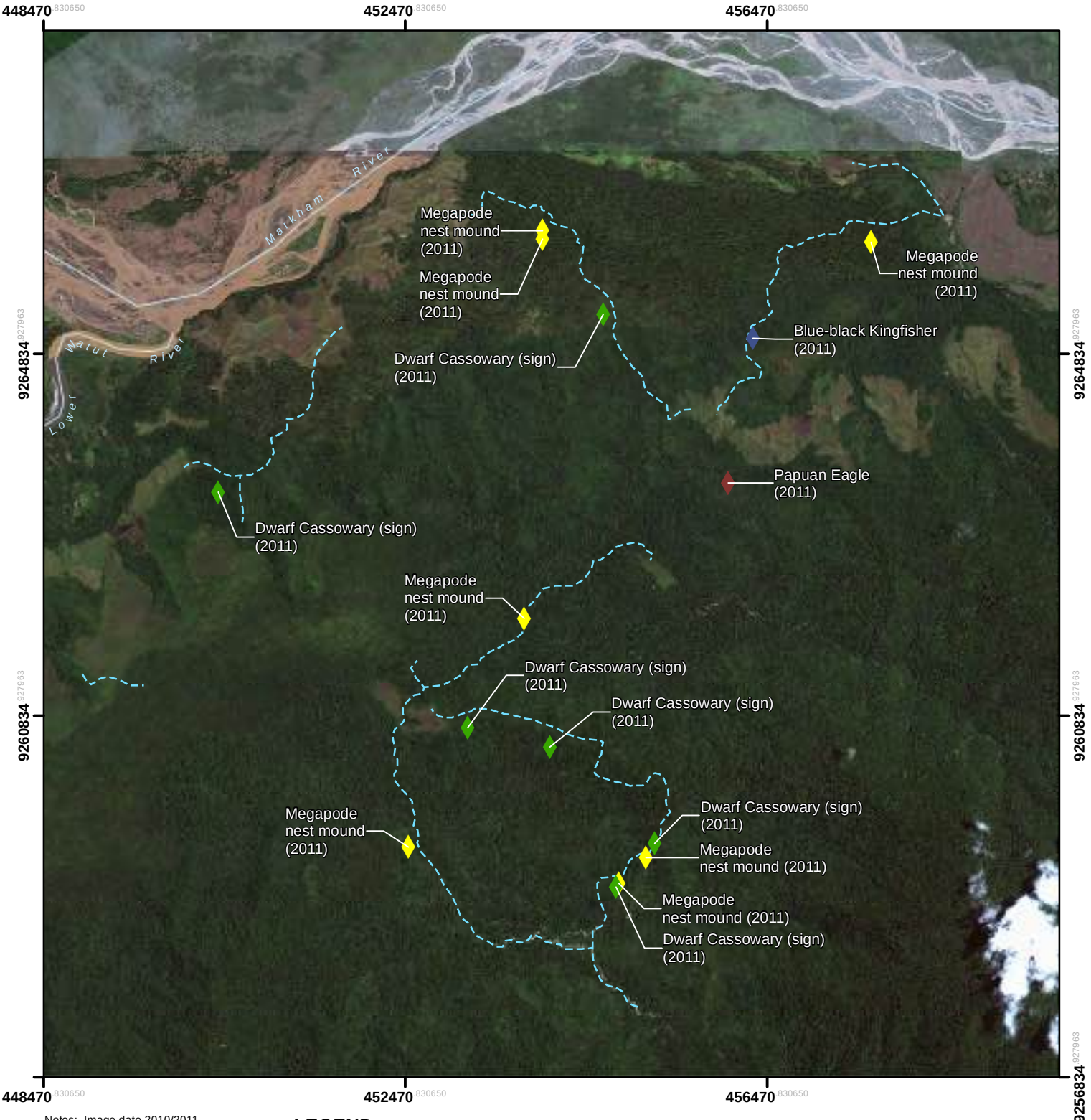
N W E S

Figure:	**5.5**
Title:	Location of significant species and ecological features (2010-2015) - Overview
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

BAAM ECOLOGICAL CONSULTANTS

Document Location: G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-5 Location of significant species and ecological features (2010-2015) Overview 20180322.r



Notes: Image date 2010/2011

LEGEND

- Proposed infrastructure footprint
- Waterways

Significant ecological features

- Megapode nest mound
- Blue-black Kingfisher
- Dwarf Cassowary (sign)
- Papuan Eagle

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

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Kilometres
1:60,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

N W E S

Figure:	**5.5.a Map 1 of 4**
Title:	Location of significant species and ecological features (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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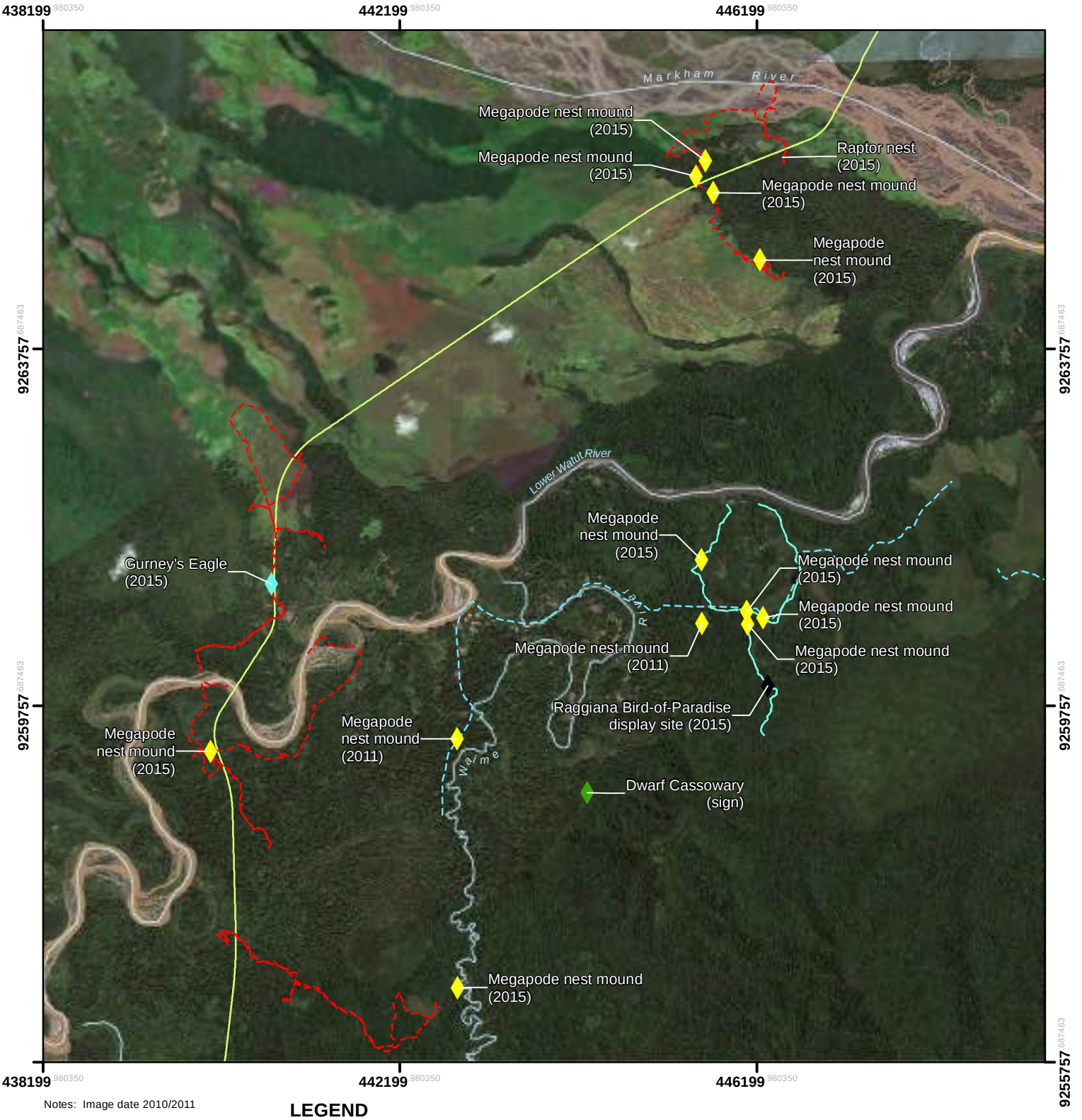

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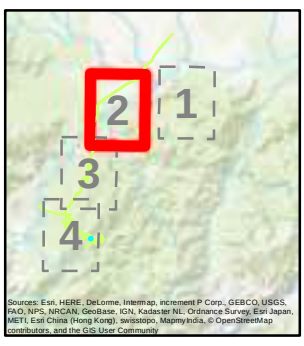

LEGEND

- Proposed infrastructure footprint
- Waterways

Significant ecological features

- Megapode nest mound
- Dwarf Cassowary (sign)
- Gurney's Eagle
- Raggiana Bird-of-Paradise display site

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

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Kilometres
1:60,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

N W E S

Figure:	**5.5.b Map 2 of 4**
Title:	Location of significant species and ecological features (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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Document Location:
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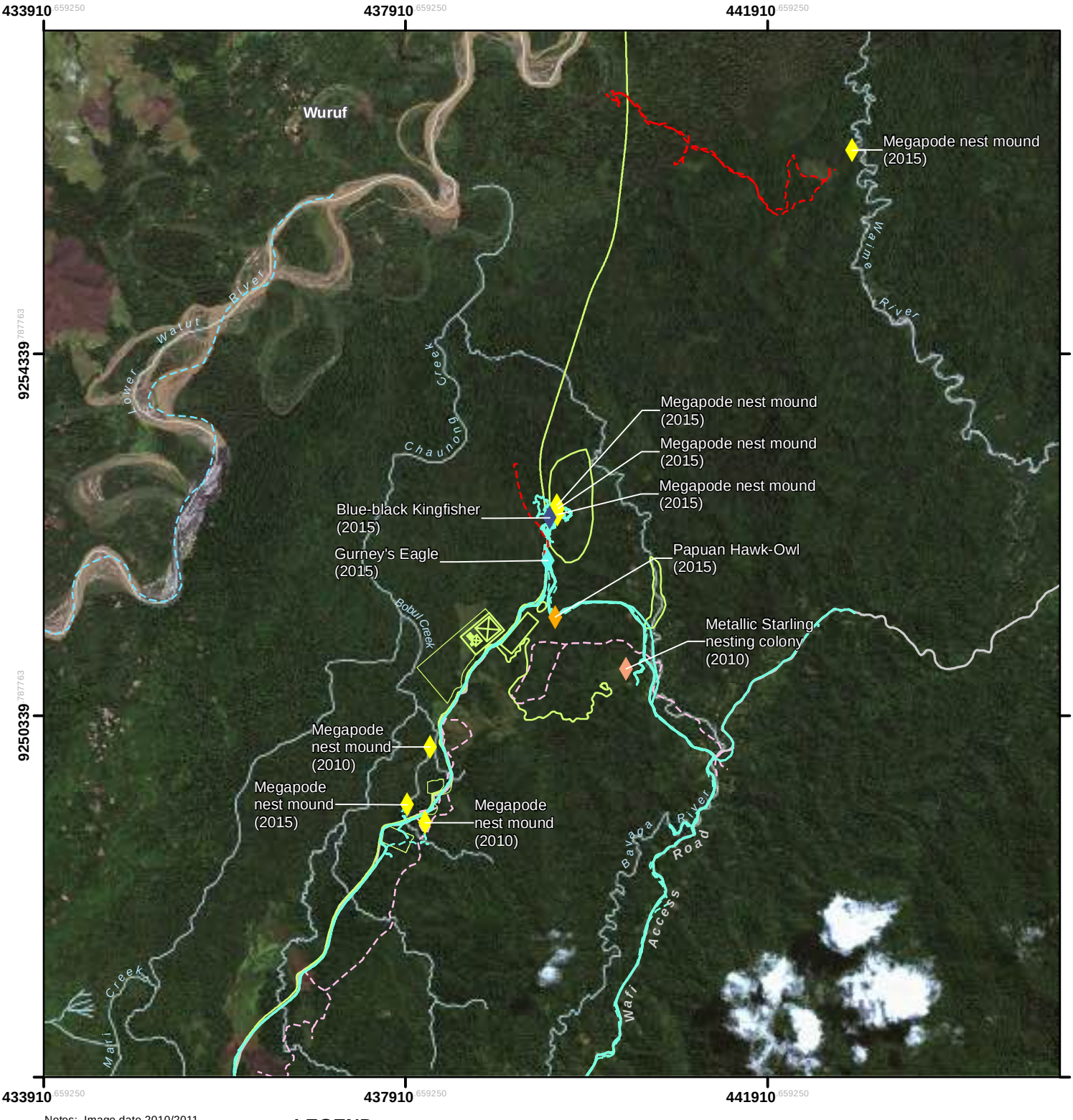

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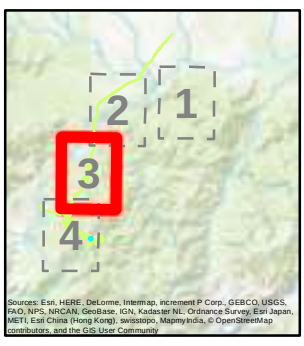

LEGEND

- Proposed infrastructure footprint
- Waterways

Significant ecological features

- Megapode nest mound
- Blue-black Kingfisher
- Gurney's Eagle
- Metallic Starling nesting colony
- Papuan Hawk-Owl

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

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Kilometres
1:60,000 at A4
Coordinate System: PNG94 PNGMG94 Zone 55

Figure:	**5.5.c Map 3 of 4**
Title:	Location of significant species and ecological features (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

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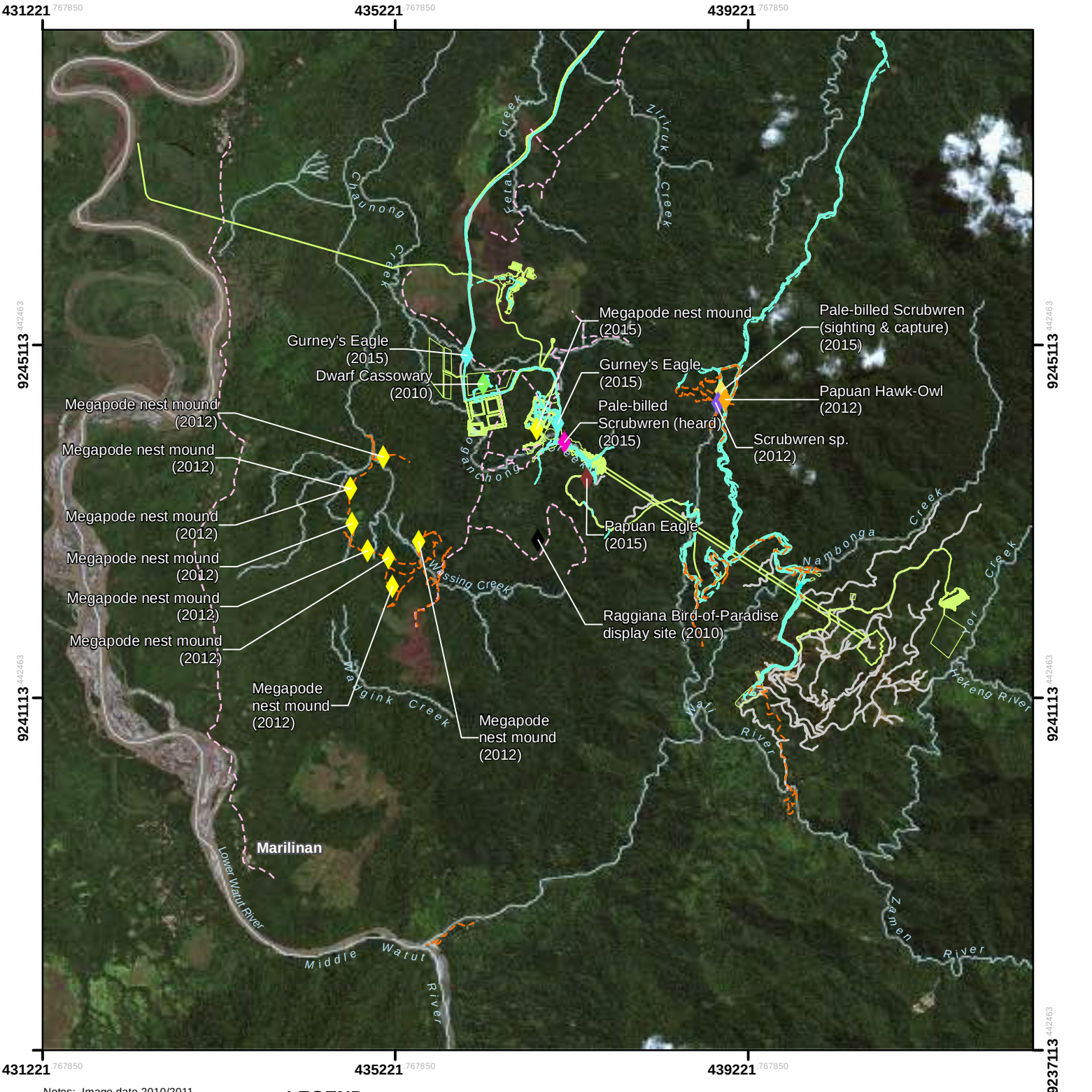

Notes: Image date 2010/2011

LEGEND

- Proposed infrastructure footprint
- Waterways

Significant ecological features

- Megapode nest mound
- Dwarf Cassowary
- Gurney's Eagle
- Pale-billed Scrubwren (heard)
- Pale-billed Scrubwren (sighting & capture)
- Papuan Eagle
- Papuan Hawk-Owl
- Raggiana Bird-of-Paradise display site
- Scrubwren sp. (2012)

Survey tracks (Year):

- 2015 (September)
- 2015 (March-April)
- 2012
- 2011
- 2010

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Coordinate System: PNG94 PNGMG94 Zone 55

Drawn By: KM
Reviewed by: PL
Date: 22/03/2018

Figure:	**5.5.d Map 4 of 4**
Title:	Location of significant species and ecological features (2010-2015) - Detailed maps
Project:	Terrestrial Flora and Fauna Baseline Assessment - Mine Area to Markham River, Wafi-Golpu Project
Client:	**Advisian**

BAAM ECOLOGICAL CONSULTANTS

Document Location:
G:\201001\00515 PROJ - Golpu Project - ENV Services\10.0 Engineering\10 GM-Geomatics\Jobs\2018-001 BAAM map update\Output\Figure 5-5 Location of significant species and ecological features (2010-2015) Detailed Maps 20180322.mxd

The rich diversity of birds, including several threatened, near threatened or otherwise noteworthy, forest-dependent species that are typically found only in relatively large, undisturbed tracts of primary forest, indicate that forested habitats across the study area are in good condition for supporting bird diversity typical of intact, primary forest.

Megapode nest mounds were regularly encountered in each of the five surveys (see **Figure 5.5** for mapped locations), particularly in alluvial forest, and both Collared Brush-Turkey and New Guinea Scrubfowl appeared to be relatively common (**Photo 5.8**). Collared Brush-Turkey occurred in both alluvial and hill forest, and was heard calling from steep forested slopes in the Buvu Creek catchment. New Guinea Scrubfowl appeared to be more common in alluvial forest, but was also detected in hill forest at lower elevations. Raggiana Bird-of-Paradise was the only true lekking bird-of-paradise species (Beehler and Pruett-Jones 1983) recorded within the study area; the species was relatively common, several likely lek sites were identified (see **Figure 5.5** for mapped locations) and males were heard calling from additional sites that could not be confirmed as lek sites. No waterbird nesting colonies have been detected in the study area, despite the occurrence in the study area of species that nest in such colonies, including Great Egret (*Ardea alba*) and Intermediate Egret (*Ardea intermedia*).

5.3.3 Reptiles

A total of 33 reptile species recorded within the study area (see **Appendix E**) included 31 reptiles observed within the study area and two species displayed in local villages, namely Saltwater Crocodile (*Crocodylus porosus*) identified from a trophy skull and New Guinea Snapping Turtle (*Elseya novaeguineae*) served as a meal and apparently caught in an oxbow lake at Chiatz village. The 31 species directly observed in the study area included one species of dragon (family Agamidae), four species of gecko (family Gekkonidae) including the introduced Common House Gecko (*Hemidactylus frenatus*), 11 species of skink (family Scincidae, **Photo 5.9**), two species of monitor (family Varanidae) and 12 species of snake in four different families including four species of python (**Photo 5.10**). Two species of gecko and two species of skink were identified only to genus. None of the reptile species detected in the study area are listed as threatened or near threatened species under the IUCN Red List, but eight species are declared restricted under the PNG Fauna Act (see **Section 5.5.2**).

Photo 5.9. Red-eyed Crocodile Skink (*Tribolonotus gracilis*) found under a rotting log in foot-slope forest in 2015.

Photo 5.10. White-lipped (D'Albertis) Python (*Leiopython albertisii*), one of four python species detected in the study area.

5.3.4 Amphibians (frogs)

The 15 species of frog detected in the study area (see **Appendix E**) are all relatively widely distributed in lowland habitats in PNG, and none are listed as threatened or near threatened under the IUCN Red List or declared protected or restricted under the PNG Fauna Act. Frog species richness and abundance was greatest in close proximity to clear, fast-flowing mountain streams in hill forest, where *Papurana papua, P. garritor, P. arfaki* (**Photo 5.11**) and *Litoria eucnemis* (**Photo 5.12**) were commonly observed. Species that were more prominent in alluvial and swamp forests included *Litoria infrafenata, Papurana daemeli* and *Platymantis papuensis*. One introduced amphibian species was observed, namely Cane Toad (*Bufo marinus*).

Photo 5.11. Arfak Mountain Frog (*Papurana arfaki*) found on a rocky mountain stream bank.

Photo 5.12. Fringed Tree Frog (*Litoria eucnemis*) perched in vegetation adjoining a mountain stream.

5.4 FAUNA HABITATS

Five main terrestrial fauna habitat types were characterised within the study area: (1) alluvial forest; (2) hill forest; (3) grassland; (4) watercourses and wetlands; and (5) highly disturbed anthropogenic habitats. These broad habitat types and their characteristic terrestrial fauna assemblages are described in more detail in the sections below.

5.4.1 Alluvial forest

Alluvial forest dominates the broad Watut River alluvial plain as a complex mosaic of Large to Medium Crowned Forest (PL), Mixed Swamp Forest (FSW) and Swamp Woodland (WSW). The floristic and structural characteristics of these vegetation communities are described in detail in **Sections 4.3.1, 4.3.5** and **4.3.7**. The tree canopy or emergent tree layer ranges in height from 30m to 55m in undisturbed areas. The sub-canopy is typically divided into two to three tree layers and climbing palms and thick woody lianas are generally common throughout all structural layers. The height and structural complexity of alluvial forest supports a wide variety of ecological niches for fauna, allowing, for example, a diverse community of birds to minimise competition by utilising similar resources but within different structural layers (Bell 1982c, 1983). The abundance and diversity of fruiting plants, particularly large-fruited trees including fig trees, supports a rich community of frugivorous (fruit-eating) mammals and birds. This is evidenced in the diversity and abundance of pteropodid bats and frugivorous parrots and pigeons that was recorded in alluvial forest. The bird community in lowland rainforest in PNG comprises a greater proportion of frugivorous species than in other tropical regions of the world (Bell 1982a). The structural complexity of alluvial forest, including a relatively open understorey, also resulted in a higher species richness of microbats in alluvial forest compared with hill forest. The species richness of reptiles recorded during the surveys was also greater in alluvial forest than in hill forest, although this may also have reflected the generally easier track access in alluvial forest.

The permanently wet nature of the forest floor in Mixed Swamp Forest and Swamp Woodland reduces the floristic complexity of the sub-canopy, shrub and groundcover layers in these alluvial forest types, but provides habitat for a variety of species more associated with wet forests, including birds such as Red-necked Crake (*Rallina tricolor*), Azure Kingfisher (*Ceyx azureus*), Little Kingfisher (*Ceyx pusillus*), and the rare Blue-Black Kingfisher. Other bird species recorded only in alluvial forest included Ochre-collared Monarch (*Arses insularis*), whose presence in the study area represents a range extension approximately 100km south of its documented range (Pratt and Beehler 2014), Large-billed Gerygone (*Gerygone magnirostris*) and Black-headed Whistler (*Pachycephala monacha*). The abundance of frogs in alluvial forest swamps supports a number of frog-eating snakes, including Many-scaled Keelback (*Tropidonophis multiscutellatus*) and New Guinea Ground Boa (*Candoia aspera*).

Evidence of hunting pressure in alluvial forest was particularly prominent during the September 2015 survey in the prevailing dry conditions; numerous hunting trails, particularly in forest patches on the western side of the Watut River, showed recent evidence of being swept clear of leaf litter to facilitate the hunting of bandicoots at night.

5.4.2 Hill forest

Hill forest occupies the gentle- to steeply-sloping terrain of the mountain foothills throughout the eastern portions of the study area, and incorporates the Medium Crowned Forest (HM) and Small Crowned Forest (HS) on foothills vegetation communities that are described in detail in **Section 4.3.2**. The tree canopy extends to a height of 30 m to 45 m and there is generally a dense sub-canopy. Steep upper slopes and ridges are vegetated with a drier and structurally simple forest with a limited diversity of canopy species and typically a dense understorey of saplings, vines and palms. Similar to alluvial forest, the height and structural complexity of hill forest supports a wide variety of ecological niches for fauna, also allowing a diverse community of birds to minimise competition by utilising similar resources but within different structural layers (Terborgh and Diamond 1970). Fruiting plants were also abundant in hill forest, resulting in a similarly diverse and abundant frugivorous mammal and bird community.

Most species found in alluvial forest also occur in hill forest. Species recorded predominantly or only in hill forest included the Dwarf Cassowary, Variable Goshawk (*Accipiter hiogaster*), the rare Papuan Hawk Owl (*Uroglaux dimorpha*), White-eared Catbird (*Ailuroedus buccoides*), Scrub Honeyeater (*Meliphaga albonotata*), Meyer's Friarbird (*Philemon meyeri*), Papuan Black Myzomela (*Myzomela nigrita*), Tawny Straightbill (*Timeliopsis griseigula*), Pygmy Longbill (*Oedistoma pygmaeum*), Pale-billed Scrubwren (*Sericornis spilodera*), Great Woodswallow (*Artamus maximus*) and Black-fronted White-eye (*Zosterops minor*). Dwarf Cassowary signs (scats and footprints) were observed at six locations in the densely forested foothills above the Markham Gap Basin in 2011 (Woxvold 2012) and at one location in foothill forest south of Chiatz in 2015. These observations, together with the results of community interviews in local villages suggest that this species likely persists at a low density in hill forest and adjoining alluvial forest away from areas of human settlement, and appears to be relatively more abundant in the Markham Gap Basin, an area that may represent a local stronghold for the species (Woxvold 2012).

5.4.3 Grassland

Large patches of native grassland occur on the foot-slopes of the Watut River Valley, extending onto the alluvial plain in some localities, particularly to the west of the lower Watut River. As described in more detail in **Section 4.3.3**, these native grasslands have developed as a consequence of a long history of human use of fire for clearing and hunting. Grassland on hill-slopes is generally dominated by the native grass *Imperata cylindrica* (Kunai), and is typically referred to as Kunai Grassland. In alluvial areas, the robust grass *Polytocha macrophylla* becomes prominent, whereas the reed *Phragmites vallatorius* frequently occupies swampier depressions.

By comparison with the surrounding forests and wetland habitats, grassland supports a relatively species poor but distinct vertebrate fauna. Mammals associated with this habitat include

Grassland Melomys (*Melomys lutillus*) and Polynesian Rat (*Rattus exulans*), the latter an introduced species (Woxvold and Aplin 2013). The bird community is a little more diverse, including species such as Eastern Grass Owl (*Tyto longimembris*), Pheasant Coucal (*Centropus phasianinus*), Black-billed Coucal (C*. bernsteini*), Pied Bush Chat (*Saxicola caprata*), White-shouldered Fairywren (*Malurus alboscapulatus*), Horsfield's Bushlark (*Mirafra javanica*) and Golden-headed Cisticola (*Cisticola exilis*).

5.4.4 Watercourses and wetlands

A variety of watercourses flow through the study area, from large and generally turbid floodplain rivers to small, fast-flowing mountain streams with clear water, and low-gradient, slow-flowing floodplain tributary streams (BMT WBM 2018). The large Markham and Watut rivers dissect the floodplains on the western and northern sides of the study area, have relatively high turbidity, especially when in flood, and expose extensive areas of shingle, sand and mud sediments when not in flood. Waterbirds are more prominent on the larger rivers, including species such as Little Ringed Plover (*Charadrius dubius dubius*) and the migratory Common Sandpiper (*Actitis hypoleucos*) that frequent areas of exposed sediments along the river's edge, as well as Pacific Black Duck (*Anas superciliosa*) on open waters. Other non-forested wetlands include scattered oxbow lakes on the Watut River floodplain and scattered patches of Swamp Grassland (BMT WBM 2018). The floristic and structural characteristics of these wetland communities are described in more detail in **Sections 4.3.6** and **4.3.10**.

The fringes of rivers, oxbow lakes and swamp grassland provide foraging habitat for waterbirds such as egrets and cormorants that occur in small numbers in the study area. Oxbow lakes are particularly rich in wetland fauna, supporting waterfowl such as ducks, grebes, cormorants, Dusky Moorhen (*Gallinula tenebrosa*), White-browed Crake (*Porzana cinerea*) and Comb-crested Jacana (*Irediparra gallinacea*), as well as New Guinea Snapping Turtle (*Elseya novaeguineae*). White-bellied Sea-Eagle (*Haliaeetus leucogaster*) and Eastern Osprey (*Pandion cristatus*) are occasional visitors foraging for fish in larger areas of open water. The clear, fast-flowing waters of mountain creeks provide breeding habitat for a variety of frogs, including species such as *Nyctimystes cf cheesmanae* and *Litoria eucnemis* that likely depend on clean, clear water for successful reproduction (Woxvold and Aplin 2013).

5.4.5 Highly disturbed anthropogenic habitats

Highly disturbed habitats largely cleared of forest are most abundant close to villages and other settled areas. Some areas on richer, alluvial soils are under long-term cultivation of food plants and cash crops such as cocoa. Areas of untended garden or swidden agriculture are vegetated with young regrowth forest, as described in more detail in **Section 4.3.11**. Due to the juxtaposition of highly disturbed anthropogenic habitats with surrounding forest, fauna species richness is still relatively high, at least at the edges of these habitats. Species recorded only or more commonly in these highly disturbed habitats included Singing Starling (*Aplonis cantoroides*), Metallic Starling (*A. metallica*), Peaceful Dove (*Geopelia striata*), Chestnut-breasted Mannikin (*Lonchura castaneothorax*) and Streak-headed Mannikin (*Lonchura tristissima*).

5.5 CONSERVATION SIGNIFICANT SPECIES

5.5.1 Threatened and near threatened species

The desktop assessment identified a total of 15 threatened or near threatened vertebrate fauna species with potential to occur in the study area, including six mammal species and nine bird species (**Table 5.3**). Three threatened species (Goodfellow's Tree Kangaroo (IUCN: Endangered), New Guinea Pademelon (IUCN: Vulnerable) and Papuan Eagle (IUCN: Vulnerable)) and two Near Threatened species (Gurney's Eagle and Blue-Black Kingfisher) were detected within the study area during the various field surveys. Goodfellow's Tree Kangaroo and New Guinea Pademelon were detected only on the basis of single captive individuals present in local villages. The Goodfellow's Tree Kangaroo held in captivity at Madzim village on the Watut River plain in 2010

was said to have been captured as a young animal at high elevations in the upper Watut River valley (Woxvold 2011a). The New Guinea Pademelon held captive at Pekumbe village was apparently caught locally, though the precise location and habitat were not determined (Woxvold and Aplin 2013). Based on an assessment of field survey results, habitat suitability assessment and the nature of threatening processes at a broader landscape scale, the revised likelihood of occurrence assessment determined that three threatened or near threatened vertebrate fauna species are known to occur within the study area (Papuan Eagle, Gurney's Eagle and Blue-Black Kingfisher), one species is likely to occur (Doria's Goshawk), two species have potential to occur (New Guinea Pademelon, Forest Bittern) whereas the remaining nine species are unlikely to occur (see **Table 5.3** for details).

Table 5.3. Assessment of the likelihood of occurrence in the study area of threatened and near threatened vertebrate fauna species.

Scientific name	Common name	Status[1]		Likelihood of occurrence in the study area
		IUCN	PNG	
Mammals				
Zaglossus bartoni	Eastern Long-beaked Echidna	V	P	**Unlikely to occur**. While this species is likely to have occurred historically, it is highly sensitive to hunting pressure and the close proximity of local settlements means the species has likely been hunted to local extinction in the study area (Leary *et al.* 2016a). Local residents interviewed during community interviews in prior surveys recognised this species and indicated it occurs only in remoter, higher elevation forests, though within walking distance (Woxvold 2011, 2012).
Dasyurus albopunctatus	New Guinea Quoll	NT		**Unlikely to occur**. The study area occurs within the historical range of the species. However, during community interviews in prior surveys this species was either not recognised or said to be absent by local residents (Woxvold 2011, 2012). The species is sensitive to hunting by dogs (Woolley *et al.* 2016), so is likely to have been locally extirpated by the high hunting pressure with dogs that occurs within the study area.
Dendrolagus goodfellowi	Goodfellow's Tree Kangaroo	EN	P	**Unlikely to occur**. While this species is likely to have occurred historically, it is highly sensitive to hunting pressure and the close proximity of local settlements means the species has likely been hunted to local extinction in the study area (Leary *et al.* 2016b). The species is known to local residents who report it being restricted to the most remote parts of the local region; one held in captivity at Madzim village on the Watut Plains in 2010 was said to have been captured as a young animal at high elevations in the upper Watut valley (Woxvold 2011a).
Dorcopsulus vanheurni	Small Dorcopsis	NT		**Unlikely to occur.** This species is restricted to upper hill to upper-montane forests at elevations of 800 to 3,100m ASL and is sensitive to hunting pressure; therefore, it is unlikely to occur in the study area (Leary *et al.* 2016c).
Thylogale browni	New Guinea Pademelon	VU		**Potential to occur.** The study area occurs within the range of the species. However, the only evidence of occurrence was a captive individual observed in Pekumbe village in 2012(origin unknown) and the species is considered unlikely to be resident in the study area (Woxvold 2011, 2012, Woxvold and Aplin 2013), in large part due to the heavy hunting pressure in the study area and the species' known sensitivity to hunting (Leary *et al.* 2016d). Therefore, the species has potential to occur only as transitory individuals that may rarely move down from higher elevations. Therefore, the study area does not represent important habitat for this species.
Spilocuscus rufoniger	Black-spotted Cuscus	CR	P	**Unlikely to occur**. This rare species has been extirpated from parts of its range through overhunting and its intolerance of human disturbance, and is known only from areas north of Lae (Leary *et al.* 2016e); therefore, it is unlikely to occur in the study area.
Birds				
Psittrichas fulgidus	Pesquet's Parrot	VU	P	**Unlikely to occur**. This species is restricted to hill and lower montane forest, mostly at elevations of 500 to1,800 m ASL (Mack and Wright 1998, BirdLife International 2017d). While the study area occurs at the edge of the current range of the species, no evidence of occurrence of this highly distinctive species has been obtained after multiple surveys. The species is sensitive to hunting pressure and has been historically and recently extirpated from large areas in PNG (BirdLife International 2012b).

Scientific name	Common name	Status[1]		Likelihood of occurrence in the study area
		IUCN	PNG	
Goura victoria	Victoria Crowned-Pigeon	NT	P	**Unlikely to occur**. The Project area occurs outside the current known range of the species (BirdLife International 2016b) and this distinctive species was not detected after multiple surveys; therefore, it is unlikely to occur in the study area.
Megatriorchis doriae	Doria's Goshawk	NT		**Likely to occur.** This unobtrusive and therefore cryptic species occurs only in lowland forest and adjoining hill forest foothills (BirdLife International 2016c). The study area occurs within the current range of the species and it has been reported in lowland habitat north-west of Lae (Eastwood 1995). While it has not been detected during multiple surveys, suitable habitat occurs.
Harpyopsis novaeguineae	Papuan Eagle	VU	P	**Known to occur**. The species was heard calling in the Markham Gap Basin in 2011 (Woxvold 2012) and a single adult bird was seen and photographed perched in hill forest at the Watut Declines Portal Terrace area in 2015.
Aquila gurneyi	Gurney's Eagle	NT	R	**Known to occur**. Both adult and immature birds have been recorded perched or flying over lowland and hill forest during surveys in 2010, 2012 and 2015.
Zonerodius heliosylus	Forest Bittern	NT		**Potential to occur**. This widely distributed species is reclusive and very rarely seen (BirdLife International 2017e). The study area occurs within the range of the species and suitable habitat occurs in the form of streams, pools and swamps in alluvial and hill forest.
Todiramphus nigrocyaneus	Blue-Black Kingfisher	NT		**Known to occur**. Blue-Black Kingfisher was heard calling in alluvial forest in the Markham Gap Basin in 2011 (Woxvold 2012) and a single bird was observed roosting in alluvial forest during a spotlighting survey in 2015.
Poecilodryas placens	Banded Yellow Robin	NT		**Unlikely to occur**. The study area occurs outside the current known range of the species (BirdLife International 2016d) and it was not detected after multiple surveys; therefore, it is unlikely to occur in the study area.
Loboparadisea sericea	Yellow-breasted Satinbird	NT	P	**Unlikely to occur**. This species inhabits montane forest from 600-2,000 m but mostly above 1,200 m (BirdLife International 2017f); therefore, it is unlikely to occur in the study area, which is restricted to areas with elevations under 500 m.

[1] Extinction risk status under the IUCN Red List (IUCN) and protection status under the PNG Fauna Act (PNG): CR = Critically Endangered; EN = Endangered; VU = Vulnerable; NT = Near Threatened; P = protected; R = restricted.

Species profiles for the six threatened and near threatened species assessed as known, likely or to have potential to occur in the study area are outlined in more detail below.

New Guinea Pademelon (*Thylogale browni*)

Status: IUCN: Vulnerable (A2d, 2008). The species is experiencing an ongoing population decline, suspected to exceed 30% over the last three generations (i.e., 15-20 years), due to increased hunting pressures (Leary *et al.* 2008).

Distribution and population: New Guinea Pademelon has a widespread distribution across northern and north-eastern New Guinea and was introduced (6,000 - 7,000 years ago) to the islands of Bagabag, New Britain, New Ireland, and Umboi. The total population size is not known but it is moderately common in suitable habitat (Leary *et al.* 2008).

Habitat and ecology: New Guinea Pademelon inhabits primary and secondary tropical moist forest, with an apparent preference for disturbed areas.

Threats: The main threat to the species is subsistence hunting by local people (hunting with dogs) for food; hunting has heavily depleted populations over parts of its range, where it is now restricted to remote mountainous interior areas (Heinsohn 2005).

Occurrence and habitat extent in the study area: No field evidence of occurrence of the species in the study area was obtained during multiple field surveys, and the results of community interviews suggest that macropods are either extremely rare or absent from the study area (Woxvold 2012). A single captive individual was observed in Pekumbe village in 2012 (origin unknown), but the

species is considered unlikely to be resident in the study area (Woxvold 2011, 2012, Woxvold and Aplin 2013), in large part due to the heavy hunting pressure that prevails in the study area and the species' known sensitivity to hunting. Therefore, the species has potential to occur only as transitory individuals that may rarely move down from higher elevations or more remote mountains in the local region.

Papuan Eagle (*Harpyopsis novaeguineae*)

Status: IUCN: Vulnerable (C2a(ii) (2016)). The species has an estimated small population which may be declining through habitat loss and hunting pressure (BirdLife International 2016e).

Distribution and population: Papuan Eagle is widely distributed across New Guinea, with a population size that is estimated to number 2,500-9,999 mature individuals based on an assessment of known records, descriptions of abundance and range size (BirdLife International 2016e).

Habitat and ecology: Papuan Eagle inhabits forested landscapes and is most common in undisturbed forest at elevations from sea level to 3,700m (BirdLife International 2016e). In suitable habitat of extensive, old-growth forest, pairs occupy large home ranges that average 13 km^2 (Watson and Aysoma 2001). It feeds mainly on mammals, particularly marsupials and rats, but also pigs and dogs, and sometimes takes birds, lizards and snakes (BirdLife International 2016e).

Threats: The main threat to Papuan Eagle is from hunting for its tail and flight feathers which are used in ceremonial head-dresses, especially in the highlands. Road construction and logging are indirect threats that open up previously inaccessible areas to hunters (BirdLife International 2016e).

Occurrence and habitat extent in the study area: The species was heard calling in hill/alluvial forest in the Markham Gap Basin in 2011 (Woxvold 2012) and a single adult bird was seen and photographed perched in hill forest at the Watut Declines Portal Terrace area in 2015 (**Figure 5.5, Photo 5.13**). These sightings suggest the study area falls within the home range of at least one resident breeding pair of Papuan Eagle, and it is likely to utilise most forested areas of the study area.

Photo 5.13. Papuan Eagle (*Harpyopsis novaeguineae*), also known as the New Guinea Harpy Eagle (IUCN: Vulnerable), photographed in primary hill forest at the Watut Declines Portal Terrace area.

Gurney's Eagle (*Aquila gurneyi*)

Status: IUCN: Near Threatened (2016). The species has a moderately small population that is declining due to habitat loss (BirdLife International 2016f).

Distribution and population: Gurney's Eagle is widely distributed in Indonesia and New Guinea. There are no estimates of population sizes or trends but the species occurs at low population densities in suitable habitat (BirdLife International 2016f).

Habitat and ecology: Gurney's Eagle inhabits a variety of forested habitats to 1,000m elevation, but seems to prefer primary, relatively undisturbed forest (BirdLife International 2016f). It constructs a substantial stick nest in a tall forest tree, but there is no further information on its breeding biology (Debus *et al.* 2015).

Threats: The main threat to Gurney's Eagle appears to be habitat loss through forest clearing and degradation (BirdLife International 2016f).

Occurrence and habitat extent in the study area: Both adult and immature birds have been recorded perched or flying over lowland and hill forest during surveys in 2010, 2012 (Woxvold 2012, Woxvold and Aplin 2013) and 2015 (see **Figure 5.5** for locations). A large raptor nest located in the crown of a large emergent tree in a patch of Swamp Forest in close proximity to the proposed Mine Access Road and Northern Access Road alignment immediately south of the Markham River in September 2015 (see **Photos 5.14** and **5.15)** could be the nest of Whistling Kite, Black Kite or Gurney's Eagle; however, no birds were present at the time of the observation to confirm identity). These sightings suggest Gurney's Eagle is resident in the study area, and it is likely to utilise most primary forest through the study area.

Photo 5.14. Large raptor nest in the tall crown of a Swamp Forest tree south of the Markham River.

Photo 5.15. Large raptor nest in a Swamp Forest tree south of the Markham River.

Doria's Goshawk (*Megatriorchis doriae*)

Status: IUCN: Near Threatened (2016). The species has experienced a moderately rapid population reduction (BirdLife International 2016c).

Distribution and population: Doria's Goshawk occupies a wide range across New Guinea. With a potential range over at least 400,000 km^2 of forest, the total population is estimated to number in the thousands (BirdLife International 2016c).

Habitat and ecology: Doria's Goshawk inhabits a variety of lowland forest habitats, sometimes including mangrove and semi-deciduous forest at elevations from sea-level to 1,100 m, occasionally up to 1,400 m. The species is very rarely recorded due to its unobtrusive habits.

Threats: The main threat to the species is thought to be loss of lowland forest habitat that is subject in increasing pressure from logging (BirdLife International 2016c).

Occurrence and habitat extent in the study area: Doria's Goshawk has not been recorded within the study area, but extensive suitable lowland alluvial and hill forest occurs and the species has previously been recorded north-west of Lae; therefore, the species is likely to occur in the study area.

Forest Bittern (*Zonerodius heliosylus*)

Status: IUCN: Near Threatened (2017). The species has a moderately small population that is thought to be undergoing a moderate decline owing to habitat degradation (BirdLife International 2017e).

Distribution and population: Forest Bittern is widely distributed throughout New Guinea and on the adjacent islands of Salawati and Aru, Indonesia. The total population is estimated to number less than 10,000 individuals (BirdLife International 2017e).

Habitat and ecology: Forest Bittern occurs in association with streams, pools and swamps in lowland alluvial and hill forest at elevations up to 1,430m (BirdLife International 2017e).

Threats: The main threat to the species is thought to be loss of lowland forest habitat that is subject in increasing pressure from logging (BirdLife International 2017e).

Occurrence and habitat extent in the study area: The species has not been recorded within the study area. However, the study area occurs within the range of the species and extensive suitable habitat occurs in the form of streams, pools and swamps in alluvial and hill forest; therefore, this cryptic species could potentially occur.

Blue-Black Kingfisher (*Todiramphus nigrocyaneus*)

Status: IUCN: Near Threatened (2017). The increasing numbers of records, along with data on habitat loss and degradation, suggest that it has a small population and perhaps very small subpopulations undergoing an ongoing slow decline (BirdLife International 2017g).

Distribution and population: Blue-Black Kingfisher is patchily distributed across a wide range and is usually rare or uncommon. The total population is precautionarily estimated to number less than 10,000 mature individuals (BirdLife International 2017g).

Habitat and ecology: Blue-Black Kingfisher has been recorded from streams, swamps and ponds in forest to 600m elevation and in alluvial forest near sago palm forest and in mangroves. It feeds on lizards, crabs and fish (BirdLife International 2017g).

Threats: The species' population is suspected to be in decline owing to ongoing habitat destruction and may be threatened by logging, particularly of lowland swamp forests, and the consequential decline in water quality (BirdLife International 2017g).

Occurrence and habitat extent in the study area: Blue-Black Kingfisher was heard calling in alluvial forest in the Markham Gap Basin in 2011 (Woxvold 2012) and a single bird was observed roosting in alluvial forest during a spotlighting survey in 2015; both records were from mixed swamp forest with Sago Palms (see **Figure 5.5** for locations). The few records despite the extensive survey effort confirm that this species occurs at low density in suitable habitats in the study area.

5.5.2 Species protected under the PNG Fauna Act

A total of 11 species declared protected and a further 14 species declared restricted under the PNG Fauna Act have been recorded within the study area (**Table 5.4**).

Table 5.4. Summary of terrestrial vertebrate species declared protected (P) or restricted (R) under the PNG Fauna Act that have been confirmed as occurring within the study area.

Scientific name	Common name	Status[1]	
		IUCN	PNG
Birds			
Ardea alba	Great Egret		P
Ardea intermedia	Intermediate Egret		P
Rhyticeros plicatus	Blyth's Hornbill		P
Probosciger aterrimus	Palm Cockatoo		P
Cacatua galerita	Sulphur-crested Cockatoo		R
Otidiphaps nobilis	Pheasant Pigeon		R
Harpyopsis novaeguineae	Papuan Eagle	VU	P
Aquila gurneyi	Gurney's Eagle	NT	R
Falco berigora	Brown Falcon		R
Haliaeetus leucogaster	White-bellied Sea-eagle		R
Pandion cristatus	Eastern Osprey		P
Circus spilothorax	Papuan Harrier		R
Manucodia atra	Glossy-mantled Manucode		P
Manucodia chalybata	Crinkle-collared Manucode		P
Cicinnurus regius	King Bird-of-paradise		P
Paradisaea raggiana	Raggiana Bird-of-paradise		P
Reptiles			
Crocodylus porosus	Saltwater Crocodile		R
Varanus jobiensis	Peach-throated Monitor		R
Varanus prasinus	Emerald Monitor		R
Candioa aspera	New Guinea Ground Boa		R
Leiopython bennettorum	Bennett's White-lipped Python		R
Leiopython albertisii	White-lipped (D'Albertis) Python		R
Morelia amethistina	Amethystine Python		R
Morelia viridis	Northern Emerald Python		R

[1] Conservation status under the IUCN Red List (IUCN) and PNG Fauna Act (PNG): EN = Endangered; VU = Vulnerable; NT = Near Threatened; P = protected; R = restricted.

With the exception of the species also listed under the IUCN Red List, which have been discussed in the previous section, all these species occupy wide ranges across PNG and none of these species is of particular conservation concern. These latter species appear to be listed as Protected or Restricted due to them being at risk of trade.

5.5.3 New or undescribed species

Mammals

Two of the mammal species trapped and identified by Dr Ken Aplin during the 2012 survey currently lack scientific names – a tube-nosed bat of the genus *Nyctimene*, and a blossom bat of the genus *Macroglossus*. The description and discussion of these species presented below is reproduced from Woxvold and Aplin (2013). Both are known to occur widely in PNG and to be locally common at other localities.

The tube-nosed bat belongs to a complex assemblage of small-bodied species that are currently lumped under the name *Nyctimene albiventer* (e.g. Bonaccorso 1998). Two different representatives of this group were captured in each of the Buvu-Nabonga and Watut Plains areas. The less abundant of these taxa is referred to as *N. papuensis* (sometimes treated as a subspecies of *N. albiventer*; however, true *N. albiventer* appears to be restricted to the Moluccan islands of Indonesia). The other, more abundant taxon is un-named but has a wide distribution that includes hill forest habitats along both the north and south side of the Central Range of PNG. This second taxon is herein listed as *Nyctimene* sp. A (Woxvold and Aplin 2013, **Photo 5.4**).

Macroglossus specimens collected during the 2012 survey are clearly referrable to two different species – one larger-bodied and with a long snout and large ears; the other smaller-bodied with a shorter snout and smaller ears. Only one form of *Macroglossus* (*M. m. nanus*) is currently recognised on the main island of New Guinea (Banaccorso 1998; IUCN 2012). However, the existence of 'long-faced' and 'short-faced' forms has been noted in prior collections from eastern PNG (Aplin unpublished; K. Helgen, US National Museum, personal communication with K. Aplin). The taxonomic work needed to establish the identity of the two species has not been completed and, for present purposes, they are listed as *Macroglossus* sp. A and *Macroglossus* sp. B (Woxvold and Aplin 2013).

Birds

Woxvold and Aplin (2013) noted that on 23 May 2012 two scrubwrens (*Sericornis* sp.) of uncertain affinity were observed on sloping terrain in hill forest in the Buvu Creek headwaters (at 6.835055°S 146.446833°E). The birds were observed on two occasions with the aid of binoculars over a five minute period while they foraged in lower-storey, dense and well-shaded sapling canopies and vine tangles at heights of *c.* 2–4m above the ground. Woxvold and Aplin (2013) further noted that "*views were sufficient to clearly identify the birds as scrubwrens, to note well the major plumage features, and to give the immediate impression of a Sericornis unlike any known from mainland PNG*. *One or both of the birds gave regular, genus-typical contact calls, though no song was heard that might be taken as a more helpful diagnostic feature*". Woxvold and Aplin (2013) report that the birds they observed "*do not conform to any of the known forms of these [other PNG scrubwren] species, being clearly distinguishable from each by facial pattern and/or upperparts colouration, as each of these species normally has a much larger area of buff patterning that covers most or all of the facial area. In particular, the Buvu headwaters birds showed a very different facial plumage pattern, one most strongly recalling that of the Vogelkop Scrubwren (S. rufescens), which is known only from the Vogelkop Mountains of far west Papua (Indonesia) at elevations above 1,300m ASL*".

A diagnostic feature of Vogelkop Scrubwren is a *pronounced buff eye-ring* (Pratt and Beehler 2015). Woxvold and Aplin (2013) made no mention of the bill colour or throat colour/pattern of the birds they observed; however, Dr Iain Woxvold has subsequently confirmed that the birds he observed both had dark bills but that the view of throat markings was inconclusive (Dr Iain Woxvold, personal communication). Following a discussion as to the possible identity of the scrubwrens observed in the upper Buvu, Woxvold and Aplin (2013) concluded "*In the absence of additional data regarding the identity, status and distribution of these birds, the area of Hill Forest in the upper Buvu catchment … should conservatively be considered the only area known to support a possible new bird species*".

New Guinea has nine currently recognised *Sericornis* scrubwren species (six of which occur in eastern PNG) that can be characterised into two series of species that differ in foraging mode, the members of each of which occupy different altitudinal ranges (IOC 2015, Pratt and Beehler 2015). The first series of larger branch-foragers comprises one species that occurs in eastern PNG, namely Large Scrubwren (*S. nouhuysi*), which occurs in montane and cloud forest within the altitudinal range of 1,200 to 3,750 m (Pratt and Beehler 2015). The second series of leaf-gleaning species comprises three species that occur in eastern PNG: Pale-billed Scrubwren (*S. spilodera*) that occurs at lower elevations (200-1,200 m) in hill forest, ranging locally to lowlands; Buff-faced Scrubwren (*S. perspicillatus*) that occupies montane forest at elevations of 850 to 2,800 m (but mostly 1,700-2,600 m); and Grey-Green Scrubwren (*S. arfakianus*) that occupies a rather narrow elevation range (1,100-1,700 m, occasionally to 700m) and fits between the ranges of Pale-billed and Grey-Green scrubwrens (Pratt and Beehler 2015). The study area occupies hill forest and adjoining lowland alluvial forest within an elevational range of approximately 50 to 500 m ASL. Within this altitudinal range, only Pale-billed Scrubwren is expected to occur (cf. Pratt and Beehler 2015).

Pale-billed Scrubwren is distinguished from other scrubwrens by having a *pale bill* (a diagnostic feature as all other New Guinea scrubwren species have a dark bill) and a *pale throat with black spots* that contrasts with the rather dark, greenish plumage (Pratt and Beehler 2015). It should also be noted that Pratt and Beehler (2015) make no mention of a buff facial pattern being a

characteristic feature of Pale-billed Scrubwren. Pale-billed Scrubwren exhibits regional variation in plumage appearance, particularly in the colour of the crown, darkness of overall plumage and presence/absence of throat spotting, with five subspecies recognised; the subspecies that occurs on the south-eastern peninsula of Papua New Guinea (including the Wafi region), namely *S. s. guttifera*, is distinguished by having a greenish crown (Pratt and Beehler 2015).

No scrubwrens were seen during the first two weeks of the general fauna survey, but a scrubwren was heard singing on one occasion in hill forest at an elevation of 226 m in the Watut Declines Portal Terrace area. The song of this bird matched a recorded sequence of song of Pale-billed Scrubwren downloaded from Xeno-canto (http://www.xeno-canto.org/122101) that was played in the field directly after the scrubwren was heard calling. On the first day of the targeted scrubwren survey in 2015, the location of the Woxvold and Aplin (2013) scrubwren observation in the upper Buvu Creek catchment was visited on foot. Within the first hour, two scrubwrens were observed foraging in lower-storey vegetation along a creek 100 m from the original Woxvold and Aplin (2013) scrubwren observation; good views were obtained to confirm that both birds had pale bills and spotted throats, characteristic of Pale-billed Scrubwren. Mist-nets were set in the area early the next morning and soon captured a single scrubwren close to the earlier sighting, in hill forest at an elevation of 456 m in the upper Buvu Creek catchment. This individual matched the following features of Pale-billed Scrubwren *S. s. guttifera*: (1) pale bill; (2) pale throat with dark spotting; and (3) overall dark greenish plumage with dark greenish crown (**Photos 5.16** and **5.17**). The bird lacked the buff colouring around the facial area that birds in some populations of Pale-billed Scrubwren exhibit. Another single scrubwren was observed the following day a little further upslope of the creek; it too had a pale bill and spotted throat. No further scrubwrens were seen, heard or mist-netted despite the extensive mist-netting effort both in the upper Buvu Creek catchment and the vicinity of the Watut Declines Portal Terrace area.

Photo 5.16. Pale-billed Scrubwren (*Sericornis spiloda guttifera*) captured in the upper Buvu Creek catchment.

Photo 5.17. Pale-billed Scrubwren showing diagnostic pale bill and strong spotting on the throat.

To summarise, the available evidence supports the presence of only one scrubwren species, namely Pale-billed Scrubwren, within the study area. The dark-billed scrubwrens observed by Dr Iain Woxvold in 2012 at the highest elevation surveyed within the study area may represent a second, unidentified species of scrubwren. However, the single observation of dark-billed birds in 2012 at a site where only Pale-billed Scubwren was confirmed in 2015, suggests dark-billed birds must occupy higher elevations within the broader study area, rarely moving to lower elevations. The higher elevation areas potentially occupied by an unconfirmed, unidentified species of scrubwren occur outside of the proposed Project footprint.

Herpetofauna

New herpetofauna species for New Guinea are being regularly discovered or described, particularly frog species in isolated, high elevation mountain ranges (e.g. Günther and Richards

2011, Günther *et al.* 2012, Rittmeyer *et al*. 2012, Kraus 2013a, 2013b). However, few hereptofauna species of uncertain taxonomy were documented during the various surveys of the study area.

The large ranid frog *Rana* cf *grisea* recorded in the 2012 survey is part of a taxonomically difficult species-complex that is widespread across New Guinea (Woxvold and Aplin 2012). Woxvold and Aplin (2012) noted that the species-boundaries and hence geographic boundaries of members of this group remain to be clarified but that it is highly unlikely that the population is restricted to the study area. The microhylid frog *Mantophryne* sp. (**Photo 5.18**) was commonly encountered during the 2012 survey, and while it is an undescribed species, Woxvold and Aplin (2012) reported that it is known to occur widely across the lowlands of northern Papua New Guinea. Similarly, Woxvold and Aplin (2012) reported that the taxonomic status of the *Cophixalus* species (**Photo 5.19**) recorded during the 2012 survey is unclear, and that additional material with call data would be required to clarify the taxonomic status of the species.

Photo 5.18. *Mantophryne* sp. (*lateralis* complex), an undescribed frog species that occurs in the study area (Photo: K. Aplin in Woxvold and Aplin (2013)).

Photo 5.19. *Cophixalus* sp., a frog species of uncertain taxonomic status that occurs in the study area (Photo: K. Aplin in Woxvold and Aplin (2013)).

5.5.4 Other notable species

Photo 5.20. An immature Papuan Hawk Owl (*Uroglaux dimorpha*) photographed in hill forest in the study area.

Papuan Hawk Owl was heard calling at night in hill forest in the upper Buvu Creek catchment in 2012 (Woxvold and Aplin 2013), and an immature bird was spotlighted and photographed in hill forest west of Bavaga in 2015 (**Photo 5.20**, and see **Figure 5.5** for locations). Papuan Hawk Owl is sparsely distributed across a wide range in New Guinea in lowland rainforest and gallery forest in savannah, occasionally up to 1,500m elevation (BirdLife International 2017h). While this species appears to be very scarce or rare and its population is suspected to be slowly declining owing to ongoing habitat destruction, it is listed as least concern under the IUCN Red List (BirdLife International 2017h).

5.6 EXOTIC FAUNA SPECIES

Six exotic (i.e. introduced) fauna species have been recorded within the study area, including four mammals, Water Buffalo (*Bubalus bubalis*), Feral Pig (*Sus scrofa*), Feral Cat (*Felis catus*) and Polynesian Rat (*Rattus exulans*), one reptile, Common House Gecko (*Hemidactylus frenatus*) that is restricted to human settlements, and one amphibian, Cane Toad (*Bufo marinus*), that is widely distributed but more common in disturbed areas. While Feral Pig has potential to damage rainforest habitats when it occurs at high density (e.g. Mitchell *et al.* 2008, Taylor *et al.* 2011), local population density is constrained by the heavy hunting pressure that targets this species.

5.7 IMPORTANT FAUNA HABITAT AREAS

The height and floristic and structural complexity of both alluvial and hill forest provides for a wide variety of ecological niches for fauna. These two general lowland rainforest types therefore support an equally rich diversity of terrestrial fauna species across the study area. While large areas of this rainforest remain relatively undisturbed in a structural sense, more accessible areas that are closer to access roads and village settlements experience greater hunting pressure that has resulted in the local loss of highly prized species that are sensitive to hunting pressure. While certain of these species have largely disappeared from the study area, such as Goodfellow's Tree Kangaroo, New Guinea Pademelon and Eastern Long-beaked Echidna, the Dwarf Cassowary still persists in remoter areas of intact primary rainforest that experience lower hunting pressure, particularly within and adjoining the Markham Gap Basin.

The Markham Gap Basin is an area of especially high terrestrial biodiversity value within the study area. This area supports a complex mosaic of intact and little disturbed rainforest and swampy habitats that show a high degree of connectivity, a combination that is considered to be unique within the local region (Booyong Forest Science 2011b, Woxvold 2012). Rainforest in the Markham Gap Basin includes a large patch of Large to Medium Crowned Forest (PL). The persistence of Dwarf Cassowary at a moderate density in the Markham Gap Basin provides evidence that the area is relatively remote and experiences reduced hunting pressure compared with the remainder of the study area. All the threatened and near-threatened terrestrial fauna species that are known to occur in the study area are known or are likely to occur within or adjoining the Markham Gap Basin. The complex mosaic of Sago Palm swamps and adjoining rainforest habitats within the Markham Gap Basin also provides particularly suitable habitat for Blue-Black Kingfisher, a Near Threatened species that is unusually rare in PNG.

5.8 CRITICAL FAUNA HABITATS

No terrestrial vertebrate species listed as Critically Endangered or Endangered under the IUCN Red List are considered likely to occur in the study area. Furthermore, there are no sites supporting globally significant concentrations of migratory species and/or congregatory species (e.g. cave-dwelling bats) within the study area. While the Blue-Black Kingfisher and Papuan Hawk Owl are two notable rare species, neither species is endemic to PNG nor occupies a restricted range, with both being widely but patchily distributed through New Guinea. Due to the rarity of the species in the study area, the study area is highly unlikely to support greater than 100 individuals of Blue-Black Kingfisher, the threshold for recognition of the habitat as critical habitat for an endemic or restricted-range species, noting that the global population is precuationarily estimated to number less than 10,000 mature individuals (BirdLife International 2017g). Consequently, no critical fauna habitat, as defined by the IFC Performance Standard 6 guideline, is assessed as occurring within the study area.

6.0 PROTECTED AND SPECIAL PURPOSE AREAS

Papua New Guinea currently has three areas that are formally protected as national parks, namely: 1) Lake Kutubu; 2) Varirata National Park; and 3) McAdam National Park. Only McAdam National Park is located in Morobe Province, situated at least 40 km from the study area in the upper reaches of the Watut River catchment system. As the Project is unlikely to impact on any national park, no specific aspects of the *National Parks Act 1982 a*nd National Parks Regulation 1984 will be triggered by the Project.

Two Conservation Areas are located in Morobe Province: Labu Tali Conservation Area; and Yus Conservation Area. The Labu Tali Turtle Conservation Area is located along several kilometres of sandy beach immediately south of the Markham River mouth and protects the nesting sites of Leatherback Turtle that visit between late November and early February to lay eggs. Yus Conservation Area is located on the Huon Peninsula, outside the zone of influence of the Project. As the Project is unlikely to impact on any conservation area, no specific aspects of the *Conservation Areas Act 1978* will be triggered by the Project.

The only Wildlife Management Area in Morobe Province is the Kamiali Wildlife Management Area located in the Salamaua District (at 07º 23' 24'' S; 147° 09' 39'' E), about 80 km south along the coast from the city of Lae. The Project will not impact on any Wildlife Management Area and will therefore not trigger aspects of the *Fauna (Protection and Control) Act 1966* specific to Wildlife Management Areas.

Papua New Guinea's two wetlands listed under the Ramsar Convention, Lake Kutubu in the Southern Highlands, and Tonda Wildlife Management Area in Western Province, are both remote from the study area. The Project will therefore have no implications for PNG's commitments under the Ramsar Convention.

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APPENDIX A

Terrestrial flora field site data

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
WG1	24/03/2015	-6.79898	146.43346	113m	Finchif	Alluvial	Secondary regrowth (8-12 m) along disturbed road margins adjacent to primary lowland forest.	Canopy: *Alstonia scholaris, Anthocephalus chinensis, Melanolepis multiglandulosa, Pometia pinnata, Terminalia* sp., *Trema* sp., *Muntingia calabura**. Understorey: *Musa* sp., *Papaya cairica*, Macaranga* sp., *Pipturus argenteus, Ludwigia octovalvis, Piper adunctum*, Merremia peltata*. Groundcover: *Passiflora foetida*, Echinochloa colona*, Synedrella nodiflora*, Eleusine indica*, Solanum americanum*, Mimosa pudica*, Euphorbia hirta*, Mikania microcephala*, Crassipetalum crepidoides*, Coleus argentea*, Cordyline terminalis, Dactyloctineum aegyptum*, Conyza* sp.*	5a
WG2	25/03/2015	-6.8394	146.4366	305m	Portal	Steep ridge slopes	Medium Crowned Forest on steep foothills dominated by *Hopea iriana* with subdominant *Intsia bijuga*. Canopy 35-35 m, Subcanopy 21-26 m, Mid-storey 6-12 m, Understorey 1-5 m, Groundcover 0-1 m.	Canopy: *Hopea iriana* (d), *Intsia bijuga* (sd), *Ficus* sp. (a), *Syzygium* sp. (a). Subcanopy: *Hopea iriana, Intsia bijuga, Myristica fatua, Maniltoa psilogyne, Semecarpus* sp., *Anisoptera thurifeMara, Cerbera floribunda, Celtis latifolia, Pometia pinnata*. Midstorey: *M. fatua, P. macgregorii, G. gnemon, P. amboinicum, Ixora klanderiana, Anthocephalus chinensis, Calamus* sp., *P. pinnata, Sterculia schumanniana, Mangifera minor, Myristica* sp. (DGF WG14). Understorey: *Archidendron glabrum, G. gnemon, P. amboinicum, Pandanus* sp., *Pothos helwigii, Tetracera nordtiana, Alyxia* sp., *Ptychosperma* sp., *Aglaia* sp. (DGF WG13). Groundcover: *Dianella ensifolia, Pollia macrophylla, Desmodium ormocarpoides*, fern (DGF WG10), *Amyema* sp. (DGF WG18).	5
WG3	25/03/2015	-6.84016	146.43718	217m	Portal	Steep ridge slopes	Medium Crowned Forest on steep foothills dominated by *Hopea iriana* with subdominant *Intsia bijuga*. Canopy 35-45 m, Subcanopy 21-26 m, Mid-storey 6-12 m, Understorey 1-5 m, Groundcover 0-1 m.	Canopy: *Hopea iriana* (d), *Intsia bijuga* (sd), *Ficus* sp. (a), *Syzygium* sp. (a). Subcanopy: *Hopea iriana, Intsia bijuga, Myristica fatua, Melicope* sp. (DGF WG20), *Celtis latifolia, Pometia pinnata*. Midstorey: *M. fatua, P. macgregorii, G. gnemon, P. amboinicum, Ixora klanderiana, Anthocephalus chinensis, Calamus* sp., *P. pinnata, Sterculia*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								schumanniana. Understorey: *Archidendron glabrum, Alstonia scholaris, Calycanthus magnusianus, G. gnemon, P. amboinicum, Neololeba atra, Cordyline congesta, Leea novoguineensis, Harpullia ramiflora, Caryota rumphii, Pandanus* sp., *Pothos helwigii, Aglaia* sp. (DGF WG21). Groundcover: *Dianella ensifolia, Pollia macrophylla, Meremmia peltata*.	
WG4	25/03/2015	-6.83927	146.429031	215m	Portal	Steep ridge slopes	Medium Crowned Forest on steep foothills dominated by *Hopea iriana* with codominant *Pometia pinnata* and *Intsia bijuga*, and assocaited *Vitex quinata*. Canopy 30-40 m, Subcanopy 15-25 m, Mid-storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m.	Canopy: *Hopea iriana* (d), *Intsia bijuga* (cd), *Pometia pinnata* (cd), *Syzygium* sp. (a), *Anisoptera thurifera* (a). Subcanopy: *P. pinnata, Ficus* sp 1., *Ficus* sp. 2, *Gnetum gnemon, Pimelodrendron amboinicum, H. iriana, Melanolepis multiglandulosa, I. bijuga, Protium macgregorii, Myritica fatua, Maniltoa* sp., *Horsefieldia subtilis*. Midstorey: *M. fatua, P. macgregorii, G. gnemon, P. amboinicum, Calamus* sp., *P. pinnata, Sterculia schumanniana*. Understorey: *Buchanania* sp., *P. pinnata, Ptychosperma* sp., *Pandanus* sp., *Ficus* sp., *P. macgregorii, Cordyline terminalis, Ardisia* sp., *Psychotria* sp., *Atractocarpus* sp., *Syzygium* sp., *Flagellaria indica, Orania* sp., *Arenga microcarpa, Dioscorea transversa, Pothis hellwigii, Alstonia scholaris, Polyscias* sp., *Leea novoguineensis, Mangifera minor*. Groundcover: *Alpina* sp., *Piper* sp., *Costus* sp., *Dianella ensifolia, Pollia macrophylla, Meremia peltata, Aneilema humile*.	5
WG5	25/03/2015	-7.2225	146.48125	94m	Waime River	Alluvial floodplain	Large Crowned Forest on seasonally flooded alluvium dominated by *Octomeles sumatrana, Pometia pinnata, Dracontomelon dao* and *Antiaris toxicarya*. Canopy 45-55 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 54 m^2/ha	Canopy: *Octomeles sumatrana* (d), *Dracontomelon dao* (sd), *Pometia pinnata* (sd), *Antiaris toxicarya* (a), *Melicope* sp. (a), *Vitex quinata* (a), *Manilkara* sp. (DGF WG40) (a), *Alstonia scholaris* (a), *Sterculia* sp. Subcanopy: *Syzygium* sp. (DGF WG41), *Kleinhovia hospita, Pimelodendron amboinicum, Gnetum gnemon, Pisonia umbellifera*. Understorey: *Aglaia sapindina, Aphanamixis polystachya,*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Semecarpus sp., *Arenga microcarpa, Osmoxylon* sp., *Aglaia* sp., *Gnetum gnemon, Myristica globosa, Calamus* sp., *Barringtonia* sp., *Harpullia ramiflora, K. hospita, Neololeba atra, Cordyline terminalis, Haplostichanthus longirostrus, Phaleria microcarpa, Syzygium* sp. (DGF WG45), *Strychnos minor, Cissus* sp., *Voacanga grandiflora, Dictyoneura obtusa, Licuala* sp., *Ficus* sp. 1, Fic*us wassa, Ficus* sp. 2. Groundcover: *Pneumatopteris sogerensis, Nephrolepis* sp., *Piper* sp., *Alocasia nicholsonii*. Ephiphytes: *Scindapsis* sp., *Epipremum* sp.	
WG6	25/03/2015	-6.71949	146.46239	97m	Waime River	Alluvial floodplain	Secondary forest on alluvial floodplain with *Pometia pinnata*.		
WG7	25/03/2015	-6.71912	146.48178	98m	Waime River	Alluvial floodplain	Large Crowned Forest on seasonally flooded alluvium dominated by *Octomeles sumatrana, Pometia pinnata, Dracontomelon dao*, and *Endospermum medullosum*. Canopy 45-55 m, Subcanopy 20-35 m, Mid-storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 60 m^2/ha.	Canopy: *Octomeles sumatrana* (d), *Dracontomelon dao* (sd), *Pometia pinnata* (sd), *Alstonia scholaris* (a), *Endospermum medullosum* (a), *Pterocarpus indicus* (a). Subcanopy: *P. pinnata, Pimelodendron amboinicum, Gnetum gnemon, Ficus* sp., *Pisonia umbellifera, Aglaia* sp., *Tristriopsis acutangula, Myristica* sp. Midstorey: *Aphanamixis polystachya, Ficus* sp., *P. pinnata, Dysoxylum* sp. (DGF WG50), *Ficus tinctoria, Chisocheton ceramicus, Alectryon ferrugineum, Chrysophyllum roxburgii, Caryota rumphii, Carallia brachiata, Tristriopsis acutangula*. Understorey: *Aphanamixis polystachya, Semecarpus* sp., *Arenga microcarpa, Osmoxylon* sp., *Aglaia* sp., *Gnetum gnemon, Myristica* sp., *K. hospita, Neololeba atra, Faradraya splendida, Cordyline terminalis, Haplostichanthus longirostrus, Phaleria microcarpa, Strychnos minor, Dictyoneura obtusa, Licuala* sp., *Ficus wassa*. Groundcover: *Hoya sannae, Dioscorea* sp., *Nephrolepis* sp., *Alocasia nicholsonii*. Ephiphytes: *Scindapsis* sp., *Epipremum* sp.	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
WG8	25/03/2015	-6.71912	146.48178	80m	Waime River	Oxbow lakes, alluvial floodplain	Tall grassland and Swamp Forest on margins of oxbow freahwater lakes with *Phragmites karka* with *Stenochleana palustris*.	*Phragmites karka, Stenochleana palustris, Scleria* sp., *Myriophyllum* sp. (DGF WG57), Cyperaceae (DGF WG58)	8
WG9	25/03/2015	-6.6878	146.5138	76m	Waime River	Alluvial floodplain	Outer margin of primary Large Crowned Forest on alluvial floodplain.	Canopy: *Pometia pinnata, Alstonia scholaris, Pterocarpus indica, Octomeles sumatrana, Intsia bijuga, Bombax ceiba, Palaquim galactoxylon, Tristriopsis canarioides, Celtis latifolia*. Subcanopy: *Carallia brachiata, Hydriastele costata, Polyalthia oblongifolia*. Understorey: *Licuala* sp., *Mangifera minor, Arenga microcarpa, Archidendron* sp. (DGF WG59), *Gnetum latifolium, Diospyros* cf. *hebecarpa, Kibara* sp., *Flagellaria indica*.	4
WG10	25/03/2015	-6.69265	146.51318	80m	Waime River	Alluvial floodplain	Large Crowned Forest on seasonally flooded alluvium dominated by *Pometia pinnata*, with *Celtis latifolia* and *Octomeles sumatrana*. Canopy 35-50 m, Subcanopy 15-25 m, Mid storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m. Basal Area 35 m^2/ha.	Canopy: *Pometia pinnata* (d), *Celtis latifolia* (a), *Dysoxylum* sp. (a), *Myristica* sp. 1 (a), *Myristica* sp. 2 (a), *Pterocarpus indicus* (a), *Endospermum medullosum* (a), *Tristiropsis acutangula* (a). Subcanopy: *P. pinnata, Dysoxylum* sp., *Pouteria* sp., *Myristica* sp. 1, *Carypta rumphii, Ficus* sp.1, *Ficus* sp. 2, *Calamus* sp., *Intsia bijuga, Aglaia* sp. (DGF WG63), *Pimelodendrum amboinicum, Canarium* sp., *T. acutangula*. Mid and Understorey: *P. pinnata, Myristica* spp., *Pisonia umbellifera, G. gnemon, Miliusa* sp., *Rhyticaryum longifolium, Calamus* sp., *Clematis* sp., *Smilax* sp., *Faradraya splendida, P. amboinicum, Maniltoa psilogyne, Ficus* sp. 3, *Ficus* sp. 4, *Canthium* sp. (DGF WG38), *Polyalthia oblongifolia, Atractocarpus* sp., *Syzygium* sp., *Arenga microcarpa, Cordyline terminalis, Pandanus* sp., *Tetrastigma* sp. Groundcover: *Alocasia nicholsonii, Alpinia* sp., *Epipremum* sp.	4
WG11	25/03/2015	-6.6927	146.51418	87m	Waime River	Oxbow lakes, alluvial	Swamp Forest of *Pandanus* spp., *Metroxylon sagu, Stenochleana palustris* and *Phragmites karka*.	Canopy: *Pandanus* sp., *Metroxylon sagu, Hibiscus tiliaceus, Dolichandrone spathaceus, Cerbera floribunda*. Groundcover: *Stenochleana*	8

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
						floodplain		*palustris, Phragmites karka, Scleria* sp.	
WG12	28/03/2015	-6.8352	146.428	229m	Portal	Steep foothill slopes	Medium Crowned Forest on steep foothills dominated by *Pometia pinnata* and *Intsia bijuga*. Canopy 25-35 m, Subcanopy 15-25 m, Mid storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m.	Regrowth on margins of exploration track of *Trema orientalis, Garuga floribunda, Commersonia bartramia, Melicope* sp., *Homolanthus novoguineensis, Mallotus* sp., *Macaranga* sp. Groundcover of *Cyperus* sp., *Scleria* spp., *Juncus* sp., *Echinochloa colona, Coleus argentea*, Meremmia peltata, Sida* sp., *Crassipetalum crepidoides*, Cayratia* sp., *Phyllanthus* sp., *Ludwigia octovalvis, Eleusine indica**, and *Euphorbia hirta**.	5a
WG13	28/03/2015	-6.83524	146.42967	212m	Portal	Steep foothill slopes	Medium Crowned Forest on foothills dissected by steep gullies dominated by *Protium macgregorii* with codominant *Pometia pinnata, Celtis latifolia, Elaeocarpus* sp., *Ficus* sp., and *Maniltoa psilogyne*. Emergents 30-40 m, Canopy 17-25 m, Subcanopy 12-17 m, Mid storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m. Basal Area 25 m^2/ha.	Emergents: *Ficus* sp. Canopy: *Protium macgregorii* (d), *Celtis latifolia* (cd), *Pometia pinnata* (a), *Maniltoa psilogyne* (a), *Elaeocarpus* sp. (DGF WG80)(a), *Syzygium butettnerianum* (a), *Garuga floribunda* (a). Subcanopy: *P. macgregorii, P. pinnata, Canarium* sp., *Semecarpus* sp., *Alstonia brassii, Gnetum gnemon, Melicope* sp., *Firmiana papuana, Aglaia* sp., *Vitex coffasus*. Midstorey: *P. macgregorii, C. latifolia, Semecarpus* sp., *Maniltoa* sp., *A. brassii, Syzygium* sp., *Casearia clutiifolia, Ixora* sp. (DGF WG78), *Mangifera minor, Pimelodendrum amboinicum*. Understorey: *Cycas scratchlyeana, Osmoxylon novoguineensis, Ptychosperma* sp., *Antiaris toxicarya, Cordyline terminalis, Syzygium* sp., *Sterculia shillinglawiii, Flagellaria indica, Pandanus* sp., *Trophis scandens, Donax canniformis, Arenga microcarpa, Harpullia ramiflora, Caryota rumphiana, Myristica* sp., *Polyalthia* sp., *Derris* sp., *Asplenium nidus, Platycerium* sp., *Ficus* sp., *Mangifera minor, Psychotria* sp., *Claoxylon* sp., *Gnetum gnemon, Pavetta* sp., *Ichnocarpus* sp., *Micromelum minutum, Diospyros* sp., *Polyscias* sp., *Jasminum* sp., *Mischocarpus* sp., *Garcinia latissima*, *Cordia dichotoma*. Groundcover: *Donax canniformis,*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Piper sp., *Dianella ensifolia, Alocasia nicholsonii, Oplismenus* sp., *Aneilema humile, Alpinia* sp., *Scleria polycarpa*.	
WG14	28/03/2015	-6.8368	146.4277	242m	Portal	Steep ridge slopes	Medium Crowned Forest on steep foothills dominated by *Intsia bijuga*, and *Protium macgregorii* with associated *Campnosperma brevipetiolatum*. Canopy 18-26 m, Subcanopy 10-15 m, Mid storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m.	Canopy: *Intsia bijuga* (d), *Protium macgregorii* (sd), *Campnosperma brevipetiolatum* (a), *Aglaia* sp. (a), *Melicope* sp. (a), *Gmelina moluccana* (a). Subcanopy: *I. bijuga* (d), *Pandanus* sp., *Maniltoa* sp., *Commersonia bartramia, Syzygium buttnerianum*, Rubiaceae sp., *Cerbera floribunda*, *P. pinnata, Gnetum gnemon, Alstonia brassii, Melicope* sp. Mid/Understorey: *Alyxia* sp., *Cordyline terminalis, Ardisia* sp., *Ficus* sp. 1, *Lygodium* sp. (DGF WG96), *Psychotria* sp., *Pandanus* sp., *P. pinnata, Flagellaria indica, Leea novoguineensis, Pavetta* sp., *Smilax* sp. *Epipremum* sp., *Xanthomyrtus* sp., *Pimelodendrum amboinicum, Merremia peltata, Ficus* sp. 2, *Alectryon ferrugineum, Alstonia brassii, Strychnos minor, Tetracera nordtiana, Cycas scratchlyeana, Ixora* sp., *Mischocarpus* sp., *Breynia cernua, Ficus* sp. 3, *Glochidion* sp., *Cupaniopsis* sp., *Diospyros* sp. (DGF WG92), *Arenga microcarpa, Decaspermum* sp. (DGF WG93), *Cissus* sp. (DGF WG95). Groundcover: *Dianella ensifolia, Scleria* sp. (DGF WG99), *Oplismenus* sp., *Alpinia* sp. 1, *Alpinia* sp. 2, *Amorphophallus paeoniifolius, Nephrolepis bisserata*, Fern 1, Fern 2, Fern 3.	5
WG15	28/03/2015	-6.8362	146.4303	215m	Portal	Steep ridge slopes	Medium Crowned Forest on steep foothills dominated by *Protium macgregorii* with codominant Po*metia pinnata, Celtis latifolia*, and *Syzygium* sp. Canopy 20-30 m, Subcanopy 12-17 m, Mid storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m. Basal Area 23 m^2/ha.	Canopy: *Protium macgregorii* (d), *Pometia pinnata* (cd), *Celtis latifolia* (a), *Ficus* sp. (a), *Syzygium* sp. (a), *Pimelodendrum amboinicum* (a), *Polyalthia oblongifolia* (a), *Terminalia* sp. (a), *Garuga floribunda* (a). Subcanopy: *Melicope* sp., *Gnetum gnemon, Myristica* sp., Ho*malium foetidum, P. pinnata, C. latifolia, P. amboinicum, Mischocarpus* sp. (DGF WG103). Mid/Understorey: *Garcinia* sp. (DGF WG101), *Acalypha* cf. *grandis*, *Melicope*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								sp., *Calamus hollrungii, G. gnemon, Xanthomyrtus* sp., *Salacia* sp., *Homalium foetidum, Arenga microcarpa, Pandanus* sp., *P. pinnata, C. latifolia, Maniltoa psilogyne, P. amboinicum, Diospyros* sp. (DGF WG92), *Mangifera minor, Leea novoguineensis, Ploemele angustifolia, Epipremum* sp., *Mischocarpus* sp., *Jagera* sp., *Litsea* sp., *Ficus* sp. 1, *Ficus* sp. 2, *Ficus* sp. 3, *Ficus* sp. 4, *Myrsine* sp., *Alstonia brassii, Asplenium nidus*. Groundcover: *Piper* sp., *Donax canniformis, Costus* sp., *Cissus* sp., Fern 1, Fern 2, Fern 3.	
WG16	29/03/2015	-6.84001	146.432	240m	Portal	Steep foothills	Small to Medium Crowned Forest on steep foothills with *Hopea iriana, Protium macregorii, Canarium* sp., *Intsia bijuga, Trichosperma pleiostigma* and *Commersonia bartramia*. Canopy 20-35 m, Subcanopy 12-18 m, Mid storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m. Basal Area 26 m^2/ha.	Canopy: *Hopea iriana* (d), *Protium macgregorii* (d), *Pometia pinnata* (cd), *Canarium* sp. (sd), *Intsia bijuga* (a), *Maniltoa psilogyne* (a), *Commersonia bartramia* (a), *Trichosperma pleiostigma, Tarenna* sp. (DGF WG11). Subcanopy: *Traenna* sp., *C. bartramia, Hopea iriana, P. macgregorii, Canarium* sp., *Pometia pinnata, Myristica* sp., *I. bijuga, Sterculia shilinglawii, Ficus* sp. 3, *Maniltoa psilogyne, Melicope* sp. Midstorey: *H. iriana, P. macgregorii, P. pinnata, Calamus aurensis, Alstonia brassii, Gnetum latifolia, Myristica* sp., *Ficus* sp. 2, *I. bijuga, Celtis latifolia, Rhodomyrtus* sp., *S. shillinglawii, Epipremum* sp., *Ficus* sp. 3, *Ficus* sp. 4, *Maniltoa* sp., *Ixora* sp., *Pandanus* sp., *Polyscias* sp. Understorey: H. *iriana, P. macgregorii, Tarenna* sp. (DGFWG11), *Cordyline terminalis, Derris* sp., *Myrsine sp., Psychotria* sp., *P. pinnata, Ptychosperma* sp., *Pandanus* sp., *Cissus* sp. (DGF WG95), *A. brassii, G. latifolia, Ficus* sp. 1, *Diospyros* sp. (DGF WG92), *Garcinia* sp., *Myristica* sp., *Ficus* sp. 2, *Ficus* sp. 3, *Celtis latifolia, Horsefieldia* sp., L*eea novoguineensis, Guioa* sp., *Arenga microcarpa, Piper* sp., *Ficus* sp. 4, *Pothos hellwigii, Pandanus* sp., *Strychnos*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								minor, Arecaceae, *Ficus* sp. 5, *Ficus* sp. 6, *Tetrastigma* sp., *Mangifera minor*. Groundcover: *Dianella ensifolia, Alpinia* sp., *Alocasia nicholsoni, Caryota rumphii, Ficus* sp. 6, *Aneilema humile*, Fern 1, Fern 2.	
WG17	29/03/2015	-6.84001	146.432	240m	Portal	Narrow drainage line in foothills.	Medium Crowned Forest with *Pometia pinnata, Intsia bijuga Celtis latifolia*, and *Syzygium* sp. Canopy 20-30 m, Subcanopy 12-17 m, Mid-storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m.	Canopy: *Intsia bijuga, Pometia pinnata, Pterocarpus indicus, Celtis latifolia*. Subcanopy: *Syzygium longipes, Gnetum gnemon, Myristica* sp., *Litsea guppyi, Cryptocarya medicinalis, Pimelodendrum amboinicum*. Understorey: *Saurauia pungens, Ficus wassa, Mallotus peltatus, Leucosyke australis, Harpullia ramiflora, Ficus* sp., *Mangifera minor, Syzygium* sp. (DGF WG112). Groundcover: Fern (DGF WG109), *Piper* sp., *Alpinia* sp. 1, *Calamus aurensis, Canavalia* sp., *Meremmia peltata, Angiopteris evecta.*	5
WG18	29/03/2015	-6.834	146.4283	278m	Portal	Upper ridge slopes	Advanced secondary forest with *Protium macgregorii*, and *Commersonia bartramia*. Canopy 17-23 m.	Canopy: *Protium macgregorii, Ficus variegata, Commersonia bartramia, Pometia pinnata, Tristiropsis acutangula*. Mid/understorey: *Pandanus* sp., *Melicope* sp., *Litsea guppyi, Glyricidia sepium*, Cycas scratchlyeana, Rhodamnia* sp., *Canavalia* sp. (DGF WG 114), *Decaspermum fruticosum*.	5a
WG19	30/03/2015	-6.8458	146.8458	300m	Portal	Steep ridge crest	Smal to Medium Crowned Forest dominated by *Anisoptera thurifera* with *Hopea iriana*, and subcanopy of *Anthocephalus chinensis, Commersonia bartramia, Trichosperma pleiostigma* and *Artocarpus* sp. Canopy 30-40 m.	Canopy: *Anisoptera thurifera* (d), *Hopea iriana* (a), *Celtis latifolia* (a), *Protium macregorii* (a), *Intsia bijuga* (a), *Gmelina moluccana* (a), *Vitex quinata* (a). Subcanopy: *Anthocephalus chinensis, Commersonia bartramia, Trichoserma pleiostigma, Artocarpus* sp., *Myristica* sp., *Syzygium* sp., *C. latifolia, Tristiropsis acutangula, Maniltoa psilogyne, Ficus destruens, Sterculia schummaniana, Alectryon ferugineum*. Understorey: *Gnetum gnemon, Ficus* sp. 3, *Meremmia peltata, Costus* sp., *Coryline terminalis, Pandanus* sp., *Dioscorea* sp., *Ficus* sp. 2, *Tarenna* sp., *Arenaga microcarpa, Canarium*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								vitiense, Smilax sp., *Macaranga* sp., *Pandora pandorana, Cayratia* sp., *Pimelodendron amboinicum, Trema orientalis, Tetracera nordtiana, Commersonia bartramia, Ichnocarpus* sp., *Piper aduncum*, Polyscias murrayi, Pipturus argentea, Leucosyke australis, Faradraya splendida, Ixora* sp., *Chistocheton* sp.	
WG20	30/03/2015	-6.8404	146.4288	228m	Portal	Foothills	Medium Crowned Forest on foothills dominated by *Celtis latifolia, Maniltoa* sp., and *Anisoptera thurifera* with *Eucalyptopsis papuana*, and *Protium macgregori*. Canopy 17-25 m, Subcanopy 10-16 m. Basal Area 19 m^2/ha.	Canopy: *Celtis latifolia* (d), *Maniltoa* sp. (cd), *Protium macregorii* (sd), *Anisoptera thurifera* (sd), *Ficus* sp. (a), *Hopea iriana* (a), *Eucalyptopsis papuana* (a), *Microcos* sp. (a). Subcanopy: *Melanolepis multiglandulosa, Myristica* sp., *C. latifolia, Microcos* sp., *Gnetum gnemon, Pimeleidendron amboinicum, Garcinia dulcis, Haplolobus floribundus, Horsfieldia subtilis, Gmelina moluccana, Mangifera minor, Alectryon ferruginea, Polyalthia oblongifolia, Syzygium* sp., *Maniltoa psilogyne, Euroschinus papuana, Pometia pinnata*. Mid/Understorey: *Alstonia brassii, Ficus* sp. 1, *Ficus* sp. 2, *Ellatostachys* sp., *Lepidopetalum fructoglabrum, Psychotria* sp., *Arenga microcarpa, Cordyline terminalis, Haplostichamthus longiristrus, Caryota rumphiana, Meremmia peltata, Garcinia* sp., *Jasminum* sp., *Pavetta* sp., *Leea novoguineensis, Endospermum medullosum, Pouteria* sp., *P. pinnata, Litsea* sp. (DGF WG121), *Pothos* sp., *Salacia* sp., *Vitex quinata, Abrus precatorius, Tetracera nordtiana*. Groundcover: *Alpinia* sp. 1, *Alpinia* sp. 2, *Piper caninum, Asplenium nidus, Donax canniformisa, Alpinia* sp. 2.	5
WG21	30/03/2015	-6.8221	146.4267	216m	Finchif Kunai Hills	Foothills	Advanced successional forest in steep gullies dominated by *Intsia bijuga, Protium macgregorii* and *Rhus* sp.	Canopy: *Intsia bijuga* (d), *Protium macgregorii* (sd), Rhus sp. (sd), *Commersonia bartramia* (sd), Rubiaceae (a). Subcanopy: *Commersonia bartramia, Caryota rumphiana, Buchanania microcarpa, Gnetum latifolia, Arenga microcarpa, Glochidion* sp., *Trichosperma pleiostigma,*	5a

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Pimelodendrum amboinicum. Understorey: *Ixora* sp., *Cissus* sp., *Psychotria* sp., *Litsea guppyi, Leea novoguineensis, Guioa acutifolia, Xanthomyrtus* sp., *Macaranga involucrata*, *Smilax* sp., *Tarenna* sp., *Flagellaria indica, Pittosporum revolutum, Elaeocarpus* sp. , Calamus holrungii, Epipremum sp., Unknown (DGF WG126). Groundcover: *Nephrolepis bisserata, Dendrobium* sp.	
WG22	31/03/2015	-6.8225	146.4262	192m	Finchif Kunai Hills	Foothills	Tall grassland on steep rolling foothills dominated by *Polytocca macrophylla* and *Themeda triandra*.	*Polytocca macrophylla* (d), *Themeda triandra* (cd), *Eulalia trispicata* (sd), *Uraria* sp. (DGF WG126a), *Mukia* sp. (DGF WG127), *Fimbristylis* sp. (DGF WG129), *Crotalaria sessiliflora, Osbeckia chinensis, Euphorbia serrulata, Phyllanthus amarus, Fimbristylis littoralis, Scleria lithosperma, Polygala longifolia, Fimbristylis* sp., *Cyperus brevifolius, Mitrasacme pygmaea*, Poaceae (DGF WG141), *Sarga* sp. (DGF WG142), *Phyllanthus* sp. (DGF WG144), *Pycnospora lutescens, Polygala triflora, Evolvulus alsinoides*, Poaceae (DGF WG148), Fabaceae (DGF WG149), *Polygala chinensis*.	6a
WG23	31/03/2015	-6.8136	146.4222	101m	Finchif Kunai Plains	Alluvial Plains	Tall grassland (1.5 - 2.5 m) on alluvial plain dominated by *Polytocca macrophylla* with *Themeda triandra, Sarga* sp., and scattered emergent shrubs of *Antidesma ghaesambilla* and *Albizia procera*.	Emergents: *Albizia procera, Antidesma ghaesambilla, Leea novoguineensis*. Groundcover: *Polytocca macrophylla, Themeda triandra, Scleria* sp., *Sarga* sp., *Uraria* sp., *Phyllanthus* sp., *Phragmites karka, Crotalaria* sp., *Euphorbia serrulata, Fimbristylis* sp., *Abelmochus* sp., *Abroma* sp., *Costus* sp., *Puraria lobata, Apluda mutica, Lygodium reticulatum, Passiflora foetida**,	6b
WG24	31/03/2015	-6.79539	146.44011	141m	Finchif	Foothills	Medium Crowned Forest on foothills dominated *Intsia bijuga* with *Protium macgregorii, Endospermum* sp. and *Gmelina moluccana*.	Canopy: *Intisa bijuga* (d), *Endospermum medullosum* (a), *Gmelina moluccana* (a), *Protium macgregorii* (a), *Alstonia scholaris* (a). Subcanopy: *Intsia bijuga, Myristica buchneriana, Myristica globosa, Pometia pinnata, Semecarpus* sp., *Cerbera floribunda, Celtis latifolia, Tristriopsis*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								acutangula, Pimelodendrumamboinicum, Gnetum gnemon, Buchanania microcarpa, Rubiaceae, A. scholaris, Maniltoa sp., *Ficus nodosa, Melanolepis multiglandulosa, Caryota rumphiana, Cryptocarya medicinalis*. Mid/Understorey: *Gnetum latifolia, Myrsitica* sp., *Arenga microcarpa, Smilax* sp., *Myrsine* sp., *Celtis latifolia, T. acutangula, Pandora pandorana, P. pinnata, Cordyline terminalis, Piper caninum, Buchanania sp., Epipremum* sp., *P. magregorii, P. amboinicum, Ixora* sp., *Jasminum* sp., *Ficus* sp., *Leea novoguineensis, Calamus holrungii, Syzygium* sp., *Alyxia* sp., *A. scholaris, Sterculia schummaniana, Ficus sp*. 2, *Garcinia latissima, Tetracera* sp., *Psychotria* sp., *Mischocarpus* sp., *Flagellaria indica*. Groundcover: *Alpinia* sp. 1, *Drynaria* sp., *Dianella ensifolia, Amorphophallus paeonifolius, Aneilema humilis, Alocasia nicolsoni, Asplenium nidus, Platycerium* sp.	
WG25	31/03/2015	-6.7919	146.4873	101m	Finchif	Alluvial floodplain	Large Crowned Forest on alluvial floodplain, dominated by *Dracontomelon dao* and *Pometia pinnata*, with *Octomeles sumatrana, Celtis latifolia, Alstonia scholaris, Toona sureni* and *Pterocymbium beccarii*. Canopy 45-55 m, Subcanopy 25-35 m, Midstorey 10-18 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 33 m^2/ha.	Canopy: *Dracontomelon dao* (d), *Pometia pinnata* (cd),*Pterocymbium beccarii* (a), *Celtis latifolia* (a), *Intsia bijuga* (a), *Octomeles sumatrana* (a), *Ficus* sp. (a), *Casearia grewiifolia* (a), *Alstonia scholaris* (a), *Tristiropsis acutangula* (a), *Toona sureni* (a). Subcanopy: *I. bijuga, C. latifolia, O. sumatrana, Palaquim galactoxylon, Maniltoa* sp., *Pimelodendon amboinicum, Ficus* sp. 2, *Harpullia* sp., *Aglaia* sp., *P. pinnata, Dysoxylum arborescens, Tristiropsis acutangula, Semecarpus* sp. Midstorey: *P. pinnata, C. latifolia, Epipremum* sp., *Pytchosperma* sp., *Gnetum latifolia, D. arborescens, I. bijuga, T. acutangula, Caryota rumphiana, Syzygium* sp., *Maniltoa* sp., *Myristica bucheriana, Calamus holrungii, Jagera* sp., *Harpullia* sp., *Litsea guppyi, Semecarpus* sp. Understorey: *P. pinnata, Salacia* sp., *Piper* sp., *C. latifolia, Epipremum* sp., *Pandanus* sp.,	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Macaranga sp., *Flagellaria indica, Ptychosperma* sp., *Myrsine* sp., G. *latifolium, D. arborescens, I. bijuga, Arecaceae, T. acutangula, Haplostichanthus longirostrus, Pothos* sp., *Caryota rumphiana, P. galactoxylon, Leea novoguineensis, Arenga microcrapa, M. buchneriana, Calamus holrungii, Harpullia ramiflora, Myristica globosa, Meremia peltata, Litsea guppyi, Jasminum* sp., *Ixora* sp., *Semecarpus* sp., *Sterculia shillinglawii, P. amboinensis, Licuala* sp., *Ficus wassa*. Groundcover: *Corymborkis veratrifolia, Alpinia* sp., Fern 1, *Alocasia* sp.	
WG26	2/04/2015	-6.77373	146.4629	138m	Near Bavaga Village	Alluvial floodplain	Disturbed secondary regrowth on riverine margins and roadway.	*Piper aduncum** (d), *Muntingia cathartica*, Commersonia bartramia, Anthocephalus chinensis, Parasponia rugosa, Glochidion* sp., *Passiflora foetida, Ipomoea hederifolia*, Leucaena leucocephala, Sarga helapense*, Pipturus argenteus, Sida acuta*, Eleusine indica*, Echinochoa colona*, Clittoria ternatea*, Urena lobata*, Desmodium tortuosum*, Mimosa pudica*, Senna alata*, Aegeratum houstianum*, Phragmites karka, Cyperus difformis, Chromolaena odorata*, Neololebra atra, Ficus wassa, Coleus argentea, Ecliptera procera, Ludwigia octovalvis, L. hysoppifolia, Ipomoea quamoclit*, Calopoonium mucunoides*, Dactyloctineum aegyptum*, Euphorbia heterophylla*, Bambusa* sp., *Kleinhovia hospita, Pterocarpus indica, Solanum torvum*, Alternanthera pungens*, Pueraria lobata*, Setaria* sp.*, *Saccharum* sp., *Mikania microcephala*, Caryota rumphiana, Oplismenus hirtellus, Synedrella nodiflora*, Nephrolepis bisserata, Terminalia kaernbachii, Cocos nucifera*, Hyptis suaveolens*, Imperata cylindrica, Alpinia* sp., *Lepistemon urceolatus, Melochia corchorifolia,*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Melochia umbellata, Abroma angusta, Macaranga quadriglandulosa, Mangifera minor.	
WG27	2/04/2013	-6.7764	146.4614	147m	Near Bavaga Village	Steep foothills	Medium Crowned Forest on steep foothills dominated by *Pometia pinnata* and *Intsia bijuga*.	*Pometia pinnata, Intsia bijuga*.	5
WG28	2/04/2015	-6.77839	146.4606	255m	Near Bavaga Village	Steep foothill slopes	Advanced succesional forest of *Hopea iriana, Vitex cofassus,* and *Protium macgregorii.*	Canopy: *Hopea iriana, Vitex cofassus, Protium macgregorii, Sterculia schumanniana, Pterocymbium beccari, Tristiropsis acutangula, Ficus* sp., *Chrysophyllum roxburghii, Trichospermum pleiostigma, Mangifera minor, Firmiana papuana.*	5a
WG29	2/04/2015	-6.77969	146.46512	255m	Near Bavaga Village		Secondary regrowth and garden areas.		CO
WG30	2/04/2015	-6.76639	146.52139	126m	Waime River, road crossing	Alluvial floodplain	Disturbed secondary regrowth on riverine margins.	*Kleinhovia hospita, Bambusa* sp., *Glyricidia sepium, Meremmia peltata, Pterocarpus indicus, Dysoxylum gaudichaudianum, Rhus* sp., *Ficus* sp., *Octomeles sumatrana*.	CO
WG31	2/04/2015	-6.7807	146.47066	132m	Near Bavaga Village	Steep foothill slopes	Advanced secondary forest with *Trichospermum pleiostigma, Commersonia bartramia, Gnetum gnemon* and *Terminalia kaernbachii*.	Canopy: *Trichospermum pleiostigma, Commersonia bartramia, Gnetum gnemon, Terminalia kaernbachii, Dysoxylum gaudichaudianum, Harpullia ramiflora, Pterocarpus indicus, Litsea guppyi, Melanolepis multiglandulosa, Anisoptera thurifera*. Mid/Understorey: *Glochidion* sp., *Metroxylon sagu, Manihot esculenta**, *Musa* sp., *Piper aduncum**, *Syzygium* sp., *Carallia brachiata, Macranga* sp., *Mikania microcephala*.*	5a
WG32	2/04/2015	-6.777147	146.48064	130m	Near Bavaga Village		Disturbed secondary regrowth with scattered trees of *Octomeles sumatrana, Falcataria moluccana*, and *Anthocephalus caudatus*.	*Octomeles sumatrana, Falcataria moluccana, Anthocephalus caudatu, Intsia bijuga, Piper adunctum*, Hyptis capitata*, Sarga helapense*, Leucaena leucocephala, Solanum torvum*, Clittorea ternatea*, Mimosa diplotricha*.*	5a
WG33	3/04/2015	-6.79859	146.436754	104m	Finchif	Alluvial floodplain	Large Crowned Forest on alluvial floodplain of *Celtis latifolia, Octomeles sumatrana, Pterocymbium beccarii* and *Alstonia*	Canopy: *Celtis latifolia, Octomeles sumatrana, Pterocymbium beccarii, Alstonia scholaris, Polyalthia oblongifolia, Pouteria chartacea, Pimelodendron amboinicum, Pometia pinnata,*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
							scholaris. Canopy 45-55 m, Subcanopy 25-35 m, Midstorey 10-18 m, Understorey 2-10 m, Groundcover 0-2 m. Basal area 36 m^2/ha.	*Celtis philippinensis, Tristiropsis acutangula, Ficus* sp., *Miliusa* sp., *Microcos grandiflora, Pterocymbium beccarii, Vitex quinata, Antiaris toxicarya, Syzygium* sp., *Terminalia* sp. (DGF WG175), *Wrightia leavis, Dracontomelon dao, Cryptocarya* sp. Subcanopy: *Celtis latifolia, O. sumatrana, Mangifera minor, Garcinia dulcis, Myristica* sp., *Microcos grandiflora, Gerbera manghas, A. scholaris, Chrysophyllum roxburghii, Melanolepis multiglandulosa*. Midstorey: *Aranga microcarpa, T. acutangula, Rhapidophora* sp., *Epipremum* sp., *P. pinnata, Vites quinata, Maniltoa* sp., *Cryptocarya* sp., *Flagellaria indica, Syzygium* sp., *Dysoxylum* sp., *Litsea guppyi, Caryota rumphiana, Meremmia peltata, Gnetum gnemon, A. scholaris, Sterculia shillinglawii, Miliusa* sp., Ganophyllum falcata, M. multiglandulosa, Pandanus sp., *Elaeocarpus sphaericus, Gnetum latifolia*. Understorey: *A. microcarpa, Myrsine* sp., *T. acutangula, Smilax* sp., *Aglaia sapindina, P. pinnata, V. quinata, Mailtoa sp., Cryptocarya sp., F. indica, Pandanus* sp. 2, *Leea novoguineensis, Macaranga* sp., *Donax canniformis, Syzygium* sp. 2, *Dioscorea* sp., *Etlingera* sp., *Dysoxylum* sp., *Caryota rumphiana, Meremmia peltata*. Groundcover: *Etlingera* sp., Fern 1, Fern 2, Fern 3, *Oplismenus* sp., *Alocasia* sp., *Donax canniformis, Alpinia* sp.	
WG34	3/04/2015	-6.79364	146.43562	108m	Finchif	Swampy alluvial floodplain	Lowland Swamp Forest dominated by *Anthocephalus chinensis, Alstonia scholaris, Pterocarpus indicus,* and *Campnosperma brevipetiolatum* with *Metroxylon sagu*. Canopy 40-45 m.	Canopy: *Anthocephalus chinensis, Alstonia scholaris, Campnosperma brevipetiolatum, Palaquim* sp., *Pterocarpus indicus, Terminalia* sp., *Intsia bijuga*. Subcanopy: *Carallia brachiata, Hydriastele costata, Metroxylon sagu, Trema* sp., *Dysoxyloum gaudichaudianum, Platycerium* sp., *Dendrobium* spp., *Dischidia* sp., *Hupzeria* sp. (DGF WG176), *Asplenium nidus*.	7
WG35	3/04/2015	-6.76709	146.45183	100m	Finchif	Swampy	Lowland Swamp Forest dominated	Canopy: *Metroxylon sagu* (d), *Anthocephalus*	9

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
						alluvial floodplain	by *Metroxylon sagu* with *Anthocephalus chinensis, Terminalia* sp., *Pterocarpus indicus*, and *Dysoxylum gaudichaudianum*.	*chinensis, Terminalia* sp., *Pterocarpus indicus, Dysoxylum gaudichaudianum*. Subcanopy: *Metroxylon sagu* (d), *Stenocleana palustris, Ficus* sp., *Campnosperma brevipetiolatum, Inocarpus fagifer, Horsfieldia* sp. Understorey: *Metroxylon sagu, Stenocleana palustris, Derris* sp., *Ficus* sp., *Donax canniformis, Leucosyke australis, Musa* sp. (DGF WG177), Apocynaceae (DGF WG179), fern (DGF WG178).	
WG36	4/04/2015	-6.76324	146.45239	103m		Steep foothill slopes	Medium Crowned Forest on steep foothills with *Dysoxylum* sp., *Wrightia leavis, Celtis* sp., *Dracontomelon dao* and *Maniltoa* sp. Canopy 30-45 m, Subcanopy 15-25 m, Mid-storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m.	Canopy: *Dysoxylum* sp., Unknown tree 1, Unknown tree 2, *Wrightia laevis, Celtis* sp., *Dracontomelon dao, Aglaia* sp., *Ficus* sp., *Garuga floribunda, Dysoxylum* sp., *Maniltoa* sp. Subcanopy: *Garcinia dulcis, Aglaia* sp. (DGF WG189), *Siphonodon celastrineus, Ganophyllum falcatum, Harpullia ramiflora, Pometia pinnata, Calamus* sp., *Diospyros* sp. (DGF WG180), Myri*stica globosa, Garcinia latissima, Aglaia* sp. (DGF WG189), *Aglaia* sp. (DGF WG188). Midstorey: *Diospyros papuana, Myristica globosa, Psychotria* cf. *beccarii* var. *beccarii*, *Haplostichanthus longirostrus, Versteegia cauliflorus, Mangifera minor, Arenga microcarpa, H. ramiflora, Aglaia sapindina, Cryptocarya* sp., *Miliusa* sp., *P. pinnata, Gnetum latifolia, Tristiropsis acutangula, Ficus* sp., *Archidendron glabrum, Antiaris toxicarya*. Understorey: *Garcinia* sp. (WG DGF182), *Phaleria coccinea, Pittosprorum pulliflolium, Arenga microcarpa, Flagellaria indica, Capparis sepiaria, Salacia* sp., Claoxylon sp., *Leea novoguineensis, Mischocarpus* sp., *Alpinea* sp., *Caryota rumphiana, H. ramiflora, Haplostichanthus longirostrus, Miliusa* sp., *P. pinnata, Clematis* sp., *Piper caninum, Trophis scandens, Cordyline terminalis, Osmoxylon* sp., *Elaeocarpus* sp., *Archidendron glabrum, Strychnos minor,*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Chionanthus sp., *Syzygium* sp. (DGF WG186).	
WG37	4/04/2015	-6.76198	146.45241	100m		Swampy alluvial floodplain	Large Crowned Forest with emergent *Ficus* sp., and canopy dominated by *Elaeocarpus* sp., *Horsefieldia* sp., *Pterocarpus indicus* and *Intsia bijuga*. Basal Area 33 m^2/ha.	Emergents: *Ficus* sp. Canopy: *Elaeocarpus* sp., *Horsfieldia* sp., Rubiaceae, *Myristica globosa, Maniltoa psilogyne, Pterocarpus indicus, Alstonia scholaris, Buchanania microcarpa, Myristica* sp., *Polyalthia* sp., *Terminalia* sp., *Inocarpus fagifer, Dracontomelon dao, Anthocephalus chinensis, Endospermum* sp. Subcanopy: *Myristica globosa, Intsia bijuga, Inocarpus fagifer, Miliusa* sp., *Maniltoa* sp., *Scindapsis* sp., *Hoya* sp., *Pimelodendrum amboinicum, Cerbera manghas, Semecarpus* sp. Midstorey: *Psychotria* sp. (DGF WG53), *Myristica* sp., *Miliusa* sp., *Maniltoa* sp., *Aglaia* sp., *Psychotria* cf. *beccarii* var. *beccarii*, *Hydnophytum* sp., *Metroxylon sagu, Rhaphidophora* sp., *Gnetum latifolia, Livistona* sp., *Caryota rumphiana, Agalai* sp. 2, *Smilax* sp., P*. amboinicum, Micromelum minutum*. Understorey: *Garcinia latissima, Maclura cochichinesis, Tetracera nordtiana, Austrosteenisia* sp., *Faradraya splendida, Haplosticanthus longirostrus, Pothos* sp., *Livistona* sp., *Derris* sp., *Pandanus* sp., *Freycinetia* sp., *Calamus* sp., *Donax canniformis*. Groundcover: *Stenochleana palustris, Derris* sp., *Alpinia* sp., Fern 1, Fern 2, *Aneilema humilis*.	7
WG38	5/04/2015	-6.84495	146.44652	358m	Buvu Ck area	Steep foothill slopes	Medium Crowned Forest on steep foothills dominated by *Pometia pinnata, Pimelodendrum amboinicum*, and *Vitex cofassus*. Canopy 30-40 m, Subcanopy 15-25 m, Mid-storey 5-10 m, Understorey 1-5 m, Groundcover 0-1 m. Basal Area 33 m^2/ha.	Canopy: *Pometia pinnata, Pimelodendrum amboinicum, Vitex cofassus, Pterocarpus indicus, Myritica* sp., *Celtis latifolia*, *Anthocephalus chinensis, Spondias cynerea, Maniltoa psilogyne*. Subcanopy: *Pometia pinnata, Polyalthia* sp., *Canarium* sp., *P. amboinicum, Prunus* sp., *Ficus* sp., *Myristica* sp., *Dysoxylum* sp., *A. chinensis, M. psilogyne*. Midstorey: *Polyalthia* sp., *Canarium* sp., *Aglaia sexipetala, Aglaia* sp. (DGF WG189), *Gnetum gnemon, Buchanania arborescens, Syzygium* sp., *Flagellaria indica*, *Pandanus* sp.,	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Dysoxylum arborescens, *Schefflera* sp., *Mangifera minor, Meremmia peltata, Arytera* sp., *Maniltoa* sp., *Xanthomyrtus* sp., *Melicope denhamii, Memecylon hepaticum*. Understorey: *Aglaia* sp. (DGF WG189), *Phaleria microcarpa, Diospyros* sp. (DGF WG92), *G. gnemon, Calamus* sp., *Psychotria* cf. *beccarii* var. *beccarii*, *Glochidion* sp., *Memecylon hepaticum, Salacia* sp., *Flagellaria indica, Drynatia* sp., *Strychnos minor, Litsea* sp., Rubiaceae (DGF WG195), *Leea novoguineensis, Hydriastele* sp., *Pandanus* sp., *Alpinia* sp., *Osmoxylon* sp., *Ficus wassa, Premna* sp., *Cordyline terminalis, Rhaphidophora* sp., *Piper caninum, Dysoxylum arborescens, Ganophyllum falcatum, Lygodium* sp., *Jasminum* sp., *Neolitsea* sp., *Costus* sp., *Mangifera minor, Archidendron glabrum, Licuala* sp., *Carallia brachiata, Cryptocarya* sp., *Aglaia sexipetala*. Groundcover: *Donax canniformis, Flagellaria indica*, Fern 1, Fern 2, Fern 3, *Drynaria* sp., *Begonia* sp., *Aneilema humilis, Alpinia* sp., *Alocasia* sp.	
WG39	5/04/2015	-6.84502	146.44249	409m	Buvu Ck area	Steep foothill upper slope / ridge crest	Small Crowned Forest dominated by *Hopea iriana* and *Anisoptera thurifera* with *Intsia bijuga*. Canopy 35-45 m. Basal Area 34 m^2/ha	Canopy: *Anisoptera thurifera* (d), *Hopea iriana* (a), *Intsia bijuga* (sd), *Myristica* sp. Subcanopy: *Polyscias murrayi, Rhuis* sp., *Gmelina moluccana, Trichosperma pleiostigma, Protium macgregorii, Mangifera minor, Commersonia bartramia, Trema cannabina, Dysoxylum* sp., *Harpullia ramiflora, Orania* sp., *Schefflera* sp. Understorey: *Cordyline terminalis, Alpinia* sp., *Ardisia* sp., *Cyathea* sp., *Smilax* sp., *Commersonia bartramia, Ficus* sp., *Neololebra atra, Clematis* sp., *Pandanus* sp., *Piper aduncum*, Cissus* sp., *Calamus* sp., *Diospyros* sp. (DGF WG92), *Pimelodendron amboinicum, Pometia pinnata, Harpullia ramiflora, Hoya susuella, Garcinia latissima, Canarium* sp., *Davallia solida, Arytera* sp., *Ficus* sp. 2.,	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Archidendron glabrum, Gnetum gnemon, Pipturus argenteus, Apocynaceae (DGF WG201), *Lunasia amara*. Groundcover: *Nephrolepis bisserata*, Fern (DGF WG200), *Costus* sp., *Alpinia* sp. 1, *Alpinia* sp. 2, *Smilax* sp., Selaginella sp., Fern 1, Fern 2, Fern 3, *Davallia solida, Dianella ensifolia, Cissus* sp., Fern 4, Fern 5, *Hoya susuella*.	
WG40	6/04/2015	-6.85039	146.4463	448m	Buvu Ck Quarry Site	Steep foothill slopes	Disturbed regrowth on margins of quarry.	*Piper aduncum*, Commersonia bartramia, Anthocephalus chinensis, Acalypha insulana, Ochrosia coccinea, Parasponia rugosa*, *Glochidion* sp., *Passiflora foetida, Ipomoea hederifolia*, Leucaena leucocephala, Sarga helapense*, Pipturus argenteus, Sida acuta*, Eleusine indica*, Stachytarpheta cayennsis*, Timonius timon, Trichosperma pleiostigma, Euphorbia hirta*, Solanum torvum*, Calopogonium mucunoides*, Macaranga involucrata, Aegeratum conyzioides*, Stylosanthes humilis*, Conyza sumatrensis*, Crassipetalum crepidoides*, Coleus argentea*, Arthraxon* cf. *hispidus*, *Aeschyenome americana*, Mangifera minor, Papaya cairica*, Macroptileum atropurpurea**	CD
WG41	6/04/2015	-6.8361	146.44637	416m	Microwave tower	Steep upper slopes	Disturbed roadside area dissecting disturbed Small To Medium Crowned Forest dominated by *Hopea iriana*.	*Piper aduncum*, Breynia cernua, Macaranga* sp., *Musa* sp., *Chromolaena odorata*, Mikannia microcephala**.	5a
WG42	6/04/2015	-6.85409	146.44609	448m	Microwave tower	Steep upper slopes	Small to Medium Crowned Forest dominated by *Hopea iriana*. Basal Area 25 m^2/ha.	Canopy: *Hopea iriana* (d), *Polyscias* sp. (a), *Gmelina moluccana* (a). Subcanopy: *Commersonia bartramia, Caryota rumphiana, Hopea iriana, Macaranga involucrata, Atractocarpus* sp., *Ficus* sp. Understorey: *Piper aduncum*, Cordyline terminalis, Protium macgregorii, Ficus wassa, Mussaenda scratchleyi, Diospyros* sp. (DGF WG92), *Leea novoguineensis, Pothos* sp., Apocynaceae (DGF WG201), *Cissus* sp., *Adenia heterophylla, Phaleria microcarpa, Ixora* sp., *Mangifera minor,*	5

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Litsea sp., *Gnetum gnemon, Ichnocarpus* sp. (DGF WG205), *Costus* sp., *Heliconia* sp., *Derris* sp., *Dysoxylum* sp., *Arenga microcarpa, Sterculia schumanniana, Aglaia* sp., *Hoya susuella, Pandora pandorana, Pandanus* sp., *Cycas scratchleyana*., *Breynia cernua*. Groundcover: *Nephrolepis bisserata, Leptaspis* sp., *Heliconia* sp., *Spathloglottis plicata, Scleria polycarpa, Pothos* sp., *Pteris* sp., Fern (DGF WG200).	
WG43	17/07/15	-6.72859	146.47826	95	Chiatz area	Alluvial floodplain	Large Crowned Forest. Emergents 40-50 m, Canopy 30-40 m, Subcanopy 20-35 m, Mid-storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 38 m^2/ha.	Canopy including emergents: *Pometia pinnata, Intsia bijuga, Dracontomelon dao, Vitex cofassus, Ficus* sp.	4
WG44	17/07/15	-6.73050	146.47667	90	Chiatz area	Alluvial floodplain	Large Crowned Forest. Emergents 40-50 m, Canopy 30-40 m, Subcanopy 20-35m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 38 m^2/ha.	Canopy including emergents: *Pterocymbium beccarii, Pometia pinnata, Pterocarpus indicus, Intsia bijuga, Dracontomelon dao, Octomeles sumatrana, Vitex cofassus, Ficus* sp., *Manilkara* sp.	4
WG44b	17/07/15	-6.73349	146.47484	98	Chiatz area	Lower footslope	Interface between Large Crowned Forest and Medium Crowned Forest on footslope. Canopy 30-45 m	Canopy: *Intsia bijuga, Pterocarpus indicus, Anthocephalus chinensis, Pterocymbium beccarii, Dracontomelon dao, Pometia pinnata, Garuga floribunda, Palaquium galactoxylum*. Sub-canopy: *Diospyros lolinopsis.*	5
WG45	18/07/15	-6.83571	146.41032	109m	Finchif TSF	Alluvial floodplain	Large Large Crowned Forest. Emergents 40-50 m, Canopy 30-40 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 38 m^2/ha	Emergents: *Dracontomelon dao, Elaeocarpus* sp., *Ficus* sp., *Octomeles sumatranum*. Canopy: *Tristiropsis acutangula, Antiaris* sp., *Dracontomelon dao, Pterocarpus indicus, Elaeocarpus* sp., *Horsefieldia* sp., *Celtis* sp., *Celtis latifolia, Pimelodendron amboinicum, Sapindaceae, Alstonia scholaris, Pometia pinnata, Annonaceae, Cryptocarya* sp., *Semecarpus* sp., Subcanopy: *P. amboinicum, Intsia bijuga, Pometia pinnata, Tristiropsis acutangula.*	4
WG46	18/07/15	-6.85191	146.41301	100m	Finchif TSF	Alluvial	Large Large Crowned Forest.	Emergents: *Dracontomelon dao, Elaeocarpus* sp.,	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
						floodplain	Emergents 40-50 m, Canopy 30-40 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m.	*Ficus* sp., *Octomeles sumatranum*. Canopy: *Antiaris* sp., *Dracontomelon dao, Pterocarpus indicus, Vitex cofassus, Terminalia complanata, Polyalthia oblongifolia, Elaeocarpus sphaericus, Horsefieldia* sp., *Celtis* sp., *Celtis latifolia, Pimelodendron amboinicum,* Sapindaceae, *Alstonia scholaris, Pometia pinnata*.	
WG47	19/07/15	-6.70430	146.49513	90	Chiatz area	Footslopes	Mixed Small To Medium Crowned Forest. Canopy 35 – 50 m	Canopy: *Octomeles sumatranum, Pometia pinnata, Dracontomelon dao, Pometia Intsia bijuga, Diospyros lolinopsis, Ficus* spp. Subcanopy: *Diospyros lolinopsis, I. bijuga, Polyalthia oblongifolia, Cerbera manghas, Tristiropsis* sp., Sapotaceae, *Arenga microcarpa.*	5
WG48	19/07/15	-6.70576	146.49603	130m	Chiatz area	Steep hillslopes	Mixed Small To Medium Crowned Forest. Canopy 30-40 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 35 m^2/ha	Canopy: *Intsia bijuga, Diospyros lolinopsis, Dysoxylum* sp. 1, *Garcinia* sp., *Tristiropsis* sp., *Syzygium* sp., *Dysoxylum* sp. 2, *Sterculia* sp., *Ganophyllum falcatum, Celtis latifolia*, Unknown, *Ficus* sp., *Maniltoa sheffleri, Aphananthe philippinensis,* Sapotaceae, *Dysoxylum* sp. 2. Subcanopy: *Diospyros lolinopsis, I. bijuga, Polyalthia oblongifolia, Cerbera manghas, Tristiropsis* sp., Sapotaceae, *Arenga microcarpa*.	5
WG49	20/07/15	-6.66911	146.53194	85m	Chiatz area, lower Watut.	Steep foothills above river	Simple Small To Medium Crowned Forest dominated by *Intsia bijuga* with *Myristica* sp., *Alstonia scholaris, Dysoylum* sp. and *Ficus* sp.	Canopy: Ints*ia bijuga, Alstonia scholaris, Myristica* sp., *Octomeles sumatrana, Ficus* sp. Subcanopy: *Myristica* sp., *Arenga* sp., *Calamus* spp.	5
WG50	20/07/15	-6.67568	146.52721	90m	Chiatz area, lower Watut.	Alluvial floodplain	Large Crowned Forest. Emergents 40-50 m, Canopy 30-40 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 38 m^2/ha	Emergents: *Octomeles sumatrana*. Canopy: *Intsia bijuga, Alstonia scholaris, Pterocarpus indicus, Myristica* sp., *Polyalthia* sp., *Barringtonia* sp., *Vitex coffasus, Celtis latifolia, Neonauclea* sp., *Cananga odorata* (DGF WG307), *Octomeles sumatrana, Dracontomelon dao, Ficus* sp., *Cryptocarya* sp.. Subcanopy: *Myristica* sp., *Polyalthis* sp., *Licuala* sp., *Canarium* sp., *Pterocarpus indicus, Semecarpus* sp., *Ignocarpus fagifer*.	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
WG51	20/07/15	-6.67931	146.52536	130m	Chiatz area, lower Watut.	Steep foothills	Closed forest 10-15 m	Canopy: *Intsia bijuga, Alstonia scholaris, Myristica* sp., *Ficus* sp., *Protium macgregorii, Pimelodendron amboinicum, Leea novoguineensis, Cryptpcarya* sp., *Gnetum gnemon.*	5r
NAB1	24/09/2015	-6.75743	146.4493	91m	Babuaf Area - NAR	Alluvial floodplain	Large Crowned Forest on alluvial soils dominated by *Octomeles sumatrana, Pometia pinnata, Dracontomelon dao* and *Antiaris toxicarya*. Canopy 45-55 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 47 m^2/ha	Canopy: *Octomeles sumatrana* (d), *Dracontomelon dao* (sd), *Pometia pinnata* (sd), *Pterocarpus indicus* (sd), *Antiaris toxicarya* (a), *Celtis latifolia, Terminalia impediens, Ganophyllum falcatum, Tristiropsis acutangula* (a), *Vitex cofassus* (a), *Pterocymbium beccarii* (a), *Alstonia scholaris* (a), *Endospermum medullosum, Ficus albipila* . Subcanopy: *Hydriastele costata*, *Myristica sp., Horsfeildia hellwigii, Kleinhovia hospita, Pommetia tomentosa, Maniltoa sp., Pimelodendron amboinicum, Dysoxylum parasiticum, Cerbera manghas, Caryota rumphiana, Artocarpus altilus, Sterculia schumanniana, Ficus sp., Endospermum medullosum, Semecarpus magnificus, Hydriastele costata, Gnetum gnemon, Semecarpus forstenii, Pisonia umbellifera*, *Melanolepis multiglandulosa, Ganophyllum falcatum, Cananga odorata* Understorey: *Aglaia sapindina, Aglaia tomentosa, Aphanamixis polystachya, Fittingia cf. Urceolate, Semecarpus* , *Arenga microcarpa, Osmoxylon* sp., *Aglaia* sp., *Sterculia schumanniana, Gnetum gnemon, Myristica globosa, Calamus* sp., *Psychotria Neololeba atra, Cordyline terminalis, Haplostichanthus longirostrus, Syzygium hylophyllum*, *Arenga microcarpa, Licuala lauterbachii*, *Ficus wassa, Ficus spp*., *Faradaya splendid*, *Entada rheedii*, *Alsomitra microcarpa, Mucuna pruriens subsp. novoguineensis, Calamus sp.* Groundcover: *Pneumatopteris sogerensis, Nephrolepis* sp., *Piper* sp., *Alocasia*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								nicholsonii, *Donax canniformis, Alpinia sp. Malaxis megalantha, Aneilema humilis,*	
NAB2	24/09/2015	-6.75942	146.44931	90m	Babuaf Area - NAR	Swampy alluvial floodplain	Swamp forest with canopy 25 – 40m and emergents to 50m	Emergents: *Terminalia impediens, Ficus* sp. Canopy: *Terminalia impediens, Anthocephalus chinensis, Metroxylon sagu, Caryota rumphiana, Pterocarpus indicus, Hydriastele costata*, *Cananga odorata* Subcanopy: *Horsfieldia hellwigii, Aphanmiaxis polystachya, Myristica cf. hollrungii, Pterocarpus indicus, Fittingia urceolata, Campnosperma breviumbellata, Anthocephalus chinensis,, Cerbera manghas, Semecarpus* sp. Midstorey: *Psychotria* sp. *Maniltoa* sp., *Aglaia* sp., *Psychotria* cf. *beccarii* var. *beccarii*, *Hydnophytum* sp., *Metroxylon sagu, Gnetum latifolia, Caryota rumphiana, Agalai* sp. 2, *Smilax* sp., Understorey: *Tetracera nordtiana, Austrosteenisia* sp., *Faradraya splendida, Haplosticanthus longirostrus, Pothos* sp., *Derris* sp., *Pandanus* sp., *Freycinetia* sp., *Calamus* sp., *Donax canniformis*. Groundcover: *Stenochleana palustris, Derris* sp., *Alpinia* sp., *Aneilema humilis*, *Blechnum indicum*	7
NAB3	24/09/2015	-6.75976	146.44971	90m	Babuaf Area - NAR	Swampy alluvial floodplain	Swamp forest with canopy 25 – 40m and emergents to 50m	Canopy: *Terminalia impediens, Anthocephalus chinensis, Metroxylon sagu, Caryota rumphiana, Pterocarpus indicus, Hydriastele costata* Subcanopy: *Calamus sp., Horsfieldia hellwigii, Myristica cf. hollrungii, Fittingia urceolata, Cerbera manghas, Semecarpus* sp., *Pisonia umbellifera* Groundcover: *Cyrtosperma sp., Derris* sp., *Alpinia* sp., *Aneilema humilis*.	7
NAB4	24/09/2015	-6.76232	146.45157	90m	Babuaf Area - NAR	Swampy alluvial floodplain	Swamp woodland with canopy 25 – 35m and emergents to 45m	Emergents: *Terminalia impediens, Anthocephalus chinensis, Pterocarpus indicus* Canopy: *Metroxylon sagu*	9
NAB5	25/09/2015	-6.719	146.45818	88m	Geng near the Watut River	Ox-bow lagoon	Tall grassland and Swamp Forest on margins of oxbow freahwater lakes with *Phragmites karka* with *Stenochleana palustris*.	*Phragmites karka, Stenochleana palustris, Myriophyllum sp.*	8

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
NAB6	25/09/2015	-6.75743	146.4493	91m	Geng near the Watut River	Alluvial floodplain	Large Crowned Forest on alluvial soils dominated by *Octomeles sumatrana, Pometia pinnata,* Canopy 45-55 m, Subcanopy 20-35 m, Mid storey 8-15 m, Understorey 1-6 m, Groundcover 0-1 m. Basal Area 55 m^2/ha	Canopy: *Octomeles sumatrana* (cd), *Pometia pinnata* (cd), *Dracontomelon dao* (sd), *Ficus sp., Terminalia impediens, Alstonia scholaris* (a), Subcanopy: *Pimelodendron amboinicum*, *Hydriastele costata*, *Artocarpus altilus, Semecarpus forstenii, Cananga odorata, Celtis latifolia, Semecarpus magnificus, Metroxylon sagu, Cryptocarya sp. Myristica sp., Dysoxylum parasiticum, Cerbera manghas, Caryota rumphiana, Artocarpus altilus, Sterculia schumanniana, Ficus sp., Semecarpus magnificus, Hydriastele costata, Gnetum gnemon, Semecarpus forstenii,* Understorey: *Aglaia sapindina, Archidendron glabrum, Pandanus sp., Aphanamixis polystachya, Fittingia cf. urceolate, Semecarpus schlecteri, Sterculia schumanniana, Gnetum gnemon, Calamus* sp., *Psychotria cf. beccarii, Neololeba atra, Cordyline terminalis, Haplostichanthus longirostrus, Syzygium hylophyllum*, *Faradaya splendida*, *Mucuna pruriens subsp. novoguineensis, Calamus sp. Casaeria clutiifolia,* Groundcover: *Pneumatopteris sogerensis, Nephrolepis* sp., *Piper* sp., *Alocasia nicholsonii*, *Donax canniformis, Alpinia sp., Aneilema humilis,*	4
NAB7	25/09/2015	-6.71973	146.46025	93m	Geng near the Watut River	Alluvial floodplain	Secondary forest – regrowth on alluvial flood plain. Canopy at 8 – 12m.	Canopy: *Artocarpus altilis* (cd), *Ficus nodosa* (cd), *Pometia pinnata* (a), *Myristica sp* (sd)., *Melanolepis multiglandulosa* (sd), *Macaranga involucrata, Metroxylon sagu, Alstonia scholaris* Understorey: *Pandanus sp., Alpinia sp., Metroxylon sagu, Dysoxylum parasiticum, Cerbera manghas, Caryota rumphiana, Gnetum gnemon,* Groundcover: *Alpinia sp., Heliconia sp., Piper* sp., *Donax canniformis*	4r
NAB8	25/09/2015	-6.72073	146.46135	132m	Geng near the Watut River	Alluvial fan / river terrace	Boundary of Intact BCF with Secondary forest on alluvial flood plain. Canopy of BCF at 35– 50m.	Canopy: *Octomeles sumatrana* (cd), *Pometia pinnata* (cd), *Pterocarpus indicus* (a), *Instia bijuga* (a), *Ficus sp., Terminalia impediens, Alstonia*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
							Basal area = 46m^2 / ha	*scholaris* (a), *Celtis latifolia* (a), *Dracontomelum dao* (a) Subcanopy: *Pimelodendron amboinicum*, *Hydriastele costata*, *Semecarpus forstenii, Celtis latifolia, Chisocheton ceramicus, Semecarpus magnificus, Cryptocarya sp. Myristica sp., Dysoxylum parasiticum, Cerbera manghas, Caryota rumphiana, Artocarpus altilus, Sterculia schumanniana, Ficus sp., Semecarpus magnificus, Hydriastele costata, Gnetum gnemon, Semecarpus forstenii,* Understorey: *Archidendron glabrum, Pittosporum sinuatum, Pandanus sp., Fittingia cf. urceolata, Semecarpus schlecteri, Syzygium gonatanthum, Gnetum gnemon, Calamus* sp., *Cordyline terminalis, Haplostichanthus longirostrus, Syzygium hylophyllum*, *Calamus sp.* Groundcover: *Pneumatopteris sogerensis, Nephrolepis* sp., *Piper* sp., *Alocasia nicholsonii*, *Donax canniformis, Alpinia sp.*	
NAB9	25/09/2015	-6.72174	146.46172	91m	Geng near the Watut River	Alluvial floodplain	Large Crowned Forest on alluvial soils dominated by *Octomeles sumatrana*	Canopy: *Octomeles sumatrana* (cd), *Pometia pinnata* (cd), *Pterocarpus indicus* (a), *Intsia bijuga* (a) *Dracontomelon dao* (a), *Alstonia scholaris* (a), Subcanopy: *Pimelodendron amboinicum*, *Hydriastele costata*, *Semecarpus forstenii, Celtis latifolia, Semecarpus magnificus, Chisocheton ceramicus, Cryptocarya sp. Myristica sp., Cerbera manghas, Caryota rumphiana, Sterculia schumanniana, Ficus sp., Semecarpus magnificus, Hydriastele costata, Gnetum gnemon, Semecarpus forstenii,* Understorey: *Archidendron glabrum, Pandanus sp., Fittingia cf. urceolata, Semecarpus schlecteri, Sterculia schumanniana, Gnetum gnemon, Calamus* sp., *Cordyline terminalis, Haplostichanthus longirostrus, Syzygium hylophyllum*, *Faradaya splendida*, *Mucuna pruriens subsp. novoguineensis, Calamus sp.* Groundcover: *Pneumatopteris*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								sogerensis, Nephrolepis sp., *Piper* sp., *Alocasia nicholsonii*, *Donax canniformis, Alpinia sp., Aneilema humilis*	
NAB10	25/09/2015	-6.72214	146.46219	118 m	Geng near the Watut River	Alluvial fan / River terrace	Secondary forest – regrowth. Canopy at 8 – 12m.	Canopy: *Artocarpus altilis* (cd), *Ficus nodosa* (cd), *Pometia pinnata* (a), *Myristica sp* (sd)., *Melanolepis multiglandulosa* (sd), *Macaranga involucrata, Metroxylon sagu*	4r
NAB11	25/09/2015	-6.72272	146.4639	114m	Geng near the Watut River	Alluvial fan / River terrace	Large Crowned Forest on alluvial soils dominated by *Octomeles sumatrana*. Partially disturbed	Canopy: *Octomeles sumatrana* (cd), *Dracontomelon dao* (a), *Pometia pinnata* (cd), *Pterocarpus indicus* (a), Subcanopy: *Pimelodendron amboinicum*, *Metroxylon sagu, Ficus sp., Caryota rumphiana, Pterocarpus indicus, Hydriastele costata*, *Dysoxylum sp., Semecarpus forstenii, Celtis latifolia, Semecarpus magnificus, Chisocheton ceramicus, Cryptocarya sp. Myristica sp., Cerbera manghas, Caryota rumphiana, Gnetum gnemon, Calamus sp.*	4a
NAB12	25/09/2015	-6.72746	146.46449	135m	Between Geng Village and Waime River.	Footlslope	Medium crowned forest with dominant *Intsia bijuga*. Canopy 25 – 35m.	Canopy: *Intsia bijuga*(d), *Gmelina moluccana* (a), *Myristica sp.* (a), *Proteum macgregorii* (a), Subcanopy: *Myristica sp. Aglaia tomentosa, Pandanus sp., Vitex coffasus.* ,	5
NAB13	26/09/2015	-6.69912	146.46777	89m	East bank of Watut River	River alluvium on low terrace	Low thicket / scrub with dominant pandanus sp. Canopy heights at 7 – 15m. Secondary vegetation.	Canopy: *Ficus nodosa, Artocarpus altilis, Pandanus sp., Nauclea orientalis, Melanolepis multiglandulosa, Macaranga involucrata, Bischofia javanica, Alstonia scholaris.* Shrubs: *Intsia bijuga, Commersonia bartramiana.*	4r
NAB14	26/09/2015	-6.70215	146.46516	89m	East bank of Watut River	River alluvium on low terrace	Large Crowned Forest on alluvial soils dominated by *Octomeles sumatrana.* Intact canopy with heights from 35 to 50m. BA = 49 m^2/ ha.	Canopy: *Octomeles sumatrana* (cd), *Pometia pinnata* (cd), *Pterocarpus indicus* (a), *Intsia bijuga* (a) *Dracontomelon dao* (a), *Alstonia scholaris* (a), *Eleaocarpus sp., Eleaocarpus sphaericus, Celtis latifolia, Cryptocarya sp.* Subcanopy: *Dysoxylum parasiticum, Pimelodendron amboinicum*, *Hydriastele costata*, *Semecarpus forstenii, Semicarpus magnificus, Sterculia schumanniana, Celtis latifolia, Cryptocarya sp. Myristica sp., Caryota rumphiana, Sterculia schumanniana,*	4

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Ficus sp. Understorey: *Ptychosperma sp., Ficus spp., Myristica sp., Pandanus sp., Fittingia cf. urceolata, Gnetum gnemon, Calamus* sp., *Cordyline terminalis, Haplostichanthus longirostrus, Syzygium hylophyllum*, *Mucuna pruriens subsp. novoguineensis, Calamus sp., Alsomitra microcarpa* Groundcover: *Nephrolepis* sp., *Piper* sp., *Alocasia nicholsonii*, *Donax canniformis, Alpinia sp., Aneilema humilis, Doryopteris concolor*	
NAB15	26/09/15	-6.70128	146.46185	91m	East bank of Watut River	River alluvium on low terrace	Seral forest to 12m	Canopy: *Octomeles sumatrana* (cd), *Artocarpus altilis* (cd), *Melanolepis multiglandulosa. Commersonia bartramiana, Macaranga sp.* Shrub layer: *Piper aduncum.*	4r
NAB16	26/09/15	-6.70128	146.45776	91m	East bank of Watut River	River alluvium on low terrace	Seral forest to 20m	Canopy: *Artocarpus altilis* (d), *Melanolepis multiglandulosa, Intsia bijuga Commersonia bartramiana, Macaranga sp.* Shrub layer: *Piper aduncum, Pandanus sp. Alpinia sp.*	4r
NAB17	26/09/15	-6.70175	146.45604	91m	East bank of Watut River	River alluvium on low terrace	Seral forest at 15 to 23m	Canopy: *Intsia bijuga* (d), *Melicope elleryana, Artocarpus altilis* (cd), *Melanolepis multiglandulosa, Ficus nodosa, Commersonia bartramiana, Macaranga sp., Hibiscus tiliaceus, Vitex coffassus* Shrub layer: *Arenga microcarpa, Piper aduncum, Pandanus sp. Alpinia sp., Aglaia tomentose, Caryota rumphiana, Clerodendrum tomentosum*	4r
NAB18	26/09/15	-6.70366	146.45746	91m	East bank of Watut River	River alluvium on low terrace	Disturbed Large Crowned Forest - Seral forest at 18 to 25m with emergents to 50m	Emergents: *Octomeles sumatrana* Canopy: *Melanolepis multiglandulosa, Ficus nodosa, Dysoxylum sp., Pometia pinnata, Artocarpus altilis Macaranga sp., Hibiscus tiliaceus, Vitex coffassus* Shrub layer: *Arenga microcarpa, Piper aduncum, Pandanus sp. Alpinia sp.*	4r
NAB19	26/09/15	-6.70395	146.46028	91m	East bank of Watut River	River alluvium on low terrace	Disturbed Large Crowned Forest - Seral forest at 25 to 45m with emergents to 55m	Emergents: *Octomeles sumatrana* Canopy: *Dracontomelum dao, Pometia pinnata* Sub-canopy: *Artocarpus altilis,Melanolepis multiglandulosa, Ficus nodosa, Dysoxylum sp.,*	4a

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Pometia pinnata, Artocarpus altilis, Macaranga sp., Vitex coffassus, Metroxylon sagu Shrub layer: *Arenga microcarpa, Calamus sp., Pandanus sp. Alpinia sp.*	
NAB20	26/09/15	-6.70673	146.46123	98m	East bank of Watut River	River alluvium	Large Crowned Forest with canopy at 35 to 55m	Canopy: *Dracontomelum dao, Octomeles sumatrana, Pometia pinnata, Eleaocarpus sphaericus, Pterocarpus indicus, Terminalia complanata, Ailanthus integrifolia* Sub-canopy: *Artocarpus altilis,Melicope elleryana, Anthocephalus chinensis, Endospermum medulosum, Melanolepis multiglandulosa, Ficus nodosa, Dysoxylum sp., Pometia pinnata, Caryota rumphiana, Dysoxylum papuanum*	4
NAB21	26/09/15	-6.71114	146.46364	98m	East bank of Watut River	River alluvium	Large Crowned Forest with canopy at 35 to 50m. Some minor canopy disturbance	Canopy: *Anthocephalus chinensis, Pometia pinnata, Dracontomelum dao, Octomeles sumatrana, Eleaocarpus sphaericus, Pterocarpus indicus* Sub-canopy: *Metroxylon sagu*	4a
NAB22	27/09/15	-6.68134	146.464	90m	West bank of Watut River	River alluvium	Seral forest. *Planchonia papuana* dominant with canopy at 18 to 30m with emergents to 50m	Canopy: *Planchonia papuana, Nauclea orientalis, Gnetum gnemon, Alstonia scholaris , Sterculia shillinglawii , Hydnophytum* Sub-canopy: *Litsea sp., Carallia brachiata, Artocarpus altilis Macaranga sp., Hibiscus tiliaceus, Ptychosperma sp., Arenga microcarpa, Commersonia bartramiana, Sterculia sp.* Shrub layer: *Leea novoguinensis, Piper aduncum, Pandanus sp., Morinda citrifolia, Alpinia sp., Flagellaria indica* Ground layer: *Flagellaria indica, Chromolaena odorata, Cissus sp.*	11
NAB23	27/09/15	-6.69068	146.45943	90m	West bank of Watut River	River alluvium	Seral – secondary forest with emergent Ficus sp. to 50m.	Emergents: *Ficus sp.* Canopy: *Terminalia complanata, Planchonia papuana, Anthocephalus chinensis, Intsia bijuga, Endospermum medulosum, Maniltoa sp., Alstonia scholaris, Hydriastele costata, Pterocarpus indicus, Proteum macgregorii* Sub-canopy: *Gnetum gnemon, Arenga microcarpa, Commersonia bartramiana,* Shrub layer: *Alpinia sp., Pandanus sp., Flagellaria*	11

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								indica Ground layer: *Flagellaria indica, Donax canniiformis*	
NAB24	27/09/15	-6.69171	146.45663	90m	West bank of Watut River	River alluvium	Large crowned forest with canopy at 35 to 50m and emergents to 60m. BA = 47 m^2/ ha.	Emergents: *Octomeles sumatrana* Canopy: *Octomeles sumatrana, Terminalia impediens, Pterocarpus indicus, Intsia bijuga, Alstonia scholaris, Anthocephalus chinensis, Pouteria sp., Vitex cofassus, Cananga odorata, Hydriastele costata, Ailanthus integrifolia, Myristica sp.* Sub-canopy: *Semecarpus sp., Semecarpus magnificus, Melanolepis multiglandulosa, Timonius sp., Gnetum gnemon, Arenga microcarpa, Commersonia bartramiana, Pimelodendron amboinicum, Artocarpus altilis* Shrub layer: *Pandanus sp., Leea novoguinensis, Syzygium aqueum, Syzygium gonatanthum, Medusanthera laxiflora,* Ground layer: *Donax canniiformis, Neumatopteris sogerensis, Nephrolepis* sp., *Piper* sp., *Alocasia nicholsonii, Aneilema humilis, Freycinetia sp., Ardisia sp.,*	4
NAB25	27/09/2015	-6.67951	146.46442	94m	Western floodplain of Watut River	Alluvial Plain	Native grassland (1 -1.5 m) on alluvial plain dominated by *Imperata cylindrical, Polytocca macrophylla* with *Themeda triandra, Sarga* sp., and scattered emergent shrubs of *Antidesma ghaesambilla* , *Albizia procera, Morinda citrifolia*	Emergents: *Albizia procera, Antidesma ghaesambilla, Morinda citrifolia* Groundcover: *Imperata cylindrica, Polytocca macrophylla, Themeda triandra, Fabaceae sp.*	6b
NAB26	27/09/15	-6.67668	146.46097	95m	West bank of Watut River	River alluvium	Seral – secondary forest merging into swamp woodland sp.	Emergents: *Ficus sp.* Canopy: *Terminalia complanata, Planchonia papuana, Anthocephalus chinensis , Timonius sp.* Sub-canopy: *Gnetum gnemon, Arenga microcarpa, Metroxyon sagu,* Shrub layer: *Pandanus sp., Flagellaria indica* Ground layer: *Donax canniiformis, Heliconia sp.*	11 merging with 9
NAB27	27/09/15	-6.67109	146.46715	93m	West bank of Watut River	Swampy alluvial floodplain	Swamp Forest dominated by *Pouteria sp.,Anthocephalus chinensis, Alstonia scholaris* with *Metroxylon sagu*. Canopy 30-45 m.	Canopy: *Palaquium sp., Anthocephalus chinensis, Alstonia scholaris, Terminalia impediens, Pimelodendron amboinicum, Metroxylon sagu, Hydriastele costata,*	7

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
							BA = 55 m^2/ ha.	*Pterocarpus indicus* Subcanopy: *Myristica sp., Horsfeildia hellwigii, Arenga macrocarpa, Metroxylon sagu, Campnosperma brevipetiolatum, Mangifera indica, Carallia brachiata, Hydriastele costata, Dysoxyloum parasiticum, Gnetum gnemon, Syzygium gonatanthum, Syzigium aquem, Caryota rumphiana, Semecarpus forstenii, Intsia bijuga, Medusanthera laxiflora* Ground: *Donax canniformis, Alocasia nicholsonii, Alpinia sp., Asplenium nidus*.	
NAB28	27/09/2015	-6.66656	146.46059	94m	Western floodplain of Watut River	Alluvial Plain	Native grassland (1 -1.5 m) on alluvial plain dominated by *Imperata cylindrical, Polytocca macrophylla* with *Themeda triandra, Sarga* sp., and scattered emergent shrubs of *Antidesma ghaesambilla* , *Albizia procera, Morinda citrifolia*	Emergents: *Albizia procera, Antidesma ghaesambilla, Morinda citrifolia, Clerodendrum tomentosum* Groundcover: *Imperata cylindrica, Polytocca macrophylla, Themeda triandra*	6b
NAB29	27/09/15	-6.68043	146.46939	90m	West bank of Watut River	River alluvium	Large crowned forest with canopy at 35 to 50m. Subject to disturbance	Canopy: *Ailanthus integrifolia, Dracontomelum dao, Pometia pinnata, Rubiaceae sp., Intsia bijuga, Alstonia scholaris, Anthocephalus chinensis, Hydriastele costata, Myristica sp.* Sub-canopy: *Myristica sp., Caryota rumphiana, Semecarpus sp., Melanolepis multiglandulosa, Gnetum gnemon, Arenga microcarpa, Pimelodendron amboinicum, Artocarpus altilis, Dysoxylum sp.,* Shrub layer: *Pandanus sp., Syzygium gonatanthum, Ixora sp., Arenga macrocarpa, Calamus sp.* Ground layer: *Donax canniiformis, Neumatopteris sogerensis, Nephrolepis* sp., *Piper* sp.	4a
NAB30	27/09/15	-6.67865	146.46909	90m	West bank of Watut River	River alluvium	Large crowned forest with canopy at 35 to 50m. Subject to disturbance	*Ailanthus integrifolia, Dracontomelum dao, Pometia pinnata, Alstonia scholaris, Hydriastele costata* Sub-canopy: *Myristica sp., Caryota rumphiana, Semecarpus sp., Melanolepis multiglandulosa, Gnetum gnemon, Arenga microcarpa,*	4a

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
NAB31	28/09/2015	-6.65162	146.510892	95m	Floodplain west of the Markham / Watut River confluence	Alluvial Plain	Native grassland (1 -1.5 m) . Heavily grazed. Emergent trees	Emergents: *Nauclea orientalis* Groundcover: *Imperata cylindrical, Polytocca macrophylla,*	6b
NAB32	28/09/15	-6.67668	146.46097	95m	West bank of Watut River	River alluvium	Swamp forest merging into swamp woodland sp. BA = 35 m^2 / ha.	Emergents: *Ficus sp.* Canopy: *Terminalia impediens, Bischofia javanica, Nauclea orientalis, Ficus nodosa, Timonius sp., Anthocephalus chinensis , , Myristica sp., Alstonia scholaris, Carallia brachiata, Metroxylon sagu, Litsea sp., Melicope elleryana* Sub-canopy: *Gnetum gnemon,* Pimelodendron amboinicum, *Arenga microcarpa, Metroxylon sagu, Ficus wassa, Ficus nodosa, Pandanus sp., Semecarpus magnificus, Dysoxylum sp.,Pometia tomentosa , Hydriastele costata, Annonaceae sp., Caryota rumphiana, Syzygium aqueum, Syzygium gonatanthum, Alsomitra macrocarpa* Shrub layer: *Pandanus sp., Flagellaria indica , Gouania leptostachya, Psychotria cf. beccarii, Haplostichanthus longirostris, Leea novoguinensis* Ground layer: *Donax canniiformis, Heliconia sp., Crinum asiaticum, Alpinia sp.*	11 merging with 9
NAB33	28/09/15	146.50928	-6.64529	92m	Creek terrace running parallel to Markham River	River alluvium	Large crowned forest with canopy at 35 to 50m BA = 41 m^2/ ha. Partial canopy disturbance	Canopy: *Celtis latifolia, Sterculia shillinglawii, Intsia bijuga, Hydriastele costata, Pometia pinnata, Sapindaceae sp., Ficus sp., Alstonia scholaris, Anthocephalus chinensis, Hydriastele costata, Ailanthus integrifolia, Rubiaceae sp.* Sub-canopy: *Semecarpus sp., Ficus wassa, Ficus nodosa, Semecarpus schlecterii, Myristica sp., Melanolepis multiglandulosa, Commersonia bartramiana, Gnetum gnemon, Arenga microcarpa, Pimelodendron amboinicum, Artocarpus altilis* Shrub layer: *Pandanus sp., Neololeba atra, Leea novoguinensis, Syzygium aqueum, Syzygium gonatanthum* Ground layer: *Donax canniiformis, Alocasia nicholsonii,*	4a

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Neumatopteris sogerensis, Nephrolepis sp., *Piper* sp., *Aneilema humilis,*	
NAB34	28/09/15	-6.64338	146.5071	91m	Creek terrace running parallel to Markham River	River alluvium on low terrace	Disturbed Large Crowned Forest – Canopy opening in former garden area.	Canopy: *Artocarpus altilis (d), Ficus wassa, Ficus nodosa, Ixora sp., Melanolepis multiglandulosa, Commersonia bartramiana, Macaranga sp., Mangifera indica, Areca sp., Alstonia scholaris* Shrub and ground layer: *Alpinia sp., Piper aduncum, Pandanus sp.*	4r
NAB35	28/09/15	-6.64067	146.50755	91m	Kunai ridgeline on south bank of Markham River	Low ridgeline	Kunai grassland with margin of low scrub at canopy height of 6m. Recently burnt	Grassland shrub and ground layer: *Imperata cylindrica, Cycas schumanniana* (occasional) – recently burnt. Scrub component: *Mallotus sp., Morinda citrifolia, Cycas schumanniana* (on margins).	6a / 12
NAB36	28/09/15	-6.64097	146.50928	94m	Creek terrace running parallel to Markham River	River alluvium	Large crowned forest with canopy at 30 to 45m. Partial canopy disturbance	Canopy: *Celtis latifolia, Planchonia papuana, Alstonia scholaris, Intsia bijuga, Hydriastele costata, Pometia pinnata, Anthocephalus chinensis, Hydriastele costata, Ailanthus integrifolia* Sub-canopy: *Mallotus paniculatus, Horsfieldia hellwigii, Ficus nodosa, Myristica sp., Melanolepis multiglandulosa, Gnetum gnemon, Arenga microcarpa, Hydriastele costata, Artocarpus altilis*	4a
NAB37	28/09/15	-6.6418	146.51602	94m	Base of kunai ridge running parallel to Markham River	River alluvium	Secondary forest with canopy 15 to 30m	Canopy: *Alstonia scholaris, Hydriastele costata, Myristica sp., Ixora sp., Intsia bijuga, Ailanthus integrifolia, Nauclea orientalis, Pometia pinnata* Sub-canopy: *Mallotus paniculatus, Ficus nodosa, Myristica sp., Melanolepis multiglandulosa, Gnetum gnemon, Arenga microcarpa, Hydriastele costata, Artocarpus altilis* **Note: Dense cover of *Merremia peltata* in canopy towers,	4r
NAB38	28/09/15	-6.6418	146.51602	93m	South side of Markham River – Swamp Forest	Swampy alluvial floodplain	Swamp Forest dominated by *Pouteria sp., Anthocephalus chinensis, Alstonia scholaris* with *Metroxylon sagu*. Canopy 30-45 m with emergents to 55m	Emergents:*Terminalia impediens, Alstonia scholaris* Canopy: *Metroxylon sagu, Hydriastele costata, Anthocephalus chinensis, Alstonia scholaris, Terminalia impediens, Intsia bijuga, Pimelodendron amboinicum, Hydriastele costata, Pterocarpus indicus, Pometia pinnata* Subcanopy:	7

Site #	Date	Latitude	Longitude	Alt.	Locality	Landform	Structure	Characteristic floristics	Mapping unit
								Myristica sp., Metroxylon sagu, Campnosperma brevipetiolatum, Ficus nodosa, Melicope elleryana, Carallia brachiata, Hydriastele costata, Dysoxyloum parasiticum, Gnetum gnemon, Syzygium gonatanthum, Caryota rumphiana, Semecarpus forstenii, Intsia bijuga, Ficus sp. Ground: *Donax canniformis, Alocasia nicholsonii, Alpinia sp., Asplenium sp.*	

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APPENDIX B

Terrestrial flora species recorded within the study area

APPENDIX B – Terrestrial Flora Species Recorded Within the Study Area

Abbreviations:
Status: IUCN: Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT).
Habitat type: Grasslands on hills (GH), Grasslands on alluvium (GA), Oxbow Swamps (OS), Lowland swamp forest (SF), Large to medium-crowned lowland rainforest on alluvial plains (RA), Medium-crowned foothill rainforest (RF), Gardens and secondary growth (GS), Seral and pioneer vegetation (SPV).
* Denotes an exotic plant species.
Survey record sources:
2011a: Booyong Forest Science (2011a). Terrestrial Flora Survey for the MMJV Wafi-Golpu Project. Unpublished report prepared for Coffey Environments.
2011b: Booyong Forest Science (2011b). Terrestrial Flora Survey for the Markham Gap Basin Tailings Storage Facility for the WGJV Golpu Project. Booyong Forest Science, Canungra.
2011c: Papua New Guinea Forestry Research Institute (PNGFRI) (2011c). Forest Resources Inventory Along Access Road to Wafi-Golpu Mine Exploration Site, Lower Watut Area, Morobe Province, Papua New Guinea.
2013: Booyong Forest Science (2013). Terrestrial Flora Survey for the Wafi-Golpu Advanced Exploration Project. Booyong Forest Science, Canungra.
2015: This study.

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Ferns & fern allies																	
Adiantaceae	*Adiantum hispidulum*	Rough maidenhair	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Adiantaceae	*Pityrogramma calomelanos*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Aspleniaceae	*Asplenium adiantoides*		-	-	-	-	-	-	X	X	-	-	-	X	X	-	-
Aspleniaceae	*Asplenium musifolium*		DGF WG293	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Aspleniaceae	*Asplenium nidus*	Bird's nest fern	-	-	-	-	-	-	-	X	-	X	X	X	-	X	X
Athyriaceae	*Diplazium cordifolium*		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Adiantaceae	*Doryopteris concolor*		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Blechnaceae	*Blechnum keysseri*		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Blechnaceae	*Stenochlaena palustris*	Alligator fern	-	-	-	-	X	X	X	-	-	-	-	X	X	-	X
Cyatheaceae	*Cyathea contaminus*		-	-	-	-	-	-	X	-	-	-	X	X	-	X	-
Davalliaceae	*Davallia solida*	Hares foot fern	-	-	-	-	-	-	-	X	-	-	-	X	X	-	X
Dennstaediaceae	*Lindsaea* sp.		-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
Dennstaediaceae	*Microlepia speluncae*	Microlepia fern	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Dryopteridaceae	*Tectaria crenata*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Dryopteridaceae	*Tectaria* sp.		-	-	-	-	-	-	X	-	-	-	X	-	-	X	-
Dryopteridaceae	*Tectaria* sp. aff. *teratocarpa*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Gleicheniaceae	*Dicranopteris* sp.		-	-	-	-	X	X	-	-	-	-	-	-	-	-	X
Gleicheniaceae	*Gleichenia* sp.		-	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Gleicheniaceae	*Sticherus milnei*		-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Lomariopsidaceae	*Bolbitis quoyana*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Lycopodiaceae	*Hupzeria* sp.	Tassle fern	DGF WG 176	-	-	-	-	X	X	-	-	-	-	-	-	-	X
Marratiaceae	*Angiopteris evecta*	Giant fern	DGF WG228a	-	-	-	-	-	X	X	-	-	-	X	-	X	X
Nephrolepiadaceae	*Nephrolepis bisecta*	Sword fern	-	-	-	-	-	-	X	X	-	-	X	-	-	X	X
Nephrolepiadaceae	*Nephrolepis bisserata*	Giant sword fern	-	-	-	-	X	X	X	X	X	-	-	X	X	-	X
Nephrolepiadaceae	*Nephrolepis hirsutula*	Scaly sword fern	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Nephrolepiadaceae	*Nephrolepis radicans*	fishbone fern	-	-	-	X	-	X	-	-	-	-	-	X	-	-	-
Polypodiaceae	*Aglaomorpha heraclea*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Polypodiaceae	*Drynaria quercifolia*	Basket fern	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Polypodiaceae	*Drynaria rigidula*	Basket fern	-	-	-	-	X	X	X	X	-	X	-	-	-	-	X
Polypodiaceae	*Drynaria sparsisora*	Basket fern	-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Polypodiaceae	*Microsorum punctatum*		-	-	-	-	-	X	-	-	-	-	-	-	X	-	-
Polypodiaceae	*Platycerium bifurcatum*	Elkhorn fern	-	-	-	-	-	-	X	X	-	-	-	X	-	-	X
Polypodiaceae	*Pyrrosia* sp.		-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
Psilotaceae	*Psilotum nudum*	Skeleton fork fern	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Pteridaceae	*Pteris deltoidea*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Pteridaceae	*Pteris ensiformis*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Pteridaceae	*Pteris pacifica*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Salaginallaceae	*Selaginella velutina*	Selaginella	DGF WG231	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Salaginellaceae	*Selaginella* sp.	Selaginella	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-
Schizaeaceae	*Lygodium circinatum*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Schizaeaceae	*Lygodium microphyllum*	Climbing fern	DGF WG247		-	X	-	-	-	-	-	-	-	-	-	-	X
Lygodiaceae	*Lygodium* sp.		DGF WG 96	-	-	-	-	-	-	X	-	-	X	X	-	X	X
Schizaeaceae	*Schizaea dichotoma*	Forked fern	DGF WG251		-	X	-	-	X	-	-	-	-	-	-	-	X
Thelypteridaceae	*Amphineuron ceramicum*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thelypteridaceae	*Amphineuron subattenuatum*		DGF WG275	-	-	-	-	X	X	-	-	-	-	-	X	-	X
Thelypteridaceae	*Christella arida*		-	-	-	X	-	-	-	X	-	-	-	X	-	-	-
Thelypteridaceae	*Cyclosorus interruptus*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Thelypteridaceae	*Cyclosorus* sp.		-	-	-	-	-	-	X	X	-	-	X	X	-	X	-
Thelypteridaceae	*Macrothelypteris polypodioides*		DGF WG255	-	-	-	-	-	X	-	X	-	-	-	-	-	X
Thelypteridaceae	*Pneumatopteris sogerensis*		DGF WG42	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Thelypteridaceae	*Pronephrium pentaphyllum*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Thelypteridaceae	*Sphaerostephanos heterocarpus*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Thelypteridaceae	*Sphaerostephanos unitus*		-	-	-	-	-	-	-	X	-	-	-	X	-	X	-
Thelypteridaceae	*Thelypteris* sp.		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Vittaraceae	*Antrophyum alatum*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Unidentified Fern	Unidentified Fern		DGF WG33	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGFWG10	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGF WG109	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGF WG49	-	-	-	-	-	X		-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGF WG178	-	-	-	-	X	-		-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGF WG200	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGF WG62	-	-	-	-	X	-		-	-	-	-	-	-	X
Unidentified Fern	Unidentified Fern		DGF WG8	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Conifers, cycads and allies																	
Cycadaceae	*Cycas apoa*		DGF WG19	NT	-	-	-	-	-	X	-	-	-	-	-	-	X
Cycadaceae	*Cycas circinalis*		-	-	-	-	-	-	-	X	-	-	-	X	-	-	-

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Cycadaceae	*Cycas schumanniana*		-	NT	X	-	-	-	-	-	-	-	X	X	-	X	X
Cycadaceae	*Cycas scratchlyeana*		-	NT	-	-	-	-	-	X	-	-	-	X	X	-	-
Gnetaceae	*Gnetum costatum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Gnetaceae	*Gnetum gnemon*	Tulip	DGF WG52	-	-	-	-	-	X	X	-	X	X	X	X	X	X
Gnetaceae	*Gnetum latifolium*		DGF WG60	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Gnetaceae	*Gnetum* sp.		DGF WG56	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Flowering plants												-					
Acanthaceae	Acanthaceae		DGF WG104	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Acanthaceae	*Blechum brownei*		DGF WG260	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Acanthaceae	*Calycacanthus magnusianus*		DGF WG23, 243, 301	-	-	-	-	-	-	X	-	-	-	X	X	-	X
Acanthaceae	*Calycacanthus* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Acanthaceae	*Hemigraphis reptans*	Red ivy	DGF WG216, 233	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Acanthaceae	*Ptyssiglottis cyrtandroides*		DGF WG5	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Acanthaceae	*Thunbergia* cf. *grandiflora*	Thunbergia	DGF WG161	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Actinidiaceae	*Saurauia purgans*		DGF WG108	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Amaranthaceae	*Achyranthes aspera*	Chaff flower	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Amaranthaceae	*Alternanthera brasiliana**	Brazilian joyweed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Amaranthaceae	*Alternanthera denticulata var. denticulata**	Lesser joyweed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Amaranthaceae	*Alternanthera ficoidea**	Red threads	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Amaranthaceae	*Amaranthus* sp.		DGF WG34	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Amaranthaceae	*Amaranthus viridis**	Slender amaranth	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Amaranthaceae	*Celosia spicata**	Cockscomb	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Amaranthaceae	*Cyathula prostrata*		-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Amaryllidaceae	*Crinum asiaticum*	Crinum lily	DGF WG278	-	-	-	-	X	X	-	-	-	-	X	-	-	X
Anacardiaceae	*Buchanania amboinensis*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Anacardiaceae	*Buchanania arborescens*	Satinwood	-	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Anacardiaceae	*Buchanania macrocarpa*		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Anacardiaceae	*Campnosperma brevipetiolatum*	Campnosperma	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Anacardiaceae	*Campnosperma montana*	Campnosperma	-	-	-	-	-	-	X	X	-	-	-	X	-	-	-
Anacardiaceae	*Dracontomelon dao*	New Guinea walnut	DGF WG31	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Anacardiaceae	*Euroschinus papuanus*		-	-	-	-	-	-	-	X	-	-	X	-	-	X	X
Anacardiaceae	*Euroschinus* sp.		-	-	-	-	-	-	X	-	-	-	X	-	-	X	-
Anacardiaceae	*Mangifera minor*	Wild mango	DGF WG173	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Anacardiaceae	*Pleiogynium timorense*	Burdekin plum	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Anacardiaceae	*Rhus lamprocarpa*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Anacardiaceae	*Rhus taitensis*	Sumac	DGF WG 68	-	-	-	-	-	-	X	-	-	-	X	-	-	X
Anacardiaceae	*Semecarpus aurensis*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Anacardiaceae	*Semecarpus cassuvium*		-	-	-	-	-	-	X	-	-	-	X	-	-	X	-
Anacardiaceae	*Semecarpus forstenii*		DGF WG215, 263, 279	-	-	-	-	-	X	X	-	-	-	-	X	X	X
Anacardiaceae	*Semecarpus magnificus*		DGF WG16, 121	-	-	-	-	-	X	X	-	-	X	-	X	-	X

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Anacardiaceae	*Semecarpus schlecteri*		DGF WG274	-	-	-	-	X	X	-	-	-	-	-	-	-	X
Anacardiaceae	*Spondias cytherea*	Ambarella	DGF WG16	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Anacardiaceae	*Spondias dulcis*		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Annonaceae	*Cananga odorata*	Ylang ylang	DGF WG307	-	-	-	-	-	X	X	X	-	-	X	X	-	X
Annonaceae	*Goniothalmus* cf. *aruensis*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Annonaceae	*Haplostichanthus longirostris*		DGF WG43, 48, 190, 206	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Annonaceae	*Miliusa* sp.		DS NAB32		-	-	-	X	-	-	-	-	-	-	-	-	X
Annonaceae	*Petalolophus* sp.		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Annonaceae	*Polyalthia lateriflora*		-	-	-	-	-	-	X	X	-	-	X	-	X	X	-
Annonaceae	*Polyalthia oblongifolia*		-	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Annonaceae	*Polyalthia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Annonaceae	*Popowia pisocarpa*		-	-	-	-	-	-	X	X	-	-	X	-	X	X	-
Annonaceae	*Pseudovaria* sp.		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Annonaceae	*Uvaria cordata*		-	-	-	-	-	-	-	X	-	-	-	-	-	X	-
Annonaceae	*Uvaria* sp.		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Apiaceae	*Centella asiatica*	Gotu kolu	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Apocynaceae	*Alstonia brassii*	Hard alstonia	DGF WG250	-	-	-	-	-	X	X	X	-	-	-	X	-	X
Apocynaceae	*Alstonia scholaris*	Milky pine	DGF WG287	-	-	-	-	-	X	X	X	X	X	X	X	X	X
Apocynaceae	*Alyxia* sp.		DGF WG179, 201	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Apocynaceae	*Asclepias curassavica**	Inkweed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Apocynaceae	*Catharanthus roseus**	Madagascar periwinkle	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Apocynaceae	*Cerbera floribunda*	Cassowary plum	-	-	-	-	-	X	X	X	-	-	X	X	X	X	X
Apocynaceae	*Cerbera manghas*	Beach milkwood	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Apocynaceae	*Delpyodon oliganthus*		DGF WG205, 295	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Apocynaceae	*Dischidia littoralis*		-	-	-	-	-	-	X		-	-	-	-	-	-	X
Apocynaceae	*Dischidia nummularia*	Button orchid	-	-	-	-	X	X	-	-	X	-	-	-	-	-	X
Apocynaceae	*Dischidia* sp.		-	-	-	-	-	-	X	X	-	X	-	-	-	-	X
Apocynaceae	*Hoya sussuela*	Hoya	DGF WG199	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Apocynaceae	*Ichnocarpus novoguineensis*		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Apocynaceae	*Ichnocarpus* sp.		DGF WG168	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Apocynaceae	*Micrechites rhombifolius*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Apocynaceae	*Ochrosia coccinea*		DGF WG204	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Apocynaceae	*Parsonsia* sp.		-	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Apocynaceae	*Rejoua* sp.		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Apocynaceae	*Voacanga grandifolia*		DGF WG32	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Apocynaceae	*Voacanga papuana*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Apocynaceae	*Wrightia laevis*	White cheesewood	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Aquifolaceae	*Ilex* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Araceae	*Aglaenema marantifolium*		-	-	-	-	-	-	X	-	-	-	-	X	X	-	-
Araceae	*Alocasia magnifica*	Elephant ear	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-

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Araceae	*Alocasia nicolsonii*		DGF WG 46, 262	-	-	-	-	X	X	X	-	X	-	-	-	-	X
Araceae	*Alocasia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Araceae	*Amorphophallus paeoniifolius*	Elephant yam	-	-	-	-	-	-	X	-	-	X	-	-	X	X	X
Araceae	*Amorphophallus* sp.		-	-	X	-	-	-	-	-	-	-	X	X	-	-	-
Araceae	*Amyydrium magnificum*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Araceae	*Calocasia esculenta**	Taro	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Araceae	*Cyrtosperma* sp.				-	-	-	-	X	-	X	-	-	-	-	-	X
Araceae	*Epipremum amplissimum*		-	-	-	-	-	-	X	X	-	-	-	X	X	-	X
Araceae	*Homalomena lauterbachii*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Araceae	*Homalomena* sp.		-	-	-	-	-	-	X	-	-	-	X	-	-	X	-
Araceae	*Pothos hellwigii*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Araceae	*Pothos rumphii*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Araceae	*Rhaphidophora korthalsii*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Araceae	*Rhaphidophora pachyphylla*		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Araceae	*Rhapidophora* sp.		-	-	-	-	-	X	X	-	-	-	-	X	-	-	-
Araceae	*Spathiphyllum* sp.		-	-	-	--	-	-	-	-	-	-	-	X	-	-	-
Araliaceae	*Osmoxylon novoguineense*		-	-	-	-	-	-	X	X	-	-	X	X	-	X	X
Araliaceae	*Polyscias spectabilis*		-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Araliaceae	*Schefflera* sp.	Umbrella tree	-	-	-	-	-	-	X	X	-	-	-	X	X	-	X
Arecaceae	*Areca catchu*	Betel nut	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Arecaceae	*Arenga microcarpa*	Arenga palm	DGF WG303	-	-	-	-	-	X	X	-	X	X	X	X	X	X
Arecaceae	*Brassiophoenix* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Arecaceae	*Calamus aruensis*		-	-	-	-	-	-	X	X	-	X	-	-	-	-	X
Arecaceae	*Calamus hollrungii*		-	-	-	-	-	-	X	X	-	-	X	X	-	X	X
Arecaceae	*Calamus humboltianus*		-	-	-	-	-	-	-	X	X	-	-	-	X	-	-
Arecaceae	*Calamus hunsteinii*		-	-	-	-	-	-	X	-	-	-	-	-	-	X	-
Arecaceae	*Calamus longipinna*		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Arecaceae	*Calamus* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Arecaceae	*Calyptrocalyx lauterbachianus*		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Arecaceae	*Caryota rumphiana*	Fishtail palm	-	-	-	-	-	-	X	-	-	X	X	X	X	X	X
Arecaceae	*Cocos nucifera**	Coconut palm	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Arecaceae	*Cyrtostachys* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Arecaceae	*Hydriastele costata*	Galubia palm	-	-	-	-	-	X	X	-	-	-	-	X	X	X	X
Arecaceae	*Hydriastele micropadix*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Arecaceae	*Hydriastele* sp.		-	-	-	-	-	-	X	-	-	-	X	-	-	X	X
Arecaceae	*Licuala lauterbachii*	Fan palm	DGF WG284	-	-	-	-	-	X	X	-	-	-	X	X	-	X
Arecaceae	*Linospadix* sp.	Walking stick palm	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Arecaceae	*Metroxylon sagu*	Sago palm	-	-	-	-	-	X	-	-	X	-	-	X	-	X	X
Arecaceae	*Orania* sp.		-	-	-	-	-	-	X	X	-	-	X	X	-	X	X
Arecaceae	*Ptychosperma macarthurii*	MacArthur Palm	-	-	-	-	-	-	X	X	-	X	-	-	-	-	X
Arecaceae	*Ptychosperma microcarpum*		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Arecaceae	*Ptychosperma* sp.		-	-	-	-	-	X	X	-	-	-	-	X	-	-	-

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Arecaceae	*Ptychosperma vestitum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Aristolochiaceae	*Aristolochia momandul*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Asteraceae	*Acmella grandiflora var. brachyglossa*		-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Aegeratum conyzoides**	Billy goat weed	-	-	-	X	-	-	-	-	X	-	X	X	-	-	X
Asteraceae	*Aegeratum houstianum**	Billy goat weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Bidens pilosa**	Cobblers pegs	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Chromolaena odorata**	Siam weed	-	-	-	-	-	-	-	-	X	X	-	X	-	-	X
Asteraceae	*Conyza sumatrensis**	Conyza	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Crassocephalum crepidioides**	Thickhead	-	-	-	-	-	-	-	X	X	-	-	X	-	-	X
Asteraceae	*Cyanthillium cinereum*	Little ironweed	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Eclipta prostrata*	False daisy	-	-	-	X	X	-	-	X	X	-	-	X	-	-	X
Asteraceae	*Elephantopus mollis*	Tobacco weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Eleutheranthera ruderalis*	Ogiera	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Asteraceae	*Microglossa pyrifolia*		DGF WG254	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Mikania micrantha**	Bitter vine	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Asteraceae	*Sphagneticola trilobata**	Singapore daisy	-	-	X	-	-	-	-	-	-	-	-	X	-	-	X
Asteraceae	*Sigesbeckia orientalis*	Indian weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Synedrella nodiflora**	Cinderella weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Tagetes erecta**	Mexican marigold	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Asteraceae	*Tridax procumbens**	Tridax daisy	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Balsaminaceae	*Impatiens* sp.*	Impatiens	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Begoniaceae	*Begonia* sp.		-	-	-	-	-	-	X	-	X	-	-	X	-	-	-
Bignoniaceae	*Dolichandrone spathacea*	Mangrove trumpet tree	DGF WG 66	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Bignoniaceae	*Neosepicaea viticoides*	Jungle vine	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Bignoniaceae	*Pandorea pandorana*	Wonga vine	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Bignoniaceae	*Tecoma stans var. stans**	Yellow bells	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Bombacaceae	*Bombax ceiba var. leiocarpum*	Bombax	-	-	-	-	-	-	X	X	X	-	-	-	X	X	X
Bombacaceae	*Salmalia malabarica*	Silk cotton tree	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
Boraginaceae	*Cordia dichotoma*	Cordia	-	-	-	-	X	-	-	-	X	-	-	-	-	X	X
Boraginaceae	*Heliotropium* sp.	Heliotropium	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Bromeliaceae	*Ananus comosus**	Pineapple	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Burseraceae	*Canarium acutiflolium var. acutifolium*	Canarium	-	-	-	-	-	-	-	X	-	-	-	X	X	-	X
Burseraceae	*Canarium* c.f. *macadamii*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Burseraceae	*Canarium schlechteri*		-	-	-	-	-	-	-	-	X	-	-	-	X	-	-
Burseraceae	*Canarium vitiense*	Canarium	-	-	-	-	-	-	X	X	-	-	X	-	X	X	-
Burseraceae	*Canarium* sp.		-	-	-	-	-	-	X	-	-	-	X	X			
Burseraceae	*Garuga floribunda var. floribunda*	Garuga	-	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Burseraceae	*Haplolobus floribundus*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Burseraceae	*Haplolobus* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Burseraceae	*Protium macgregorii*		DGF WG 93, WG 125	-	-	-	-	-	-	X	-	-	X	X	X	X	X

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Byttneriaceae	*Ambroma augusta*	Devils cotton	DGF WG167	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Malvaceae	*Abroma* sp.		DGF WG158	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Byttneriaceae	*Commersonia bartramia*	Brown kurrajong	DGF WG77, 124	-	-	-	-	-	-	X	X	-	X	-	-	X	X
Byttneriaceae	*Commersonia novoguinensis*		-	-	-	-	-	-	-	X	-	-	-	-	-	X	X
Byttneriaceae	*Commersonia* sp.		DS NAB22	-	-	-	-	-	-	-	X	-	-		-	-	X
Byttneriaceae	*Commersonia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Byttneriaceae	*Kleinhovia hospita*	Kleinhovia	-	-	-	-	-	X	-	-	X	-	X	X	X	X	X
Caesalpiniaceae	*Casealpinia* sp.		-	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Caesalpiniaceae	*Intsia bijuga*	Kwila	-	VU	-	-	-	-	X	X	X	X	X	X	X	X	X
Caesalpiniaceae	*Kingiodendron novoguineensis*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Caesalpiniaceae	*Maniltoa lenticellata*	Cascading Maniltoa	-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Caesalpiniaceae	*Maniltoa psilogyne*		DGF WG4, DGF WG306	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Caesalpiniaceae	*Maniltoa* sp.		DGF WG 27	-	-	-	-	-	-	X	-	-	X	-	-	-	X
Caesalpiniaceae	*Senna alata**	Candlenut bush	-	-	-	-	-	-	-	-	X	-	X	X	-	X	X
Caesalpiniaceae	*Senna occidentalis**	Coffee bush	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Capparaceae	*Capparis sepiaria*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Capparaceae	*Capparis zippeliana*		DGF WG217		-	-	-	-	-	X	-	-	-	-	-	-	X
Caricaceae	*Papaya carica**	Papaya	-	-	-	-	-	-	X	X	X	-	-	X	-	-	X
Celastraceae	*Salacia erythrocarpa*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Celastraceae	*Salacia papuana*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Celastraceae	*Salacia* sp.		DGF WG 84	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Celastraceae	*Siphonodon celastrineus*		DGF WG185	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Clusiaceae	*Calophyllum* sp.		-	-	-	-	-	-	X	X	-	-	-	X	-	-	X
Clusiaceae	*Garcinia dulcis*	Gourka	DGF WG172, 299	-	-	-	-	-	X	X	-	-	X	-	-	X	X
Clusiaceae	*Garcinia hollrungii*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Clusiaceae	*Garcinia hunsteinii*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Clusiaceae	*Garcinia latissima*		DGF WG194, 296	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Clusiaceae	*Garcinia maluensis*		DGF WG232, 302	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Clusiaceae	*Garcinia* sp.		DGF WG101	-	-	-	-	-	-	X	-	-	-	X	-	-	X
Clusiaceae	*Garcinia* sp.		DGF WG192	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Combretaceae	*Quisqualis indica*	Rangoon creeper	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Combretaceae	*Terminalia brassii*		-	-	-	-	-	-	X	-	X	-	-	-	-	-	-
Combretaceae	*Terminalia catappa*	Indian almond	-	-	-	-	-	-	-	-	X	-	-	-		X	X
Combretaceae	*Terminalia complanata*	Damson	-	-	-	-	-	-	X	-	-	X	X	-		X	X
Combretaceae	*Terminalia impediens*				-	-	-	-	-	X	-	-	-	-	-	-	X
Combretaceae	*Terminalia kaernbachii*	Red-brown Terminalia, Ngalonka	-	-	-	-	-	X	X	-	X	-	-	-	X	X	X
Combretaceae	*Terminalia orientalis*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Combretaceae	*Terminalia* sp.		DGF WG175	-	-	-	-	-	X	-	-	-	X	X	-	-	X

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Commeliniaceae	*Aneilema humile*		DGF WG 82, 240	-	-	-	-	X	X	X	X	-	-	-	X	-	X
Commelinaceae	*Commelina* cf. *benghalensis*	Benghal dayflower	-	-	-	-	-	-	-	-	X	-	-	-	X	-	X
Commelinaceae	*Commelina diffusa*	Wandering jew	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X
Commelinaceae	*Commelina* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Commeliniaceae	*Pollia secundiflora*		DGF WG297	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Commeliniaceae	*Pollia macrophylla*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Convolvulaceae	*Evolvulus alsinoides*	Dwarf morning glory	DGF WG147	-	X	-	-	-	-	-	-	-	-	-	-	X	X
Convolvulaceae	*Ipomoea batatas*	Sweet potato	-	-	-	-	-	-	-	-	X	-	-	X	X	-	X
Convolvulaceae	*Ipomoea hederifolia*	Scarlet creeper	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Convolvulaceae	*Ipomoea* sp.		DGF WG159	-	-	-	-	-	-	-	X	-	X	-	-	-	X
Convolvulaceae	*Lepistemon urceolatus*		DGF WG163	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Convolvulaceae	*Merremia peltata*	Merremia	DGF WG116	-	-	-	-	X	X	X	X	X	X	X	X	X	X
Cornaceae	*Mastixia chinensis*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Costaceae	*Costus speciosa*	Crepe ginger	-	-	-	-	-	-	X	-	-	-	-	-	X	X	X
Costaceae	*Costus* sp.		DS NAB26	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Costaceae	*Tapeinochilos ananassae*	Torch Ginger	DGF WG283	-	-	-	-	-	X	-	X	-	-	X	X	-	X
Cucurbitaceae	*Alsomitra macrocarpa*	Javan cucumber	DS NAB14	-	-	-	-	X	X	-	-	-	-	-	-	-	X
Cucurbitaceae	*Citrullus lanatus**	Watermelon	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Cucurbitaceae	*Cucumis melo*	Melon	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Cucurbitaceae	*Cucumis sativus**	Cucumber	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Cucurbitaceae	*Cucurbita maxima**	Pumpkin	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Cucurbitaceae	*Diplocyclos palmatus*	Striped cucumber	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Cucurbitaceae	*Momordica cochinchinensis**	Gac	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Cucurbitaceae	*Momordica charantia*	Bitter melon	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Cucurbitaceae	*Mukia* sp.		DGF WG127	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Cucurbitaceae	*Trichosanthes edulis*		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Cucurbitaceae	*Trichosanthes* sp.		-	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Cunoniaceae	*Weinmannia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Cyperaceae	*Carex* sp.		-	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Cyperaceae	*Cyperaceae*		DGF WG58	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Cyperaceae	*Cyperus brevifolius*	Mullumbimby couch	DGF WG139	-	X	-	-	-	-	-	-	-	-		-	-	X
Cyperaceae	*Cyperus difformis*	Variable flatsedge	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Cyperaceae	*Cyperus haspan* subsp. *haspan*		-	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Cyperaceae	*Cyperus* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Cyperaceae	*Cyperus* sp.		DS NAB22		-	-	-	-	-	-	X	-	-	-	-	-	X
Cyperaceae	*Cyperus unioloides*		-	-	-	X	-	-	-	-	-	-	X	X	-	X	-
Cyperaceae	*Eleocharis dulcis*	Water chestnut	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Cyperaceae	*Eleocharis spiralis*		DGF WG258	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Cyperaceae	*Fimbristylis dichotoma*	Common fringerush	DGF WG		X							-		X			X

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Cyperaceae	*Fimbristylis littoralis*	Lesser fimbristylis	DGF WG133	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Cyperaceae	*Fimbristylis* sp.		DGF WG72	-	-	-	-	-	-	X	-	-	-	-	-	-	-
Cyperaceae	*Fimbristylis* sp.		DGF WG91	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Cyperaceae	*Fimbristylis* sp.		DGF WG138	-	X	-	-	-	-	-	-	-	-	-	-	-	-
Cyperaceae	*Scirpus mucronatus*		DGF WG257	-	-	-	X	-	-	-	X	-	-	-	-	-	X
Cyperaceae	*Scleria bruno*		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Cyperaceae	*Scleria ciliaris*		-	-	-	-	X	-	-	-	-	-	-	X	-	-	X
Cyperaceae	*Scirpus grossus*		-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Cyperaceae	*Scleria leavis*		-	-	-	X	-	-	-	-	X	-	-	X	-	X	X
Cyperaceae	*Scleria lithosperma*		DGF WG134	-	X	-	-	-	X	-	-	-	-	-	X	-	X
Cyperaceae	*Scleria polycarpa*		DGF WG88	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Cyperaceae	*Scleria* sp.		DGF WG99	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Cyperaceae	*Scleria* sp.		DGF WG70	-	-	-	-	-	-	X	X	-	-	X	-	-	X
Cyperaceae	*Thoracostachyum sumatranum*	Saw grass	-	-	-	X	X	-	-	-	-	-	-	X	-	-	X
Datiscaceae	*Octomeles sumatrana*	Erima	DGF WG285	-	-	-	-	X	X	-	-	-	X	X	X	X	X
Dilleniaceae	*Tetracera nordtiana var. nordtiana*	Small leaved fire vine	-	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Dioscoreaceae	*Dioscorea bulbifera*	Yam	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Dioscoreaceae	*Dioscorea transversa*	Yam	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Dioscoreaceae	*Dioscorea* sp.		-	-	X	-	-	-	-	-	-	-	X	X	-	-	-
Dipterocarpaceae	*Anisoptera thurifera*	Anisoptera	DGF WG29, 117	-	-	-	-	-	-	X	-	-	-	-	-	X	X
Dipterocarpaceae	*Hopea iriana*	Hopea	DGF WG17, 105	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Dracaenaceae	*Pleomele angustifolia*	Native draceaena	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Ebenaceae	*Diospyros* cf. *hebecarpa*	Scrub ebony	DGF WG61	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Ebenaceae	*Diospyros* cf. *insularis*		-	EN	-	-	-	-	-	-	-	-	-	-	-	X	-
Ebenaceae	*Diospyros crebripilis*		DGF WG181	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Ebenaceae	*Diospyros elliptica*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Ebenaceae	*Diospyros ferrea* var. *buxifolia*		DGF WG92	-	-	-	-	-	-	X	-	-	X	-	X	X	X
Ebenaceae	*Diospyros lolinopsis*	Giap fossa	DGF WG180, 181, 183, 209, 213, 289, 290, 291	CR	-	-	-	-	X	X	-	-	-	X	X	X	X
Ebenaceae	*Diospyros* sp.		DGF WG180	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Elaeocarpaceae	*Elaeocarpus amplifolius*		-	-	-	-	-	-	X	-	-	-	-	X	X	-	-
Elaeocarpaceae	*Elaeocarpus dolichodactylus*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elaeocarpaceae	*Elaeocarpus sphaericus*		DGF WG286	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Elaeocarpaceae	*Elaeocarpus* sp.		DGF WG80	-	-	-	-	X	X	-	-	-	-	X	-	-	X
Elaeocarpaceae	*Elaeocarpus* sp.		DSWG 12_NAB14	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Elaeocarpaceae	*Muntingia calabura**	Jamaican cherry	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Elaeocarpaceae	*Sloanea* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Escalloniaceae	*Polyosma* sp.		-	-	-	--	-	X	-	-	-	-	-	X	-	-	-
Euphorbiaceae	*Abelmoschus manihot* subsp. *manihot*	Aibeka	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Euphorbiaceae	*Acalypha* cf. *grandis*		DGF WG102	-	-	-	-	-	-	X	-	-	-	-	-	-	X

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Euphorbiaceae	*Acalypha insulana*		DGF WG203	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Euphorbiaceae	*Aleurites rockinghamensis*	Candlenut	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Euphorbiaceae	*Bischofia javanica*	Java cedar	-	-	-	-	-	X	X	X	-	-	-	X	X	-	X
Euphorbiaceae	*Claoxylon capillipes*		-	-	-	-	-	-	-	X	X	-	-	-	X	-	-
Euphorbiaceae	*Claoxylon polot*		DGF WG277	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Euphorbiaceae	*Croton* sp.		-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Euphorbiaceae	*Endospermum medullosum*	Moon tree	DGF WG271	-	-	-	-	X	X	X	-	-	X	X	X	X	X
Euphorbiaceae	*Endospermum moluccana*		-	-	-	-	-	-	X	-	-	-	-	-	-	X	-
Euphorbiaceae	*Endospermum* sp.		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Euphorbiaceae	*Euphorbia bifida*		DGF WG131	-	X	X	-	-	-	-	-	-	-	-	-	-	X
Euphorbiaceae	*Euphorbia cyathophora**	Painted spurge	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Euphorbiaceae	*Euphorbia heterophylla**	Painted spurge	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X
Euphorbiaceae	*Euphorbia hirta**	Caustic weed	DGF WG259	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Euphorbiaceae	*Euphorbia* sp.		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Euphorbiaceae	*Homalanthus novoguineensis*	Bleeding heart		-	-	-	-	-	-	X	X	-	-	-	-	-	X
Euphorbiaceae	*Homalanthus* sp.		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Euphorbiaceae	*Homonoia riparia*		-	-	-	-	-	-	X	-	-	-	X	-	X	X	-
Euphorbiaceae	*Macaranga aleuritoides*		-	-	-	-	-	-	X	-	-	-	-	-	X	X	-
Euphorbiaceae	*Macaranga inermis*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Euphorbiaceae	*Macaranga involucrata*		DGF WG73	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Euphorbiaceae	*Macaranga quadriglandulosa*		DGF WG171	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Euphorbiaceae	*Macaranga* sp.		-	-	-	X	-	-	-	-	-	-	X	X	-	-	-
Euphorbiaceae	*Macaranga tanarius*	Macaranga	-	-	-	-	-	-	X	X	X	-	X	-	X	X	X
Euphorbiaceae	*Mallotus mollissimus*		-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Euphorbiaceae	*Mallotus paniculatus*	Turn in the wind	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Euphorbiaceae	*Mallotus peltatus*		DGF WG111	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Euphorbiaceae	*Mallotus philippensis*	Red kamala	-	-	-	-	-	-	-	-	X	-	-	-	X	-	-
Euphorbiaceae	*Mallotus* sp.		DGF WG30	-	-	-	-	-	-	X	-	-	X	-	-	-	X
Euphorbiaceae	*Mallotus* sp.		-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Euphorbiaceae	*Manihot esculenta**	Cassava	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Euphorbiaceae	*Phyllanthus amarus*		DGF WG132	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Euphorbiaceae	*Phyllanthus virgatus*	Seed under leaf	-	-	X	-	-	-	-	-	-	-	X	-	-	-	X
Euphorbiaceae	*Pimelodendron amboinicum*	Pimelodendron	-	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Euphorbiaceae	*Melanolepis multiglandulosa*		-	-	-	-	-	-	X	X	X	-	-	X	X	X	X
Euphorbiaceae	*Omphalea papuana*		-	-	-	-	-	-	-	X	X	-	-	-	X	-	X
Euphorbiaceae	*Ricinis communis**	Castor oil plant	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Eupomatiaceae	*Eupomatia laurina*	Bolwarra	DGF WG153	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Fabaceae	*Abrus precatorius* subsp. *precatorius*	Precatory bean	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Fabaceae	*Aeschynomene americana* var. *americana*	American Jointvetch	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Aeschynomene indica**	Buddha pea	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Alysicarpus vaginalis**	Alyce clover	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X

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Fabaceae	*Calopogonium mucunoides**	Calapo	-	-	-	X	-	-	-	-	X	-	-	X	-	-	X
Fabaceae	*Canavalia* sp.		DGF WG114	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Fabaceae	*Centrosema molle**	Centro	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Clitoria ternatea**	Butterfly pea	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Crotalaria montana*		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Fabaceae	*Crotalaria pallida**	Streaked rattlepod	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Crotalaria* sp.		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Fabaceae	*Crotalaria ochroleuca*		DGF WG265	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Crotalaria sessiliflora*	Rattlepod	DGF WG128	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Fabaceae	*Dalbergia densa* var. *densa*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Fabaceae	*Derris cf. montana*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Fabaceae	*Derris koolgibberah*	Hairy derris	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-
Fabaceae	*Derris submontana*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Fabaceae	*Desmodium ormocarpoides*	Cascading pea	DGF WG9	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Fabaceae	*Desmodium* sp.		DGF WG49	-	X	-	-	-	-		-	-	-	X	-	-	X
Fabaceae	*Entada rheedii*	Match box bean	-	-	-	-	-	X	X	X	-	-	-	-	-	-	X
Fabaceae	Fabaceae		DGF WG85	-	-	-	-	-	-	X	-	-	--	-	-	-	X
Fabaceae	Fabaceae		DS NAB31	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Fabaceae	*Glycine* sp.		-	-	-	-	-	-	-	-	X	-	X	-	-	X	-
Fabaceae	*Glyricidia sepium**	Glyricidia	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Inocarpus fagifer*	Tahitian chestnut	-	-	-	-	-	X	X	-	X	-	-	X	-	X	X
Fabaceae	*Indigofera linnaei**	Nine leaf indigo	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Fabaceae	*Macroptilium atropurpureum**	Siratro	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Macroptilium lathyroides**	Phasey bean	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Millettia pinnata*	Pongam	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Fabaceae	*Mucuna pruriens* subsp. *novoguineensis*	New Guinea creeper	-	-	-	-	-	-	-	X	X	-	-	X	-	X	X
Fabaceae	*Pterocarpus indicus*	New Guinea Rosewood	-	VU	-	-	-	X	X	X	X	-	-	X	X	X	X
Fabaceae	*Pueraria lobata*	Kudzu	DGF WG165	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Fabaceae	*Pycnospora lutescens*		DGF WG145	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Fabaceae	*Rhynchosia acumatissima*	Pointed trefoil	-	-	-	-	-	-	-	-	X	-	X	-	-	X	-
Fabaceae	*Stylosanthes guianensis**	Stylo	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Stylosanthes hamata**	Carribean stylo	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Fabaceae	*Stylosanthes humilis*	Stylo	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-
Fabaceae	*Uraria lagopodioides*	Chakulia	DGF WG126a, 249	-	X	X	-	-	-	-	-	-	X	X	-	X	X
Fabaceae	Fabaceae		DS NAB31	-	-	X	-	-	-	-	-	-	-	-	-	-	X
Flacourtiaceae	*Casearia clutiifolia*		DGF WG79, 126	-	-	-	-	X	X	X	-	-	-	X	X	-	X
Flacourtiaceae	*Homalium foetidum*		-	-	-	-	-	-	-	X	-	-	X	X	X	X	X
Flacourtiaceae	*Pangium edule*	Payang	-	-	-	-	-	-	X	X	X	-	X	-	X	X	X
Flacourtiaceae	*Ryparosa javanica*		-	-	-	-	-	-	X	-	-	-	X	-	X	X	-
Flagellariaceae	*Flagellaria indica*	Supplejack	-	-	-	-	-	-	X	X	-	X	X	X	X	X	X

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Haemoracallidaceae	*Dianella ensifolia*	Dianella	DGF WG97	-	-	-	-	-	X	X	X	-	-	X	X	-	X
Haloragaceae	*Myriophyllum* sp.		DGF WG57	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Heliconiaceae	*Heliconia* sp.		-	-	-	-	-	X	-	-	X	-	-	-	X	-	X
Hemerocallidaceae	*Geitonoplesium cymosum*	Scrambling lily	-	-	-	-	-	-	X	-	-	-	-	X	-	-	X
Hernandiaceae	*Hernandia ovigera*	Chinese lantern tree	-	-	-	-	-	-	X	-	-	-	-	X	-	X	X
Hypoxidaceae	*Curculigo erecta*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Icacinaceae	*Gonocaryum litorale*		DGF WG288	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Icacinaceae	*Gonocaryum* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Icacinaceae	*Mastixiodendron* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Icacinaceae	*Medusanthera laxiflora*		DGF WG220, 221, 266	-	-	-	-	X	X	X	-	-	X	X	X	X	X
Icacinaceae	*Polyporandra* sp.		-	-	-	-	-	-	-	-	X	-	X	-	-	X	-
Icacinaceae	*Ryticaryum longifolium*		DGF WG236	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Icacinaceae	*Stemonorus amui*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Lamiaceae	*Actinodaphne* sp.		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Lamiaceae	*Callicarpa pentandra*	Callicarpa	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Lamiaceae	*Faradaya splendida*	Glory vine	-	-	-	-	-	X	X	X	-	-	-	-	X	-	X
Lamiaceae	*Gmelina moluccana*	White beech	-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Lamiaceae	*Hyptis capitata**	Hytpis	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Lamiaceae	*Hyptis suaveolens**	Chinese mint	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Lamiaceae	*Ocimum gratissimum*	Wild basil	-	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Lamiaceae	*Plectranthus parviflorus*	Blue spires	-	-	X	-	-	-	X	-	-	-	-	X	-	-	X
Lamiaceae	*Premna obtusifolia*		-	-	-	-	-	-	-	-	X	-	-	-	X	-	-
Lamiaceae	*Premna serratifolia*	Malbou	-	-	X	-	-	-	-	-	-	-	X	X	-	-	-
Lamiaceae	*Vitex cofassus*	Garamut	-	-	-	-	-	-	X	X	-	-	X	X	X	-	X
Lamiaceae	*Vitex quinata*		DGF WG121a	-	-	-	-	X	X	X	-	-	-	-	X	-	X
Lauraceae	*Cassytha filiformis*	Dodder	-	-	X	-	-	-	-	-	-	-	-	X	-	-	X
Lauraceae	*Cinnamomum* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Lauraceae	*Cryptocarya medicinalis*		DGF WG107	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Lauraceae	*Cryptocarya mossoy*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Lauraceae	*Cryptocarya multinervis*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Lauraceae	*Cryptocarya weinlandii*		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-
Lauraceae	*Cryptocarya* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	X
Lauraceae	*Endiandra brassii*		-	-	-	-	-	-	X	X	-	-	X	-	-	-	-
Lauraceae	*Endiandra* cf. *leptodendron*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Lauraceae	Lauraceae		DGF WG121	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Lauraceae	*Litsea collina*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Lauraceae	*Litsea guppyi*		DGF WG113	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Lauraceae	*Litsea timoriana*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Lauraceae	*Litsea* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Lauraceae	*Neolitsea* sp.		-	-	-	-	-	-	-	X	-	-	-	X	-	-	X

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					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Laxmanniaceae	*Cordyline terminalis*	Cordyline	DGF WG267	-	-	-	-	-	X	X	X	-	X	X	X	-	X
Laxmanniaceae	*Cordyline fruticosa*	Cordyline	-	-	-	-	-	-	X	X	X	-	-	-	-	-	X
Laxmanniaceae	*Cordyline* sp.		-	-	-	-	-	X	-	-	-	-	-	-	-	-	X
Lecythidaceae	*Barringtonia calyptrocalyx*		-	-	-	-	-	-	X	X	-	-	X	X	-	X	-
Lecythidaceae	*Barringtonia* sp.		-	-	-	-	-	-	X	X	-	-	-	-	-	-	-
Lecythidaceae	*Planchonia papuana*	Planchonia	DGF WG304	-	-	-	-	-	X	-	X	X	-	X	X	X	X
Loganiaceae	*Fagraea racemosa*	False coffey tree	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Loganiaceae	*Mitrasacme pygmaea*	Pygmy bishop's hat	DGF WG140	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Loganiaceae	*Mitrasacme* sp.		DGF WG69	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Loganiaceae	*Neubergia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Loganiaceae	*Strychnos minor*	Snakewood	-	-	-	-	-	-	X		-	-	-	-	X	-	X
Loranthaceae	*Amyema* sp.	Mistletoe	DGF WG18	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Loranthaceae	*Amyema* sp.	Mistletoe	DGF WG160	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Magnoliaceae	*Magnolia tsiampacca*		-	-	-	-	--	-	X	-	-	-	-	X	-	-	-
Malvaceae	*Abelmochus moschatus*	Musk mallow	-	-	-	X	-	-	-	-		-	X	-	-	X	X
Malvaceae	*Abelmochus* sp.		DGF WG56	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Malvaceae	*Abutilon indicum*	Indian lantern flower	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Malvaceae	*Hibiscus tiliaceus*	Cotton wood	-	-	-	-	X	-	-	-	X	-	-	-	-	-	X
Malvaceae	*Pterocymbium beccarii*		-	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Malvaceae	*Pterygota* sp.		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-
Malvaceae	*Sida acuta*	Spinyhead sida	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Malvaceae	*Sida cordifolia**	Fannel weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Malvaceae	*Sida rhombifolia**	Arrowleaf sida	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X
Malvaceae	*Theobroma cacao**	Cacao	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Malvaceae	*Urena lobata**	Caeser weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Marantaceae	*Calathea* sp.		-	--	-	-	-	-	X	-	-	-	-	X	-	-	-
Marantaceae	*Cominsia gigantea*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Marantaceae	*Donax canniformis*	Bemban	DGF WG47	-	-	-	-	X	X	X	X	-	X	X	X	X	X
Marantaceae	*Phrynium macrocephalium*		DGF WG240	-	-	-	-	X	X	X	X	-	-	X	X	-	X
Melastomataceae	*Melastoma malabathricum* subsp. *malabathricum*	Native lasiandra	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Melastomataceae	*Memecylon hepaticum*		DGF WG198	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Melastomataceae	*Osbeckia chinensis*		DGF WG 130	-	X	X	-	-	-	-	-	-	-	-	-	-	X
Meliaceae	*Aglaia argentea*	Silver boodyara		-	-	-	-	-	X	-	-	-	-	-	-	X	X
Meliaceae	*Aglaia* cf. *euryanthera*		-	NT	-	-	-	-	X	-	-	-	-	-	X	-	-
Meliaceae	*Aglaia* cf. *exima*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Meliaceae	*Aglaia* cf. *parviflora*		-	NT	-	-	-	-	-	-	-	-	-	-	-	-	-
Meliaceae	*Aglaia* cf. *silvestris*		-	NT	-	-	-	-	-	X	-	-	-	-	X	-	-
Meliaceae	*Aglaia cucullata*		DGF WG 52	DD	-	-	-	-	X	-	-	-	-	-	X	-	X
Meliaceae	*Aglaia sapindina*	Smooth Fruited	DGF WG 39, 253,	-	-	-	-	X	X	-	-	-	X	X	X	X	X

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					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
		Aglaia	276														
Meliaceae	*Aglaia sexipetala*		DGF WG196	NT	-	-	-	-	-	X	-	-	-	-	-	-	X
Meliaceae	*Aglaia silvestris*		-	NT	-	-	-	-	X	X	-	-	X	-	-	-	-
Meliaceae	*Aglaia tomentosa*	Hairy aglaia	DGF WG207	LC	-	-	-	-	X	X	-	-	-	X	-	-	X
Meliaceae	*Aglaia* sp.		-	-	-	-	-	-	-	X	-	-	X	X	-	-	-
Meliaceae	*Aglaia* sp.		DGF WG40	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Meliaceae	*Aglaia* sp.		DGF WG188	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Meliaceae	*Aglaia* sp.		DGF WG189	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Meliaceae	*Aglaia* sp.		DGF WG13	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Meliaceae	*Aglaia* sp.		DGF WG21	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Meliaceae	*Aglaia* sp.		DGF WG63	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Meliaceae	*Aglaia subminutiflora*		DGF WG	-	-	-	-	-	X	-	-	-	-	-	-	X	X
Meliaceae	*Aphanamixis polystachya*		DGF WG36	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Meliaceae	*Chisocheton ceramicus*		DGF WG54	-	-	-	-	-	X	X	-	-	X	-	-	X	X
Meliaceae	*Chisocheton* cf. *cumingianus*		-	-	-	-	-	-	X	-	-	-	-	X	X	-	-
Meliaceae	*Chisocheton lasiocarpus*		DGF WG252	-	-	-	-	-	X	-	-	-	X	-	X	X	X
Meliaceae	*Chisocheton sapindicus*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Meliaceae	*Dysoxylum arborescens*	Mahogany	-	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Meliaceae	*Dysoxylum gaudichaudianum*	Ivory mahogany	DGF WG281	-	-	-	-	-	X	-	X	-	-	-	-	X	X
Meliaceae	*Dysoxylum latifolium*		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Meliaceae	*Dysoxylum macranthum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Meliaceae	*Dysoxylum parasiticum*	Yellow mahogany	DGF WG269	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Meliaceae	*Dysoxylum pettigrewianum*	Spur mahogany	-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Meliaceae	*Dysoxylum* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Meliaceae	*Dysoxylum* sp.		DGF WG50	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Meliaceae	*Dysoxylum* sp.		DGF WG67	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Meliaceae	*Toona sureni*	Sureni cedar	-	-	-	-	-	-	X	X	-	-	-	X	X	X	-
Menispermaceae	*Tinospora dissitiflora*		DGF WG281	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Menispermaceae	*Tinospora glabra*		-	-	-	-	-	-		X	-	-	-	-	X	-	-
Menispermaceae	*Tinospora* sp.		-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
Mimosaceae	*Albizia procera*	Forest siris	-	-	-	X		-	-	-	-	-	-	-	-	-	X
Mimosaceae	*Archidendron forbesii*		-	VU	-	-	-	-	-	-	-	-	-	X	-	X	-
Mimosaceae	*Archidendron glabrum*		DGF WG15, 59, 227	-	-	-	-	X	X	X	-	-	-	-	-	-	X
Mimosaceae	*Falcataria moluccana*	Moluccan albizia	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Mimosaceae	*Leucaena leucocephala* subsp. *leucocephala**	Leucaena	-	-	-	-	-	-	-	-	X	X	-	-	-	-	X
Mimosaceae	*Mimosa diplotricha**	Giant sensitive weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Mimosaceae	*Mimosa pudica**	Sensitive weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Mimosaceae	*Samanea saman**	Rain tree		-	-	-	-	-	-	-	-	X	-	-	-	-	X
Monimiaceae	*Kairoa suberosa*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Monimiaceae	*Kibara ilicifolia*		-	-	-	-	-	-	X	-	-	-	X	-	-	X	-

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Monimiaceae	*Kibara* sp.		-	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Monimiaceae	*Palmeria* sp.		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Moraceae	*Antiaris toxicaria*	Poison fig	-	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Moraceae	*Artocarpus altilis*	Breadfruit	-	-	X	-	-	-	-	X	-	-	-	X	-	-	X
Moraceae	*Antiaris* sp.		DS NAB1	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Moraceae	*Artocarpus communis*	A breadfruit	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Moraceae	*Artocarpus sepicanus*	A breadfruit	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X
Moraceae	*Ficus adenosperma*	Riverine fig	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-
Moraceae	*Ficus albipila var. albipila*	Abbey fig	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Moraceae	*Ficus ampelos*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Moraceae	*Ficus benjamina var. benjamina*	Weeping fig	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Moraceae	*Ficus* cf. *bernaysii*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Moraceae	*Ficus* cf. *casearioides*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Moraceae	*Ficus copiosa*	Plentiful fig	-	-	-	-	-	-	-	-	X	-	-	-	X	X	X
Moraceae	*Ficus drupacea*	Hairy fig	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Moraceae	*Ficus erythrosperma*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Moraceae	*Ficus gul*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Moraceae	*Ficus mollior*	Sandpaper fig	-	-	-	-	-	-	X	-	X	-	-	-	X	-	X
Moraceae	*Ficus nodosa*	Cape fig	-	-	-	-	-	-	X	-	X	X	X	-	X	X	X
Moraceae	*Ficus pachystemon*		-	-	-	-	-	-	-	X	X	-	X	-	X	X	-
Moraceae	*Ficus septica*	Septic fig	-	-	-	-	-	-	X	X	-	-	-	-	-	X	X
Moraceae	*Ficus* sp.		DGF WG122	-	-	-	-	-	-	X	-	-	-	X	-	-	X
Moraceae	*Ficus tinctoria*	Fig	DGF WG 51	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Moraceae	*Ficus variegata*	Red stem fig	-	-	-	-	-	-	X	X	-	-	-	-	X	X	-
Moraceae	*Ficus wassa*		DGF WG110	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Moraceae	*Maclura cochichinensis*	Cockspur	-	-	-	-	-	-	-	-	X	-	-	-	X	-	X
Moraceae	*Trophis scandens* subsp. *scandens*	Burney vine	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Musaceae	*Musa* sp.	Banana	-	-	-	-	-	-	X	X	X	-	-	X	-	-	X
Musaceae	*Musa* sp.	Banana	DGF WG177					X	X	-	X	-	-	-	-	X	X
Myristicaceae	*Gymnacranthera* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Myristicaceae	*Horsfieldia hellwigii* var. *hellwigii*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Myristicaceae	*Horsfieldia irya*		-	-	-	-	-	-	X	-	-	-	X	-	X	-	-
Myristicaceae	*Horsfieldia spicata*		-	-	-	-	-	-	X	-	-	-	X	-	X	X	-
Myristicaceae	*Horsfieldia subtilis*		DGF WG 28, 71	-	-	-	-	X	-	X	-	-	X	-	-	X	X
Myristicaceae	*Horsfieldia* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Myristicaceae	*Myristica buchneriana*		DGF WG151	VU	-	-	-	-	-	X	-	-	-	X	X		X
Myristicaceae	*Myristica* cf. *hollrungii*		-	-	-	-	-	-	X	-	-	-	-	X	X	X	-
Myristicaceae	*Myristica* cf. *longipes*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myristicaceae	*Myristica chrysophylla*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Myristicaceae	*Myristica fatua*		DGF WG 12	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Myristicaceae	*Myristica fatua* var. *papuana*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myristicaceae	*Myristica globosa*	Nutmeg	DGF WG14, 182,	NT	-	-	-	-	X	X	-	-	X	X	X	X	X

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					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
			187, 208														
Myristicaceae	*Myristica spicata*		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-
Myristicaceae	*Myristica subalulata*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myristicaceae	*Myristica* sp.		DGF WG14	-	-	-	-	-	-	X	-	-	-	X	-	-	X
Myristicaceae	*Myristica* sp.		DS NAB36		-	-	-	-	X	-	-	-	-	-	-	-	X
Myrisinaceae	*Ardisia forbesii*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myrisinaceae	*Ardisia* sp.		-	-	-	-	-	-	X	-	-	-	X	-	-	-	-
Myrsinaceae	*Conandrium polyanthum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Myrsinaceae	*Fittingia* cf. *urceolata*		DGF WG300	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Myrtaceae	*Decaspermum bracteatum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Myrtaceae	*Decaspermum neurophyllum*		DGF WG94, 115	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Psidium guajava**	Native guava	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Myrtaceae	*Melaleuca leucadendra*		-	-	-	-	-	-	-	-	-	X	-	-	-	-	X
Myrtaceae	*Rhodamnia latifolia*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Rhodamnia* sp.		-	-	-	-	-	-	-	X	-	-	X	-	-	-	-
Myrtaceae	*Rhodomyrtus pinnatinervis*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Myrtaceae	*Syzygium aquem*	Bell fruit	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Myrtaceae	*Syzygium buettnerianum*	New Guinea satinash	-	-	-	-	-	-	X	X	-	-	X	-	-	X	X
Myrtaceae	*Syzygium* cf. *goniopterum*		-	-	-	-	-	-	X	-	-	-	-	X	X	-	-
Myrtaceae	*Syzygium* cf. *malaccanse*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myrtaceae	*Syzygium corymbosum*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myrtaceae	*Syzygium effusum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Myrtaceae	*Syzygium gonatanthum*		DGF WG7, 41, 305	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Myrtaceae	*Syzygium hylophyllum*		DGF WG45	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Myrtaceae	*Syzygium leptopodium*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Myrtaceae	*Syzygium longipes*		DGF WG106	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Myrtaceae	*Syzygium* sp.		DGF WG210	-	-	-	-	-	X	X	-	-	X	X	-	-	X
Myrtaceae	*Syzygium* sp.		DGF WG41	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Myrtaceae	*Syzygium* sp.		DGF WG86	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Syzygium* sp.		DGF WG186	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Syzygium* sp.		DGF WG112	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Syzygium* sp.		DGF WG79, 98	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Syzygium* sp.		DS NAB34	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Myrtaceae	*Syzygium tierneyanum*	River cherry	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Myrtaceae	*Xanthomyrtus* sp.		-	-	-	-	-	-	-	X	-	-	-	X	X	-	-
Nyctaginaceae	*Boerhavia erecta*		-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Nyctaginaceae	*Pisonia longirostrus*		-	-	-	-	-	-	X	-	-	-	-	X	X	-	-
Nyctaginaceae	*Pisonia umbellifera*	Cabbage wood	DGF WG261, 272	-	-	-	-	-	X	-	-	-	-	X	X	-	X
Ochnaceae	*Schuurmansia* sp.		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Oleaceae	*Chionanthus* cf. *riparius*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Oleaceae	*Chionanthus laxifolius*		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-

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Oleaceae	*Jasminum* sp.		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Onagraceae	*Ludwigia hyssopifolia**	Seed box	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Onagraceae	*Ludwigia octovalis*	Willow primrose	DGF WG256	-	-	X	-	-	-	-	X	-	-	X	-	-	X
Opiliaceae	*Cansjera leptostachya*		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Opiliaceae	*Gjellerupia papuana*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Orchidaceae	*Bulbophyllum* sp.		-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Orchidaceae	*Corymborkis veratrifolia*	White Cinnamon Orchid	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Orchidaceae	*Dendrobium bifalce*	Native bee orchid	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Orchidaceae	*Dendrobium* sp.		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Orchidaceae	*Goodyera arfakensis*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Orchidaceae	*Malaxis megalantha*		DGF WG219, 225		-	-	-	-	X	X	-	-	-	-	-	-	X
Orchidaceae	*Spathoglottis plicata*	Large purple orchid	-	-	-	-	X	-	-	-	X	-	-	-	-	X	X
Orchidaceae	*Spathoglottis* sp.		-	-	X	-	-	-	-	-	-	-	X	X	-	-	-
Pandanaceae	*Freycintia* sp. *1*		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Pandanaceae	*Freycintia* sp. *2*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Pandanaceae	*Pandanus* sp. *1*		-	-	-	-	-	X	X	X	-	-	X	X	-	X	X
Pandanaceae	*Pandanus* sp. *2*		-	-	-	-	-	-	X	X	-	-	-	-	-		X
Pandanaceae	*Pandanus tectorius*	A screw pine	-	-	-	-	-	-	-	X	X	-	-	-	-	X	-
Passifloraceae	*Adenia heterophylla*	Lacewing vine	-	-	-	-	-	-	X	X	X	-	-	-	-		X
Passifloraceae	*Passiflora foetida*	Stinking passionflower	-	-	-	X	-	-	-	X	X	-	X	-	-	X	X
Pentaphylaceae	*Adinandra* sp.		-	-	-	X	-	-	-	-	-	-	X	X	-	X	-
Phyllanthaceae	*Antidesma* cf. *myriocarpum*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Phyllanthaceae	*Antidesma ghaesembilla*	Black currant tree	-	-	-	X	-	-	-	-	-	-	X	X	-	X	X
Phyllanthaceae	*Antidesma olivaceum*		-	-	-	X	-	-	X	X	-	-	-	X	X	X	-
Phyllanthaceae	*Breynia cernua*	Imer	DGF WG100	-	X	X	-	-	-	X	X	X	X	X	-	X	X
Phyllanthaceae	*Glochidion magnificum*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Phyllanthaceae	*Glochidion* sp.		-	-	-	X	-	-	X	X	-	-	-	X	X	-	X
Phyllanthaceae	*Phyllanthus tenellus**		-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Phyllanthaceae	*Phyllanthus virgatus*		-	-	X	X	-	-	-	-	X	-	-	X	-	-	X
Phyllanthaceae	*Phyllanthus* sp.		DGF WG144	-	X	-	-	-	-	-	-	-	-	X	-	-	X
Piperaceae	*Peperomia* sp.		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Piperaceae	*Piper aduncum**	Spiked pepper	-	-	-	-	-	-	X	X	X	X	X	X	X	X	X
Piperaceae	*Piper betle*	Betel	-	-	-	-	-	-	-	-	X	-	-	-	-	X	X
Piperaceae	*Piper caninum*	Common piper	-	-	-	-	-	X	X	X	X	-	-	-	-	-	X
Piperaceae	*Piper celtidiforme*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Piperaceae	*Piper* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Pittosporaceae	*Pittosporum ferrugineum*	Hairy pittosporum	-	-	-	-	-	-	-	X	-	-	X	X	-	X	X
Pittosporaceae	*Pittosporum pullifolium*		DGF WG1	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Pittosporaceae	*Pittosporum sinuatum*		DGF WG226	-	-	-	-	X	X	X	-	-	-	-	-	-	X

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Plantaginaceae	*Mecardonia procumbens*	Baby jump up	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Plantaginaceae	*Scoparia dulcis**	Scoparia	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Allopteropsis semialata*	Cockatoo grass	-	-	X	X	-	-	-	-	-	-	X	X	-	X	X
Poaceae	*Apluda mutica*	Mauritian grass	DGF WG155	-	-	X	-	-	-	-	-	-	-	X	-	-	X
Poaceae	*Arthraxon* cf. *hispidus*	Hairy joint grass	DGF WG123	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Arundinella setosa*		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Poaceae	*Axonopus compressus**	Broad leaved carpet grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Bambusa* sp.	A bamboo	-	-	-	-	-	-	-	-	X	-	X	X	-	X	X
Poaceae	*Bothriochloa bladhii* subsp. *bladhii*	Forest bluegrass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Brachiaria decumbens**	Signal grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Capillipedium spicigerum*		-	-	X	X	-	-	-	-		-	-	-	-	-	X
Poaceae	*Centotheca latifolia*		DGF WG230		-	-	-	-	X	-	-	-	-	-	-	-	X
Poaceae	*Chloris* sp.*		-	-		X	-	-	-	-	-	-	-	X	-	-	-
Poaceae	*Cynodon dactylon**	Bermuda grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Dactyloctinuem aegyptum**	Button grass	DGF WG 89	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Digitaria ciliaris**	Summer grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Digitaria setigera**	Hairy crab grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Digitaria* sp.*		-	-	-	X	-	-	-	-	-	-	X	-	-	-	-
Poaceae	*Echinochloa colona**	Barnyard awn grass	-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Poaceae	*Eleusine indica**	Crows foot grass	-	-	-	-	-	-	-	-	X	-	X	X	-	X	X
Poaceae	*Eragrostis pilosa*		-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Eulalia trispicata*		DGF WG137	-	X	X	-	-	-	-		-	X	X	-	X	X
Poaceae	*Ichanthus* sp.*		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Poaceae	*Imperata cylindrica*	Blady grass	-	-	X	X	-	-	-	-	X	-	X	X	-	X	X
Poaceae	*Leptaspis urceolata*		DGF WG222	-	-	-	-	-	X	-		-	-	-	-	-	X
Poaceae	*Megathyrsus maximus* var. *maximus**	Giant Guinea grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Mnesithea rottboellioides*		-	-	X	X	-	-	-	-	-	-	X	X	-	X	X
Poaceae	*Neololeba atra*	Cape bamboo	-	-	-	-	-	X	X	X	X	-	-	-	-	-	X
Poaceae	*Ophiuros exaltatus*		-	-	X	X	-	-	-	-	-	-	-	-	-	-	X
Poaceae	*Oplismenus hirtellus*		-	-	-	-	-	-	X	X	X	-	-	-	-	-	X
Poaceae	*Oplismenus compositus*		DGF WG 230	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Poaceae	*Panicum* sp.		DGF WG 76	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Poaceae	*Paspalum* sp.*		-	-	-	X	-	-	-	-	-	-	X	-	-	-	-
Poaceae	*Phragmites karka*	Bamboo reed	-	-	-	X	X	-	-	-	X	-	-	-	-	-	X
Poaceae	*Phragmites vallatorius*		-	-	-	X	-	X	-	-	-	-	-	X	-	-	X
Poaceae	*Polytoca macrophylla*		DGF WG142, 245	-	X	X	-	-	-	-	-	-	X	X	-	X	X
Poaceae	*Rottboelia cochinchinensis*		-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
Poaceae	*Rottboelia exaltata*		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Poaceae	*Rottboelia* sp.		-	-	X	X	-	-	-	-	-	-	X	-	-	-	-

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Poaceae	*Saccharum myosuroides*		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Poaceae	*Saccharum edule*	Pit Pit			-	-	-	-	-	-	X	X	-	-	-	-	X
Poaceae	*Saccharum robustum*	Robust cane	-	-	-	-	-	-	-	-	X	-	X	X	-	X	X
Poaceae	*Saccharum spontaneum*	African fodder cane	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Sarga* sp.		DGF WG143	-	X	-	-	-	-	-	-	-	-		-	-	X
Poaceae	*Scleria laevis*		-	-	X	-	-	-	-	-	-	-	X	-	-	-	-
Poaceae	*Scleria* sp.		DGF WG154	-	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Poaceae	*Setaria palmifolia*	Palm grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Setaria* sp.*		-	-	-	-	-	-	-	-	X	-	-	X	-	-	X
Poaceae	*Sorghum almun**	Columbus grass	-	-	-	-	-	-	-	-	X	-	X	X	-	X	-
Poaceae	*Sorghum halepense**	Johnson grass	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Sporobolus* sp.		-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	*Themeda triandra*	Kangaroo grass	DGF WG246	-	X	X	-	-	-	-	-	-	X	X	-	X	X
Poaceae	*Thysanolaena maxima**		-	-	-	-	-	-	-	-	X	-	X	X	-	X	-
Poaceae	*Zea mays**	Corn	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Poaceae	Poaceae indet		DGF WG 37	-	-	-	-	-	X	-	X	-	-	-	-	-	X
Poaceae	Poaceae indet		DGF WG 83	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Poaceae	Poaceae indet		DGF WG 87	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Poaceae	Poaceae indet		DGF WG 90	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Poaceae	Poaceae indet		DGF WG141	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Poaceae	Poaceae indet		DGF WG148	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Polygalaceae	*Polygala chinensis*		DGF WG150	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Polygalaceae	*Polygala longifolia*		DGF WG136	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Polygalaceae	*Polygala triflora*		DGF WG146	-	X	-	-	-	-	-	-	-	-	-	-	-	X
Polygonaceae	*Polygonum barbatum*		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Polygonaceae	*Polygonum* sp.		-	-	-	-	-	-	-	X	-	-	X		X	X	-
Ranunculiaceae	*Clematis* sp.		-	-	-	-	-	X	-	-	-	-	-		X	X	-
Rhamnaceae	*Alphitonia oblata*	Hairy sarsaparilla ash	-	-	-	-	-	-	-	X	-	-	-	X	-	-	-
Rhamnaceae	*Alphitonia macrocarpa*		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-
Rhamnaceae	*Guoania leptostachya*		DGF WG273	-	-	-	-	X	X	-	-	-	-	-	-	X	X
Rhamnaceae	*Zizyphus* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Rhizophoraceae	*Carallia brachiata*	Carallia	-	-	-	-	-	X	X	X	-	X	-	-	-	-	X
Rhizophoraceae	*Gynotroches axillaris*		-	-	-	-	-	X	-	-	-	-	-	X	-	-	-
Ripogonaceae	*Ripogonum* sp.		-	-	-	-	-	-		X	-	-	-	-	-	-	X
Rosaceae	*Prunus* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Rubiaceae	*Anthocephalus chinensis* (syn. *Neolamarckia cadamba)*	Laran	-	-	-	-	-	X	X	X	X	-	X	X	X	X	X
Rubiaceae	*Atractocarpus macarthurii*		DGF WG294	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Rubiaceae	*Canthium* sp.		DGF WG 38	-	-	-	-	X	-	-	-	-	-	-	-	-	X
Rubiaceae	*Dicranotaenia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-

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Rubiaceae	*Gardenia hansemannii*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Rubiaceae	*Gardenia* sp.		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-
Rubiaceae	*Guettarda speciosa*	Sea randa	-	-	-	-	-	-	X	-	-	-	X	-	-	X	-
Rubiaceae	*Hydnophytum* sp.		-	-	-	-	X	X	X	-	X	-	-	-	-	-	X
Rubiaceae	*Ixora klanderiana*	Native Ixora	DGF WG11	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Rubiaceae	*Ixora moszkowskii*		DGF WG78, 235	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Rubiaceae	*Ixora subauriculata*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubiaceae	*Morinda citrifolia*	Noni plum	-	-	-	-	-	-	-	-	X	X	-		-	-	X
Rubiaceae	*Morinda* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Rubiaceae	*Morinda umbellata* var. *papuana*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Rubiaceae	*Mussaenda ferruginea*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Rubiaceae	*Mussaenda scratchleyi*		-	-	-	X	-	-	-	X	X	-	X	X	-	X	X
Rubiaceae	*Mussaenda* sp.		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Rubiaceae	*Nauclea coadunatus*		-	-	-	-	-	-	X	X	-	-	-	-	X	-	-
Rubiaceae	*Nauclea orientalis*	Yellow cheeswood	-	-	-	-	-	X	X	-	X	X	-	-		-	X
Rubiaceae	*Nauclea* sp.		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Rubiaceae	*Neonauclea* sp.		-	-	-	-	-	-	X	-	-	-	-	X	X	-	X
Rubiaceae	*Ophiorrhiza decipiens*		DGF WG224	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Rubiaceae	*Pavetta pachyclada*		DGF WG 26	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rubiaceae	*Pavetta* sp.		DGF WG24	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rubiaceae	*Psychotria* cf. *beccarii* var. *beccarii*		DGF WG184	-	-	-	-	X	X	X	-	-	-	-	-	-	X
Rubiaceae	*Psychotria leptothrysa*		DGF WG223	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Rubiaceae	*Psychotria membranifolia*		-	-	-	-	-	X	-	-	-	-	X	-	-	X	-
Rubiaceae	*Psychotria micrococca*		DGF WG 234		-	-	-	-	X	X	-	-	-	-	-	-	X
Rubiaceae	*Psychotria* sp.		DGF WG 53	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Rubiaceae	*Psychotria* sp.		DGF WG 64	-	-	-	X	-	-	-	-	-	-	-	-	-	X
Rubiaceae	*Randia decora*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	
Rubiaceae	*Randia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	
Rubiaceae	Rubiaceae		DGF WG195	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rubiaceae	*Spermacocce* sp.		-	-	-	-	-	-	-	-	X	-	X	-	-	X	-
Rubiaceae	*Tarenna* sp.		DGF WG2	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rubiaceae	*Timonius timon*	Timonius	-	-	-	-	X	-	-	-	X	-	X	X	-	X	X
Rubiaceae	*Timonius* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Rubiaceae	*Timonius* sp.		DS NAB26	-	-	-	-	-	-	-	X	-	-		-	-	X
Rubiaceae	*Uncaria* sp.		-	-	-	-	-	X	X	-	-	-	-	X	-	-	X
Rubiaceae	*Versteegia cauliflorus*		DGF WG191, 214	-	-	-	-	-	-	X	-	-	X	-	-	X	X
Rutaceae	*Flindersia amboinensis*		-	NT	-	-	-	-	X	X	-	-	-	-	-		X
Rutaceae	*Flindersia pimenteliana*	Maple silkwood	-	EN	-	-	-	-	-	-	-	-	-	-	X	-	-
Rutaceae	*Flindersia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Rutaceae	*Halfordia papuana*		-	CR	-	-	-	-	-	-	-	-	-	[X]	-	-	-
Rutaceae	*Lunasia amara*	Lunasia	DGF WG 02	-	-	-	-	-	X	X	-	-	-	-	X	-	X
Rutaceae	*Melicope bonwickii*	Yellow evodia	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Rutaceae	*Melicope denhamii*		DGF WG197	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rutaceae	*Melicope elleryana*	Pink doughwood	DGF WG 75	-	-	-	-	-	-	X	-	-	-	-	X	-	X
Rutaceae	*Melicope xanthoxyloides*	Yellow evodia	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rutaceae	*Melicope* sp.		-	-	-	-	-	-	X	-	-	-	X	X	-	-	-
Rutaceae	*Melicope* sp.		DGF WG 20	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Rutaceae	*Micromelum minutum*	Lime berry	-	-	-	-	-	X	-	X	-	-	-	-	X	-	X
Rutaceae	*Wenzelia platysperma*	Bush orange	DGF WG242, 298	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Salicaceae	*Flacourtia zipellii*		-	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Sapindaceae	*Alectryon ferrugineus*		DGF WG 55, 118, 244	-	-	-	-	-	X	X	X	-	X	-	X	X	X
Sapindaceae	*Cupaniopsis* sp.		-	-	-	-	-	-	X	X	-	-	X	-	X	X	-
Sapindaceae	*Dictyoneura obtusa*		DGF WG 35	-	-	-	-	-	X	-	-	-	-	-	X	X	X
Sapindaceae	*Dimocarpus longan*	Longan	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Sapindaceae	*Ganophyllum falcatum*	Scaly bark	-	-	-	-	-	-	-	X	-	-	X	-	X	-	X
Sapindaceae	*Guioa* sp.		-	-	-	-	-	-	-	X	-	-	X	X	-	X	X
Sapindaceae	*Harpullia cupanioides*		DGF WG270	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Sapindaceae	*Harpullia* cf. *longipetala*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Sapindaceae	*Harpullia ramiflora*	Tulipwood	DGF WG 22	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sapindaceae	*Harpullia* sp.		DGF WG169, 211	-	-	-	-	-	-	X	-	-	-	X	-	-	X
Sapindaceae	*Jagera javanica*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sapindaceae	*Lepidopetalum fructoglabrum*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sapindaceae	*Lepisanthes* sp.		-	-	-	-	-	-	-	X	-	-	X	-	-	X	-
Sapindaceae	*Mischocarpus longifolius*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Sapindaceae	*Mischocarpus* sp.		DGF WG103	-	-	-	-	-	-	-	-	-	-	-	-	-	X
Sapindaceae	*Pometia pinnata*	Taun	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X
Sapindaceae	*Pometia tomentosa*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sapindaceae	Sapindaceae		DGF WG 81	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sapindaceae	*Sarcotoechia bilocularis*		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sapindaceae	*Tristiropsis acutangula*	Fern leaved tamarind	-	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Sapotaceae	*Chrysophyllum roxburghii*	Star apple	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Sapotaceae	*Manilkara* sp.		DGF WG40a	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Sapotaceae	*Palaquium galactoxylon*	Cairns pencil cedar	-	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Sapotaceae	*Palaquium* sp.		DS NAB27		-	-	-	X	-	-	-	-	-	-	-	-	X
Sapotaceae	*Pouteria chartacea*	Thin leaved plum	-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Sapotaceae	*Pouteria* sp.		-	-	-	-	-	-	X	-	-	-	-	X	X	-	-
Simaroubaceae	*Ailanthus integrifolia*	White siris	-	-	-	-	-	-	X	-	-	-	-	X	X	-	X
Smilacaceae	*Smilax novaguineensis*	Smilax	-	-	-	-	-	-	X	X	-	-	-	-	-	-	X
Smilacaceae	*Smilax ovatolanceolata*		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Smilacaceae	*Smilax* sp.		-	-	-	-	-	-	-	X	-	-	-	X	X	X	X
Solanaceae	*Nicotiana tabaccum**	Tobacco	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Solanaceae	*Solanum americanum**	Black nightshade	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
Solanaceae	*Solanum torvum**	Devils fig	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X
Sparrmanniaceae	*Grewia retusifolia*	Dogs balls	-	-	-	X	-	-	-	-	-	-		-	-	-	X
Sparrmanniaceae	*Trichospermum pleiostigma*	False Commersonia	-	-	-	-	-	-	X	X	X	-	X	X	X	X	X
Sparrmanniaceae	*Trichospermum* sp.		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Sterculiaceae	*Firmiana papuana*		DGF WG170	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Sterculiaceae	*Heritiera littoralis*	Looking glass mangrove	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Sterculiaceae	*Melochia corchorifolia*		DGF WG16	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Sterculiaceae	*Melochia odorata**		-	-	X	-	-	-	-	-	-	-	-	X	-	-	-
Sterculiaceae	*Melochia umbellata*		DGF WG166	-	-	-	-	-			X	-	-	-	-	-	X
Sterculiaceae	*Sterculia ampla*		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Sterculiaceae	*Sterculia cowentzii*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Sterculiaceae	*Sterculia schumanniana*		DGF WG120	-	-	-	-	-	-	X	-	-	X	-	X	X	X
Sterculiaceae	*Sterculia shillinglawii* subsp. *shillinglawii*	Tulip sterculia	-	-	-	-	-	-	X	X	-	-	X	-	-	X	X
Sterculiaceae	*Sterculia* sp.		-	-	-	-	-	-	X	-	-	-	-	X	-	-	-
Taccaceae	*Tacca leontopetaloides*	Native arrowroot	-	-	-	X	-	-	-	-	X	-	-	-	-	-	X
Theaceae	*Eurya* sp.		-	-	-	-	-	-	-	X	-	-	X	-	-	-	-
Thymelaeaceae	*Phaleria coccinea*		DGF WG193	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Thymelaeaceae	*Phaleria macrocarpa*		DGF WG44	-	-	-	-	-	X	-	-	-	-	-	X	X	X
Thymeliaceae	*Phaleria* sp.		DGF WG25	-	-	-	-	-	X	-	-	-	-	-	-	-	X
Tiliaceae	*Microcos argentata*		DGF WG218	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Tiliaceae	*Microcos grandiflora*		DGF WG65, 174	-	-	-	-	-	X	X	-	-	X	X	X	X	X
Tiliaceae	*Microcos tetrasperma*		-	-	-	-	-	-	X		-	-	-	-	X		-
Typhaceae	*Typha orientalis*	Bul lrush	-	-	-	-	-	X	-	-	-	-	-	X	-	-	X
Ulmaceae	*Celtis latifolia*	Celtis	DGF WG2, 3, 119	-	-	-	-	-	X	X	-	-	X	-	X	X	X
Ulmaceae	*Celtis philippensis*	Celtis	-	-	-	-	-	-	-	X	-	-	X	X	X	X	X
Ulmaceae	*Celtis rigescens*		-	-	-	-	-	-	-	X	-	-	-	X	X	-	X
Ulmaceae	*Parasponia rugosa*		DGF WG162	-	-	-	-	-	-	X	X	-	-	-	X	-	X
Ulmaceae	*Trema cannabina*	Lesser trema	-	-	-	-	-	-	-	X	X	-	-	-	-	-	X
Ulmaceae	*Trema orientalis*	Tree peach	-	-	-	-	-	-	X	X	X	-	-	X	-	-	X
Urticaceae	*Dendrocnide cordata*	Stinging bush	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Urticaceae	*Dendrocnide corollodesme*	Mango leaf stinger	-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Urticaceae	*Dendrocnide* sp.	Stinger	-	-	-	-	-	-	X	-	-	-	-	X	X	X	X
Urticaceae	*Elatostema beccarii*		DGF WG282	-	-	-	-	-	X	-	-	-	X	-	X	X	X
Urticaceae	*Leucosyke australis*		DGF WG6	-	-	-	-	-	-	X	-	-	X	X	-	X	X
Urticaceae	*Nothocnide frutescens*		-	-	-	-	-	-	-	-	X	-	-	-	-	X	-
Urticaceae	*Nothocnide repanda*		-	-	-	-	-	-	X	-	-	-	-	-	X	-	-
Urticaceae	*Pipturus argenteus*	False stinger	-	-	-	-	-	-	-	X	-	-	X	-	X	X	X
Urticaceae	*Pouzolzia hirta*		-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
Urticaceae	*Pouzolzia pentandra*		-	-	-	X	-	-	-	-	-	-	X	X	-	X	-
Verbenaceae	*Clerodendrum tomentosum*	Hairy	DS NAB17	-	-	X	-	-	-	X	X	X	-	X	-	-	X

Family name	Species	Common name	2015 Collection Number	IUCN status	Habitat type								Survey records				
					GH	GA	OS	SF	RA	RF	GS	SPV	2011a	2011b	2011c	2013	2015
		clerodendrum															
Verbenaceae	*Clerodendrum* sp.		-	-	-	-	-	-	-	X	X	-	-	X	-	-	X
Verbenaceae	*Duranta erecta**	Geisha girl	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Verbenaceae	*Stachytarpheta cayennensis**	Snake weed	-	-	-	-	-	-	-	-	X	-	-	-	-	-	X
Verbenaceae	*Stachytarpheta jamaicensis**	Dark blue snake weed	-	-	-	-	-	-	-	-	X	-	X	-	-	X	X
Vitaceae	*Cayratia geniculata*		-	-	-	-	-	-	X	-	-	-		-	X	-	-
Vitaceae	*Cayratia japonica*	Bushkiller	-	-	-	-	-	-	-	X	-	-		-	-	-	X
Vitaceae	*Cayratia* sp.		-	-	-	X	-	-	-	-	-	-	X	-	-	-	-
Vitaceae	*Cissus discolor*		-	-	-	-	-	-	-	X	X	-	-	-	X	-	-
Vitaceae	*Cissus* sp.		DGF WG95	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Vitaceae	*Cissus* sp.		DS NAB22	-	-	-	-	-	X	-	X	X	-	-	X	-	X
Vitaceae	*Leea indica*	Bandicoot berry	DGF WG248	-	-	X	-	-	X	-	-	X	X	X	-	-	X
Vitaceae	*Leea novoguineensis*	Bandicoot berry	-	-	-	-	-	X	X	X	X	X	-	X	-	-	X
Vitaceae	*Tetrastigma* sp.		-	-	-	-	-	-	-	X	-	-	-	-	-	-	X
Xanthophyllaceae	*Xanthophyllum papuana*		-	-	-	-	-	-	-	X	-	-	-	-	X	-	-
Zingiberaceae	*Alpinia* sp.	A ginger	-	-	-	-	-	-	X	X	-	X	X	X	X	-	X
Zingiberaceae	*Amomum aculeatum*		DGF WG308	-	-	-	-	-	X	X	-	X	-	X	-	-	X
Zingiberaceae	*Etlingera* sp.		-	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Zingiberaceae	*Hornstedtia scottiana*	Scott's ginger	-	-	-	-	-	-	X	-	-	-	X	X	X	-	-
Zingiberaceae	*Pleuranthodium giellerupii*		DGF WG237	-	-	-	-	-	X	-	-	-	-	-	X	-	X
Zingiberaceae	*Pleuranthodium tephrochlamys*		DGF WG238, 258	-	-	-	-	-	X	-	-	-	-	-	X	-	X
unknown	unknown herb		DGF WG157	-	-	X	-	-	-	-	-	-	-	-	-	-	X

APPENDIX C

Assessment of likelihood of occurrence of threatened and near threatened flora within the study area

Status abbreviations: IUCN: Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC), Data Deficient (DD).

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
Threatened Species that are Known or considered Likely to Occur								
Aglaia flavescens	No	Lae	Meliaceae	VU D2 ver 2.3 (1994)	Unspecified	A small tree confined to the island of New Guinea. So far it is known from only four localities all within the Milne Bay, Madang and Morobe Provinces.	Habitat loss through clearing	Likely
Aglaia lepiorrhachis	Yes – Harvard Herbaria	Harvard Herbaria	Meliaceae	VU A1c ver 2.3 (1994)	Sub-canopy tree of lowland forest.	Endemic to PNG. 8 Collections from the Madang and Morobe Province.	Utilised for house construction	Likely throughout the study area
Arthrophyllum proliferum	Yes – PNG Trees	BRI, LAE, CANB	Araliaceae	VU D2 ver 2.3 (1994)	Submontane rainforest on steep slopes.	Known only from two collections in the Kuper Range, Morobe District (IUCN 2007). Known from disturbed lowland forest in Morobe district and lowland rainforest in Manus District (PNG Plants Database). A single record from Mt Lululua, ca 30 miles NE of Fulleborn Harbour. Dist. E New Britain Subdistrict Pomio is from montane Nothofagus forest (PNG Plants Database). Collection from vicinity of Wafi area.	Unspecified	Likely
Calophyllum morobense	Yes – PNG Plants	BRI, LAE, CANB	Clusiaceae	EN B1+2c ver 2.3 (1994)	Lowland rainforest on alluvium	Endemic to Morobe Province with records in the Lae district.	Logging and habitat destruction	Likely throughout the study area.
Calophyllum robustum	Yes – PNG Plants	CANB	Clusiaceae	VU B1+2abcde ver 2.3 (1994)	This uncommon tree is found in lowland rainforest.	In the Morobe district and near Ioma in the Northern district. However, the limits of this taxon are unclear.	It is vulnerable on account of restricted distribution and possible exploitation.	Likely throughout the study area.
Flindersia pimenteliana	Yes –Leaf Atlas	BRI, LAE	Rutaceae	EN C2a ver 2.3 (1994)	A large tree found mainly in lower montane rainforest or in foothill rainforest.	In PNG, the species is widespread but uncommon and sporadic. The population status in Australia is not taken into consideration in this evaluation. Fifty collections throughout the Central, Morobe, Milne Bay Provinces and Papua (Indonesia). Collections in the Lae district.	It has been heavily exploited in the Bulolo/Wau region of Morobe Province. Populations on spurs and ridges of mountain ranges may be spared from future exploitation.	Likely throughout the study area. Recorded during field surveys undertaken by PNGFRI in Bavaga area although vouchers not taken.
Diospyros lolinopsis	No	BRI, LAE	Ebenaceae	CR B1+2c, C2b ver 2.3 (1994)	Open hillside forest.	Only a few recorded occurrences of this tree. Type collection from near the Bigei River in Madang Province and also in Adelbert Mountains (Madang Province). Additional records provided by the Lae Herbarium in the Madang and Milne Bay Provinces.	Habitat Loss/Degradation - Extraction - Wood - Clear-cutting (ongoing).	Known to occur. Recorded during field survey.
Gluta papuana (Hekakoro – timber trade name)	Yes – Harvard Herbaria		Anacardiaceae	VU A1cd+2cd ver 2.3 (1994)	This tree grows in seasonally inundated forest along rivers, in freshwater swamps and on well-drained soils up to 50 m.	Endemic to New Guinea. It occurs in Gulf, Western and Morobe Provinces with 8 collections throughout its range	The area is now subject to heavy logging activities. The timber is sought-after for its decorative grain.	Likely to occur.
Intsia bijuga	Yes	BRI	Fabaceae	VU A1cd ver 2.3 (1994)	A lowland rainforest tree which produces one of the most valuable timbers of South East Asia.	American Samoa (American Samoa); Australia; British Indian Ocean Territory (Chagos Archipelago); Cambodia; India; Indonesia (Irian Jaya, Kalimantan, Lesser Sunda Is.); Japan; Madagascar; Malaysia (Peninsular Malaysia, Sabah, Sarawak); Myanmar; PNG (Bismarck Archipelago); Philippines; Seychelles; Singapore; Solomon Islands; Tanzania, United Republic of; Thailand; Vanuatu; Vietnam.	The species has been exploited so intensively for merbau timber that few sizeable natural stands remain. Few plantations are established.	Known to occur – lowland portions of study area.
Myristica buchneriana	PNG Plants _ illustration	BRI	Myristicaceae	VU A1d ver 2.3 (1994)	Frequently found on ridge tops between 300 and 1,300 m.	22 Collection records from Irian Jaya and PNG in Northern, Central, Morobe and Milne Bay Provinces. Specimens from Ramu Valley in Madang Province	Unspecified	Known to occur. Frequently recorded during field surveys.
Pterocarpus indicus (Amoyna Wood Burmese Rosewood Red Sandlewood Santal Rouge)	Yes	BRI	Fabaceae	VU A1d ver 2.3 (1994)	A widespread tree found in lowland primary and some secondary forest, mainly along tidal creeks and rocky shores.	Cambodia; India; Indonesia (Bali, Irian Jaya, Jawa, Kalimantan, Lesser Sunda Is., Maluku, Sulawesi, Sumatera); Malaysia (Peninsular Malaysia, Sabah); Myanmar; PNG (Bismarck Archipelago, North Solomons); Philippines; Solomon Islands; Sri Lanka; Taiwan, Province of China; Thailand; Vanuatu. Collections also form Madang Province (Gogol Valley)	Subpopulations have declined because of overexploitation, sometimes illegal exploitation of the timber, as well as from increasing general habitat loss.	Known to occur. Frequently recorded during field surveys.
Near Threatened Species that are considered Known or Likely to Occur								
Aglaia flavida	Yes	BRI	Meliaceae	Lower Risk – Near Threatened	A rainforest tree. Six collections in the Morobe Province, Milne Bay and Bouganville	Six collections in the Morobe Province, Milne Bay and Bouganville	Habitat loss	Likely
Aglaia euranthera	Yes	CANB, LAE, BRI	Meliaceae	Lower Risk – Near Threatened	A small tree found in many forest habitats up to 2,100 m.	Known to occur in Papua New Guinea, Australia and Irian Jaya. Six collections throughout PNG (PNG Plants. Org)	Habitat loss through clearing	Likely – recorded during surveys undertaken by PNGFRI.
Aglaia lepidopetala	Yes	BRI, LAE, CANB	Meliaceae	Lower Risk – Near Threatened	Understorey forest tree	Widespread species with collections in the Morobe district.	Habitat loss through clearing –	Likely
Aglaia rimosa	Yes	BRI, LAE	Meliaceae	Lower Risk – Near Threatened	Generally found in secondary forests around rivers or streams	Morobe, Western, Gulf, Central, Milne Bay, New Britain, Manus & Bougainville.	Habitat Loss	Likely
Aglaia sexipetala	No	????	Meliaceae	Lower Risk – Near Threatened	Limited information	Indonesia (Irian Jaya, Jawa, Sumatera); Malaysia (Peninsular Malaysia); Papua New Guinea;	Limited information	Known to occur –recorded during field surveys.

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
						Singapore; Thailand		
Aglaia silvestris	Yes	BRI, LAE	Meliaceae	Lower Risk – Near Threatened	A widespread, variable species of various habitat types, occurring up to 2,100 m.	Cosmopoliton species with widespreas scattered distribution throughout Papua New Guinea	Habitat loss through clearing	Likely
Aglaia subcuprea	No –detailed description	BRI	Meliaceae	Lower Risk – Near Threatened	A tree of primary and secondary forest up to 2,570 m, often in periodically inundated areas.	Restricted to Morobe – Milne Bay Area	Logging and habitat loss through clearing	Likely
Cycas schumanniana (Cites Listing)	No	BRI, CANB	Cycadaceae	Near Threatened	A grassland species locally abundant in savanna grasslands or less frequently in woodlands or forests with a dense grassy understorey (RBGSYD 2012b).	Commonly occurs along the foothills of the Bismarck Range, in the Markham and Ramu valleys. Restricted to the northern side of PNG (RBGSYD 2012b).	Not specified	Known to occur. Recorded during field surveys.
Cycas apoa (Cites Listing)	No	BRI, CANB	Cycadaceae	Near Threatened	Closed mesophyll forest in wet lowland areas.	Known from northern coastal New Guinea, from the Huon Peninsula west to at least the Mamberamo River in Indonesian New Guinea. Species is an occupant of wet lowland rainforest although is often associated with low ridgelines (RBGSYD 2012c)	Not specified	Known t occur. Recorded during field surveys.
Flindersia amboinensis	Yes	BRI, CANB	Rutacaea	Lower Risk – Near Threatened	Lowland and sub-montane rainforest	A large tree, widespread but of sporadic occurrence on mainland Papua New Guinea, Seram Island and Tanimbar Islands of the Moluccas. Collections also from Morobe Province.	Logging	Known to occur
Myristica globosa	Yes	BRI, LAE, CANB	Myristicaceae	Lower Risk – Near Threatened	Rainforest up to 1200m	West Sepik, East Sepik, Madang, Morobe, Eastern Highlands, Western, Gulf, Central, Northern, Milne Bay, Papuan Islands, New Britain & Bougainville. A large number of collections in the Ramu Valley, Madang Province	Habitat destruction	Known to occur
Eucalyptopsis papuana	Yes -Illustration	BRI, CANB	Myrtaceae	Lower Risk – Near Threatened	This tree is locally common, sometimes forming pure stands, in scattered areas of rainforest up to 1,500 m.	It occurs in a small patch on Woodlark Island, in the headwaters of the Watut River in the Morobe Province and in the Western and East Sepik Provinces.	The species has been logged and exported from Woodlark Island and occurs in areas subject to further exploitation.	Known to occur. Recorded during field surveys.
Threatened Species that are considered to have Potential to Occur								
Aglaia brassii	Yes	BRI	Meliaceae	VU A1c ver 2.3 (1994)	This understorey tree is fairly common in lowland primary and secondary forest up to 500 m.	Aust. PNG and Solomon Islands with collections also from the Madang Province	Habitat loss through clearing	Possible – Lowland habitats
Aglaia cremea	Yes	Lae	Meliaceae	VU A1c ver 2.3 (1994)	It grows in secondary forest and hill forest.	Scattered collections through Irian Jaya, West Sepik, Central Highlands to Morobe Province	Habitat loss through clearing	Possible - cannot discount due to limited information on this species
Aglaia leucoclada	Yes	Lae (BRI??)	Meliaceae	VU A1c ver 2.3 (1994)	Understory tree in rainforest.	Endemic to PNG with local distribution unknown.	Habitat loss through clearing	Possible/ Unknown
Aglaia mackiana	No	??	Meliaceae	CR D ver 2.3 (1994)	Mid –elevation rainforest. Trees may be easily overlooked as this dioecious species is only identified from the fruit. It is only definitely known from the type locality. Additional collections, which differ from the type specimen but may represent the same species, have been gathered from three localities.	Endemic to PNG with local distribution unknown.Type specimen known from the Crater Mountain Wildlife Area in Simbu Province in mixed evergreen rainforest at 900 – 1200 m elevation (Mack et al 1999)	Habitat fragmentation. Dioceous species which requires undisturbed habitat to pollinate.	Possible/ Unknown
Aglaia parksii	No	???	Meliaceae	VU A1c ver 2.3 (1994)	A small tree of lowland primary forest.	PNG-North Solomon Islands.	Habitat loss through clearing	Possible/ Unknown
Aglaia penningtoniana	Yes	Lae	Meliaceae	VU A1c ver 2.3 (1994)	It occurs in rainforest from low to montane elevations.	A taxonomically variable species endemic to PNG.	Logging and habitat loss through clearing	Possible. Herbarium records from within 50km of study area.
Aglaia polyneura	No	???	Meliaceae	VU D2 ver 2.3 (1994)	Small shrubby tree confined to two unspecified localities	Indonesia (Irian Jaya); PNG.	Restricted Range	Possible/ Unknown
Aglaia puberulanthera	No	Lae	Meliaceae	VU D2 ver 2.3 (1994)	Primary montane rainforest	A very small tree, endemic to New Guinea with collections from Western and Morobe Provinces	Restricted Range	Possible dependant on altitude
Cupaniopsis bullata	Yes – Harvard Herbaria	BRI, CANB	Sapindaceae	VU D2 ver 2.3 (1994)	A small tree found in secondary vegetation.	Morobe and Central Province; known only from the type collection.	Habitat destruction	Possible - cannot discount due to limited information on this species
Flindersia laevicarpa	Leaf Atlas	BRI, LAE	Rutaceae	VU C1+2a ver 2.3 (1994)	Found in monsoon, gallery and hill forest from lowland to sub-montane rainforest.	This large tree is threatened in New Guinea by exploitation and logging activities. Its status in Australia is not considered in this evaluation.	It has a sporadic occurrence in hill forest in Varirata National Park, Central Province, where it is hoped populations will survive. Collections also from Western and Morobe Province	Possible - cannot discount due to limited information on this species
Gonystylus macrophyllus	Yes – PNG Plants	BRI, CANB	Thymeliaceae	VU A1cd ver 2.3 (1994)	A widespread tree occurring in primary forest reaching an altitude of 1,500 m in some areas	IUCN (2007) consider the species to be extremely rare however in PNG Plant Database lists 13 collections are recorded. Records from coastal/sub-coastal lowland and foothill habitats at Admiralty Is., Morobe Province south of Lae, Milne Bay, Salomoua, and Madang areas.	Unspecified	Possible
Guioa grandifolia	No	BRI	Sapindaceae	CR	From lowland rainforest and	An extremely localised species known only from	Large areas of lowland forest	Possible

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
				B1+2c ver 2.3 (1994)	advanced secondary forest.	four collections near the Buso River (Morobe Province)	in PNG are threatened by increased logging activity.	
Guioa scalariformis	No	BRI	Sapindaceae	VU D2 ver 2.3 (1994)	A shrub or small tree restricted to primary montane forest.	Morobe province. It has been collected only twice.	Unspecified	Possible – although altitudinal range appears unsuitable.
Guioa unguiculata	No	BRI	Sapindaceae	VU D2 ver 2.3 (1994)	Unspecified	A small tree known only from four collections in the Central Highlands and Morobe Province	Unspecified	Possible - cannot discount due to limited information on this species
Halfordia papuana	Yes	LAE	Rutaceae	CR ver 2.3 (1994)	This tree is scattered in submontane and montane rainforest between 1,200 and 2,700 m. Some collections as low as 250m.	Mostly confined to the Bulolo/Wau region in Morobe Province. Collections also in the West New Britain, Central Highlands Province	Logging and plantation development	Possible – note recorded occurrence in Markham Gap area (Booyong 2011). Herbarium record not confirmed.
Helicia subcordata	Yes – Harvard Herbaria		Proteaceae	CR B1+2abcde ver 2.3 (1994)	Tall forest tree in primary forest.	A tall tree found only once near Wagau in the Morobe province.	Habitat Loss/Degradation - Extraction - Wood - Clear-cutting (ongoing)	Possible - Note floristic collections from within 50 km of study area are in Queensland Herbarium database.
Horsfieldia clavata	No		Myristicaceae	VU D2 ver 2.3 (1994)	A shrub or small tree from tall lowland forest on well-drained soils	Although locally common, has been collected only three times in the Northern Province and Morobe Province.	Unspecified	Possible - limited collection data
Horsfieldia urceolata	No		Myristicaceae	VU D2 ver 2.3 (1994)	A small tree or shrub from lowland primary rainforest.	PNG-Unspecifed with range in NB unknown. Although only confirmed collections are from the Milne Bay Province	Unspecified	Low potential – limited floristic information.
Koompassia grandiflora	Yes -Illustrated		Caesalpiniaceae	VU A1cd+2cd ver 2.3 (1994)	A primary rainforest tree occurring on coastal plain foothills and stony low hills.	Vogelkop, Irian Jaya and the Morobe, Gulf and Central provinces of PNG.	Observations of active exploitation for the timber of this species in PNG were made in the 1960s; the timber continues to be in high demand and is heavily exploited in areas subject to logging. As it occurs in primary forest and in readily accessible areas, the species is considered highly vulnerable.	Possible- limited information and cannot rule out.
Mammea papyracea	Yes Harvard Herbaria	BRI	Clusiaceae	VU D2 ver 2.3 (1994)	Unspecified	A small tree, known only from the type collection, found in Buso, south of Lae in the Morobe district.	Unspecified	Possible - cannot discount due to limited information on this species
Mangifera altissima	Mangifera minor only	BRI	Anacardiaceae	VU A1d ver 2.3 (1994)	A timber species of lowland evergreen forest.	Indonesia (Irian Jaya, Lesser Sunda Is., Maluku, Sulawesi); Malaysia (Sabah); PNG (Bismarck Archipelago); Philippines; Solomon Islands.	Logging	Possible - cannot discount due to limited information on this species
Myristica pygmaea	No	BRI	Myristicaceae	VU D2 ver 2.3 (1994)	Lowland rainforest and logged forest.	A small tree, endemic to Morobe Province, where it has been collected twice.	Unspecified	Possible
Myristica schlechteri	No		Myristicaceae	VU D2 ver 2.3 (1994)	Unspecified	The only specimen of this understorey tree was collected in 1908 in forest near Pema, Morobe Province.	Unspecified	Possible
Myristica sinclairii	Yes (PNG Plants database)		Myristicaceae	VU D2 ver 2.3 (1994)	This understorey tree grows in *Castanopsis* forest	A total of five collections have been gathered from Morobe Province.	Unspecified	Possibly occurs although suitable habitat not recorded in study area.
Near Threatened Species that are considered to have Potential to Occur								
Adinandra forbesii	Yes	BRI, LAE	Pentaphylaceae	Lower Risk – Near Threatened	A tree scattered in monsoon forest, savannah woodland and lower montane forest up to 1,200 m.	Morobe, Western Highlands, Eastern Highlands, Southern Highlands, Western, Gulf, Central, Northern & New Britain	In Papua New Guinea, the subpopulation has suffered from logging activities over recent years in the Oriomo River area, Western Province, where the species was once fairly common.	Possible
Agathis labillardieri	No	CANB	Araucariaceae	Near Threatened	Scattered emergents survive in small exposed groves of rainforest in the eastern highlands.	Collections in the Morobe Province, Sepik and Irian Jaya	Over exploitation of the timber is a threat.	Possible – limited floristic information.
Geijera salicifolia	Yes	BRI, CANB	Rutaceae	Lower Risk – Near Threatened	Lowland and sub-montane rainforest	A timber species, which in New Guinea is mainly confined to the Bulolo/Wau region of Morobe Province. Also known from Australia	This region was once heavily exploited, logged and converted into *Araucaria* plantations.	Possible
Podocarpus rumphii	No	???	Podocarpaceae	Near Threatened	Widespread tree occurring in lowland to lower montane forest.	Widespread throughout Oceania	Habitat degradation	Possible
Threatened Species that are considered to Unlikely to Occur								
Acacia crassicarpa	Yes		Mimosaceae	VU A1cd	A tree of savannah woodland, monsoon forest and gallery-type forest at altitudes of between 10 and 30 m.	Restricted to the Western Province, PNG, and to Queensland, Australia.	Logging is occurring and the timber is actively sought-after.	Unlikely
Aglaia barbanthera	No		Meliaceae	VU A1c ver 2.3 (1994)	This species is restricted to primary forest between 60 and 2,000 m.	Indonesia and PNG. Collections from Milne Bay area (Rossel Island)	Habitat loss and clearing	Unlikely - cannot discount due to limited information on this species

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
Aglaia brownii	Yes	Lae (BRI??)	Meliaceae	VU A1c ver 2.3 (1994)	Small tree mainly found in coastal forest.	Australia (Northern Territory, Queensland); Indonesia (Irian Jaya); PNG. Distribution in Bismarck Archipelago unknown.	Habitat loss through clearing	Unlikely based on current information
Aglaia cinnamomea	Yes	Lae	Meliaceae	VU A1c ver 2.3 (1994)	Unspecified	PNG- Distribution unknown.	Unspecified	Unlikely - cannot discount due to limited information on this species
Aglaia cuspidata	Yes	Lae	Meliaceae	VU D2 ver 2.3 (1994)	Primary and secondary rainforest	Known from three localities in PNG in the Milne Bay and Madang Provinces	Habitat loss through clearing	Unlikely– outside species general range
Aglaia integrifolia	Yes – Harvard Herbaria	Lae BRI	Meliaceae	VU D2 ver 2.3 (1994)	A small tree restricted to lowland deciduous hill forest.	So far it is known from only four undisclosed localities.	Utilised for house construction	Unlikely - Isotype collected in Gulf Province east of Port Moresby at 400 m altitude
Aglaia rubrivenia	No		Meliaceae	VU A1c ver 2.3 (1994)	Primary montane rainforest	Restricted to the North Solomon Islands.	Forest Clearing and Habitat Destruction	Unlikely
Albizia carrii	No		Mimosaceae	VU A1c ver 2.3 (1994)	Monsoon forest	This endemic tree is so far known only from areas in the Port Moresby region and Motupore Island.	Forest Clearing and Habitat Destruction	Unlikely
Alectryon repandodentatus	Yes (3d Enviro)		Sapindaceae	VU B1+2c ver 2.3 (1994)	A small tree of scrub and savannah.	Only known from the Port Moresby region and Motupore Island in PNG and Murray Island in Australia.	Continued and projected decline in range.	Unlikely
Alloxylon brachycarpum	Illustrated		Proteaceae	EN A2cd ver 2.3 (1994)	This tree is scattered in lowland rainforest and monsoon forest.	Confined to Western Province in south PNG and adjacent Digul District, Irian Jaya, extending into the Aru Islands. 16 individual collections in lowland rainforest	Continued and projected decline in range.	Unlikely
Alstonia breviloba	Yes – Harvard Herbaria		Apocynaceae	VU B1+2c ver 2.3 (1994)	The species occurs in secondary and primary montane forest.	Endemic to PNG with single collection in the Eastern Highlands Province	Continued and projected decline in range. Restricted distribution	Unlikely
Alstonia rubiginosa	Yes – Harvard Herbaria		Apocynaceae	VU B1+2c ver 2.3 (1994)	The species occurs in secondary and primary montane forest.	Endemic to PNG. Single collection from the Central Province.	Continued and projected decline in range. Restricted distribution	Unlikely
Archidendron forbesii	Yes – Harvard Herbaria		Mimosaceae	VU B1+2c ver 2.3 (1994)	A late secondary tree scattered in lowland rainforest.	It is confined to the Central province.	Unspecified	Unlikely – Note records in Booyong (2011) which are inconsistent with known range of the species.
Avicennia rumphiana	No Image	???	Avicenniaceae	Vulnerable –A2c (2008)	Mangrove forest	Littoral zone around the coast of PNG including Madang district	Harvesting of mangrove forests	Unlikely
Bleasdalea papuana	Illustrated		Proteaceae	EN C2a ver 2.3 (1994)	Lower montane forest on serpentine soils.	An uncommon species of isolated occurrence. It has been recorded from the Vogelkop Peninsula and Jayapura in Irian Jaya and the East Sepik and Morobe provinces in PNG.	Habitat destruction	Unlikely
Brachychiton carruthersii	Yes – PNG Plants Database		Sterculiaceae	VU B1+2c, C2a ver 2.3 (1994)	A tree scattered in lowland coastal and monsoon forest, often in the transition zone between savannah woodland and lowland forest	It is mainly restricted to monsoon forest in Central Province, Milne Bay, Popondetta, Gulf Province. Single collection in vicinity of Lae (PNG Plants).	Habitat destruction	Unlikely - Study area likely to be too wet.
Brachychiton velutinosus	No		Sterculiaceae	VU B1+2c, C2a ver 2.3 (1994)	A tree scattered in lowland coastal and monsoon forest, often in the transition zone between savannah woodland and lowland forest. In PNG, it is mainly restricted to monsoon forest.	In PNG, it is mainly restricted to the Central Province. It occurs also on the Cape York Peninsula, Qld, Australia.	Habitat destruction	Unlikely
Bruguiera hainesii	No Image		Rhizophoraceae	CR – C1 (2008)	Very rare tree restricted to mangrove forest	South coast of Papua New Guinea in mangrove forest	Mangrove harvesting	Unlikely
Calophyllum acutiputamen	No		Clusiaceae	CR B1+2abcde ver 2.3 (1994)	This canopy species is found on ridges in colline forest.	Known only from Rossel Island.	Habitat destruction	Unlikely
Calophyllum waliense	Yes _PNG Plants		Clusiaceae	EN B1+2abcde ver 2.3 (1994)	A species restricted to lowland rainforest on ridges.	Manus Island – Bismarck Archipelago	The habitat has been heavily logged and degraded.	Unlikely – out of known geographic range.
Canthium suborbiculare	No		Rubiaceae	VU D2 ver 2.3 (1994)	It is found in savannah or scrub.	This shrub or small tree is restricted to the Port Moresby region and Morupore Island. It is known only from five or six collections.	Unspecified	Unlikely – outside geographic range.
Ceratopetalum succirubrum	Yes – PNG Plants	LAE	Cunoniaceae	VU A2cd ver 2.3 (1994)	Primary monsoon forest. Lowland to sub montane forest	19 collections in PNG across, West New Britain, Western Province, Milne Bay and Papua Indonesia. In PNG sub-populations are mainly confined to Western Province. More information is needed on the sub-population status in Australia.	Habitat degradation	Unlikely. Not consistent with broad geographic range.
Chisocheton stellaris	Illustrated - yes	LAE	Meliaceae	VU D2 ver 2.3 (1998)	Primary and Secondary Rainforest	In PNG known from Madang Province	Logging and woodchipping operations	Unlikely – outside general geographic range.
Cupaniopsis acuticarpa	Yes		Sapindaceae	VU D2 ver 2.3 (1994)	Unspecified	A small tree or shrub known only from the type collection from Central Province.	Habitat Destruction	Unlikely – outside geographic range.
Cupaniopsis euneura	No		Sapindaceae	VU D2 ver 2.3 (1994)	Montane Rainforest. Collection at 2250m	This species is only known from the type collection, gathered from West Highlands Province.	Habitat destruction with restricted range	Unlikely
Cupaniopsis napaensis	No		Sapindaceae	VU D2 ver 2.3 (1994)	Scrub	This species is known only from the type collection, which was located near a dry creek in Central Province.	Unspecified	Unlikely

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
Cupaniopsis phanerophleibia	No	BRI	Sapindaceae	VU D2 ver 2.3 (1994)	Understorey tree in primary rainforest	A tree from Western Province, known only from a single collection.	Unspecified	Unlikely –Outside general species range.
Diospyros benstonei	No		Ebenaceae	CR C2b ver 2.3 (1994)	This small rare tree occurs in streamside rainforest in a gorge.	Apparently confined to Misima Island in Milne Bay Province.	The population is threatened by mining and cutting for local use.	Unlikely
Diospyros gillisonii	Yes – Harvard Herbarium		Ebenaceae	EN A1cd+2cd, C2a ver 2.3 (1994)	Occurs in beach scrub on coral limestone at sea level.	A tree scattered throughout the small coral islands in the Kiriwina (Trobriand) Group and the Louisiade Archipelago. Very few mature trees, if any, remain.	Heavily exploited by the local people for its black heartwood, which is used in carvings, native hair combs and ceremonial pieces.	Unlikely
Diospyros insularis	No		Ebenaceae	EN A1cd+2cd, B1+2c ver 2.3 (1994)	A tree of primary lowland rainforest.	Found in only a few localities in the Solomon Islands and New Ireland of the Bismarck Archipelago.	Overexploitation and logging have resulted in the species becoming highly endangered, possibly critically endangered.	Unlikely – Note records in Booyong (2011) which are inconsistent with known range of the species.
Elattostachys aiyurensis	No	BRI	Sapindaceae	VU D2	Small palmoid tree in primary rainforest	Known only from type description in the Eastern Highlands (Madang Province??)	Habitat Loss	Unlikely – outside geographic range
Elattostachys goropuensis	No	CANB	Sapindaceae	VU D2	Small palmoid tree in ficus Euphorbia forest.	Known only from type description in the Northern Province	Habitat Loss	Unlikely – outside geographic range
Elattostachys rubrofractus	No	BRI	Sapindaceae	VU B1 and 2c	Small tree of lowland rainforest and swamp forest	Seven collections all from northern and central provinces. Collection also from eastern highlands	Fragmentation and habitat loss	Unlikely – outside geographic range
Flindersia ifflaiana	Leaf Atlas		Rutaceae	EN A2cd, B1+2c ver 2.3 (1994)	This tree is found in monsoon and gallery forest up to 50 m.	PNG. The species occurs in the Oriomo River ecosystem in Western Province. The above threat category applies only to the population in PNG. More information is needed from Queensland.	The area is relatively restricted, fragile and threatened by logging activities.	Unlikely – outside geographic range
Geniostoma umbellatum	No		Loganiaceae	VU D2 ver 2.3 (1994)	Hillside secondary forest on well-drained soil.	A small semi-erect tree found only once on Guadalcanal.	Unspecified	Unlikely – outside geographic range
Guioa hospita	No		Sapindaceae	CR D ver 2.3 (1994)	Unspecified	The only record of this species is the type specimen collected in 1890 in Gulf Province. Despite the area being relatively well studied, it has not been recorded since.	Unspecified	Unlikely – outside geographic range
Guioa molliuscula	No		Sapindaceae	VU D2 ver 2.3 (1994)	Understorey tree of alluvial swamp.	To date there are just two collections from the 1950-'60s in the Eastern Highlands NB distribution unknown	Unspecified	Unlikely – outside geographic range
Guioa normanbiensis	No		Sapindaceae	VU D2 ver 2.3 (1994)	Unspecified	Confined to the Milne Bay province on Normanby Island, this tree is known from only four collections to date.	Unspecified	Unlikely – outside geographic range
Guioa novobritannica	No		Sapindaceae	VU D2 ver 2.3 (1994)	*Casuarina rumphiana*-dominated montane forest.	A tree known only from the type specimen, collected in west New Britain.	Unspecified	Unlikely – outside geographic range
Guioa oligotricha	No		Sapindaceae	VU D2 ver 2.3 (1994)	Found in lowland secondary forest.	A small tree, known only from three collections in the Southern Division of Irian Jaya and the Western Province of PNG. These areas are under explored.	Unspecified	Unlikely – outside geographic range
Guioa pauciflora	No		Sapindaceae	VU D2 ver 2.3 (1994)	Unspecified	Single specimen collection from the West Sepik area.	Unspecified	Unlikely – outside geographic range
Guioa plurinervis	No		Sapindaceae	VU D2 ver 2.3 (1994)	Secondary hill rainforest.	To date this species is known only from three collections in Milne Bay Province in Rossel Island. There has been little collecting from this island.	Unspecified	Unlikely – outside geographic range
Helicia acutifolia	Illustrated		Proteaceae	VU D2 ver 2.3 (1994)	A small tree of secondary forest at 2,040 m.	Confined to Mt. Victoria in the central district.	Unspecified	Unlikely – outside geographic range
Helicia australasica	No		Proteaceae	VU C2b ver 2.3 (1994)	A tree usually found in patches of rainforest along rivers and streams.	In PNG, it is known only from the Western province. The status of this species in Northern Australia has not been considered in this threat category.	Unspecified	Unlikely – outside geographic range
Helicia calocoma	Illustrated Harvard Herbaria		Proteaceae	VU B1+2c ver 2.3 (1994)	Montane and sub-montane rainforest	Confined to the Morobe district up to 1800m	Extraction - Wood - Clear-cutting (ongoing)	Unlikely – Suitable geography range although outside general altitudinal range.
Helicia insularis	Yes – Harvard Hebaria		Proteaceae	EN B1+2abcde ver 2.3 (1994)	This tree is restricted to ridgeline mossy rainforests	Milne Bay Province – Normanby and Ferguson Islands	Habitat Destruction	Unlikely –unsuitable habitat
Helicia neglecta	Illustrated		Proteaceae	VU A1cd, C2a ver 2.3 (1994)	A tree of primary and secondary forest up to 400 m.	Occurs only on New Britain and New Ireland in the Bismarck Archipelago.	It is potentially threatened by ongoing and future logging activities and encroaching agriculture.	Unlikely –outside known geographical range
Helicia peekelii	Illustrated		Proteaceae	VU D2 ver 2.3 (1994)	It is thought to occur in coastal forest.	This lowland tree is known only from Namatanai, New Ireland.	Unspecified	Unlikely –outside known geographical range

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
Helicia peltata	Yes – Harvard Hebaria		Proteaceae	CR B1+2abcde ver 2.3 (1994)	This tree occurs in forest at 450 m.	Known only from a single location, Bisiatabu in the Central Province.	The habitat is threatened by logging and the increasing settlement.	Unlikely –outside known geographical range
Helicia polyosmoides	Illustrated		Proteaceae	CR B1+2abcde ver 2.3 (1994)	Occurs in ridge forest between the elevations of 100 and 550 m.	This small tree is restricted to Manus Island in the Bismarck Archipelago.	This species may face extinction through the commercial logging of its habitat.	Unlikely –outside known geographical range
Helicia retusa	No		Proteaceae	VU D2 ver 2.3 (1994)	Occurring in ridge forest between 1,600 and 1,900 m.	This small tree found is known only from Milne Bay District.	Unspecified	Unlikely –outside known geographical range
Helicia rostrata	Yes – Harvard Herbaria		Proteaceae	VU D2 ver 2.3 (1994)	A small tree, so far known only from lower montane forest between 2,000 and 2,200 m.	Only collection at Mt. Dayman.- Milne Bay Province	Unspecified	Unlikely –outside known geographical range
Hopea inexpectata	Yes		Dipterocarpaceae	CR A1cd, B1+2c ver 2.3 (1994)	Occurs in primary forest on clay soils (PNG Plant Database).	West Papua - Irian Jaya (PNG Plant Database).	Unspecified	Unlikely –outside known geographical range
Horsfieldia ampla	No		Myristicaceae	VU D2 ver 2.3 (1994)	Dense humid forest.	A small tree known only from the type collection which was found in Sepik Province.	Unspecified	Unlikely –outside known geographical range
Horsfieldia ampliformis	No		Myristicaceae	VU D2 ver 2.3 (1994)	A small tree of lower montane rainforest.	Known from two collections, one from Sepik Province and the other from Morobe Province.	Unspecified	Unlikely - limited collection data although altitudinal range appears unsuitable.
Horsfieldia sepikensis	No		Myristicaceae	VU D2 ver 2.3 (1994)	Tree found in both primary and secondary forest.	So far it is only known from three collections from East Sepik Province.	Unspecified	Unlikely –outside known geographical range
Horsfieldia squamulosa	Yes – Harvard Herbaria		Myristicaceae	VU D2 ver 2.3 (1998)	Unspecified	A locally common understorey shrub or small tree restricted to the Western Province and known only from three collections.	Unspecified	Unlikely –outside known geographical range
Kayea coriacea	No		Clusiaceae	VU D2 ver 2.3 (1994)	Occurs in lowland seasonally flooded or ridge forest.	This tree is found in Western District and has recently been discovered on Sudest Island, Milne Bay. The taxonomic limits of the species are presently unknown. It could represent more than one taxon.	Unspecified	Unlikely -Limited information.
Kayea macrophylla	No		Clusiaceae	VU D2 ver 2.3 (1994)	A small tree of lowland rainforest.	Known from two collections: one from Geelvink Bay, Irian Jaya, and the other from an area near Angoram in the East Sepik district of PNG.	Unspecified	Unlikely –outside known geographical range
Madhuca boerlageana	Madhuca leucodermis only		Sapotaceae	CR A1cd, C2ab, D ver 2.3 (1994)	Tree of primary lowland forest.	New Guinea and the Moluccas. In PNG, this species is extremely rare and known from a single sterile collection made from the Vanimo area, West Sepik province. The above threat category applies to the situation in PNG only.	Habitat Loss/Degradation - Extraction - Wood - Clear-cutting (ongoing)	Unlikely –outside known geographical range
Mammea grandifolia	Yes		Clusiaceae	VU D2 ver 2.3 (1994)	Unspecified (Lowland Rainforest)	This small tree, known only from the type collection, was found along Pinini Creek in the Gulf province. The taxonomic limits of this species are unclear.	Unspecified	Unlikely –outside known geographical range
Mammea papuana	No		Clusiaceae	VU D2 ver 2.3 (1994)	Unspecified	A rainforest tree known only from two collections from East Sepik. The taxonomic limits of this species are unclear.	Unspecified	Unlikely –outside known geographical range
Mammea veimauriensis	No		Clusiaceae	VU D2 ver 2.3 (1994)	Lowland rainforest.	The description of this species is based on two herbarium specimens. This tree is found along the Veimauri River, Pt Moresby district where it is reported to be quite common.	Unspecified	Unlikely – although impossible to discount
Manilkara kanosiensis	No	CANB	Sapotaceae	EN A1cd+2cd, C2a ver 2.3 (1994)	This timber tree is scattered in primary lowland rainforest.	Relatively widespread but uncommon. It occurs mainly in areas where intense logging is being carried out, such as New Britain and New Ireland in the Bismarck Archipelago and the north-west of PNG.	Logging	Unlikely based on known distribution.
Mastixiodendron stoddardii	Mastixiodendron pachyclados only		Rubiaceae	VU A1cd+2cd, B1+2abcde ver 2.3 (1994)	A large timber tree of primary lowland rainforest.	Poorly collected with existing data indicating this species is restricted to Kiunga area, New Britain in the Bismarck Archipelago and the Solomon Islands.	New Britain is one of the most intensively logged islands in the Bismarck Archipelago, thereby threatening this species with habitat destruction. The Solomon Islands subpopulation is also at risk from logging activities.	Unlikely –outside known geographical range
Myristica atresens	No		Myristicaceae	VU D2 ver 2.3 (1994)	Lowland forest.	The type specimen is the only known collection of the tree. It was gathered near the border of PNG in south-eastern Irian Jaya.	Unspecified	Unlikely –outside known geographical range
Myristica brachypoda	Yes		Myristicaceae	VU D2 ver 2.3 (1994)	Lowland forest.	The type species was gathered in 1955 in logged-over forest near the Seribi River in the Gulf Province. It is the only known collection of the species.	Unspecified	Unlikely –outside known geographical range
Myristica brevistipes	No		Myristicaceae	VU D2 ver 2.3 (1994)	Tall lowland / foothill rainforest	A small tree collected only on one occasion in tall foothill forest in the Central Province.	Unspecified	Unlikely –outside known geographical range
Myristica byssacea	Yes		Myristicaceae	VU D2 ver 2.3 (1994)	A small tree of montane forest.	Known from only two collections from the montane forest in the Northern Province.	Unspecified	Unlikely –outside known geographical range
Myristica coacta	Yes	BRI	Myristicaceae	VU D2 ver 2.3 (1994)	This species occurs in degraded Fagaceous forest.	Known only from the type collection of 1968 in West Sepik Province.	Unspecified	Unlikely –outside known geographical range

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
Myristica dasycarpa	No	_	Myristicaceae	VU D2 ver 2.3 (1994)	This subcanopy tree was found growing on a ridge at approximately 50 m.	Known only from the type collection in the Waskuk Hills, East Sepik Province. Another collection from Irian Jaya might belong to this recently described species.	Unspecified	Unlikely –outside known geographical range
Myristica fasciculata	No	-	Myristicaceae	VU D2 ver 2.3 (1994)	Primary and secondary forest.	Collected three times, this species is locally common in the upper Sepik River region of Sepik Province.	Unspecified	Unlikely –outside known geographical range
Myristica incredibilis	Yes		Myristicaceae	VU D2 ver 2.3 (1994)	Unspecified	A tree known only from the type specimen collected on Rossel Island.	This island has a fragile ecosystem, with very poor soils, which is possibly threatened by gold and copper mining and logging.	Unlikely –outside known geographical range
Myristica inundata	No		Myristicaceae	VU D2 ver 2.3 (1994)	Seasonally inundated swamp forest.	Known only from the type specimen, this species occurs in Kiunga, Western Province.	Unspecified	Unlikely –outside known geographical range
Myristica lasiocarpa	No	BRI	Myristicaceae	VU D2 ver 2.3 (1994)	A subcanopy species, occurring as solitary trees in *Nothofagus* forest.	It has only been collected only twice from the Kuper Range area of the Morobe Province.	Unspecified	Unlikely – no suitable habitat in the study area
Myristica leptophylla	Yes –PNG Plants		Myristicaceae	VU D2 ver 2.3 (1994)	The species occurs in secondary regrowth at medium elevation.	Known only from the type locality, near Busilmin, West Sepik Province.	Unspecified	Unlikely –outside known geographical range
Myristica mediterranea	No		Myristicaceae	VU D2 ver 2.3 (1994)	This small tree occurs in disturbed forest or semi-swamp in valley forest.	Known only from three collections from the southern border between Irian Jaya and PNG.	Unspecified	Unlikely –outside known geographical range
Myristica nana	Yes – PNG Plants		Myristicaceae	VU D2 ver 2.3 (1994)	Unspecified	A small tree, known from four collections, locally endemic to forest in the Central and Milne Bay Provinces.	Habitat destruction	Unlikely –outside known geographical range
Myristica olivacea	No		Myristicaceae	VU D2 ver 2.3 (1994)	An understorey rainforest tree.	Known only from four collections from near Amazon Bay, Central Province	Unspecified	Unlikely –outside known geographical range
Myristica ornata	No		Myristicaceae	VU D2 ver 2.3 (1994)	Lowland rainforest.	Known only from the type specimen, the tree was discovered in the Kiunga area, Western Province.	Unspecified	Unlikely –outside known geographical range
Myristica ovicarpa	No		Myristicaceae	VU D2 ver 2.3 (1994)	Lowland hill forest.	This tree is known only from the type collection. It was found on Mt. Don of Rossel Island.	Unspecified	Unlikely –outside known geographical range
Myristica pachycarpidia	No		Myristicaceae	VU D2 ver 2.3 (1994)	Oak forest.	A tree known only from the type locality on Mt. Dayman, Milne Bay Province.	Unspecified	Unlikely –outside known geographical range
Myristica papillatifolia	No		Myristicaceae	VU D2 ver 2.3 (1994)	Valley forest.	A small tree found only once near Ingambit in the Western Province, near the border with Irian Jaya.	Unspecified	Unlikely –outside known geographical range
Myristica pilosella	Yes – PNG Plants		Myristicaceae	VU D2 ver 2.3 (1994)	*Castanopsis* forest.	A small tree known only from a site at the junction of the Ugat and Mayu Rivers in Milne Bay Province.	Unspecified	Unlikely –not possible to discount.
Myristica polyantha	No		Myristicaceae	VU D2 ver 2.3 (1994)	A canopy or subcanopy tree.	Restricted to Goodenough Island, where it has been collected twice. The D'Entrecasteaux Islands harbour many locally endemic species and require botanical investigation.	Unspecified	Unlikely –outside known geographical range
Myristica psilocarpa	Yes (PNG Plants database)		Myristicaceae	VU D2 ver 2.3 (1994)	Lowland rainforest.	An endemic to Manus Island, this tree has been collected twice.	Unspecified	Unlikely
Myristica simulans	No		Myristicaceae	VU D2 ver 2.3 (1994)	Riverine rainforest.	The sole collection of this tree was gathered at Modewa Bay, Milne Bay Province.	Unspecified	Unlikely –outside known geographical range
Myristica sogeriensis	No		Myristicaceae	VU D2 ver 2.3 (1994)	Shrub or small tree in foothill forest.	Endemic to the Sogeri region of Central Province, it has been collected twice in foothill forest.	Unspecified	Unlikely –outside known geographical range
Neuburgia tubiflora	Neuburgia corynicarpia only		Loganiaceae	VU D2 Ver 2.3	Secondary Lowland Forest	A shrub or small tree, so far known only from two collections taken in the Vogelkop district.	Habitat destruction –restricted range	Unlikely –outside known geographical range
Nothofagus nuda	Yes		Nothofagaceae	CR D Ver 2.3	Mixed lower montane forest	A single collection in the Tauri River, Gulf Province	Habitat destruction –restricted range	Unlikely –outside known geographical range
Osmoxylon arrhenicum	No		Araliaceae	VU D2 ver 2.3 (1994)	Steep hill forest at 700 m.	Endemic to Santa Isabel, this species is known only from the site where it was first collected.	Unspecified	Unlikely –outside known geographical range
Osmoxylon chrysanthum	No		Araliaceae	VU D2 ver 2.3 (1994)	The type was found in a riverine community on the debris banks of a deep gorge at 300 m.	A small tree, known only from the type collection on Guadalcanal Island (North Solomons)	Unspecified	Unlikely –outside known geographical range
Osmoxylon corneri	No		Araliaceae	VU D2 ver 2.3 (1994)	This small tree was collected at 1,470 m.	Endemic to Guadalcanal (North Solomons), known only from the type specimen.	Unspecified	Unlikely –outside known geographical range
Osmoxylon ellipsoideum	No		Araliaceae	VU D2 ver 2.3 (1994)	A many-branched tree, presently known only from areas of secondary or disturbed lowland hill forest.	Milne Bay district.	Unspecified	Unlikely –outside known geographical range
Osmoxylon lanceolatum	No		Araliaceae	VU D2 ver 2.3 (1994)	An understorey tree in ridge-top forest on limestone between 750 and 850 m.	Endemic to central and south New Ireland.	Unspecified	Unlikely –outside known geographical range
Osmoxylon reburrum	No		Araliaceae	VU D2 ver 2.3 (1994)	Unspecified	A small tree, so far known only from the type collection from the Malaita district.	Unspecified	Unlikely –outside known geographical range
Osmoxylon whitmorei	No		Araliaceae	VU D2 ver 2.3 (1994)	Unspecified	Endemic to Guadalcanal – North Solomons	Unspecified	Unlikely –outside known

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
								geographical range
Pericopsis mooniana	Seed and description only		Leguminosae	VU D2 ver 2.3 (1998)	Coastal forest	In Papua New Guinea, this species is restricted to the heavily logged Oriomo River in the Western Province, where it is possibly now extinct.	The species has been heavily exploited for its timber.	Unlikely –outside known geographical range
Pongamia velutina	No		Leguminosae	Vulnerable B1 and B2 + C2a Version 2.3	Coastal rainforest	Coastal areas of the central province	/	Unlikely –outside known geographical range
Psydrax suborbicularis	No		Rubiaceae	Vulnerable D2 Version 2.3	Coastal rainforest	Several records near Port Moresby and more broadly in the central province		Unlikely –outside known geographical range
Rosselia bracteata	No		Burseraceae	Vulnerable B1+2c ver 2.3 (1998)	Uspecified	Endemic to Rossel Island in the Louisade Archipelago	Unspecified	Unlikely –outside known geographical range
Santalum macgregorii	No		Santalaceae	EN A1cd, C1 ver 2.3 (1994)	A parasitic or semi-parasitic species found in open savannah vegetation and in savannah forest in gullies.	Found in the Central Province, eastern part of Western Province and possibly also in south-east Irian Jaya.	As with all other sources of sandalwood, this species is overexploited for its scented wood, which is used for incense, perfume, essential oil and carving. In PNG the exploitation began at the turn of the last century; now the resource is greatly depleted as there are few mature trees or virgin stands.	Unlikely –outside known geographical range
Schistochila undulatifolia	No		Schistochilaceae (Liverwort)	Critically Endangered B1+2c ver 2.3 (2000)		Known from one type locality in the Sepik Province	Fallen trunks in undisturbed rainforest	Unlikely –outside known geographical range
Tabernaemontana remota	No		Apocynaceae	VU B1+2c ver 2.3 (1994)	A shrub or small tree up to 10 m high, occurring in submontane scrub or forest.	It is known from several collections from Sulawesi and Rossel Island of PNG.	The fragile ecosystem of Rossel Island is threatened by logging and mining activities.	Unlikely –outside known geographical range
Terminalia archipelagi	Yes	BRI	Combretaceae	EN A1cd+2cd, C2a ver 2.3 (1994)	This large well-formed tree can be locally dominant in lowland primary rainforest.	Occurring on the islands of the Bismarck Archipelago. A single collection also from the Madang Province	It has been and still is heavily exploited through intensive logging practices. It is much sought-after for the production of plywood.	Unlikely – limited floristic information.
Terminalia eddowesii	No		Combretaceae	VU B1+2abcde ver 2.3 (1994)	The species is found mainly in small pockets of riverine forest surrounded by savannah woodland, and occasionally in lowland rainforest.	Confined to Central Province with 18 collections recorded from the Central Province.	It is mainly threatened by urban expansion, local exploitation and logging activities.	Unlikely –outside known geographical range
Xanthostemon oppositifolius	No		Myrtaceae	Endangered B1+2c, C2a ver 2.3 (1998)	Coastal rainforest	Papua New Guinea, in Milne Bay Province.	Heavy exploitation	Unlikely –outside known geographical range
Near Threatened Species that are considered Unlikely to Occur								
Acacia aulacocarpa	Yes	BRI	Mimosaceae	Lower Risk – Near Threatened	Savannah and monsoon forest up to an altitude of 50 m.	In New Guinea, this tree is restricted to Digul District in Irian Jaya and the Oriomo River area in the Western Province of Papua New Guinea. More information is needed on subpopulations in eastern and northern Australia.	Part of the range is subject to logging. Continued exploitation and habitat destruction have reduced the number of mature individuals and, if not halted, will render the species as a whole vulnerable.	Unlikely
Aglaia agglomerata	Yes	LAE, BRIS, CANB	Meliaceae	Lower Risk – Near Threatened	This tree is scattered in lowland to midmontane primary and secondary forest.	Six collections all from Simbu Province	Habitat loss	Unlikely – outside known geographic range
Aglaia parviflora	No	LAE	Meliaceae	Lower Risk – Near Threatened	Small rainforest tree	Known from Bismarck Archipelago and Solomon Island	Habitat Destruction	Unlikely
Aglaia samoensis	No	??	Meliaceae	Lower Risk – Near Threatened	Understory tree in rainforest up to 830m	Samoa (American Samoa); Indonesia (Irian Jaya); Papua New Guinea (Bismarck Archipelago, North Solomons); Samoa; Solomon Islands (Santa Cruz Is.); Vanuatu; Wallis and Futuna	Habitat loss through clearing	Unlikely –outside known geographic range
Appendicula tenuispica	No –detailed description	BRI	Orchidaceae	Near Threatened	Mossy primary forest	Throughout mainland PNG	Logging and habitat loss through clearing	Unlikely – no suitable habitat in the study area
Araucaria hunsteinii	Yes	BRI, CANB, LAE	Araucariaceae	Near Threatened	Recorded to be the tallest tree in Malesia, reaching 90 m in height, the species occurs mainly in Fagaceae forest between 520 and 2,100 m.	Madang, Morobe and Eastern Highlands	Logging	Unlikely – no suitable habitat in the study area
Burckella sorei	No	??	Sapotaceae	Lower Risk – Near Threatened	This timber tree is found mainly in primary lowland rainforest.	Restricted to Bouganville and North Solomons	Logging acivities and over exploitation	Unlikely
Cycas scratchleyana (Cites Listing)	No	BRI, CANB	Cycadaceae	Near Threatened	Closed mesophyll forest in wet lowland areas.	All collections from the Western, Gulf, Central, Milne Bay Provinces plus Irian Jaya. No current collections from the northern part of PNG.	Not specified	Unlikely –outside known geographic range
Cycas bouganvilleana (Cites Listing)	No	BRI, CANB, LAE	Cycadaceae	Near Threatened	Monsoon forest	Restricted to North Solomons, New Britain with scattered collections on the north coast of Madang	Not specified	Unlikely
Cycas campestris (Cites Listing)	No	BRI, CANB, LAE	Cycadaceae	Near Threatened	Unspecified	All collections from the Central Province, mostly in the vicinity of Port Moresby	Not specified	Unlikely
Cycas papuana (Cites Listing)	No	BRI, CANB	Cycadaceae	Near Threatened	Unspecified	All collections from the Western Province, Madabuan Hill and Morehead River.	Not specified	Unlikely

Species	Image Available	Specimen Held	Family	IUCN Classification	Habitat*	Distribution*	Threats	Likelihood in Study Area
Cycas rumphii	No	BRI, CANB	Cycadaceae	Near Threatened	Unspecified	Widespread from Western Province, Irian Jaya to North Solomens including collections from Madang sub-district.	Not specified	Unlikely
Dacrydium magnum	Yes	BRI, LAE	Podocarpaceae	Near Threatened	Lowland rainforest, particularly on hill crests.	Populations are known from the islands of Guadalcanal, Choiseul and Santa Ysabel in the Solomons, from the Louisades in Papua New Guinea and Obi Island in the Moluccas.	Forest management activities and agricultural pressures could cause rapid population losses to most or all parts of the range.	Unlikely
Flindersia schottiana	Yes	BRI, LAE	Rutacaea	Lower Risk – Near Threatened	This species is widespread in monsoon, hill and lower montane forest.	Widespread although prominent in the Western and Central Provinces	In Papua New Guinea, it was subject to exploitation in two major logging areas in Morobe and Western Provinces. Subpopulations in the rugged mountains of Owen Stanley Range may be spared from exploitation.	Unlikely based on known distribution
Helicia albiflora	Yes	BRI, CANB, LAE	Proteaceae	Lower Risk – Near Threatened	A tree often found in *Castanopsis-Nothofagus* rainforest from 900 to 2,000 m.	Known from the East and Western Highlands, Morobe, Northern and Central provinces of Papua New Guinea.	Habitat destruction	Unlikely – study area is outside altitudinal range for this species.
Helicia amplifolia	Yes – Harvard Herbaria	BRI, LAE	Proteacea	Lower Risk – Near Threatened	A tree occurring in primary or secondary rainforest or submontane forest from 600 to 1,300 m.	It is known from the Eastern, Western and Southern Highlands, Madang and Morobe Provinces.	Logging and habitat destruction	Unlikely – study area is outside altitudinal range for this species.
Helicia latifolia	Text description only	BRI, LAE, CANB	Proteacea	Lower Risk – Near Threatened	A tree scattered on slopes and ridges in primary and secondary rainforest up to 800 m.	Widespread -Occurring in the Gulf, Central, Milne Bay and Northern Provinces of Papua New Guinea and New Britain of the Bismarck Archipelago.	Unspecified	Unlikely – Limited Information
Mastixiodendron plectocarpum	Yes	BRI, LAE	Rubiaceae	Lower Risk – Near Threatened	This large tree grows in lowland seasonal moist forest.	Confined to south-west Papua New Guinea and south-east Irian Jaya.	Logging.	Unlikely
Podocarpus atjehensis	Closely related P. nerifolius only – PNG Plants	???	Podocarpaceae	Near Threatened	In local forest populations, probably on poor soils, … at 2,500 to 3,300 m, near Wissel Lakes at 1,800 m." (de Laubenfels 1988).	The species occurs in the Gajo Lands in northern Sumatra and the Wissel Lakes in Papua New Guinea. The hugely disjunct range of this species, as presently known, merits a critical revision of this species.	Habitat degradation	Unlikely
Ptychosperma gracile	No		Aracaceae	Near Theatened	This palm tree is scattered in rainforest on both limestone and volcanic soils. This species can survive in open vegetation or in secondary forest if it is allowed to regenerate.	Endemic to the Bismarck Archipelago (Papua New Guinea) and the Louisiade Archipelago.	Subpopulations have declined because of rapid and extensive deforestation for plantation agriculture.	Unlikely –outside known geographical range
Sonneratia ovata	No	BRI	Sonneratiaceae	Near Threatened	Mangrove forest and woodland	All collections from Gulf and Western Province	Mangrove harvesting	Unlikely

APPENDIX D

Terrestrial vertebrate species with potential to occur in the study area

Appendix D. Terrestrial vertebrate species (mammals, birds, reptiles and amphibians) identified to have potential to occur in the study area, their threat status under the IUCN Red List (IUCN), their protection status under the PNG Fauna (Protection & Control) Act 1966, 1978 (PNG), and occurrence of records in the local region (Lowland = < 1,000m asl; Montane = 1,000–3,200m asl). Reproduced from Woxvold (2010), but with the reptile and amphibian sections updated to include species whose ranges, as represented in Bishop Museum online database mapping (Bishop Museum 2015), intersect with, or are proximate to, the study area.

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
NON-VOLANT MAMMALS					
Zaglossus bartoni	Eastern Long-beaked Echidna	V	P		X
Dasyurus albopunctatus	New Guinea Quoll	NT			X
Murexia melanurus	Black-tailed Dasyure				X
Murexia longicaudata	Short-furred Dasyure				X
Myoictis wavicus	Tate's Three-striped Dasyure				X
Echymipera kalubu	Common Echymipera			X	X
Echymipera rufescens	Long-nosed Echymipera			X	
Peroryctes raffrayana	Raffray's Bandicoot				X
Dendrolagus goodfellowi	Goodfellow's Tree Kangaroo	EN	P		X
Dorcopsis hageni	White-striped Dorcopsis				
Dorcopsulus vanheurni	Small Dorcopsis	NT			X
Thylogale browni	New Guinea Pademelon	VU			
Phalanger gymnotis	Ground Cuscus				X
Phalanger intercastellanus	Eastern (Southern) Common Cuscus			X	X
Spilocuscus maculatus	Common Spotted Cuscus			X	
Spilocuscus rufoniger	Black-spotted Cuscus	CR	P		
Distoechurus pennatus	Feather-tailed Possum		R		X
Dactylopsila trivirgata	Striped Possum			X	X
Petaurus breviceps	Sugar Glider			X	X
Pseudochirulus canescens	Lowland Ringtail				
Pseudochirulus larvatus	Masked Ringtail				X
Hydromys chrysogaster	Common Water Rat			X	X
Hydromys ziegleri	Ziegler's Water Rat				
Microhydromys richardsoni	Groove-toothed Shrew Mouse				X
Parahydromys asper	Waterside Rat				X
Anisomys imitator	Uneven-toothed Rat				X
Lorentzimys nouhuysi	Long-footed Tree Mouse				X
Melomys lutillus	Grassland Melomys				
Melomys rufescens	Black-tailed Melomys			X	X
Paramelomys moncktoni	Moncton's Paramelomys				X
Paramelomys platyops	Common Lowland Paramelomys			X	X
Paramelomys rubex	Mountain Paramelomys				X
Mammelomys rattoides	Lowland Mammelomys				
Pogonomelomys mayeri	Shaw Mayer's Pogonomelomys				X
Pogonomys loriae	Loria's Pogonomys				X
Pogonomys macrourus	Chestnut Tree Mouse				X
Uromys anak	Black-tailed Giant Rat				X
Uromys caudimaculatus	White-tailed Giant Rat			X	X
Rattus mordax	Eastern Rat				
Rattus novaeguineae	New Guinea Rat				X
Rattus steini	Small Spiny Rat				X
Rattus exulans	Polynesian Rat			X	X
Rattus niobe	Moss-forest Rat				X
Rattus verecundus	Slender Rat				X
Rattus rattus	House Rat				X
BATS					

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Dobsonia moluccensis	Greater Bare-backed Bat			X	X
Pteropus macrotis	Big-eared Flying Fox				
Pteropus neohibernicus	Giant Flying Fox			X	
Rousettus amplexicaudatus	Common Rousette Bat				X
Nyctimene aello	Greater Tube-nosed Bat				
Nyctimene albiventer	Common Tube-nosed Bat			X	
Nyctimene cephalotes	Pallas' Tube-nosed Bat				
Nyctimene certans	Mountain Tube-nosed Bat				X
Nyctimene draconilla	Lesser Tube-nosed Bat				
Paranyctimene raptor	Green Tube-nosed Bat			X	X
Macroglossus minimus	Least Blossom Bat				X
Syconycteris australis	Common Blossom Bat			X	X
Emballonura beccarii	Beccari's Sheath-tailed Bat			X	X
Emballonura furax	New Guinea Sheath-tailed Bat				
Mosia nigrescens	Lesser Sheath-tailed Bat			X	
Saccolaimus saccolaimus	Naked-rumped Sheath-tailed Bat				
Hipposideros ater	Dusky Leaf-nosed Bat				X
Hipposideros calcaratus	Spurred Leaf-nosed Bat			X	
Hipposideros cervinus	Fawn Leaf-nosed Bat			X	
Hipposideros diadema	Diadem Leaf-nosed Bat				X
Hipposideros maggietaylorae	Maggie Taylor's Leaf-nosed Bat				
Hipposideros muscinus	Fly River Leaf-nosed Bat				
Hipposideros semoni	Greater Wart-nosed Bat				X
Rhinolophus euryotis	New Guinea Horseshoe Bat			X	
Rhinolophus megaphyllus	Eastern Horseshoe Bat			X	
Myotis moluccarum	Arafura Large-footed Bat				
Philetor brachypterus	Rohu's Bat			X	
Pipistrellus angulatus	New Guinea Pipistrelle				X
Pipistrellus collinus	Mountain Pipistrelle				
Pipistrellus papuanus	Papuan Pipistrelle			X	X
Murina florium	Flute-nosed Bat				X
Nyvtophilus bifax	Northern Big-eared Bat				
Nyvtophilus microtis	Papuan Big-eared Bat				
Nyctophilus timoriensis	Greater Big-eared Bat				
Kerivoula muscina	Fly River Woolly Bat				
Phoniscus papuensis	Golden-tipped Bat				
Miniopterus australis	Little Bent-winged Bat			X	X
Miniopterus macrocneme	Small Melanesian Bent-winged Bat				
Miniopterus magnater	Western Bent-winged Bat				
Miniopterus medius	Javan Bent-winged Bat				
Miniopterus tristis	Greater Melanesian Bent-winged Bat			X	
Miniopterus schreibersi	Common Bent-winged Bat			X	X
Tadarida jobensis	Northern Free-tailed Bat				X
Mormopterus beccarii	Beccari's Free-tailed Bat				
Otomops secundus	Mantled Free-tailed Bat				
Otomops papuensis	Papuan Free-tailed Bat				
BIRDS					
Casuarius casuarius	Southern Cassowary		R		
Casuarius bennetti	Dwarf Cassowary				X
Talegalla jobiensis	Brown-collared Brush-turkey			X	X
Megapodius decollatus	New Guinea Scrubfowl			X	X
Coturnix ypsilophora	Brown Quail			X	
Coturnix chinensis	Blue-breasted Quail				X
Turnix maculosa	Red-backed Buttonquail				

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Aceros plicatus	Blyth's Hornbill		P	X	
Eurystomus orientalis	Dollarbird			X	
Alcedo atthis	Common Kingfisher				X
Alcedo azurea	Azure Kingfisher				
Alcedo pusilla	Little Kingfisher				
Ceyx lepidus	Variable Kingfisher			X	
Dacelo gaudichaud	Rufous-bellied Kookaburra			X	
Clytoceyx rex	Shovel-billed Kookaburra				X
Todirhamphus nigrocyaneus	Blue-black Kingfisher	NT			
Todirhamphus macleayii	Forest Kingfisher			X	
Todirhamphus sanctus	Sacred Kingfisher			X	
Melidora macrorrhina	Hook-billed Kingfisher			X	
Syma torotoro	Yellow-billed Kingfisher			X	
Syma megarhyncha	Mountain Kingfisher				X
Tanysiptera galatea	Common Paradise-Kingfisher				
Tanysiptera nympha	Red-breasted Paradise-Kingfisher			X	
Merops philippinus	Blue-tailed Bee-eater			X	
Merops ornatus	Rainbow Bee-eater			X	
Cuculus optatus(/saturatus)	Oriental(/Himalayan) Cuckoo			X	
Cacomantis variolosus	Brush Cuckoo			X	
Cacomantis castaneiventris	Chestnut-breasted Cuckoo				X
Rhamphomantis megarhynchus	Long-billed Cuckoo				
Chrysococcyx minutillus	Little (Malay) Bronze-Cuckoo			X	
Chrysococcyx lucidus	Shining Bronze-Cuckoo			X	
Chrysococcyx meyeri	White-eared Bronze-Cuckoo			X	X
Caliechthrus leucolophus	White-crowned Koel			X	
Microdynamis parva	Dwarf Koel			X	
Eudynamys scolopacea	Asian Koel			X	
Scythrops novaehollandiae	Channel-billed Cuckoo			X	
Centropus menbeki	Greater Black Coucal			X	
Centropus phasianinus	Pheasant Coucal			X	X
Centropus bernsteini	Lesser Black Coucal				
Pseudeos fuscata	Dusky Lory			X	X
Trichoglossus haematodus	Rainbow Lorikeet			X	X
Psitteuteles goldiei	Goldie's Lorikeet				X
Lorius lory	Black-capped Lory			X	
Charmosyna wilhelminae	Pygmy Lorikeet				X
Charmosyna placentis	Red-flanked Lorikeet			X	
Charmosyna pulchella	Fairy Lorikeet			X	X
Psittrichas fulgidus	Pesquet's Parrot	VU	R	X	
Micropsitta pusio	Buff-faced Pygmy-Parrot			X	
Cyclopsitta gulielmitertii	Orange-breasted Fig-Parrot				
Cyclopsitta diophthalma	Double-eyed Fig-Parrot			X	
Geoffroyus geoffroyi	Red-cheeked Parrot			X	
Geoffroyus simplex	Blue-collared Parrot				X
Eclectus roratus	Eclectus Parrot			X	
Alisterus chloropterus	Papuan King-Parrot				X
Loriculus aurantiifrons	Orange-fronted Hanging-Parrot				
Probosciger aterrimus	Palm Cockatoo		P	X	
Cacatua galerita	Sulphur-crested Cockatoo		R	X	
Collocalia esculenta	Glossy Swiftlet			X	X
Aerodramus hirundinaceus	Mountain Swiftlet				X
Aerodramus vanikorensis	Uniform Swiftlet			X	
Aerodramus papuensis	Papuan Swiftlet				

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Mearnsia novaeguineae	Papuan Needletail				
Hirundapus caudacutus	White-throated Needletail			X	
Hemiprocne mystacea	Moustached Treeswift			X	X
Tyto tenebricosa	Greater Sooty-Owl				X
Tyto alba	Barn Owl			X	X
Ninox rufa	Rufous Owl				
Ninox connivens	Barking Owl			X	
Ninox theomacha	Jungle Hawk-Owl				X
Uroglaux dimorpha	Papuan Hawk-Owl			X	
Aegotheles insignis	Feline Owlet-Nightjar				X
Aegotheles bennettii	Barred Owlet-Nightjar				
Aegotheles albertisi	Mountain Owlet-Nightjar				X
Podargus papuensis	Papuan Frogmouth			X	
Podargus ocellatus	Marbled Frogmouth				
Eurostopodus mystacalis	White-throated Eared-Nightjar				
Caprimulgus macrurus	Large-tailed Nightjar			X	
Columba livia	Rock Pigeon				
Columba vitiensis	Metallic Pigeon				X
Macropygia amboinensis	Slender-billed Cuckoo-Dove			X	X
Macropygia nigrirostris	Black-billed Cuckoo-Dove			X	X
Reinwardtoena reinwardtsi	Great Cuckoo-Dove			X	X
Chalcophaps indica	Emerald Dove			X	
Chalcophaps stephani	Stephan's Dove			X	
Henicophaps albifrons	New Guinea Bronzewing			X	
Geopelia striata	Zebra Dove				
Gallicolumba rufigula	Cinnamon Ground-Dove				
Gallicolumba jobiensis	White-bibbed Ground-Dove				X
Trugon terrestris	Thick-billed Ground-Pigeon				
Otidiphaps nobilis	Pheasant Pigeon		R	X	X
Ptilinopus magnificus	Wompoo Fruit-Dove			X	
Ptilinopus perlatus	Pink-spotted Fruit-Dove			X	
Ptilinopus ornatus	Ornate Fruit-Dove			X	X
Ptilinopus aurantiifrons	Orange-fronted Fruit-Dove				
Ptilinopus superbus	Superb Fruit-Dove				
Ptilinopus coronulatus	Coroneted Fruit-Dove			X	
Ptilinopus pulchellus	Beautiful Fruit-Dove				
Ptilinopus rivoli	White-bibbed Fruit-Dove				X
Ptilinopus iozonus	Orange-bellied Fruit-Dove			X	
Ptilinopus naina	Dwarf Fruit-Dove			X	
Ducula rufigaster	Purple-tailed Imperial-Pigeon				
Ducula pinon	Pinon Imperial-Pigeon			X	
Ducula zoeae	Banded Imperial-Pigeon			X	
Gymnophaps albertisii	Papuan Mountain-Pigeon			X	X
Goura victoria	Victoria Crowned-Pigeon	NT	P		
Rallina tricolor	Red-necked Crake				X
Gallirallus philippensis	Buff-banded Rail			X	X
Amaurornis moluccana	Rufous-tailed Waterhen			X	
Gallinago hardwickii	Latham's Snipe				
Gallinago megala	Swinhoe's Snipe				
Tringa stagnatilis	Marsh Sandpiper				
Actitis hypoleucos	Common Sandpiper				
Charadrius dubius	Little Ringed Plover				
Vanellus miles	Masked Lapwing				
Stiltia isabella	Australian Pratincole				

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Aviceda subcristata	Pacific Baza			X	
Henicopernis longicauda	Long-tailed Honey-buzzard			X	X
Macheiramphus alcinus	Bat Hawk			X	
Elanus caeruleus	Black-winged Kite			X	
Milvus migrans	Black Kite			X	
Haliastur sphenurus	Whistling Kite			X	
Haliastur indus	Brahminy Kite			X	X
Circus spilonotus	Eastern Marsh-Harrier		R	X	X
Accipiter novaehollandiae	Grey Goshawk			X	
Accipiter melanochlamys	Black-mantled Goshawk				X
Accipiter poliocephalus	Grey-headed Goshawk			X	
Accipiter cirrocephalus	Collared Sparrowhawk			X	X
Accipiter meyerianus	Meyer's Goshawk				X
Erythrotriorchis buergersi	Chestnut-shouldered Goshawk				
Megatriorchis doriae	Doria's Goshawk	NT		X	
Harpyopsis novaeguineae	New Guinea Eagle	VU	P		X
Aquila gurneyi	Gurney's Eagle	NT	R	X	
Hieraaetus morphnoides	Little Eagle			X	
Falco cenchroides	Australian Kestrel		R		
Falco severus	Oriental Hobby		R		
Falco longipennis	Australian Hobby		R		
Falco berigora	Brown Falcon		R		X
Falco peregrinus	Peregrine Falcon		R	X	X
Butorides striatus	Striated Heron				
Zonerodius heliosylus	Forest Bittern	NT			
Dupetor flavicollis	Black Bittern				
Pitta sordida	Hooded Pitta				
Pitta erythrogaster	Red-bellied Pitta			X	
Ailuroedus buccoides	White-eared Catbird			X	
Ailuroedus melanotis	Spotted Catbird				X
Chlamydera cerviniventris	Fawn-breasted Bowerbird			X	X
Malurus alboscapulatus	White-shouldered Fairywren			X	X
Myzomela eques	Red-throated Myzomela			X	
Myzomela cruentata	Red Myzomela			X	X
Myzomela nigrita	Black Myzomela				X
Myzomela adolphinae	Mountain Myzomela				X
Myzomela rosenbergii	Red-collared Myzomela				X
Timeliopsis griseigula	Tawny Straightbill				
Melilestes megarhynchus	Long-billed Honeyeater			X	X
Glycichaera fallax	Green-backed Honeyeater				
Meliphaga montana	Forest Honeyeater				
Meliphaga albonotata	Scrub Honeyeater			X	
Meliphaga aruensis	Puff-backed Honeyeater				
Meliphaga analoga	Mimic Honeyeater				
Meliphaga gracilis	Graceful Honeyeater			X	
Meliphaga flavirictus	Yellow-gaped Honeyeater				
Xanthotis flaviventer	Tawny-breasted Honeyeater			X	
Xanthotis polygramma	Spotted Honeyeater				
Melithreptus albogularis	White-throated Honeyeater				
Pycnopygius ixoides	Plain Honeyeater			X	
Pycnopygius cinereus	Marbled Honeyeater				X
Pycnopygius stictocephalus	Streak-headed Honeyeater			X	
Philemon meyeri	Meyer's Friarbird				
Philemon novaeguineae	New Guinea Friarbird			X	

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Melidectes torquatus	Ornate Melidectes				X
Crateroscelis murina	Rusty Mouse-warbler			X	X
Sericornis arfakianus	Grey-green Scrubwren				X
Sericornis spilodera	Pale-billed Scrubwren				
Gerygone chloronotus	Green-backed Gerygone			X	
Gerygone palpebrosa	Fairy Gerygone			X	
Gerygone chrysogaster	Yellow-bellied Gerygone				
Gerygone magnirostris	Large-billed Gerygone			X	
Amalocichla incerta	Lesser Ground-robin				X
Monachella muelleriana	Torrent Robin			X	
Microeca flavigaster	Lemon-bellied Flyrobin				
Microeca flavovirescens	Olive Flyrobin			X	
Tregellasia leucops	White-faced Robin				X
Poecilodryas hypoleuca	Black-sided Robin			X	
Poecilodryas placens	Olive-yellow Robin	NT			
Peneothello bimaculatus	White-rumped Robin				
Pachycephalopsis poliosoma	White-eyed Robin				
Drymodes superciliaris	Northern Scrub-Robin				
Pomatostomus isidorei	New Guinea Babbler				
Lanius schach	Long-tailed Shrike				X
Ptilorrhoa geislerorum	Dimorphic Jewel-babbler				
Pachycare flavogrisea	Goldenface				X
Pachycephala hyperythra	Rusty Whistler			X	
Pachycephala simplex	Brown Whistler			X	X
Pachycephala soror	Sclater's Whistler				X
Pachycephala aurea	Golden-backed Whistler				
Pachycephala monacha	Black-headed Whistler				
Colluricincla megarhyncha	Little Shrike-thrush			X	X
Colluricincla harmonica	Grey Shrike-thrush			X	
Pitohui dichrous	Hooded Pitohui			X	X
Pitohui ferrugineus	Rusty Pitohui			X	
Corvus tristis	Grey Crow			X	
Corvus orru	Torresian Crow			X	
Melampitta gigantea	Greater Melampitta				X
Loboparadisea sericea	Yellow-breasted Bird-of-paradise	NT	P		
Manucodia atra	Glossy-mantled Manucode		P	X	
Manucodia chalybata	Crinkle-collared Manucode		P	X	
Manucodia keraudrenii	Trumpet Manucode		P		X
Epimachus albertisi	Black-billed Sicklebill		P		X
Parotia lawesii	Lawes's Parotia		P		X
Ptiloris magnificus	Magnificent Riflebird		P	X	
Cicinnurus magnificus	Magnificent Bird-of-paradise		P	X	
Cicinnurus regius	King Bird-of-paradise		P	X	
Paradisaea raggiana	Raggiana Bird-of-paradise		P	X	
Cracticus cassicus	Hooded Butcherbird			X	
Cracticus quoyi	Black Butcherbird			X	
Artamus leucorynchus	White-breasted Woodswallow			X	
Artamus maximus	Great Woodswallow				X
Peltops blainvillii	Lowland Peltops			X	
Peltops montanus	Mountain Peltops				X
Oriolus szalayi	Brown Oriole			X	
Coracina novaehollandiae	Black-faced Cuckooshrike				
Coracina caeruleogrisea	Stout-billed Cuckooshrike				X
Coracina lineata	Yellow-eyed Cuckooshrike			X	X

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Coracina boyeri	Boyer's Cuckooshrike			X	
Coracina papuensis	White-bellied Cuckooshrike			X	
Coracina tenuirostris	Slender-billed Cicadabird			X	
Coracina incerta	Black-shouldered Cicadabird			X	X
Coracina melas	New Guinea Cuckooshrike			X	
Coracina montana	Black-bellied Cuckooshrike				X
Lalage tricolor	White-winged Triller			X	
Lalage leucomela	Varied Triller			X	
Rhipidura leucophrys	Willie-wagtail			X	
Rhipidura rufiventris	Northern Fantail			X	
Rhipidura threnothorax	Sooty Thicket-Fantail				
Rhipidura leucothorax	White-bellied Thicket-Fantail			X	
Rhipidura atra	Black Fantail				X
Rhipidura hyperythra	Chestnut-bellied Fantail				
Rhipidura rufidorsa	Rufous-backed Fantail			X	
Chaetorhynchus papuensis	Pygmy Drongo				X
Dicrurus bracteatus	Spangled Drongo			X	
Monarcha axillaris	Black Monarch				X
Monarcha frater	Black-winged Monarch				
Monarcha guttulus	Spot-winged Monarch			X	
Monarcha manadensis	Hooded Monarch			X	
Monarcha chrysomela	Golden Monarch			X	
Arses telescophthalmus	Frilled Monarch			X	
Myiagra rubecula	Leaden Flycatcher			X	
Myiagra cyanoleuca	Satin Flycatcher				
Myiagra alecto	Shining Flycatcher			X	
Machaerirhynchus flaviventer	Yellow-breasted Boatbill				
Machaerirhynchus nigripectus	Black-breasted Boatbill				X
Zoothera heinei	Russet-tailed Thrush				
Saxicola caprata	Pied Bushchat				X
Aplonis cantoroides	Singing Starling			X	
Aplonis metallica	Metallic Starling			X	
Mino anais	Golden Myna				
Mino dumontii	Yellow-faced Myna			X	
Hirundo rustica	Barn Swallow				
Hirundo tahitica	Pacific Swallow			X	
Hirundo daurica	Red-rumped Swallow				
Hirundo nigricans	Tree Martin				
Cisticola exilis	Golden-headed Cisticola				
Zosterops minor	Black-fronted White-eye				
Zosterops novaeguineae	New Guinea White-eye				X
Acrocephalus stentoreus	Clamorous Reed-Warbler				
Phylloscopus trivirgatus	Mountain Leaf-Warbler				X
Dicaeum geelvinkianum	Red-capped Flowerpecker			X	X
Nectarinia aspasia	Black Sunbird			X	
Nectarinia jugularis	Olive-backed Sunbird			X	
Melanocharis nigra	Black Berrypecker			X	
Melanocharis longicauda	Lemon-breasted Berrypecker				
Melanocharis striativentris	Streaked Berrypecker				X
Melanocharis crassirostris	Spotted Berrypecker				X
Toxorhamphus iliolophus	Plumed Longbill				X
Oedistoma pygmaeum	Pygmy Longbill			X	
Passer domesticus	House Sparrow				
Passer montanus	Eurasian Tree-Sparrow				

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Motacilla cinerea	Grey Wagtail				X
Erythrura trichroa	Blue-faced Parrotfinch				X
Erythrura papuana	Papuan Parrotfinch				X
Lonchura tristissima	Streak-headed Munia			X	
Lonchura grandis	Grand Munia			X	
Lonchura spectabilis	Hooded Munia				
Lonchura castaneothorax	Chestnut-breasted Munia				
REPTILES					
Elseya novaeguineae	New Guinea Snapping Turtle				
Varanus indicus	Mangrove monitor		R		
Varanus indicus (karlschmidti)	Peach-throated/Sepik Monitor		R		
Varanus prasinus	Emerald Tree Monitor		R		
Gymnodactylus novaeguineae				X	
Gekko vittatus				X	
Hemidactylus frenatus				X	
Sphenomorphus megaspilus				X	
Sphenomorphus microtympanus					
Candioa aspera	New Guinea Ground Boa		R		
Candoia carinata	Pacific Boa		R		
Chondropython viridis	Green Tree Python		R		
Liasis albertisii	D'Albertis' python		R		
Python amethistinus	Amethystine Python		R		
Typhlops mcdowelli	Blind Snake sp.				
AMPHIBIANS					
Bufo marinus	Cane Toad				
Lechroidus melanopyga					
Rana arfaki					
Rana daemeli					
Rana garritor					
Rana papua					
Rana supragrisea					
Platymantis papuensis					
Litoria amboinensis					
Litoria cf. bicolor Type 'B'					
Litoria eucnemis					
Litoria genimaculata					X
Litoria thesaurensis					X
Litoria nigropunctata					
Litoria caerulea					
Litoria graminea					
Litoria infrafrenata					X
Litoria pygmaea					
Litoria angiana					X
Litoria wollastoni					X
Litoria dux					
Litoria jeudii					
Litoria obsoleta					
Nyctimystes humeralis					
Nyctimystes cheesmanae					X
Nyctimystes daymani					X
Albericus gunnari					
Cophixalus pipilans					
Cophixalus biroi					X
Cophixalus cheesmanae					

Scientific name	Common name	Status[1]		Local records	
		IUCN	PNG	Lowland[2]	Montane[3]
Cophixalus ateles					
Copiula fistulans					
Genyophryine thomsoni				X	
Oreophryne geislerorum					
Oreophryne loriae					
Oreophryne wolterstorffi					
Austrochaperina parkeri				X	
Austrochaperina polysticta					
Sphenophryne cornuta					
Callulops doriae					
Callulops robustus					
Hylophorbus rufescens					X
Mantophryne lateralis					
Xenobatrachus subcroceus					
Xenorhina subcrocea				X	

[1] IUCN threat status indicates species listed as globally threatened (CR – Critically Endangered; EN – Endangered; VU – Vulnerable) or near threatened (NT). PNG status includes species listed as Protected (P) or Trade Restricted (R) under the *PNG Fauna (Protection & Control) Act 1966, 1978*.
[2] Local lowland records for all taxa other than birds taken from Brass (1964), and for some amphibians, from IUCN (2017a). Lowland records of birds taken from Smith (1991) and Eastwood (1995).
[3] Montane records for all taxa taken from Vatasan *et al.* (1995) and Menzies (2001).

APPENDIX E

Terrestrial vertebrate fauna species list and survey data

Table E.1 Terrestrial vertebrate fauna species list from all surveys, their extinction risk status under the IUCN Red List (IUCN), their protection status under the Papua New Guinea *Fauna (Protection and Control) Act 1966* (PNG), and the habitats they were recorded in, namely hill forest (Hill), alluvial forest (Alluv), grassland (Grass) or wetlands and watercourses (Wet).

Abbreviations: VU = vulnerable; NT = Near Threatened; P = Protected; R = Restricted; X = species detected during field survey by sight or call; [X] = species identity provisional; S = species detected during field survey by distinctive signs (scats or tracks); v = recorded only in villages as trophy material; I = reliable account from local informants; Ca = captive in village. Survey sources: 2010 (Woxvold 2011); 2011 (Woxvold 2012); 2012 (Woxvold and Aplin 2013); 2015a (March-April 2015 survey, this study); 2015b (September 2015 survey, this study).

			Status		Survey					Habitat			
Family	Scientific name	English name	IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Mammals													
Peramelidae	*Echymipera/Peroryctes* sp(p).	Unidentified bandicoots				S	I,S	X	S	X	X		
Peramelidae	*Echymipera kalubu*	Common Echymipera				v	X,I	X		X	X		
Peramelidae	*Peroryctes raffrayana*	Raffray's Bandicoot				v	I	I					
Phalangeridae	*Phalanger gymnotis*	Ground Cuscus					I						
Phalangeridae	*Phalanger intercastellanus/orientalis*	Eastern/Northern Common Cuscus				v	I						
Phalangeridae	*Phalanger intercastellanus*	Eastern Common Cuscus						X			X		
Phalangeridae	*Spilocuscus maculatus*	Common Spotted Cuscus				v	I						
Petauridae	*Petaurus breviceps*	Sugar Glider					X,I				X		
Macropodidae	*Dorcopsis hageni*	White-striped Dorcopsis					I						
Macropodidae	*Thylogale browni*	New Guinea Pademelon	VU				Ca,I						
Pteropodidae	*Dobsonia moluccensis*	Moluccan Naked-backed Fruit Bat						X			X		
Pteropodidae	*Macroglossus* cf. *minimus*	Long-nosed Blossom Bat					X			X	X		
Pteropodidae	*Macroglossus* sp. A	Long-nosed Blossom Bat					X			X	X		
Pteropodidae	*Nyctimene aello*	Broad-striped Tube-nosed Fruit Bat					X			X			
Pteropodidae	*Nyctimene* cf. *papuanus*	Common Tube-nosed Fruit Bat					X			X	X		
Pteropodidae	*Nyctimene* sp. A '*albiventer*' group	Common Tube-nosed Fruit Bat					X	X		X	X		
Pteropodidae	*Paranyctimene* cf *raptor*	Unstriped Tube-nosed Bat					X			X			
Pteropodidae	*Pteropus neohibernicus*	Giant Flying Fox			X	Ca		X		X	X		
Pteropodidae	*Rousettus amplexicaudatus*	Common Rousette Bat					X			X			
Pteropodidae	*Syconycteris* cf *australis*	Common Blossom Bat					X			X	X		
Muridae	*Hydromys chrysogater*	Water Rat					I	S					X
Muridae	*Melomys rufescens*	Black-tailed Melomys					X	X		X	X		
Muridae	*Paramelomys platyops*	Lowland Paramelomys					X			X	X		
Muridae	*Rattus exulans*	Polynesian Rat					X			X			
Muridae	*Rattus* cf *mordax*	Eastern Rat						X		X			

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Muridae	*Rattus steini*	Stein's Rat					X			X			
Muridae	*Uromys* sp. *caudimaculatus* group	Giant White-tailed Rat					X	X		X	X		
Molossidae	26 cFM cf. *Mormorpterus beccarii*	Beccari's Free-tailed Bat					X			X			
Molossidae	27 sFM *Otomops* sp.	Unidentified free-tailed bat						X		X	X		
Miniopteridae/ Vespertilionidae	38 st.cFM *Miniopterus* sp.	A bent-winged bat					X	X		X	X		
Miniopteridae/ Vespertilionidae	45/47 st.cFM	Unidentified bat					X	X		X	X		
Miniopteridae/ Vespertilionidae	53 st.cFM	Unidentified bat					X	X		X	X		
Vespertilionidae	42/50 st.bFM *Nyctophilus* sp.	Unidentified long-eared bat					X	X		X	X		
Vespertilionidae	71 st.sFM.d *Kerivoula* sp./ *Murina* sp./*Phoniscus* sp.						X				X		
Emballonuridae	50 i.fFM.d *Emballonura* sp.	Unidentified sheath-tailed bat						X		X	X		
Emballonuridae	55-60 i.fFM.d *Emballonura* sp.	Unidentified sheath-tailed bat					X						
Emballonuridae	60-65 i.fFM.d *Emballonura beccarii*	Beccari's Sheath-tailed Bat					X			X			
Emballonuridae	65-70 i.fFM.d *Emballonura beccarii / Mosia nigrescens*	Beccari's/Lesser Sheath-tailed Bat					X						
Emballonuridae	65 i.fFM.d *Mosia nigrescens*	Lesser Sheath-tailed Bat						X					
Emballonuridae	70-75 i.fFM.d *Mosia nigrescens*	Lesser Sheath-tailed Bat					X			X	X		
Emballonuridae	25 cFM *Saccolaimus saccolaimus*	Bare-rumped Sheath-tailed Bat						X		X	X	X	
Rhinolophidae	78 lCF *Rhinolophus cf megaphyllus*	Eastern Horseshoe Bat					X	X		X	X		
Hipposideridae	58 sCF *Hipposideros diadema*	Diadem Leaf-nosed Bat					X	X		X	X		
Hipposideridae	82 mCF *Hipposideros wollastoni*	Wollaston's Leaf-nosed Bat					X			X			
Hipposideridae	112 sCF *Aselliscus tricuspidatus*	Trident Leaf-nosed Bat					X	X			X		
Hipposideridae	131 sCF *Hipposideros calcaratus*	Spurred Leaf-nosed Bat					X				X		
Suidae	*Sus scrofa*	Feral Pig			X	X	X, Ca	S	S	X	X		
Bovidae	*Bubalus bubalis*	Water Buffalo				X				X	X	X	
Felidae	*Felis catus*	Feral Cat						X		X			
Birds													
Casuariidae	*Casuarius bennetti*	Dwarf Cassowary			X	[X]	[v]	I		X	X		
Megapodiidae	*Megapodius decollatus*	New Guinea Scrubfowl				X	X	X		X	X		

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Megapodiidae	*Talegalla jobiensis*	Collared Brushturkey			X	X	X	X	X	X	X		
Anatidae	*Dendrocygna guttata*	Spotted Whistling-Duck				X							X
Anatidae	*Anas superciliosa*	Pacific Black Duck				X		X	X				X
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Little Grebe				X							X
Ardeidae	*Ardea alba*	Great Egret		P	X	X			X				X
Ardeidae	*Ardea intermedia*	Intermediate Egret		P	X				X				X
Ardeidae	*Ardea alba/Egretta intermedia*	Great/Intermediate Egret		P			X						X
Ardeidae	*Nycticorax caledonicus*	Nankeen Night-Heron				X							X
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant				X			X				X
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant				X		X	X				X
Accipitridae	*Henicopernis longicauda*	Long-tailed Honey Buzzard				X	X	X	X	X	X		
Accipitridae	*Aviceda subcristata*	Pacific Baza			X	X	X	X		X	X		
Accipitridae	*Haliastur sphenurus*	Whistling Kite			X	X	X	X	X	X	X		X
Accipitridae	*Haliastur indus*	Brahminy Kite			X	X	X	X	X	X	X		X
Accipitridae	*Milvus migrans*	Black Kite			X	X	X	X	X	X	X	X	X
Accipitridae	*Circus spilothorax*	Papuan Harrier		R		X			I			X	
Accipitridae	*Accipiter hiogaster*	Variable Goshawk			X	X	X	X	I	X	X		
Accipitridae	*Accipiter fasciatus*	Brown Goshawk						X		X			
Accipitridae	*Accipiter sp.*	Goshawk sp.					X	X		X	X		
Accipitridae	*Harpyopsis novaeguineae*	Papuan Eagle	VU	P		[X]		X		X	[X]		
Accipitridae	*Aquila gurneyi*	Gurney's Eagle	NT	R	X		X	X	X	X	X		
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle		R				X					X
Accipitridae	*Pandion cristatus*	Eastern Osprey		P				X					X
Rallidae	*Amaurornis olivacea*	Plain Bush-hen			X	X				X	X		
Rallidae	*Porzana cinerea*	White-browed Crake			[X]			X					X
Rallidae	*Rallina tricolor*	Red-necked Crake						X			X		
Rallidae	*Gymnocrex plumbeiventris*	Bare-eyed Rail						[X]					X
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen				X		X					X
		Purple Swamphen							X				X
Jacanidae	*Irediparra gallinacea*	Comb-crested Jacana				X		X	X				X
Charadriidae	*Charadrius dubius dubius*	Little Ringed Plover						X	X				X
Charadriidae	*Actitis hypoleucos*	Common Sandpiper						X	X				X
Columbidae	*Macropygia amboinensis*	Slender-billed Cuckoo-Dove			X		X	X		X	X		
Columbidae	*Macropygia nigrirostris*	Bar-tailed Cuckoo-Dove				X	X			X	X		
Columbidae	*Reinwardtoena reinwardtsi*	Great Cuckoo-Dove					[X]	X		X	X		

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Columbidae	*Chalcophaps longirostris*	Pacific Emerald Dove			[X]					[X]			
Columbidae	*Chalcophaps stephani*	Stephan's Dove			X	X	X	X		X	X		
	Geopelia striata	Peaceful Dove							X			X	
Columbidae	*Otidiphaps nobilis*	Pheasant Pigeon		R			X				X		
Columbidae	*Ptilinopus magnificus*	Wompoo Fruit Dove			X	X	X	X	X	X	X		
Columbidae	*Ptilinopus perlatus*	Pink-spotted Fruit Dove			X	X	X	X		X	X		
Columbidae	*Ptilinopus superbus*	Superb Fruit Dove			X	X	X	X	X	X	X		
Columbidae	*Ptilinopus coronulatus*	Coroneted Fruit Dove			X	X	X	X	X	X	X		
Columbidae	*Ptilinopus iozonus*	Orange-bellied Fruit Dove			X	X	X	X	X	X	X		
Columbidae	*Ptilinopus nanus*	Dwarf Fruit Dove				X	X	X		X	X		
Columbidae	*Ducula pinon*	Pinon's Imperial Pigeon			X	X	X	X	X	X	X		
Columbidae	*Ducula zoeae*	Zoe's Imperial Pigeon			X	X	X	X	X	X	X		
Columbidae	*Gymnophaps albertisii*	Papuan Mountain-pigeon						X		X			
Cacatuidae	*Probosciger aterrimus*	Palm Cockatoo		P	X	X	X	X	X	X	X		
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo		R	X	X	X	X	X	X	X		
Psittacidae	*Loriculus aurantiifrons*	Papuan Hanging Parrot				X					X		
Psittacidae	*Micropsitta pusio*	Buff-faced Pygmy Parrot			X	X	X	X	X	X	X		
Psittacidae	*Trichoglossus haematodus micropteryx*	Coconut Lorikeet			X	X	X	X	X	X	X		
Psittacidae	*Lorius lory*	Black-capped Lory			X	X	X	X	X	X	X		
Psittacidae	*Pseudeos fuscata*	Dusky Lory						X			X		
Psittacidae	*Charmosyna pulchella*	Fairy Lorikeet			[X]					[X]			
Psittacidae	*Charmosyna placentis*	Red-flanked Lorikeet						X			X		
Psittacidae	*Psittaculirostris edwardsii*	Edwards's Fig Parrot			X	X		X	X	X	X		
Psittacidae	*Cyclopsitta diophthalma coccineifrons*	Double-eyed Fig Parrot						X		X			
Psittacidae		Fig-Parrot sp(p).				X	X						
Psittacidae	*Geoffroyus geoffroyi*	Red-cheeked Parrot			X	X	X	X	X	X	X		
Psittacidae	*Eclectus roratus*	Eclectus Parrot			X	X	X	X	X	X	X		
Cuculidae	*Centropus menbeki*	Ivory-billed Coucal			X	X	X	X	X	X	X		
Cuculidae	*Centropus phasianinus*	Pheasant Coucal			X	X		X				X	
Cuculidae	*Centropus bernsteini*	Black-billed Coucal			X	X						X	
Cuculidae	*Microdynamis parva*	Dwarf Koel			X	X	X	X		X	X		
Cuculidae	*Eudynamys orientalis*	Pacific Koel			[X]	[X]		X		X	X		
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo			X			X	X		X		

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo			X	X	X	X	X	X	X		
Cuculidae	*Chrysococcyx minutillus*	Little Bronze Cuckoo			X	X	X	X	X	X	X		
Cuculidae	*Chrysococcyx meyerii*	White-eared Bronze Cuckoo						X	X	X	X		
Cuculidae	*Cuculus saturatus*	Oriental Cuckoo						X			X		
Tytonidae	*Tyto tenebricosa*	Sooty Owl					X	X		X	X		
Tytonidae	*Tyto longimembris*	Eastern Grass Owl			X							X	
Strigidae	*Ninox rufa*	Rufous Owl					X				X		
Strigidae	*Uroglaux dimorpha*	Papuan Hawk-Owl					X	X		X			
Podargidae	*Podargus ocellatus*	Marbled Frogmouth					X	X		X	X		
Podargidae	*Podargus papuensis*	Papuan Frogmouth			[X]		X	X		X	X		
Caprimulgidae	*Caprimulgus macrurus*	Large-tailed Nightjar				[X]		X			X	X	
Caprimulgidae	*Aegotheles bennettii*	Barred Owlet-Nightjar						X			X		
Hemiprocnidae	*Hemiprocne mystacea*	Moustached Treeswift				X	X	X	I	X	X		
Apodidae	*Aerodramus vanikorensis/A. hirundinaceus*	Uniform/Mountain Swiftlet			X	X		X	X	X	X	X	X
Apodidae	*Collocalia esculenta*	Glossy Swiftlet						X		X			
Apodidae	*Mearnsia novaeguineae*	Papuan Spine-tailed Swift			X	X	X	X	X	X	X	X	X
Apodidae	*Hirundapus caudacutus*	White-throated Needletail						X		X			
Coraciidae	*Eurystomus orientalis*	Dollarbird			X		X	X	X	X	X	X	
Alcedinidae	*Ceyx azureus*	Azure Kingfisher				X	X	X	X		X		X
Alcedinidae	*Ceyx pusillus*	Little Kingfisher			X			X			X		
Alcedinidae	*Ceyx lepidus*	Variable Dwarf Kingfisher			X	X	X	X	X	X	X		
Alcedinidae	*Tanysiptera galatea*	Common Paradise Kingfisher			[X]	[X]	[X]			[X]	[X]		
Alcedinidae	*Tanysiptera nympha*	Red-breasted Paradise Kingfisher						X			X		
Alcedinidae	*Melidora macrorrhina*	Hook-billed Kingfisher			X	X	X	X	X	X	X		
Alcedinidae	*Dacelo gaudichaud*	Rufous-bellied Kookaburra			X	X	X	X	X	X	X		
Alcedinidae	*Todiramphus nigrocyaneus*	Blue-black Kingfisher	NT			X		X			X		
Alcedinidae	*Syma torotoro*	Yellow-billed Kingfisher			X	X	X	X	X	X	X		
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher						X	X				X
Meropidae	*Merops ornatus*	Rainbow Bee-eater					X	X	X	X	X	X	X
Bucerotidae	*Rhyticeros plicatus*	Blyth's Hornbill		P	X	X	X	X	X	X	X		
Pittidae	*Pitta sordida*	Hooded Pitta			X	X	X	X		X	X		
Ptilonorhynchidae	*Ailuroedus buccoides*	White-eared Catbird				X	X	X		X			
Maluridae	*Malurus alboscapulatus*	White-shouldered Fairywren				X	X	X	X			X	
Meliphagidae	*Myzomela eques*	Ruby-throated Myzomela						X	X	X	X		

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Meliphagidae	*Myzomela nigrita*	Papuan Black Myzomela						X		X			
Meliphagidae	*Meliphaga sp(p).*	Honeyeater sp(p).			X	X	X	X		X	X		
Meliphagidae	*Meliphaga albonotata*	Scrub Honeyeater						X	X	X			
Meliphagidae	*Meliphaga analoga*	Mimic Honeyeater						X	X	X	X		
Meliphagidae	*Meliphaga aruensis*	Puff-backed Honeyeater						X		X	X		
Meliphagidae	*Pycnopygius stictocephalus*	Streak-headed Honeyeater			X	X	X	X	X	X	X		
Meliphagidae	*Pycnopygius ixoides*	Plain Honeyeater						X			X		
Meliphagidae	*Philemon novaeguineae*	New Guinea Friarbird			X	X	X	X	X	X	X		
Meliphagidae	*Philemon meyeri*	Meyer's Friarbird			[X]			X		X			
Meliphagidae	*Melilestes megarhynchus*	Long-billed Honeyeater			X	X	X	X	X	X	X		
Meliphagidae	*Xanthotis flaviventer*	Tawny-breasted Honeyeater			X	X	X	X	X	X	X		
Meliphagidae	*Timeliopsis griseigula*	Tawny Straightbill						X		X			
Acanthizidae	*Crateroscelis murina*	Rusty Mouse Warbler			X			X	X	X	X		
Acanthizidae	*Sericornis spilodera*	Pale-billed Scrubwren						X		X			
Acanthizidae	*Sericornis sp.*	Scrubwren sp.					X			X			
Acanthizidae	*Gerygone magnirostris*	Large-billed Gerygone				X	X	X	X		X		
Acanthizidae	*Gerygone chloronota*	Green-backed Gerygone			X	X	X	X	X	X	X		
Melanocharitidae	*Melanocharis nigra*	Black Berrypecker					X	X	X	X			
Melanocharitidae	*Oedistoma pygmaeum*	Pygmy Longbill					X	X		X			
Psophodidae	*Ptilorrhoa geislerorum/castanonota*	Brown-headed/ Chestnut-backed Jewel-babbler				X	X	X	X	X	X		
Psophodidae	*Ptilorrhoa geislerorum*	Brown-headed Jewel-babbler						X		X			
Machaerirhynchidae	*Machaerirhynchus flaviventer*	Yellow-breasted Boatbill				X	X	X	X	X	X		
Cracticidae	*Cracticus quoyi*	Black Butcherbird					X	X		X	X		
Cracticidae	*Cracticus cassicus*	Hooded Butcherbird			X	X	X	X	X	X	X		
Cracticidae	*Peltops blainvillii*	Lowland Peltops			X	X	X	X		X	X		
Artamidae	*Artamus maximus*	Great Woodswallow			X			X	I	X			
Campephagidae	*Coracina boyeri*	Boyer's Cuckooshrike			X	X	X	X	X	X	X		
Campephagidae	*Coracina papuensis*	White-bellied Cuckooshrike			X	X	X	X	X	X	X		
Campephagidae	*Coracina melas meeki*	Black Cicadabird			X	X	X	X	X	X	X		
Campephagidae	*Lalage leucomela*	Varied Triller			X	X	X	X	X	X	X		
Pachycephalidae	*Pachycephala simplex brunnescens*	Grey Whistler			X	X	X	X	X	X	X		
Pachycephalidae	*Pachycephala monacha*	Black headed Whistler				[X]	[X]	X	X		X		
Pachycephalidae	*Colluricincla megarhyncha*	Little Shrike-thrush			X	X	X	X	X	X	X		

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Pachycephalidae	*Pseudorectes ferrugineus*	Rusty Pitohui				X	X			X	X		
Oriolidae	*Oriolus szalayi*	Brown Oriole			X	X	X	X	X	X	X		
Oriolidae	*Pitohui dichrous*	Hooded Pitohui			X	X	X	X		X	X		
Dicruridae	*Dicrurus bracteatus carbonarius*	Spangled Drongo			X	X	X	X	X	X	X		
Rhipiduridae	*Rhipidura leucophrys*	Willie-wagtail				X		X	X			X	X
Rhipiduridae	*Rhipidura rufiventris*	Northern Fantail			X	X	X	X	X	X	X		
Rhipiduridae	*Rhipidura threnothorax*	Sooty Thicket Fantail			X		X	X		X	X		
Rhipiduridae	*Rhipidura leucothorax*	White-bellied Thicket Fantail			X	X	X	X	X	X	X		
Monarchidae	*Myiagra alecto*	Shining Flycatcher			X	X	X	X	X	X	X		
Monarchidae	*Myiagra cyanoleuca*	Satin Flycatcher						X		X			
Monarchidae	*Symposiachrus guttula*	Spot-winged Monarch			X	X	X	X	X	X	X		
Monarchidae	*Symposiachrus manadensis*	Hooded Monarch			X		X	X		X	X		
Monarchidae	*Carterornis chrysomela*	Golden Monarch			X	X	X	X		X	X		
Monarchidae	*Arses insularis*	Ochre-collared Monarch				X		X			X		
Monarchidae	*Arses telescopthalmus*	Frilled Monarch			X	[X]	X	X	X	X	X		
Monarchidae	*Monarcha melanopsis*	Black-faced Monarch						X			X		
Corvidae	*Corvus tristis*	Grey Crow			X	X	X	X		X	X		
Corvidae	*Corvus orru*	Torresian Crow			X	X		X	X	X	X		X
Paradisaeidae	*Manucodia ater*	Glossy-mantled Manucode						X			X		
Paradisaeidae	*Manucodia chalybatus*	Crinkle-collared Manucode		P			[X]			[X]			
Paradisaeidae	*Cicinnurus regius*	King Bird-of-Paradise		P	X	X	X	X	X	X	X		
Paradisaeidae	*Paradisaea raggiana*	Raggiana Bird-of-Paradise		P	X	X	X	X	X	X	X		
Petroicidae	*Drymodes superciliaris brevirostris*	Northern Scrub Robin						X		X	X		
Petroicidae	*Poecilodryas hypoleuca*	Black-sided Robin			X	X	X	X	X	X	X		
Petroicidae	*Microeca flavovirescens*	Olive Flyrobin					X	X		X	X		
Petroicidae	*Microeca flavigaster*	Lemon-bellied Flyrobin			[X]			X	X	X			
Hirundinidae	*Hirundo tahitica*	Pacific Swallow				X			X			X	
Muscicapidae	*Saxicola caprata*	Pied Bush Chat						X				X	
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola			X	X		X	X			X	
Zosteropidae	*Zosterops minor*	Black-fronted White-eye				X				X			
		Horsefield's Bushlark							X			X	
Sturnidae	*Aplonis metallica*	Metallic Starling			X	X			X	X	X		
Sturnidae	*Aplonis cantoroides*	Singing Starling						X	X				X
Sturnidae	*Mino dumontii*	Yellow-faced Myna			X	X	X	X	X	X	X		
Dicaeidae	*Dicaeum geelvinkianum*	Red-capped Flowerpecker			X	X	X	X	X	X	X		

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Nectariniidae	*Leptocoma aspasia*	Black Sunbird			X	X	X	X	X	X	X		
Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird			X	X	X	X	X	X	X		
Estrildidae	*Lonchura tristissima*	Streak-headed Mannikin						X	X			X	
		Chestnut-breasted Mannikin							X			X	
Reptiles													
Chelidae	*Elseya novaeguineae*	New Guinea Snapping Turtle				X		X					X
Crocodylidae	*Crocodylus [porosus]*	[Saltwater] Crocodile		R		v							X
Agamidae	*Hypsilurus modestus*	Modest Forest Dragon				X		X		X	X		
Gekkonidae	*Hemidactylus frenatus*	Common House Gecko					X	X	I	X	X		
Gekkonidae	*Nactus* sp	Unidentified gecko					X				X		
Gekkonidae	*Cyrtodactylus* sp.	Unidentified gecko						X		X			
Gekkonidae	*Gehyra vorax*	Voracious Gecko						X		X	X		
Scincidae	*Tribolonotus gracilis*	Red-eyed Crocodile Skink						X			X		
Scincidae	*Emoia caeruleocauda*						X		X		X		
Scincidae	*Emoia obscura*							[X]	X	X	X		
Scincidae	*Emoia pallidiceps*							[X]		X			
Scincidae	*Emoia physicae*						X				X		
Scincidae	*Emoia longicauda*	Shrub whiptail-skink						X			X		
Scincidae	*Emoia* small sp						X				X		
Scincidae	*Emoia* sp. 1							X	X	X			
Scincidae	*Lipinia pulchra*							X			X		
Scincidae	*Sphenomorphus simus*						X				X		
Scincidae	*Sphenomorphus cf jobiensis*						X	X	X	X	X		
Scincidae	*Lamprolepis smaragdina*	Emerald Tree Skink				X	X	X		X	X		
Varanidae	*Varanus jobiensis*	Peach-throated Monitor		R	X	X	X	X		X	X		
Varanidae	*Varanus prasinus*	Emerald Monitor		R			X				X		
Boidae	*Candoia aspera*	New Guinea Ground Boa		R		X					X		
Boidae	*Boiga irregularis*	Brown Tree Snake						X		X			
Colubridae	*Dendrelaphis* sp.	Unidentified tree snake					X			X			
Colubridae	*Dendrelaphis calligastra*	Coconut Tree Snake						X			X		
Colubridae	*Tropidonophis multiscutellatus*	Many-scaled Keelback						X				X	X
Colubridae	*Stegonotus parvus*	Common Ground Snake						X	X	X			
Elapidae	*Acanthophis laevis*	New Guinea Death Adder					X			X			
Elapidae	*Micropechis ikahaka*	New Guinea Small-eyed Snake					X				X		
Pythonidae	*Leiopython bennettorum*	Bennett's white-lipped python		R			X			X			

Family	Scientific name	English name	Status		Survey					Habitat			
			IUCN	PNG	2010	2011	2012	2015a	2015b	Hill	Alluv	Grass	Wet
Pythonidae	*Leiopython albertisii*	White-lipped (D'Albertis) Python		R				X		X	X		
Pythonidae	*Morelia amethistina*	Amethystine Python		R		v		I					
Pythonidae	*Morelia viridis*	Northern Emerald Python		R			X			X			
Amphibians													
Bufonidae	*Bufo marinus*	Cane Toad			X	X	X	X		X	X		
Hylidae	*Litoria eucnemis*	Fringed Tree Frog				X	X	X		X	X		
Hylidae	*Litoria thesaurensis*				X		X	[X]		X	X		
Hylidae	*Litoria infrafrenata*	White-lipped Tree Frog			X		X	X		X	X		
Hylidae	*Litoria cf nigropunctata*							[X]			X		
Hylidae	*Nyctimystes cheesmani*						X	[X]		X			
Microhylidae	*Cophixalus* sp.						X			X			
Microhylidae	*Mantophryne* sp. (*lateralis* complex)						X			X	X		
Microhylidae	*Oreophryne geislerorum*						X			X			
Ranidae	*Platymantis papuensis*					X	X	X		X	X		
Ranidae	*Papurana arfaki*							X		X			
Ranidae	*Papurana daemeli*						X	X		X	X		
Ranidae	*Papurana garritor*						X	X		X	X		X
Ranidae	*Papurana cf grisea*						X						
Ranidae	*Papurana papua*				X	X	X	X		X	X		

Table E.2 Terrestrial vertebrate fauna species list from all surveys, their extinction risk status under the IUCN Red List (IUCN), their protection status under the Papua New Guinea *Fauna (Protection and Control) Act 1966* (PNG), and comments on their occurrence in the study area during the 2015 survey unless otherwise indicated.

Abbreviations: VU = vulnerable; NT = Near Threatened; P = Protected; R = Restricted.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Mammals					
Peramelidae	*Echymipera/Peroryctes* sp(p).	Unidentified bandicoots			Several individuals photographed by remote camera. Species uncertain, possibly more than one species involved.
Peramelidae	*Echymipera kalubu*	Common Echymipera			Dead animal brought to survey team.
Peramelidae	*Peroryctes raffrayana*	Raffray's Bandicoot			Reported by local field assistants as present.
Phalangeridae	*Phalanger gymnotis*	Ground Cuscus			
Phalangeridae	*Phalanger intercastellanus/orientalis*	Eastern/Northern Common Cuscus			
Phalangeridae	*Phalanger intercastellanus*	Eastern Common Cuscus			One was spotlighted in lowland swamp forest. Identification partly based on IUCN maps.
Phalangeridae	*Spilocuscus maculatus*	Common Spotted Cuscus			
Petauridae	*Petaurus breviceps*	Sugar Glider			
Macropodidae	*Dorcopsis hageni*	White-striped Dorcopsis			
Macropodidae	*Thylogale browni*	New Guinea Pademelon	VU		
Pteropodidae	*Dobsonia moluccensis*	Moluccan Naked-backed Fruit Bat			Several Dobsonia were seen; one seen well and photographed. Identification (from D. minor) based on apparent size and prior experience with both species.
Pteropodidae	*Macroglossus* cf. *minimus*	Long-nosed Blossom Bat			
Pteropodidae	*Macroglossus* sp. A	Long-nosed Blossom Bat			
Pteropodidae	*Nyctimene aello*	Broad-striped Tube-nosed Fruit Bat			
Pteropodidae	*Nyctimene* cf. *papuanus*	Common Tube-nosed Fruit Bat			
Pteropodidae	*Nyctimene* sp. A '*albiventer*' group	Common Tube-nosed Fruit Bat			One was spotlighted and photographed in lowland swamp forest
Pteropodidae	*Paranyctimene* cf *raptor*	Unstriped Tube-nosed Bat			

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Pteropodidae	*Pteropus neohibernicus*	Giant Flying Fox			Seen in large numbers flying over lowland habitats at dusk.
Pteropodidae	*Rousettus amplexicaudatus*	Common Rousette Bat			
Pteropodidae	*Syconycteris* cf *australis*	Common Blossom Bat			
Muridae	*Hydromys chrysogater*	Water Rat			
Muridae	*Melomys rufescens*	Black-tailed Melomys			One trapped in lowland swamp forest.
Muridae	*Paramelomys platyops*	Lowland Paramelomys			
Muridae	*Rattus exulans*	Polynesian Rat			
Muridae	*Rattus* cf *mordax*	Eastern Rat			Juvenile rat trapped in hill forest. Most likely Eastern Rat Rattus mordax .
Muridae	*Rattus steini*	Stein's Rat			
Muridae	*Uromys* sp. *caudimaculatus* group	Giant White-tailed Rat			One spotlighted in lowland swamp forest. Also the likely species for a surveillance camera image in the same location.
Molossidae	26 cFM cf. *Mormorpterus beccarii*	Beccari's Free-tailed Bat			
Molossidae	27 sFM *Otomops* sp.	Unidentified free-tailed bat			
Miniopteridae/ Vespertilionidae	38 st.cFM *Miniopterus* sp.	A bent-winged bat			
Miniopteridae/ Vespertilionidae	45/47 st.cFM	Unidentified bat			
Miniopteridae/ Vespertilionidae	53 st.cFM	Unidentified bat			
Vespertilionidae	42/50 st.bFM *Nyctophilus* sp.	Unidentified long-eared bat			
Vespertilionidae	71 st.sFM.d *Kerivoula* sp./ *Murina* sp./*Phoniscus* sp.				
Emballonuridae	50 i.fFM.d *Emballonura* sp.	Unidentified sheath-tailed bat			
Emballonuridae	55-60 i.fFM.d *Emballonura* sp.	Unidentified sheath-tailed bat			
Emballonuridae	60-65 i.fFM.d *Emballonura beccarii*	Beccari's Sheath-tailed Bat			
Emballonuridae	65-70 i.fFM.d *Emballonura beccarii* / *Mosia nigrescens*	Beccari's/Lesser Sheath-tailed Bat			
Emballonuridae	65 i.fFM.d *Mosia nigrescens*	Lesser Sheath-tailed Bat			

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Emballonuridae	70-75 i.fFM.d *Mosia nigrescens*	Lesser Sheath-tailed Bat			
Emballonuridae	25 cFM *Saccolaimus saccolaimus*	Bare-rumped Sheath-tailed Bat			
Rhinolophidae	78 lCF *Rhinolophus cf megaphyllus*	Eastern Horseshoe Bat			
Hipposideridae	58 sCF *Hipposideros diadema*	Diadem Leaf-nosed Bat			
Hipposideridae	82 mCF *Hipposideros wollastoni*	Wollaston's Leaf-nosed Bat			
Hipposideridae	112 sCF *Aselliscus tricuspidatus*	Trident Leaf-nosed Bat			
Hipposideridae	131 sCF *Hipposideros calcaratus*	Spurred Leaf-nosed Bat			
Suidae	*Sus scrofa*	Feral Pig			
Bovidae	*Bubalus bubalis*	Water Buffalo			
Felidae	*Felis catus*	Feral Cat			Occasional cats were observed along roads at night. The distances to the closest human habitation suggested feral animals.
Birds					
Casuariidae	*Casuarius bennetti*	Dwarf Cassowary			
Megapodiidae	*Megapodius decollatus*	New Guinea Scrubfowl			One photographed by remote camera in hill forest. All other records, seen and heard, were from lowland swamp forest. Eggs collected by locals from some mounds in lowland forest. Mounds apparently shared with Collared Brush-turkey.
Megapodiidae	*Talegalla jobiensis*	Collared Brushturkey			Commonly heard in both hill forest and lowland swamp forest though densities may be low. Seen once in hill forest and a pair photographed at a mound in hill forest.
Anatidae	*Dendrocygna guttata*	Spotted Whistling-Duck			
Anatidae	*Anas superciliosa*	Pacific Black Duck			A pair and a single bird seen flying along the Waime River.
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Little Grebe			
Ardeidae	*Ardea alba*	Great Egret		P	
Ardeidae	*Egretta intermedia*	Intermediate Egret		P	

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			IUCN	PNG	
Ardeidae	*Ardea alba/Egretta intermedia*	Great/Intermediate Egret		P	
Ardeidae	*Nycticorax caledonicus*	Nankeen Night-Heron			
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant			
Phalacrocoracidae	*Phalacrocorax sulcirostris*	Little Black Cormorant			One was seen at an oxbow lake in the lowlands.
Accipitridae	*Henicopernis longicauda*	Long-tailed Honey Buzzard			Common in both hill forest and lowland swamp forest.
Accipitridae	*Aviceda subcristata*	Pacific Baza			Seen in small numbers in both hill forest and lowland swamp forest.
Accipitridae	*Haliastur sphenurus*	Whistling Kite			Uncommon; occasional individuals seen in both hill forest and in the lowlands.
Accipitridae	*Haliastur indus*	Brahminy Kite			Common in hill forest, lowland swamp forest and at waterbodies.
Accipitridae	*Milvus migrans*	Black Kite			Very common in all habitats.
Accipitridae	*Circus spilothorax*	Papuan Harrier		R	
Accipitridae	*Accipiter hiogaster*	Variable Goshawk			Common in hill forest, with most records along the road or of a pair at Wafi Camp.
Accipitridae	*Accipiter fasciatus*	Brown Goshawk			One was seen in hill forest.
Accipitridae	*Accipiter sp.*	Goshawk sp.			Goshawks were seen in the lowlands but none was identified to species.
Accipitridae	*Harpyopsis novaeguineae*	Papuan Eagle	VU	P	Seen and photographed once in hill forest.
Accipitridae	*Aquila gurneyi*	Gurney's Eagle	NT	R	Seen on four occasions; an adult and immature perched in close proximity in hill forest, an immature soaring above hill forest and single adults flying over lowland forest. The sightings were within 8 kms of each other and the number of individuals is unknown.
Accipitridae	*Haliaeetus leucogaster*	White-bellied Sea-eagle		R	Single birds seen on three occasions; over the oxbow lake, the Waime River and above Kunai grasslands.
Accipitridae	*Pandion cristatus*	Eastern Osprey		P	One was seen flying along the Waime River.
Rallidae	*Amaurornis olivacea*	Plain Bush-hen			

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Rallidae	*Porzana cinerea*	White-browed Crake			Several birds seen and heard at the oxbow lake.
Rallidae	*Rallina tricolor*	Red-necked Crake			Heard regularly in lowland swamp forest in the first half of the field survey.
Rallidae	*Gymnocrex plumbeiventris*	Bare-eyed Rail			Rails were heard calling from a wet grassland close by lowland swamp forest and from swamp forest close to an artificial edge. The calls of all other likely species are known to the survey team and it is thought that these records may refer to Bare-eyed Rail. No recording of its call is available.
Rallidae	*Gallinula tenebrosa*	Dusky Moorhen			One was seen at the oxbow lake.
Jacanidae	*Irediparra gallinacea*	Comb-crested Jacana			One was seen at the oxbow lake.
Charadriidae	*Charadrius dubius dubius*	Little Ringed Plover			A pair was seen on a shingle bed on the Waime River.
Charadriidae	*Actitis hypoleucos*	Common Sandpiper			Incidental observation of a single bird on the Markham River downstream of the study area
Columbidae	*Macropygia amboinensis*	Slender-billed Cuckoo-Dove			Cuckoo-doves were seen regularly, especially in hill forest. Most sightings identified to species were Slender-billed Cuckoo-doves.
Columbidae	*Macropygia nigrirostris*	Bar-tailed Cuckoo-Dove			Based on size, one bird seen in flight in hill forest.
Columbidae	*Reinwardtoena reinwardtsi*	Great Cuckoo-Dove			Heard occasionally in hill and lowland swamp forests.
Columbidae	*Chalcophaps longirostris*	Pacific Emerald Dove			
Columbidae	*Chalcophaps stephani*	Stephan's Dove			Emerald doves seen several times in flight, typically across roads, both in hill and lowland forest could have been either Stephan's Dove or Pacific Emerald Dove. However, several birds seen perched and captured were Stephan's Dove and all emerald doves heard calling were Stephan's Dove.
Columbidae	*Otidiphaps nobilis*	Pheasant Pigeon		R	
Columbidae	*Ptilinopus magnificus*	Wompoo Fruit Dove			Common in both hill and lowland swamp forest.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Columbidae	*Ptilinopus perlatus*	Pink-spotted Fruit Dove			Common in hill forest and uncommon in lowland swamp forest during the early part of the field survey.
Columbidae	*Ptilinopus superbus*	Superb Fruit Dove			Present in both hill and lowland swamp forest.
Columbidae	*Ptilinopus coronulatus*	Coroneted Fruit Dove			Single birds seen twice in lowland swamp forest. Possibly under-reported.
Columbidae	*Ptilinopus iozonus*	Orange-bellied Fruit Dove			Common in both hill and lowland swamp forest.
Columbidae	*Ptilinopus nanus*	Dwarf Fruit Dove			Common in hill forest.
Columbidae	*Ducula pinon*	Pinon's Imperial Pigeon			Common in both hill and lowland swamp forest.
Columbidae	*Ducula zoeae*	Zoe's Imperial Pigeon			Common in both hill and lowland swamp forest.
Columbidae	*Gymnophaps albertisii*	Papuan Mountain-pigeon			Single bird seen once in hill forest.
Cacatuidae	*Probosciger aterrimus*	Palm Cockatoo		P	Recorded in both hill and lowland swamp forest. Seen and/or heard most days but this large and reasonably conspicuous species is probably uncommon.
Cacatuidae	*Cacatua galerita*	Sulphur-crested Cockatoo		R	Very common in all wooded habitats.
Psittacidae	*Loriculus aurantiifrons*	Papuan Hanging Parrot			
Psittacidae	*Micropsitta pusio*	Buff-faced Pygmy Parrot			Common in both hill and alluvial forest.
Psittacidae	*Trichoglossus haematodus micropteryx*	Coconut Lorikeet			Very common in all wooded habitats.
Psittacidae	*Lorius lory*	Black-capped Lory			Reasonably common in both hill and lowland swamp forest. Also present in gardens.
Psittacidae	*Pseudeos fuscata*	Dusky Lory			Pair seen once on the edge of lowland swamp forest on the Waime River.
Psittacidae	*Charmosyna pulchella*	Fairy Lorikeet			
Psittacidae	*Charmosyna placentis*	Red-flanked Lorikeet			Seen in small numbers on a few occasions in areas of alluvial forest. Small, unidentified lorikeets were also likely to have been this species.
Psittacidae	*Psittaculirostris edwardsii*	Edwards's Fig Parrot			Common, though somewhat patchily distributed, in both hill and lowland swamp forest.
Psittacidae	*Cyclopsitta diophthalma coccineifrons*	Double-eyed Fig Parrot			One, possibly two, birds seen once in hill forest.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Psittacidae		Fig-Parrot sp(p).			
Psittacidae	*Geoffroyus geoffroyi*	Red-cheeked Parrot			Common in hill forest and alluvial forest, particularly the latter. Also in gardens.
Psittacidae	*Eclectus roratus*	Eclectus Parrot			Common in both hill and lowland swamp forest. Also present in gardens.
Cuculidae	*Centropus menbeki*	Ivory-billed Coucal			Common in both hill and lowland swamp forest.
Cuculidae	*Centropus phasianinus*	Pheasant Coucal			Seen once in Kunai grassland.
Cuculidae	*Centropus bernsteini*	Black-billed Coucal			
Cuculidae	*Microdynamis parva*	Dwarf Koel			Heard often in both hill and lowland swamp forest, and seen once.
Cuculidae	*Eudynamys orientalis*	Pacific Koel			Uncommon in the lowlands and recorded once in hill forest; identified on call.
Cuculidae	*Scythrops novaehollandiae*	Channel-billed Cuckoo			Pair seen in flight high over hill forest.
Cuculidae	*Cacomantis variolosus*	Brush Cuckoo			Common in all wooded habitats.
Cuculidae	*Chrysococcyx minutillus*	Little Bronze Cuckoo			Uncommon in both hill and lowland swamp forest.
Cuculidae	*Chrysococcyx meyerii*	White-eared Bronze Cuckoo			Common in both hill and lowland swamp forest.
Cuculidae	*Cuculus saturatus*	Oriental Cuckoo			Single bird seen in flight at Bavaga
Tytonidae	*Tyto tenebricosa*	Sooty Owl			One seen and heard in lowland swamp forest.
Tytonidae	*Tyto longimembris*	Eastern Grass Owl			
Strigidae	*Ninox rufa*	Rufous Owl			
Strigidae	*Uroglaux dimorpha*	Papuan Hawk-Owl			Single bird seen once in hill forest in 2015, heard calling in upper Buvu Creek in 2012.
Podargidae	*Podargus ocellatus*	Marbled Frogmouth			Heard in both hill and lowland swamp forest.
Podargidae	*Podargus papuensis*	Papuan Frogmouth			Seen in both hill and lowland swamp forest.
Caprimulgidae	*Caprimulgus macrurus*	Large-tailed Nightjar			Three birds seen along the road in grassland at night. One bird unusually heard calling in lowland swamp forest during the day.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Caprimulgidae	*Aegotheles bennettii*	Barred Owlet-Nightjar			A bird heard calling at night in hill forest considered likely to be this species based on knowledge of the calls of all other nocturnal species except Papuan Nightjar. No call recording available for either species but the call heard matched the description provided in Pratt & Beehler (2015).
Hemiprocnidae	*Hemiprocne mystacea*	Moustached Treeswift			Uncommon but conspicuous species in both hill and lowland swamp forest.
Apodidae	*Aerodramus vanikorensis/A. hirundinaceus*	Uniform/Mountain Swiftlet			Common over all habitats. Not identifiable to species in flight. Both species are listed as Least Concern.
Apodidae	*Collocalia esculenta*	Glossy Swiftlet			One observation of a single bird over hill forest.
Apodidae	*Mearnsia novaeguineae*	Papuan Spine-tailed Swift			Observed over all habitat types. Less common than Aerodramus swiftlets but possibly under-recorded.
Apodidae	*Hirundapus caudacutus*	White-throated Needletail			Several seen once in the company of Papuan Spinetails over hill forest. Possibly under-recorded.
Coraciidae	*Eurystomus orientalis*	Dollarbird			Uncommon but conspicuous species found in all habitat types, including grassland.
Alcedinidae	*Ceyx azureua*	Azure Kingfisher			One was seen flying across a road between areas of lowland swamp forest.
Alcedinidae	*Ceyx pusilla*	Little Kingfisher			One was seen in lowland swamp forest on the edge of an oxbow lake.
Alcedinidae	*Ceyx lepidus*	Variable Dwarf Kingfisher			Recorded, including trapping, in both hill forest and lowland swamp forest. Relatively common.
Alcedinidae	*Tanysiptera galatea*	Common Paradise Kingfisher			
Alcedinidae	*Tanysiptera nympha*	Red-breasted Paradise Kingfisher			One adult and one immature seen in close proximity in alluvial forest. The species was not heard so may be under-reported.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Alcedinidae	*Melidora macrorrhina*	Hook-billed Kingfisher			Trapped in hill forest and seen during spotlighting in alluvial forest. Heard at dawn and/or dusk on almost every survey day including in small, isolated forest remnants. Apparently common in hill and lowland swamp forest and disturbed areas.
Alcedinidae	*Dacelo gaudichaud*	Rufous-bellied Kookaburra			Easily noted by its call though not often seen. Probably uncommon but found in all wooded habitats.
Alcedinidae	*Todiramphus nigrocyaneus*	Blue-black Kingfisher	NT		Single bird seen once in lowland swamp forest at edge of swamp at night, presumably at roost.
Alcedinidae	*Syma torotoro*	Yellow-billed Kingfisher			Commonly heard in both hill forest and lowland swamp forest. No individual was seen but presumably the species is common.
Alcedinidae	*Todiramphus sanctus*	Sacred Kingfisher			Three birds seen in riparian vegetation at Bavaga village.
Meropidae	*Merops ornatus*	Rainbow Bee-eater			Reasonably common in all habitats.
Bucerotidae	*Rhyticeros plicatus*	Blyth's Hornbill		P	Common in wooded habitats, more so in the lowlands.
Pittidae	*Pitta sordida*	Hooded Pitta			Heard twice in lowland swamp forest.
Ptilonorhynchidae	*Ailuroedus buccoides*	White-eared Catbird			Catbirds were heard and seen (poorly) in hill forest. Based on known altitudinal distribution it is assumed they were White-eared rather than Spotted Catbird A. melanotis.
Maluridae	*Malurus alboscapulatus*	White-shouldered Fairywren			Common in Kunai grassland. Also present in weedy roadside edges in lowland swamp forest.
Meliphagidae	*Myzomela eques*	Ruby-throated Myzomela			Seen three times, in both hill and alluvial forest.
Meliphagidae	*Myzomela nigrita*	Papuan Black Myzomela			Two males seen well in hill forest on one occasion.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
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Meliphagidae	*Meliphaga sp(p).*	Honeyeater sp(p).			Meliphaga honeyeaters were heard often and seen occasionally in both hill and alluvial forest. In most cases insufficient detail was seen to identify individuals to species. The call most often heard was the generic tup, which also didn't allow identification to species. Mimic Honeyeater was the species identified most often, which is consistent with Pratt & Beehler (2015), though the trapping of 3 Scrub Honeyeaters in one morning suggests under-recording of that species.
Meliphagidae	*Meliphaga albonotata*	Scrub Honeyeater			Pair seen near Wafi Camp and three trapped along a track. Only recorded in disturbed habitats in hill forest.
Meliphagidae	*Meliphaga analoga*	Mimic Honeyeater			Seen and trapped in both hill and alluvial forest.
Meliphagidae	*Meliphaga aruensis*	Puff-backed Honeyeater			Single birds seen twice in alluvial forest and trapped once in hill forest.
Meliphagidae	*Pycnopygius stictocephalus*	Streak-headed Honeyeater			Seen occasionally in both hill and lowland swamp forest. A canopy species and probably under-recorded when not vocal.
Meliphagidae	*Pycnopygius ixoides*	Plain Honeyeater			Seen once, possibly more, in edge habitats in alluvial forest.
Meliphagidae	*Philemon novaeguineae*	New Guinea Friarbird			Common in both hill and alluvial forest.
Meliphagidae	*Philemon meyeri*	Meyer's Friarbird			Seen three times in hill forest. The birds seen were not vocal and the species may have been under-recorded.
Meliphagidae	*Melilestes megarhynchus*	Long-billed Honeyeater			Recorded occasionally in both hill forest and lowland swamp forest. Either occurs at low densities or, more likely, is somewhat secretive. Trapped once in hill forest.
Meliphagidae	*Xanthotis flaviventer*	Tawny-breasted Honeyeater			Common in both hill and lowland swamp forest.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
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Meliphagidae	*Timeliopsis griseigula*	Tawny Straightbill			Four birds seen together on one occasion foraging on the forest edge in hill forest.
Acanthizidae	*Crateroscelis murina*	Rusty Mouse Warbler			Heard often in both hill and lowland swamp forest but this secretive species was not seen.
Acanthizidae	*Sericornis spilodera*	Pale-billed Scrubwren			Seen twice and trapped once at one location in hill forest. Heard once on the forest edge in hill forest at a second location.
Acanthizidae	*Sericornis sp.*	Scrubwren sp.			
Acanthizidae	*Gerygone magnirostris*	Large-billed Gerygone			
Acanthizidae	*Gerygone chloronota*	Green-backed Gerygone			Heard in both hill and lowland swamp forest.
Melanocharitidae	*Melanocharis nigra*	Black Berrypecker			One was trapped in hill forest and one was seen once in alluvial forest. Possibly over-looked.
Melanocharitidae	*Oedistoma pygmaeum*	Pygmy Longbill			A pair was seen once in hill forest.
Psophodidae	*Ptilorrhoa geislerorum/castanonota*	Brown-headed/ Chestnut-backed Jewel-babbler			Jewel-babblers were seen twice in hill and lowland swamp forest and heard regularly in both hill and alluvial forest. Based on known distribution, including altitudinal, of jewel-babblers it is likely that all records for 2015 survey were of Brown-headed Jewel-babbler.
Psophodidae	*Ptilorrhoa geislerorum*	Brown-headed Jewel-babbler			One male seen very well in hill forest, responding to call playback.
Machaerirhynchidae	*Machaerirhynchus flaviventer*	Yellow-breasted Boatbill			Seen and heard occasionally in both hill and alluvial forest. Apparently present at low densities.
Cracticidae	*Cracticus quoyi*	Black Butcherbird			One bird seen once in hill forest.
Cracticidae	*Cracticus cassicus*	Hooded Butcherbird			Common and conspicuous in wooded habitats.
Cracticidae	*Peltops blainvillii*	Lowland Peltops			Recorded in both hill forest and alluvial forest.
Artamidae	*Artamus maximus*	Great Woodswallow			A few individuals seen twice at Wafi camp. This is several hundred metres below their usual altitudinal limit and possibly reflects movement to lower elevation during wet weather.

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			IUCN	PNG	
Campephagidae	*Coracina boyeri*	Boyer's Cuckooshrike			Common in both hill and alluvial forest.
Campephagidae	*Coracina papuensis*	White-bellied Cuckooshrike			Common in both hill and alluvial forest.
Campephagidae	*Coracina melas meeki*	Black Cicadabird			Common in both hill and alluvial forest.
Campephagidae	*Lalage leucomela*	Varied Triller			Uncommon in both hill and alluvial forest.
Pachycephalidae	*Pachycephala simplex brunnescens*	Grey Whistler			Common in both hill and alluvial forest.
Pachycephalidae	*Pachycephala monacha*	Black headed Whistler			Single birds seen occasionally in the canopy of trees along forest edges in alluvial forest.
Pachycephalidae	*Colluricincla megarhyncha*	Little Shrike-thrush			Common in both hill and alluvial forest.
Pachycephalidae	*Pseudorectes ferrugineus*	Rusty Pitohui			
Oriolidae	*Oriolus szalayi*	Brown Oriole			Commonly heard and occasionally seen in both hill and alluvial forest.
Oriolidae	*Pitohui dichrous*	Hooded Pitohui			A pair and singles seen three times and an individual trapped in hill forest.
Dicruridae	*Dicrurus bracteatus carbonarius*	Spangled Drongo			Common in both hill and alluvial forest. All birds closely examined were the resident race carbonarius.
Rhipiduridae	*Rhipidura leucophrys*	Willie-wagtail			Single birds were seen occasionally along the road in Kunai grasslands and on the edges of alluvial forest.
Rhipiduridae	*Rhipidura rufiventris*	Northern Fantail			Common in both hill and alluvial forest.
Rhipiduridae	*Rhipidura threnothorax*	Sooty Thicket Fantail			Single bird seen once in lowland swamp forest.
Rhipiduridae	*Rhipidura leucothorax*	White-bellied Thicket Fantail			Common in dense edge vegetation in both hill and alluvial forest.
Monarchidae	*Myiagra alecto*	Shining Flycatcher			Common in both hill and alluvial forest.
Monarchidae	*Myiagra cyanoleuca*	Satin Flycatcher			Two individuals, one male and one female, were seen separately in hill forest at Wafi Camp.
Monarchidae	*Symposiachrus guttula*	Spot-winged Monarch			Reasonably common in both hill and alluvial forest.
Monarchidae	*Symposiachrus manadensis*	Hooded Monarch			Uncommon in both hill and alluvial forest. Half of the records were of trapped birds suggesting the species was under-recorded by observation.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Monarchidae	*Carterornis chrysomela*	Golden Monarch			Common in alluvial forest, less so in hill forest. Reportedly a canopy species (Pratt & Beehler 2015), this species was often observed in the lower- and mid-storeys, incldluing in the forest.
Monarchidae	*Arses insularis*	Ochre-collared Monarch			Seen occasionally in alluvial forest. The study area is to the south of the species' distribution as per Coates (1990) and Pratt & Beehler (2015).
Monarchidae	*Arses telescopthalmus*	Frilled Monarch			Common in both hill and alluvial forest.
Monarchidae	*Monarcha melanopsis*	Black-faced Monarch			A single bird seen and heard once in lowland swamp alluvial forest.
Corvidae	*Corvus tristis*	Grey Crow			Commonly observed in noisy flocks in both hill and alluvial forest.
Corvidae	*Corvus orru*	Torresian Crow			Seen occasionally, typically in pairs, in both hill and alluvial forest edge areas.
Paradisaeidae	*Manucodia ater*	Glossy-mantled Manucode			Single bird seen closely once, foraging in a fruiting tree on the edge of alluvial forest.
Paradisaeidae	*Manucodia chalybatus*	Crinkle-collared Manucode		P	
Paradisaeidae	*Cicinnurus regius*	King Bird-of-Paradise		P	Common in both hill and alluvial forest.
Paradisaeidae	*Paradisaea raggiana*	Raggiana Bird-of-Paradise		P	Common in both hill and alluvial forest.
Petroicidae	*Drymodes superciliaris brevirostris*	Northern Scrub Robin			Heard in both hill and lowland swamp forest.
Petroicidae	*Poecilodryas hypoleuca*	Black-sided Robin			Commonly heard and occasionally seen in both hill and alluvial forest. Trapped once in alluvial forest.
Petroicidae	*Microeca flavovirescens*	Olive Flyrobin			Seen twice in the mid-storey on the edge of alluvial forest.
Petroicidae	*Microeca flavigaster*	Lemon-bellied Flyrobin			Common in the canopy of hill and, more so, alluvial forest.
Hirundinidae	*Hirundo tahitica*	Pacific Swallow			
Muscicapidae	*Saxicola caprata*	Pied Bush Chat			Single birds seen twice in Kunai grassland.
Cisticolidae	*Cisticola exilis*	Golden-headed Cisticola			Single bird seen once in Kunai grassland.
Zosteropidae	*Zosterops minor*	Black-fronted White-eye			

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Sturnidae	*Aplonis metallica*	Metallic Starling			
Sturnidae	*Aplonis cantoroides*	Singing Starling			Active nesting colony in a dead tree stag near Chiatz village in the lowlands in 2015.
Sturnidae	*Mino dumontii*	Yellow-faced Myna			Common in both hill and alluvial forest.
Dicaeidae	*Dicaeum geelvinkianum*	Red-capped Flowerpecker			Single birds and pairs seen occasionally in both hill and alluvial forest. Also seen in gardens and other disturbed areas.
Nectariniidae	*Leptocoma sericea*	Black Sunbird			Common in both hill and alluvial forest.
Nectariniidae	*Cinnyris jugularis*	Olive-backed Sunbird			Uncommon in both hill and alluvial forest.
Estrildidae	*Lonchura tristissima*	Streak-headed Mannikin			A small flock was seen in rank riverside grasses next to a village and a few birds were seen in roadside vegetation, in lowlands.
Reptiles					
Chelidae	*Elseya novaeguineae*	New Guinea Snapping Turtle			Dead animal provided to survey team by locals. Caught in an oxbow lake in the lowlands.
Crocodylidae	*Crocodylus [porosus]*	[Saltwater] Crocodile		R	
Agamidae	*Hypsilurus modestus*	Modest Forest Dragon			Recorded in both hill forest and lowland swamp forest with most records from the latter. Apparently common.
Gekkonidae	*Hemidactylus frenatus*	Common House Gecko			Common on infrastructure at Wafi Camp.
Gekkonidae	*Nactus* sp	Unidentified gecko			
Gekkonidae	*Cyrtodactylus* sp.	Unidentified gecko			One was seen in hill forest. The species considered likely to occur, based on the Bishop Museum database*, are either listed as Least Concern or are not assessed by the IUCN.
Gekkonidae	*Gehyra vorax*	Voracious Gecko			Seen in both hill forest and lowland swamp forest. No indivdual was caught and identification is based on size.
Scincidae	*Tribolonotus gracilis*	Red-eyed Crocodile Skink			Recorded twice at one location in alluvial forest.
Scincidae	*Emoia caeruleocauda*				

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Scincidae	*Emoia obscura*				What is thought to be this species was common in hill forest and very common in lowland swamp forest. Photographed.
Scincidae	*Emoia pallidiceps*				Several individuals of what is thought to be this species were seen in hill forest. Photographed.
Scincidae	*Emoia physicae*				
Scincidae	*Emoia longicauda*	Shrub whiptail-skink			Reasonably common in lowland swamp forest.
Scincidae	*Emoia* small sp				
Scincidae	*Emoia* sp. 1				A large dark species was observed a number of times in hill forest.
Scincidae	*Lipinia pulchra*				Single individuals observed on four occasions in alluvial forest
Scincidae	*Sphenomorphus simus*				
Scincidae	*Sphenomorphus* cf *jobiensis*				Common in hill forest and lowland swamp forest, particularly the latter.
Scincidae	*Lamprolepis smaragdina*	Emerald Tree Skink			Two individuals were seen in Wafi Camp in hill forest. One was seen in alluvial forest.
Varanidae	*Varanus jobiensis*	Peach-throated Monitor		R	Common in both hill forest and lowland swamp forest.
Varanidae	*Varanus prasinus*	Emerald Monitor		R	
Boidae	*Candoia aspera*	New Guinea Ground Boa		R	
Boidae	*Boiga irregularis*	Brown Tree Snake			One seen on a road at night in hill forest.
Colubridae	*Dendrelaphis* sp.	Unidentified tree snake			
Colubridae	*Dendrelaphis calligastra*	Coconut Tree Snake			One was seen in lowland swamp forest.
Colubridae	*Tropidonophis multiscutellatus*	Many-scaled Keelback			One seen on a road in an area of grassland and swamp.
Colubridae	*Stegonotus parvus*	Common Ground Snake			One seen on a road at night in hill forest.
Elapidae	*Acanthophis laevis*	New Guinea Death Adder			
Elapidae	*Micropechis ikahaka*	New Guinea Small-eyed Snake			
Pythonidae	*Leiopython bennettorum*	Bennett's white-lipped python		R	

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Pythonidae	*Leiopython albertisii*	White-lipped (D'Albertis) Python		R	Two individuals were seen at night, in hill and alluvial forest, both of which had a whitish spot on a post-ocular scale, a character that distinguishes *L. albertisii* from *L. bennettorum* (Schleip 2008). Schleip (25008) further asserts that *L. bennettorum* 'only occurs at Wau at an elevation between 1,050 and 1,400 m'.
Pythonidae	*Morelia amethistina*	Amethystine Python		R	
Pythonidae	*Morelia viridis*	Northern Emerald Python		R	
Amphibians					
Bufonidae	*Bufo marinus*	Cane Toad			Common, especially in disturbed areas and around infrastructure.
Hylidae	*Litoria eucnemis*	Fringed Tree Frog			Common along a stream in hill forest.
Hylidae	*Litoria thesaurensis*				A Litoria thought to be this species was seen at Wafi Camp in hill forest. An individual was caught in a flooded roadside adjacent to lowland swamp forest.
Hylidae	*Litoria infrafrenata*	White-lipped Tree Frog			Common in lowland swamp forest and along inundated roadsides adjacent to lowland forest.
Hylidae	*Litoria cf nigropunctata*				A metamorph most closely matching *L. nigropunctata* was found in lowland swamp forest. This species is thought to be a species complex.
Hylidae	*Nyctimystes cheesmani*				A *Nyctimystes* was seen on a rocky stream in hill forest. It is thought most likely to be *N. cheesmani*. It was not *N. pulcher*, the only other *Nyctimystes* species thought likely to occur.
Microhylidae	*Cophixalus* sp.				
Microhylidae	*Mantophryne* sp. (*lateralis* complex)				
Microhylidae	*Oreophryne geislerorum*				
Ranidae	*Platymantis papuensis*				Very common in lowland swamp forest.
Ranidae	*Papurana arfaki*				Several seen on a rocky stream in hill forest.

Family	Scientific name	English name	Status		Comments on occurrence in the study area
			IUCN	PNG	
Ranidae	*Papurana daemeli*				Heard on the fringes of an oxbow lake in the lowlands.
Ranidae	*Papurana garritor*				Common along creeks and around inundated areas in hill forest, lowland swamp forest and grasslands. Very common in the lowlands.
Ranidae	*Papurana cf grisea*				
Ranidae	*Papurana papua*				Common along creeks and around inundated areas in hill forest and lowland swamp forest.

Table E.3 Elliott box-trapping results from the 2012 (Woxvold and Aplin 2013) and 2015 surveys.

Species	English name	2012			2015			
		Buvu-Nabonga Hill forest	Buvu headwaters Hill forest	Watut Plain Alluvial forest	Portal Hill forest	Finchif kunai grassland	Watut Plain Alluvial forest	Total
Melomys rufescens	Black-tailed Melomys	7	1				1	9
Paramelomys platyops	Lowland Paramelomys	2	12	2				16
Rattus exulans	Polynesian Rat	1						1
Rattus steini	Stein's Rat	1						1
Rattus cf mordax	Eastern Rat				1			1
Total captures		11	13	2	1	0	1	28
Trap nights (TN)		129	128	126	87	29	174	673
Capture rate (captures/TN)		8.5%	10.2%	1.6%	1.1%	0.0%	0.6%	4.2%

Table E.4 Fauna photographed by remote camera during the 2012 (Woxvold and Aplin 2013) and 2015 surveys.

Species	English name	2012			2015		
		Buvu-Nabonga Hill forest	Buvu headwaters Hill forest	Watut Plains Alluvial forest	Portal Hill forest	Watut Plain Alluvial forest	Buvu Hill forest
Echymipera kalubu			4	8			
Melomys cf rufescens	Black-tailed Melomys			1			
Paramelomys sp.	Unidentified Paramelomys		5				
Uromys cf caudimaculatus	Giant White-tailed Rat			1		1	
Rattus sp.	Unidentified rat						1
	Unidentified bandicoot				1	4	
	Unidentified rodent	2					
Canis familiaris	Dog					1	
Megapodius decollatus	New Guinea Scrubfowl			2	1		
Talegalla jobiensis	Brown-collared Brush-Turkey		1		2	2	
Chalcophaps stephani	Stephan's Dove		1	2		1	
Pitta sordida	Hooded Pitta			5			
Ptilorrhoa geislerorum/castanonota	Brown-headed/ Chestnut-backed jewel-babbler			1			
Varanus jobiensis	Peach-throated Monitor				2		

Table E.5 Mammal species observed at night during the 2012 (Woxvold and Aplin 2013) and 2015 spot-lighting surveys.

Species	English name	2012			2015	
		Buvu-Nabonga Hill forest	Buvu headwaters Hill forest	Watut Plain Alluvial forest	Portal Hill forest	Watut Plain Alluvial forest
	Bandicoots	*	*	*		
Petaurus breviceps	Sugar Glider			1h		
Melomys cf rufescens	Black-tailed Melomys			1		
Paramelomys sp.	Unidentified Paramelomys	1		1		
Uromys cf caudimaculatus	Giant White-tailed Rat	1	2	3		1
Phalanger intercastellanus						1
Pteropus neohibernicus						Hundreds
Dobsonia moluccensis						1
Nyctimene sp. A 'albiventer' group						1

Table E.6 Pteropodid bat species captured during the 2012 nocturnal mist-netting surveys of Woxvold and Aplin (2013).

Species	English name	Buvu-Nabonga Hill forest	Buvu headwaters Hill forest	Watut Plain Alluvial forest	Total All Sites
Macroglossus A	Long-nosed Blossom Bat	4	2	2	8
Macroglossus B	Long-nosed Blossom Bat	1			1
Nyctimene aello	Broad-striped Tube-nosed Fruit Bat	2			2
Nyctimene cf papuanus	Common Tube-nosed Fruit Bat	5	3	5	13
Nyctimene sp. A	Common Tube-nosed Fruit Bat	2		6	8
Nyctimene juv	Common Tube-nosed Fruit Bat	1			1
Paranyctimene cf raptor	Unstriped Tube-nosed Bat	1	1		2
Rousettus amplixicaudatus	Common Rousette Bat	3	1		4
Syconycteris cf australis	Common Blossom Bat	71	67	64	202
Total Captures		90	74	77	241
Mist net night meter/hours		972	1836	1188	3996
Captures/1000) night meter-hour		92.6	40.3	64.8	60.3

Table E.7 Echo-locating bat species detected during the 2012 bat detector surveys (from Woxvold and Aplin 2013).

Call-type / taxonomic attribution	Watut Plains	Pekumbe	Phase 1 – Buvu/Nabona Creek valleys	Phase 2 – Upper Buvu Creek	Wafi Camp
Altitude (m asl)	129-139	c. 250	326-331	412-448	433-442
26 cFM Mormorpterus beccarii	—	—	—	X	X
38 st.cFM Miniopterus sp.	X	X	X	X	X
47 st.cFM	X	X	X	X	—
50 st.bFM	—	—	—	X	—
53 st.cFM	X	X	X	X	X
58 sCF Hipposideros diadema	X	X	X	X	—
55-60 i.fFM.d Emballonura sp.	X	—	—	—	—
60-65 i.fFM.d Emballonura cf. *beccarii*	—	X	X	X	—
65-70 i.fFM.d E. cf. *beccarii / Mosia nigrescens*	X	—	—	X	—
70-75 i.fFM.d Mosia nigrescens	X	—	—	X	—
71 st.sFM,d	X	—	—	—	—
78 lCF Rhinolophus cf. *megaphyllus*	X	—	—	—	—
82 mCF Hipposideros cf. *wollastoni*	—	—	—	X	—
112 sCF Aselliscus tricuspidatus	X	—	—	—	—
131 sCF Hipposideros calcaratus	X	—	—	—	—
Call-type Richness	10	5	5	9	3
Number of recording sessions	6	1	2	9	2
Call types/session: range	4–9	5	4–5	1–6	2
Call types/session: average	6.7	5	4.5	3.9	2

Table E.8 Echo-locating bat species detected during the 2015 bat detector surveys.

Date	Time	Latitude	Longitude	Species	*S. saccolaimus*	*Miniopterus* sp.	Unidentified	Unidentified	*Otomops* sp.	*Nyctophilus* sp.	*Emballonura* sp.	*M. nigrescens*	*H. diadema*	*A. tricuspidatus*	*R. megaphyllus*
				Call type and frequency Habitat	*25 cFM*	*38 st.cFM*	*45 st.cFM*	*53 st.cFM*	*27 sFM*	*42 st.bFM*	*50 i.fFM.d*	*65 i.fFM.d*	*58 mCF*	*112 sCF*	*75 ICF*
3/04/2015	Overnight	-6.76558	146.4519	Alluvial forest	—	—	—	—	—	—	—	X	X	X	X
4/04/2015	Overnight	-6.76277	146.4523	Alluvial forest	—	—	—	X	—	X	—	X	X	—	—
5/04/2015	Overnight	-6.76191	146.4527	Alluvial forest	—	—	X	—	—	—	—	—	—	—	—
12/04/2015	Overnight	-6.83303	146.4228	Alluvial forest	—	—	—	X	—	—	—	—	—	X	—
9/04/2015	18.29-21.19	-6.76558	146.4519	Alluvial forest	X	—	X	X	—	—	—	X	—	—	—
1/04/2015	16:28-18.41	-6.79416	146.4356	Alluvial forest/grassland	X	—	X	—	—	—	—	—	—	—	—
1/04/2015	21.05-21.35	-6.79416	146.4356	Alluvial forest/grassland	X	X	X	X	X	—	—	—	—	—	—
5/04/2015	19.15-21.27	-6.79416	146.4356	Alluvial forest/grassland	—	X	X	X	X	—	X	—	—	—	—
5/04/2015	18.37-19.14	-6.81544	146.4215	Grassland swamp	X	X	X	X	—	—	—	—	—	—	—
28/03/2015	Overnight	-6.83528	146.4285	Hill forest	—	X	X	X	X	—	—	X	X	—	—
29/03/2015	Overnight	-6.83587	146.4303	Hill forest	—	X	X	X	—	—	—	X	—	—	—
6/04/2015	Overnight	-6.84537	146.4441	Hill forest	—	X	X	X	—	—	—	X	X	—	—
7/04/2015	Overnight	-6.83148	146.4472	Hill forest	—	—	—	X	—	X	—	X	X	—	—
8/04/2015	Overnight	-6.83379	146.4472	Hill forest	—	X	—	X	—	—	—	—	—	—	—
10/04/2015	Overnight	-6.83996	146.4289	Hill forest	—	X	X	X	—	—	X	—	X	—	—
11/04/2015	Overnight	-6.84804	146.4357	Hill forest	—	X	X	X	—	—	—	X	—	—	—
1/04/2015	20.53-20.53	-6.84087	146.4334	Hill forest	X	X	X	X	X	—	X	X	X	—	—
1/04/2015	21.55-22.12	-6.81029	146.4592	Hill forest	—	X	X	X	—	—	X	—	—	—	—
5/04/2015	22.16-22.35	-6.86484	146.4501	Hill forest	X	X	—	X	—	—	—	—	—	—	—
6/04/2015	19:34-20:13	-6.86484	146.4501	Hill forest	—	X	—	X	—	—	—	—	—	—	—
6/04/2015	Overnight	-6.85051	146.4434	Hill forest creek	—	X	X	X	—	—	—	—	—	—	—
9/04/2015	21.19-21.20	-6.7821	146.4636	Hill forest creek	—	X	—	X	—	—	—	—	—	—	—
30/03/2015	Overnight	-6.82285	146.4267	Kunai grassland/hill forest edge	—	X	X	X	—	—	X	X	X	—	—

Date	Time	Latitude	Longitude	Species	*S. saccolaimus*	*Miniopterus* sp.	Unidentified	Unidentified	*Otomops* sp.	*Nyctophilus* sp.	*Emballonura* sp.	*M. nigrescens*	*H. diadema*	*A. tricuspidatus*	*R. megaphyllus*
				Call type and frequency Habitat	*25 cFM*	*38 st.cFM*	*45 st.cFM*	*53 st.cFM*	*27 sFM*	*42 st.bFM*	*50 i.fFM.d*	*65 i.fFM.d*	*58 mCF*	*112 sCF*	*75 ICF*
1/04/2015	21.44-21.54	-6.7821	146.4636	Secondary forest/gardens	—	X	X	X	X	—	X	—	—	—	—
5/04/2015	21.27-21.35	-6.7821	146.4636	Secondary forest/gardens	X	X	X	X	—	—	X	—	—	—	—

Table E.9 Bird species captured during the 2012 (Woxvold and Aplin 2013) and 2015 diurnal mist-netting surveys.

Species common name	2012		2015			
	Buvu headwaters Hill forest	Watut Plain Alluvial forest	Upper Buvu Creek hill forest	Watut River valley alluvial forest	Watut River valley hill forest	Total
Azure kingfisher		1				1
Black Berrypecker			1			1
Black Sunbird				1	2	3
Black-sided Robin		1		1		2
Frilled Monarch				1	1	2
Grey Whistler				1		1
Hooded Monarch				1	2	3
Hooded Pitohui			1			1
Hook-billed Kingfisher	1		1			2
King Bird-of-Paradise				1		1
Little Shrike-thrush		2	1	1	2	6
Long-billed Honeyeater			1			1
Mimic Honeyeater			1	1	2	4
Northern Fantail		1			1	2
Orange-bellied Fruit Dove					3	3
Pale-billed Scrubwren			1			1
Puff-backed Honeyeater					1	1
Scrub Honeyeater					3	3
Shining Flycatcher		3	2	2		7
Spot-winged Monarch		1		1		2
Stephan's Dove	1				1	2
Tawny-breasted Honeyeater					3	3
Variable Dwarf Kingfisher	2		2	1		5
White-bellied Thicket Fantail				2	2	4
Totals	4	9	11	14	23	61

Table E.10. Point location data for significant species and ecological features. Co-ordinate data in either WGS84 datum or AGD 1966 AMG Zone 55 datum. Sources: 2010: Woxvold (2011); 2011: Woxvold (2012); 2013: (Woxvold and Aplin 2013); 2015: BAAM surveys.

Latitude	Longitude	Significant species and ecological features	Year
-6.762006	146.4526	Blue-black Kingfisher	2015
-6.70550	146.49603	Dwarf Cassowary (sign)	2015
-6.837124	146.4304	Gurney's Eagle	2015
-6.830058	146.4211	Gurney's Eagle	2015
-6.766297	146.4524	Gurney's Eagle	2015
-6.684277	146.464031	Gurney's Eagle	2015
-6.837672	146.4282	Megapode nest mound	2015
-6.790697	146.4383	Megapode nest mound	2015
-6.76167	146.4533	Megapode nest mound	2015
-6.761091	146.4534	Megapode nest mound	2015
-6.760765	146.4533	Megapode nest mound	2015
-6.725287	146.4828	Megapode nest mound	2015
-6.688428	146.5123	Megapode nest mound	2015
-6.687787	146.5139	Megapode nest mound	2015
-6.687107	146.5122	Megapode nest mound	2015
-6.681858	146.5076	Megapode nest mound	2015
-6.651487	146.513611	Megapode nest mound	2015
-6.644596	146.508844	Megapode nest mound	2015
-6.642946	146.50713	Megapode nest mound	2015
-6.641392	146.508071	Megapode nest mound	2015
-6.839007	146.4311	Pale-billed Scrubwren (heard)	2015
-6.833792	146.4472	Pale-billed Scrubwren (sighting & capture)	2015
-6.84276	146.4334	Papuan Eagle	2015
-6.66374	146.6023	Papuan Eagle	2011
-6.771941	146.4531	Papuan Hawk-Owl	2015
-6.853197	146.4562	Raggiana Bird-of-Paradise display site	2015
-6.694655	146.5143	Raggiana Bird-of-Paradise display site	2015
-6.641026	146.515871	Raptor nest	2015
456313	9265007	Blue-black Kingfisher	2011
436222	9244669	Dwarf Cassowary	2010
450403	9263303	Dwarf Cassowary (sign)	2011
453157	9260696	Dwarf Cassowary (sign)	2011
454066	9260483	Dwarf Cassowary (sign)	2011
454657	9265270	Dwarf Cassowary (sign)	2011
454800	9258935	Dwarf Cassowary (sign)	2011
455224	9259417	Dwarf Cassowary (sign)	2011
431037	9250943	Megapode nest mound	2011
434709	9243483	Megapode nest mound	2012

Latitude	Longitude	Significant species and ecological features	Year
434718	9243486	Megapode nest mound	2012
434730	9243082	Megapode nest mound	2012
434907	9242781	Megapode nest mound	2012
435088	9243842	Megapode nest mound	2012
435141	9242698	Megapode nest mound	2012
435191	9242371	Megapode nest mound	2012
435487	9242875	Megapode nest mound	2012
438126	9249149	Megapode nest mound	2010
438181	9249987	Megapode nest mound	2010
442844	9259380	Megapode nest mound	2011
445586	9260679	Megapode nest mound	2011
452503	9259378	Megapode nest mound	2011
453782	9261909	Megapode nest mound	2011
453986	9266101	Megapode nest mound	2011
453989	9266194	Megapode nest mound	2011
454829	9258978	Megapode nest mound	2011
455131	9259258	Megapode nest mound	2011
457618	9266068	Megapode nest mound	2011
440344	9250854	Metallic Starling nesting colony	2010
438964	9244491	Papuan Hawk-Owl	2012
436837	9242899	Raggiana Bird-of-Paradise display site	2010
438880	9244450	Scrubwren sp. (2012)	2012

Table E.11. Photographic record of mammals recorded in the study area

 Common Echymipera (*Echymipera kalubu*) trapped by a local hunter.	 Common Echymipera (*Echymipera kalubu*) camera trapped on the Watut Plains (from Woxvold & Aplin 2013).
 Unidentified small bandicoot camera trapped in hill forest in close proximity to an active burrow in an earth bank.	 Raffray's Bandicoot (*Peroryctes raffrayana*) lower jawbone kept at Uruf village (from Woxvold & Aplin 2013).
 New Guinea Pademelon (*Thylogale browni*) captive at Pekumbe village (from Woxvold & Aplin 2013).	 Goodfellow's Tree Kangaroo (*Dendrolagus goodfellowi*) kept as a pet at Majim village, apparently captured as a juvenile in montane forest in the upper Watut valley (from Woxvold & Aplin 2013).

Eastern Common Cuscus (*Phalanger intercastellanus*) in alluvial forest.

Common Spotted Cuscus (*Spilocuscus maculatus*) pelt displayed at Mare village (from Woxvold & Aplin 2013).

Water Buffalo (*Bubalus bubalis*) in kunai grassland (Photo: H. Rogers in Woxvold and Aplin 2013).

A Giant Flying-Fox kept as a pet at Mare village (from Woxvold and Aplin 2013).

Common Tube-nosed Bat (*Nyctimene* sp. '*albiventer*' group) in alluvial forest.

Moluccan Naked-backed Fruit Bat (*Dobsonia moluccensis*) in alluvial forest.

 Juvenile rat (*Rattus* cf. *mordax*) trapped in hill forest.	 Black-tailed Melomys (*Melomys rufescens*) trapped in alluvial forest.

Table E.12. Photographic record of reptiles recorded in the study area

 Peach-throated Monitor (*Varanus jobiensis*) photographed by a remote camera in 2015.	 Emerald monitor (*Varanus prasinus*) was recorded in 2012 (reproduced from Woxvold and Aplin 2013).
 Modest Forest Dragon (*Hypsilurus modestus*) was recorded in most surveys (reproduced from Woxvold 2012).	 A large Voracious Gecko (*Gehyra vorax*) resting on a tree bole in alluvial forest in 2015.

The arboreal Emerald tree skink (*Lamprolepis smaragdina*) was recorded in all surveys.

Sphenomorphus cf jobiensis was relatively common in the study area.

Emoia longicauda, a relatively large, arboreal species was recorded several times in 2015.

Emoia cf obscura was common in leaf litter in 2015, especially in alluvial forest.

Emoia pallidiceps was recorded in hill forest in 2015

Emoia sp. 1, recorded in hill forest in 2015.

Red-eyed Crocodile Skink (*Tribolonotus gracilis*) under a damp rotting log in alluvial forest in 2015.

Lipinia pulchra was recorded several times in 2015, usually on the lower trunks of trees.

Bennett's White-lipped Python (*Leiopython bennettorum*) killed by locals near the Buvu Bush Camp in 2012 (reproduced from Woxvold and Aplin 2013).

White-lipped (D'Albertis) Python (*Leiopython albertisii*) in alluvial forest in 2015.

Northern Emerald Python (*Morelia viridis*) recorded in 2012 survey (reproduced from Woxvold and Aplin 2013).

New Guinea Ground Boa (*Candoia aspera*) in Sago swamp in Markham Gap Basin in 2011 (reproduced from Woxvold and Aplin 2013).

Many-scaled Keelback (*Tropidonophis multiscutellatus*) recorded in swampy grassland.

New Guinea Death Adder (*Acanthopis laevis*) on the road on the outskirts of Venembele village in 2012 (reproduced from Woxvold and Aplin 2013).

A crocodile skull, probably that of Saltwater Crocodile (*Crocodylus porosus*) displayed at Chiatz village (reproduced from Woxvold 2012).

A grilled New Guinea Snapping Turtle (*Elseya novaeguineae*) caught in an oxbow lake presented at Chiatz village.

Emoia caeruleocauda was observed occasionally in

alluvial forest in 2012 and 2015.

Table E.13. Photographic record of frogs recorded in the study area

Litoria thesaurensis recorded in 2012 (reproduced from Woxvold and Aplin 2013).

Fringed Tree Frog (*Litoria eucnemis*) perched in vegetation adjoining a mountain stream.

Nyctimystes cheesmani was recorded in 2012 and 2015 (reproduced from Woxvold and Aplin 2013).

Oreophryne geislerorum recorded in 2012 (reproduced from Woxvold and Aplin 2013).

Mantophryne sp. (*lateralis* complex), an undescribed frog species that occurs in the study area (Photo: K. Aplin in Woxvold and Aplin (2013)).

Cophixalus sp., a frog species of uncertain taxonomic status that occurs in the study area (Photo: K. Aplin in Woxvold and Aplin (2013)).

	
Papurana garritor was recorded in 2012 and 2015 (reproduced from Woxvold and Aplin 2013).	Arfak Mountain Frog (*Papurana arfaki*) found on a rocky mountain stream bank.
	
Platymantis papuensis in alluvial forest.	*Papurana papua* was common on rocky mountain stream banks.
	
Papurana daemeli at the edge of swamp forest in 2015.	

APPENDIX F

Anabat bat detector acoustic analysis technical report of Specialised Zoological

Bat call identification from the Watut River valley, Papua New Guinea

Type:	Acoustic analysis
Prepared for:	Biodiversity Assessment and Management Pty Ltd
Date:	25 May 2015
Job No.:	SZ381

Prepared by:

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SUMMARY

Bat identifications from AnaBat acoustic recordings are provided from the Watut River valley area, c. 60 km west of Lae in Morobe Province, Papua New Guinea. A total of 11 echolocation call types and species was recognised from the recordings (**Tables 1** and **2**). Some call types require capture and further follow up morphological and genetic work to resolve the ambiguity surrounding their identification. Representative echolocation calls are provided (**Figure 1**), as recommended by the Australasian Bat Society (ABS 2006). Further data are available should verification be required. The identifications made in this report draw upon information from a previous survey by Ken Aplin Fauna Studies and Specialised Zoological in May 2012. Understanding of the echolocation call variation in many species of Papua New Guinean bat has progressed since the May 2012 survey, and call type categories are matched between the surveys in **Table 3**.

METHODS

Signals as recorded with AnaBat SD1 bat detectors were supplied as downloaded sequences (in DAT format). The frequency division ratio had been set to a factor of 8. These were parsed into both AnaBat sequence files and ZCA files with CFC Read 4.4n software. The full parsed output was inspected in AnalookW 4.0o software, with attention paid to locating single pulses from ultra-high frequency emitting bats in ZCA and MAP files. Call types observed in the recordings were first categorised according to the scheme applied in multiple projects across Papua New Guinea (e.g. Armstrong and Aplin 2011, 2014; Armstrong et al. 2015; **Figure 2**). These call types were then attributed to species, if possible, based on information in Armstrong and Aplin (2011, 2014), Leary and Pennay (2011), Robson et al. (2012), Armstrong et al. (2015).

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Table 1. Annotated listed of call types and species identified from the AnaBat recordings.

EMBALLONURIDAE ***Emballonura* sp. Unidentified Sheath-tailed Bat** **Call type *50 i.fFM.d*** Attributable to one of several candidate species of *Emballonura*. There are two species of *Emballonura* that produce calls with a characteristic frequency around 50 kHz—*E. raffrayana* and *E. furax*. Both of these are not known from the areas around Lae (Bonaccorso and Leary 2008; Leary and Bonaccorso 2008), but the distribution of *Emballonura* species is not well known in Papua New Guinea. The range in characteristic frequencies seen in this dataset (c. 46–51 kHz; K.N. Armstrong and K.P. Aplin unpublished data) is more suggestive of *E. furax*, but geographic variation in calls of *Emballonura* is also poorly understood. Capture effort is required to confirm the source of this call type. **Lesser Sheath-tailed Bat *Mosia nigrescens*** **Call type *65 i.fFM.d*** The range in characteristic frequency of general call type *i.fFM.d* observed on the present survey was much narrower than the previous survey in May 2012 (65–71 kHz, compared with 55–75 kHz). This range of variation is typical of *M. nigrescens* (Leary and Pennay 2011; K.N. Armstrong and K.P. Aplin unpublished data), which is often common at sites throughout Papua New Guinea. However, variation in the calls of *Emballonura beccarii* is known to overlap with that of *M. nigrescens (*K.N. Armstrong and K.P. Aplin unpublished data), so *E. beccarii* might also have been present. Capture is required to confirm the identification. ***Saccolaimus saccolaimus* Bare-rumped Sheath-tailed Bat** **Call type *25 cFM*** Call type *25 cFM* was attributed to *S. saccolaimus* based on the combination of the following observations: 1. characteristic call frequency between 22–25 kHz; 2. fragments of the fundamental harmonic (c. 12 kHz) in some pulses; 3. the alternating pattern of high and low characteristic frequency in successive pulses from a single individual; and 4. pulse shape in feeding buzz typical of this species (Milne et al. 2009; Corben 2010, 2011; K.N. Armstrong unpublished data). The Papuan Sheath-tailed Bat *S. mixtus* is also a candidate for pulses with a characteristic frequency 23–25 kHz, but capture would be needed to confirm the presence of this species.
HIPPOSIDERIDAE ***Hipposideros diadema griseus* Diadem Leaf-nosed Bat** **Call type *58 mCF*** Attributable based on reference calls collected elsewhere in Papua New Guinea (Leary and Pennay 2011; K.N. Armstrong and K.P. Aplin unpublished data). ***Aselliscus tricuspidatus novaguinea* Trident Leaf-nosed Bat** **Call type *112 sCF*** Attributable based on reference calls collected elsewhere in Papua New Guinea (Leary and Pennay 2011; K.N. Armstrong and K.P. Aplin unpublished data).
RHINOLOPHIDAE ***Rhinolophus megaphyllus* Eastern Horseshoe Bat** **Call type *75 lCF*** Attributed to this species based on capture records and reference echolocation calls in

Robson et al. (2012), though only a single pulse c. 3 kHz higher than is normally observed was recorded on the present survey. The available reference call information for *Rhinolophus* in Papua New Guinea lists a characteristic frequency of c. 68–70 kHz for both *R. arcuatus* and *R. megaphyllus* (Leary and Pennay 2011; Robson et al. 2012; K.N. Armstrong and K.P. Aplin unpublished data). Separating these two species based on echolocation call recordings is therefore not currently possible. Capture is therefore required to confirm this identification.

MINIOPTERIDAE

Unidentified Bent-winged Bat *Miniopterus* sp.
Call type *38 st.cFM*
Attributable to one of several medium–large candidate species of *Miniopterus* (all except *M. australis),* or an undescribed species of *Miniopterus*. Current taxonomic arrangements for Papua New Guinea are unreliable and show little concordance with the still limited available molecular assessments (Appleton et al. 2004). The attribution of available species names to Papua New Guinean *Miniopterus* (e.g. Bonaccorso 1998) to morphological forms and echolocation call types should be regarded as futile and misleading, given that there has been no application of modern genetic methods to confirm the number of taxa and their relationships with named forms described from localities outside of the country.

Unidentified Bat, possibly *Miniopterus* sp.
Call type *45 st.cFM*
Most likely to be one of several candidate species in the Miniopteridae, but a species of *Pipistrellus* is also possible, since the calls of several Papua New Guinean *Pipistrellus* (Vespertilionidae) and small-medium *Miniopterus* overlap in characteristic frequency and can be similar in pulse shape.

Unidentified Bat, possibly *Miniopterus* sp.
Call type *53 st.cFM*
Most likely to be one of several candidate species in the Miniopteridae, but a species of *Pipistrellus* is also possible, since the calls of several Papua New Guinean *Pipistrellus* (Vespertilionidae) and small-medium *Miniopterus* overlap in characteristic frequency and can be similar in pulse shape.

VESPERTILIONIDAE

Unidentified Long-eared Bat *Nyctophilus* sp. (Vespertilionidae)
Call type *42 st.bFM*
Calls of this type are attributable to one of several species of Long-eared Bat *Nyctophilus* sp., or *Pharotis imogene*, though the latter is much less likely given that it is currently only known currently from the southern coast of Papua New Guinea (Hughes et al. 2014) and its echolocation call has not yet been characterised.

MOLOSSIDAE

***Otomops* sp. Unidentified Free-tailed Bat**
Call type *27 sFM*
Calls of this shape are attributable to a species of *Otomops* based on my unpublished observations of several species from Kenya, Africa. They are higher in characteristic frequency than those of *Chaerephon jobensis*, and do not resemble the curvilinear or serpentine pulses of *Saccolaimus*. There are two candidate species—*O. papuensis* and *O. secundus*—but reference calls are not available from either of these.

Table 2. Call types and species recognised from each recording site (X: observed; —: not detected).

			S. saccolaimus	*Otomops* sp.	*Miniopterus* sp.	*Nyctophilus* sp.	Unidentified	Unidentified	*Emballonura* sp.	*M. nigrescens*	*H. diadema*	*R. arcuatus*	*A. tricuspidatus*
			25 cFM	*27 sFM*	*38 st.cFM*	*42 st.bFM*	*45 st.cFM*	*53 st.cFM*	*50 i.fFM.d*	*65 i.fFM.d*	*58 mCF*	*75 ICF*	*112 sCF*
Date	**Time**	**Site**											
AnaBat 1390 (Unit D)													
28/03/2015	—	14	—	X	X	—	X	X	—	X	X	—	—
29/03/2015	—	15	—	—	X	—	X	X	—	X	—	—	—
30/03/2015	—	16	—	—	X	—	X	X	X	X	X	—	—
3/04/2015	—	17	—	—	—	—	—	—	—	X	X	X	X
4/04/2015	—	18	—	—	—	X	—	X	—	X	X	—	—
5/04/2015	—	19	—	—	—	—	X	—	—	—	—	—	—
6/04/2015	—	20	—	—	X	—	X	X	—	—	—	—	—
AnaBat 1918 (Unit 4)													
6/04/2015	—	8	—	—	X	—	X	X	—	X	X	—	—
7/04/2015	—	9	—	—	—	X	—	X	—	X	X	—	—
8/04/2015	—	10	—	—	X	—	—	X	—	—	—	—	—
10/04/2015	—	11	—	—	X	—	X	X	X	—	X	—	—
11/04/2015	—	12	—	—	X	—	X	X	—	X	—	—	—
12/04/2015	—	13	—	—	—	—	—	X	—	—	—	—	X
AnaBat 6048 (Handheld)													
1/04/2015	16:28 – 18:41	1	X	—	—	—	X	—	—	—	—	—	—
1/04/2015	20:53 – 20:53	2	X	X	X	—	X	X	X	X	X	—	—
1/04/2015	21:05 – 21:35	1	X	X	X	—	X	X	—	—	—	—	—
1/04/2015	21:44 – 21:54	4	—	X	X	—	X	X	X	—	—	—	—
1/04/2015	21:55 – 22:12	5	—	—	X	—	X	X	X	—	—	—	—
5/04/2015	18:37 – 19:14	1B	X	—	X	—	X	X	—	—	—	—	—
5/04/2015	19:15 – 21:27	1	—	X	X	—	X	X	X	—	—	—	—
5/04/2015	21:27 – 21:35	4	X	—	X	—	X	X	X	—	—	—	—
5/04/2015	22:16 – 22:35	6	X	—	X	—	—	X	—	—	—	—	—
6/04/2015	—	6	—	—	X	—	—	X	—	—	—	—	—
9/04/2015	18:29 – 21:19	7	X	—	—	—	X	X	—	X	—	—	—
9/04/2015	21:19 – 21:20	4	—	—	X	—	—	X	—	—	—	—	—

Table 3. Correspondence between equivalent call types recorded on the May 2012 and April 2015 surveys.

May 2012 survey	April 2015 survey
cFM call types	
Not recorded	*25 cFM Saccolaimus* sp.
26 cFM M. beccarii	Not recorded
38 st.cFM Miniopterus sp.	*38 st.cFM Miniopterus* sp.
47 st.cFM	*45 st.cFM* Unidentified
53 st.cFM	*53 st.cFM* Unidentified
bFM call types	
50 st.bFM	*42 st.bFM Nyctophilus* sp.
sFM call types	
Not recorded	*35 sFM Otomops* sp.
71 st.sFM.d	Not recorded
i.fFM.d call types	
Not recorded	*50 i.fFM.d Emballonura* sp.
55-60 i.fFM.d Emballonura sp.	Not recorded
60-65 i.fFM.d E. beccarii	*65 i.fFM.d M. nigrescens*
65-70 i.fFM.d E. beccarii / M. nigrescens	*65 i.fFM.d M. nigrescens*
70-75 i.fFM.d M. nigrescens	*65 i.fFM.d M. nigrescens*
ICF call types	
78 ICF R. megaphyllus	*75 ICF R. megaphyllus*
mCF call types	
58 sCF H. diadema	*58 mCF H. diadema*
sCF call types	
82 mCF H. wollastoni	Not recorded
112 sCF A. tricuspidatus	*112 sCF A. tricuspidatus*
131 sCF H. calcaratus	Not recorded

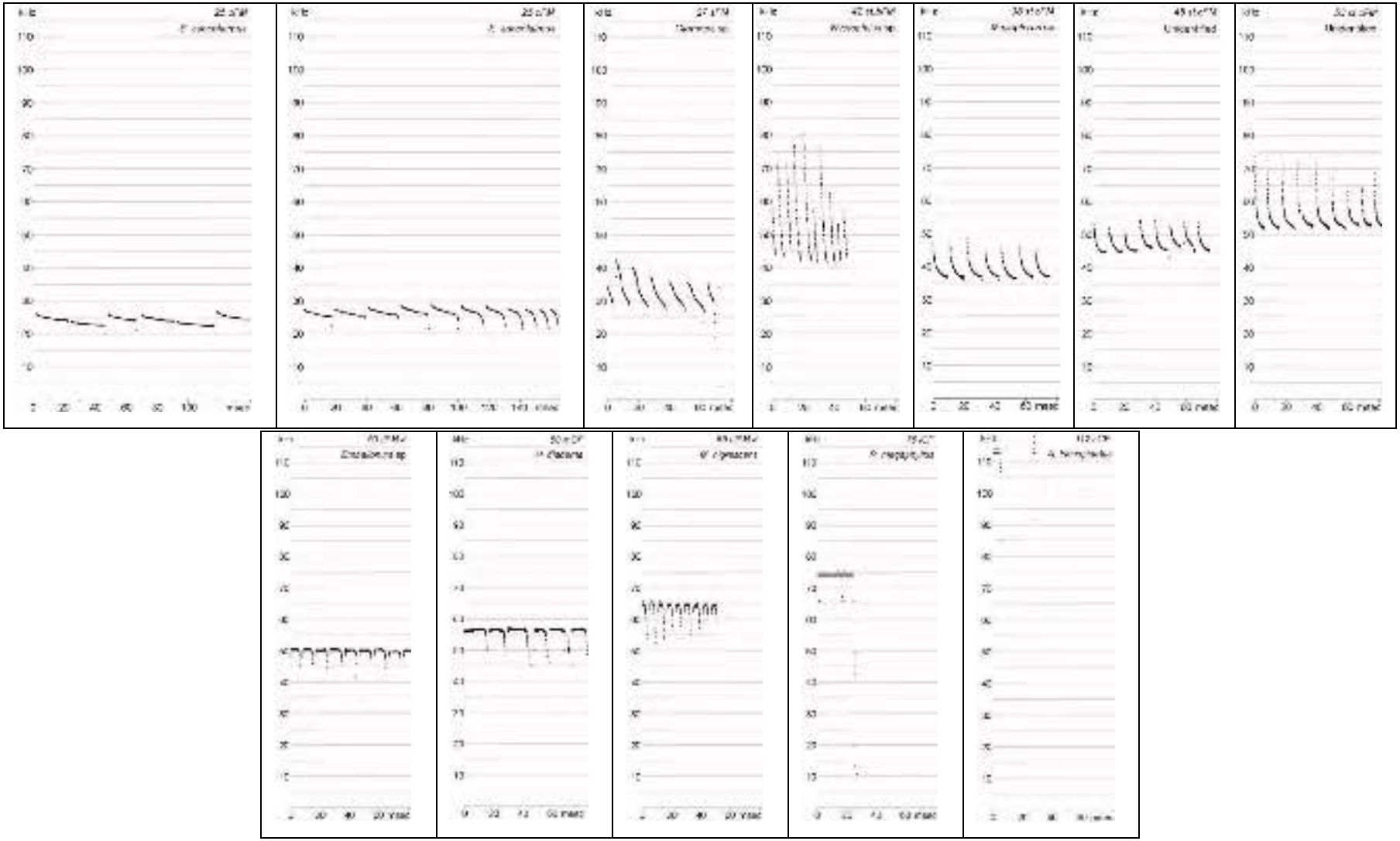

Figure 1. Representative sequences of the call types and species identified (time is compressed between pulses).

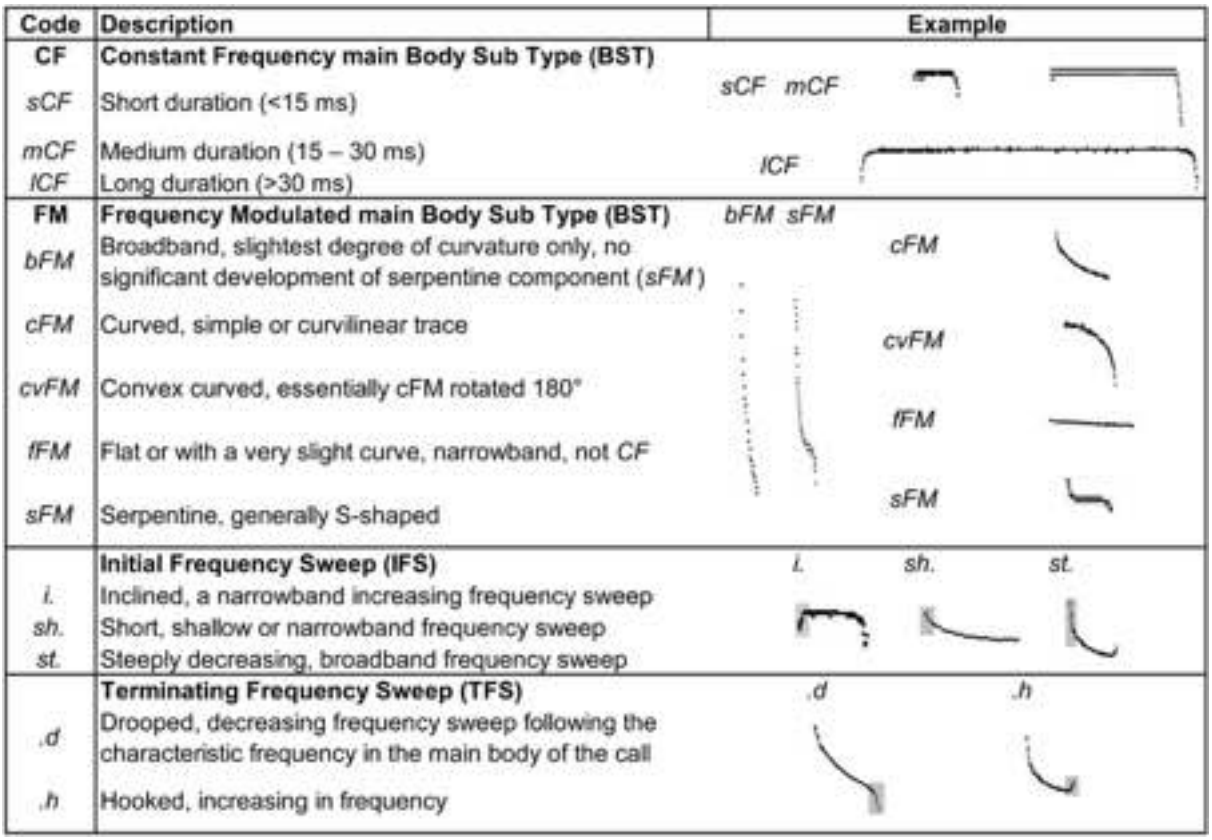

Figure 2. Echolocation call categories based on the morphology of the dominant type of search-phase pulses in high quality sequences (adapted from de Oliveira (1998a,b), Corben and O'Farrell (1999), Gannon et al. (2004), Armstrong and Aplin (2011, 2014); examples are from a Zero Crossings Analysis output and are not scaled equally). Pulses generally consist of three main sections: an initial frequency sweep (IFS), followed by the main body (BST: Body Sub Type), and ending in a terminating frequency sweep (TFS). The shape of the pulse is represented by the codes in the form 'IFS.BST.TFS', prefixed by a value representing the mean characteristic frequency in kHz. Note that most CF pulses have a recognisable initial upward frequency sweep, and all have a terminating frequency sweep, so the IFS and TFS descriptors are not used for this Body Sub Type.