



Appendix U

Cultural Heritage Baseline and Impact Assessment

DISCLAIMER

This disclaimer applies to and governs the disclosure and use of this Environmental Impact Statement (“EIS”), and by reading, using or relying on any part(s) of the EIS you accept this disclaimer in full.

This Environmental Impact Statement, including the Executive Summary, and all chapters of and attachments and appendices to it and all drawings, plans, models, designs, specifications, reports, photographs, surveys, calculations and other data and information in any format contained and/or referenced in it, is together with this disclaimer referred to as the “EIS”.

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.

Ownership and Copyright

The EIS is the sole property of the WGJV Participants, who reserve and assert all proprietary and copyright ©2018 interests.

Reliance and Use

The EIS is intended and will be made available to CEPA, for review by CEPA and other applicable agencies of the Government of the Independent State of Papua New Guinea (“**Authorised Agencies**”), for the purpose of considering and assessing the Permit Application in accordance with the Act (“**Authorised Purpose**”), and for no other purpose whatsoever.

The EIS shall not be used or relied upon for any purpose other than the Authorised Purpose, unless express written approval is given in advance by the WGJV Participants.

Except for the Authorised Purpose, the EIS, in whole or in part, must not be reproduced, unless express written approval is given in advance by the WGJV Participants.

This disclaimer must accompany every copy of the EIS.

The EIS is meant to be read as a whole, and any part of it should not be read or relied upon out of context.

Limits on investigation and information

The EIS is based in part on information not within the control of either the WGJV Participants or the Consultants. While the WGJV Participants and Consultants believe that the information contained in the EIS should be reliable under the conditions and subject to the limitations set forth in the EIS, they do not guarantee the accuracy of that information.

No Representations or Warranties

While the WGJV Participants, their Related Bodies Corporate and Consultants believe that the information (including any opinions, forecasts or projections) contained in the EIS should be reliable under the conditions and subject to the limitations set out therein, and provide such information in good faith, they make no warranty, guarantee or promise, express or implied, that any of the information will be correct, accurate, complete or up to date, nor that such information will remain unchanged after the date of issue of the EIS to CEPA, nor that any forecasts or projections will be realised. Actual outcomes may vary materially and adversely from projected outcomes.

The use of the EIS shall be at the user’s sole risk absolutely and in all respects. Without limitation to the foregoing, and to the maximum extent permitted by applicable law, the WGJV Participants, their Related Bodies Corporate and Consultants:

- do not accept any responsibility, and disclaim all liability whatsoever, for any loss, cost, expense or damage (howsoever arising, including in contract, tort (including negligence) and for breach of statutory duty) that any person or entity may suffer or incur caused by or resulting from any use of or reliance on the EIS or the information contained therein, or any inaccuracies, misstatements, misrepresentations, errors or omissions in its content, or on any other document or information supplied by the WGJV Participants to any Authorised Agency at any time in connection with the Authorised Agency’s review of the EIS; and
- expressly disclaim any liability for any consequential, special, contingent or penal damages whatsoever.

The basis of the Consultants’ engagement is that the Consultants’ liability, whether under the law of contract, tort, statute, equity or otherwise, is limited as set out in the terms of their engagement with the WGJV Participants and/or their related bodies corporate.

Disclosure for Authorised Purpose

The WGJV Participants acknowledge and agree that, for the Authorised Purpose, the EIS may be:

- copied, reproduced and reprinted;
- published or disclosed in whole or in part, including being made available to the general public in accordance with section 55 of the Act. All publications and disclosures are subject to this disclaimer.

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.

Forward looking statements inherently involve known and unknown risks, uncertainties and other factors that may cause the Company’s actual results, performance and achievements to differ materially from statements in this EIS. Relevant factors may include, but are not limited to, changes in commodity prices, foreign exchange fluctuations and general economic conditions, increased costs and demand for production inputs, the speculative nature of exploration and project development, including the risks of obtaining necessary licences and permits and diminishing quantities or grades of reserves, political and social risks, changes to the regulatory framework within which the Company operates or may in the future operate, environmental conditions including extreme weather conditions, recruitment and retention of personnel, industrial relations issues and litigation.

Forward looking statements are based on the Company’s good faith assumptions as to the financial, market, regulatory and other relevant environments that will exist and affect the Company’s business and operations in the future.

The Company does not give any assurance that the assumptions will prove to be correct. There may be other factors that could cause actual results or events not to be as anticipated, and many events are beyond the reasonable control of the Company. Readers are cautioned not to place undue reliance on forward looking statements. Forward looking statements in the EIS speak only at the date of issue. Except as required by applicable laws or regulations, the Company does not undertake any obligation to publicly update or revise any of the forward looking statements or to advise of any change in assumptions on which any such statement is based.

Non-IFRS Financial Information

Newcrest results are reported under International Financial Reporting Standards (IFRS) including EBIT and EBITDA. The EIS also includes non-IFRS information including Underlying profit (profit after tax before significant items attributable to owners of the parent company), All-In Sustaining Cost (determined in accordance with the World Gold Council Guidance Note on Non-GAAP Metrics released June 2013), AISC Margin (realised gold price less AISC per ounce sold (where expressed as USD), or realised gold price less AISC per ounce sold divided by realised gold price (where expressed as a %), Interest Coverage Ratio (EBITDA/Interest payable for the relevant period), Free cash flow (cash flow from operating activities less cash flow related to investing activities), EBITDA margin (EBITDA expressed as a percentage of revenue) and EBIT margin (EBIT expressed as a percentage of revenue). These measures are used internally by Management to assess the performance of the business and make decisions on the allocation of resources and are included in the EIS to provide greater understanding of the underlying performance of Newcrest's operations. The non-IFRS information has not been subject to audit or review by Newcrest's external auditor and should be used in addition to IFRS information.

Ore Reserves and Mineral Resources Reporting Requirements

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.

For a more detailed discussion of such risks and other factors (such as availability of credit or other sources of financing), see the Company's latest Integrated Annual Report and Form 20-F which is on file with the Securities and Exchange Commission, as well as the Company's other Securities and Exchange Commission filings. The Company undertakes no obligation to update publicly or release any revisions to these forward-looking statements to reflect events or circumstances after the date of this EIS or to reflect the occurrence of unanticipated events, except as required by law.

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.

WAFI-GOLPU PROJECT

Environmental Impact Study

Cultural Heritage Baseline and Impact Assessment Technical Report

Report to Wafi Golpu Services Ltd

Authors: Dr Michael Green, Andrew Long and Associates Pty Ltd
Dr John Muke, Social Research Institute Ltd

12/06/2018



Andrew Long + Associates Pty Ltd

ACN: 131 713 409

ABN: 86 131 713 409

PO Box 2472

Fitzroy BC Victoria 3065

Australia

email: enquiries@alassoc.com.au

telephone: +61 3 9470 9222

web: www.alassoc.com.au

Social Research Institute Limited

PO Box 172 Uni

UPNG Port Moresby

Papua New Guinea

email: sriadmin@online.net.pg

telephone: +675 323 0393

web: www.sri.org.pg

EXECUTIVE SUMMARY

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 (Figure 1.1) in the Morobe Province of the Independent State of Papua New Guinea (PNG). Related support facilities include access roads to the mine and pipelines from the mine to the Port of Lae and to new coastal facilities near the village of Wagang.

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 Cultural Heritage Baseline and Impact Assessment study.

Study Objectives

The objectives of the cultural heritage study were to:

- Identify, describe and map any cultural heritage sites that may exist in relation to the areas in which Project activities are proposed.
- Identify potential impacts to the identified cultural heritage sites arising from Project activities.
- Recommend measures that might be adopted to mitigate and manage these impacts.
- Determine the residual impacts expected following implementation of proposed management measures.

This EIS cultural heritage baseline and impact assessment comprises:

- A Baseline Study describing the existing cultural heritage in the study area.
- An Impact Assessment identifying the potential, actual and perceived impacts of the Project, recommended management measures to address the identified impacts, and an assessment of the residual impacts assuming implementation of the recommended management measures.

Study Methods

The Baseline Assessment has been collated with reference to the following research activities:

- Meetings with personnel from the PNG National Museum and Art Gallery (NMAG)
- Review of the NMAG National Site File (NSF)
- Review of all cultural heritage studies undertaken for the Wafi-Golpu Project.
- Field surveys, which included:
 - Pre-awareness discussions with local communities
 - Community consultation
 - Vehicle surveys
 - Pedestrian field surveys

The Impact Assessment method comprised the following elements:

- Development of an impact assessment framework in line with good industry practice and in consultation with WGJV.
- Identification of the cultural heritage significance of known sites that may be impacted by Project activities, aligned with criteria set out in the Burra Charter (Australia ICOMOS 2013).
- Development of practical recommendations to manage impacts (including avoidance where possible) to cultural heritage sites that may be directly or indirectly impacted by Project activities.
- Assessment of residual impacts on cultural heritage assuming the implementation of management measures.

Study Areas

Three study areas were included in this assessment as follows:

- Mine Study Area, which included:
 - ♦ Mine subsidence zone
 - ♦ Ventilation shaft
 - ♦ Nambonga Decline Portal terrace
 - ♦ Miapilli waste rock dump and clay borrow pit

- ♦ Nambonga Haul Road and Portal Haul Road
- ♦ Watut Decline Portal terrace and waste rock dump
- ♦ Process plant terrace (including the Watut process plant, raw water dam and sedimentation dam)
- ♦ Waste management facility
- ♦ Wastewater discharge pipeline and raw water make-up pipeline
- ♦ Lower Papas aggregate source and overburden stockpile
- ♦ Explosives magazine
- ♦ Fere Accommodation Facility
- ♦ Finchif Construction Accommodation Facility
- ♦ Power generation facilities
- ♦ Mt Beamena Quarry and access road
- ♦ Humphries, Northern Access Road and Migiki borrow pits
- ♦ Bavaga River and Waime River gravel extraction areas
- ♦ Mine Access Road at Fere
- Infrastructure Corridor Study Area; which included:
 - ♦ The Southern Study Area (terrestrial tailings, concentrate and fuel pipelines and the Mine Access Road)
 - ♦ The Central Study Area (terrestrial tailings, concentrate and fuel pipeline and the Northern Access Road)
 - ♦ The Eastern Study Area (terrestrial tailings, concentrate and fuel pipeline)
- Coastal Study Area, which included:
 - ♦ The Port Facilities Area
 - ♦ The Outfall Area

Baseline Assessment

Cultural Groups

The Wafi-Golpu Project EIS study areas are occupied primarily by five cultural groups:

- Babuaf: a pottery-producing group who speak a Middle Watut language belonging to the Watut group of the Markham Family of the Huon Gulf language chain (Mine Study Area and Infrastructure Corridor South and Central study areas).
- Hengambu and Yanta: separate Mumeng-speaking groups within the South Huon Gulf language chain whose collective origins potentially lie to the south-east of the Mine Area (Mine Study Area).
- Wampar: one of three language subgroups in the Lower Markham language group belonging to the Markham family of the Huon Gulf language group (Infrastructure Corridor Central and Eastern study areas).
- Ahi: comprising Aribwaungg-speaking communities and Bukawa-speaking communities in the vicinity of Lae township:
 - ♦ Aribwaungg (also known as Aliwang): one of five languages in the Busu subgroup of the Lower Markham language group belonging to the Markham family of the Huon Gulf language group (Infrastructure Corridor Eastern Study Area).
 - ♦ Bukawa (or Kawac): a North Huon Gulf language distinct from the languages spoken in the Markham River Valley (Infrastructure Corridor Eastern Study Area).

Cultural Heritage Site Types

It is acknowledged that site type classification/definition varies in different contexts. For the purposes of this baseline assessment for the Wafi-Golpu Project, site types have been classified into oral tradition, archaeological and historical (including World War II) sites as follows:

Oral Tradition Sites

- *Burial*: an inhumation or ossuary containing the remains of a single named individual.
- *Camp*: the identified location of a known hunting camp or transit camp site.
- *Cemetery*: inhumations or ossuaries containing the remains of two or more named individuals.
- *Former Village*: the identified location of a named former or ancestral village.
- *Mission*: the identified location of a structure or place associated with Christian mission activities during the historic period.
- *Rockshelter*: a cave or rockshelter identified in local oral history as being of cultural significance.
- *Story*: any place associated with a known story derived from local oral tradition.

- *Subsistence/Trade*: a place acknowledged as significant for subsistence or trade activities (e.g. sourcing clay to produce pots).

Archaeological Sites

- *Archaeological*: any place (or group of physical sites) in which evidence of prehistoric, historic or contemporary human activity is preserved, and which has been, or may be, investigated using the discipline of archaeology. No distinction is made between site types, although the specific nature of each site is elaborated in individual site descriptions.

Historical and WWII Sites

- *Historical*: any other place or object associated with the early period of Papua New Guinea's colonial history.
- *Exploration/Mining*: a place or object that preserves physical evidence in the form of equipment, structures or excavations relating to the history of exploration and mining in Papua New Guinea.
- *WWII*: any place or object associated with Japanese or Allied military actions which preserves at least some physical remnant of that action.

NMAG National Site File (NSF)

As far as can be determined through searches of the PNG National Museum and Art Gallery's National Site File (NSF), the only NSF-registered cultural heritage sites located within or in close proximity to the study areas are those recorded by Muke et al. (2007). These include archaeological, camp, rockshelter and story sites.

Previous Studies

Twelve cultural heritage studies have been completed in support of exploration and development of the Project across the cultural heritage study areas (Alo 2016; CRA 1996; Green and Muke 2013a and 2013b; Green and Sepe 2013, 2014 and 2017; Hitchcock 2012; Muke et al. 2007; Muke et al. 2015; Muke, Ipang and Mond 2016; Muke and Skelly 2017; Skelly, Muke, Sepe and Green 2017).

To avoid potential confusion arising from the use of multiple site field code systems by CRA (1996), Muke et al. (2007) and Hitchcock (2012), the individual site catalogues presented in these reports have been combined into a single Wafi-Golpu Project Cultural Heritage Site Catalogue. All previously recorded cultural heritage sites, including those contained in the National Site File, have been allocated a unique Wafi Golpu (WG) site number, which is used as the primary site identifier throughout the remainder of the present study and will guide all future phases of work.

Results

The baseline assessment identified 55 cultural heritage sites recorded within or intersecting the study areas. They include 19 archaeological sites and 41 oral tradition sites. Oral tradition sites included 29 story sites, three burial sites, three camp sites, four former village sites, one rockshelter site and one subsistence/trade site.

Impact Assessment

Potential Impacts to Cultural Heritage

Tangible and intangible cultural heritage sites identified within the study areas have the potential to be impacted by Project activities as a result of:

- Direct disturbance due to on-ground works including vegetation clearance, topsoil stripping, subsoil excavation and ground subsidence caused by underground mining.
- Direct disturbance due to the movement of Project employees and contractors and their vehicles (e.g. erosion, unauthorised removal of artefacts).
- Indirect disturbance due to associated population growth that increases the movement of people and vehicle traffic.
- Restricted physical access to cultural heritage sites by local communities.
- Physical modifications to the land resulting in the destruction of some sites and their loss from living memory and, hence, from oral tradition.
- Disturbance to ecosystems through environmental impacts on landform and soils, water resources and hydrology, and biodiversity, which have the potential to affect cultural heritage sites that are identified on the basis of these extant systems (e.g. *ples tambu* story sites associated with water).
- Restricted physical access of communities to cultural heritage sites on account of Project activities and operational requirements. This includes resettlement of Hekeng, Nambonga and Venembele villages which are located in the Special Mining Lease (SML) 10 application area.

Additional technical specialist studies indicate that operational dewatering of the declines and the block caves during the life of the mine may result in:

- The partial dewatering of aquifers above, and in the vicinity of, the declines with potential impacts on groundwater users (e.g., springs and creeks used by local people) and groundwater dependant ecosystems.
- The interception of groundwater flow, which would have under natural conditions discharged into the surface drainages, provided baseflow to the rivers, or contributed to deeper regional groundwater flow.

In addition to WG043 Mea Gova Biangova Sacred Spring Site and WG238 Mia Yo D which are located in areas of direct Project disturbance, a further five oral tradition sites (WG044 Mea Gova Tongova Sacred Spring Site, WG060 Mia Yo Sacred Spring Site, WG234 Mia Yo A, WG235 Mia Yo B, WG236 Mia Yo C) identified by the Hengambu or the Yanta based on their association with water, are located within the predicted dewatering zone and therefore have the potential to be impacted by this aspect of the Project's operation.

On this basis, these five cultural heritage sites have been included in the cultural heritage impact assessment together with the 55 sites identified in the baseline assessment.

A full appreciation of cultural heritage impacts associated with resettlement activities is subject to further consultation with the affected villages during 2018-2019 and, as such, is not discussed in detail in this report.

Cultural Heritage Site Significance Assessments

The significance of the 60 sites included in the impact assessment was assessed as follows:¹

- 19 archaeological sites: of these, 16 were rated as being of high cultural heritage significance, and three were rated as being of medium cultural heritage significance.
- 3 burial sites: all were rated as being of high cultural heritage significance.
- 3 camp sites: both are rated as being of medium cultural heritage significance.
- 4 former village sites: one was rated as being of low cultural heritage significance, two as being of medium cultural heritage significance and one as being of high cultural heritage significance.
- 1 rockshelter site: rated as being of high cultural heritage significance.
- 29 story sites: of these, 17 (58%) are rated as being of High cultural heritage significance, 10 (40%) were rated as being of medium cultural heritage significance and two (7%) was rated as being of low cultural heritage significance. Story sites attributed to the Babuaf, Hengambu, Yanta and Wampar cultural groups are all represented in the impact assessment.

No cultural heritage sites associated with Ahi communities were located within the cultural heritage study areas. This is due to changes that were made to the Project design to avoid, at the community's request, potential impacts to Hungkwangpup Story Site (WG342), recorded by Skelly, Muke, Sepe and Green (2017).

Impact Assessment

All 60 cultural heritage sites have the potential to be impacted by proposed Project activities included in the EIS. Prior to the application of management measures to reduce impacts:

- 24 sites (40%) are likely to experience an Extreme impact.
- 21 sites (35%) are likely to experience a Major impact.
- 13 sites (22%) are likely to experience a Moderate impact.
- 2 sites (3%) is likely to experience a Minor impact.

Management Measures

The following management measures were developed in response to potential impacts to cultural heritage sites resulting from Project-related activities:

- Avoidance (where practicable) of cultural heritage sites.
- Erection of protective barriers or other suitable measures such as cultural awareness training which prevent access by Project employees and contractors during construction, and reference to these protection strategies in daily toolbox meetings.

¹ Cultural heritage site significance was assessed as being either low, medium or high

- Further recording of oral traditions by suitably qualified or experienced oral historians or anthropologists.
- Offers to communities to assist with culturally appropriate ceremonies, including exhumation and relocation of skeletal remains.
- The salvage and recording of a representative proportion of an archaeological site. Salvage can include archaeological survey, surface collection and retention of artefacts, and controlled archaeological excavation.
- Development and implementation of a Cultural Heritage Management Plan (CHMP) which includes:
 - Ongoing local community consultation.
 - The requirement for pre-construction cultural heritage clearance surveys along any previously unsurveyed sections of linear infrastructure corridors, and within the facility footprints of previously unsurveyed areas, to identify any further cultural heritage sites.
 - A Chance Finds Protocol defining a process for the reporting, investigation and management of chance cultural heritage finds during all Project-related activities.
 - Site-specific management measures which have been developed in response to potential Project-related impacts to identified cultural heritage sites.

Residual Impact Assessment

In every instance where a recorded cultural heritage site is predicted to be impacted by Project infrastructure or mining activities, the application of the avoidance or management measures reduced the magnitude of the impact by at least one rating level, and in some instances by two and sometimes three rating levels. The net result is that no recorded cultural heritage site is predicted to experience an impact rated as greater than major, with the number of impacts rated as extreme reduced from 24 (prior to implementation of management measures) to zero (following the implementation of management measures).

Prior to the implementation of recommended site-specific management measures, less than one quarter of the cultural heritage sites included in the impact assessment would have experienced impacts with significance ratings of moderate or less. Subject to the appropriate implementation of the recommended management measures, this figure would improve markedly, and greater than 80% of cultural heritage sites would either experience significantly diminished impacts, or none at all.

Despite the implementation of the recommended management measures, seven cultural heritage sites would still experience impacts rated as being of major significance. These are all story sites situated on Mount Golpu that relate to water, which may be impacted by groundwater drawdown required to allow safe underground mining operation. In addition to potential groundwater drawdown, two of these sites, Mea Gova Biagova Sacred Spring Site (WG043) and Mia Yo D (WG238), may also be affected by the subsidence of Mount Golpu. The unmanaged impact magnitude ratings were assessed as high for these seven sites on this basis. The residual impact magnitude assessed for each of the sites was assessed as medium, acknowledging the mitigating influences of formal oral tradition recording by qualified specialists in concert with support for local communities to hold appropriate ceremonies in order to make the local areas safe for future works. When combined with a high cultural heritage significance rating for each of these sites, this has resulted in major residual impact significance ratings for all seven sites.

Summary information on the impact ratings to recorded cultural heritage sites before and after the application of avoidance and management measures is presented in the table below.

| Impact Significance | Number of Sites Before Implementation of Avoidance or Management Measures | | Number of Sites After Implementation of Avoidance or Management Measures | |
|---------------------|---|------------|--|------------|
| | N | % | N | % |
| Nil | 0 | 0 | 15 | 25 |
| Minimal | 0 | 0 | 3 | 5 |
| Minor | 2 | 3 | 11 | 18 |
| Moderate | 13 | 22 | 24 | 40 |
| Major | 21 | 35 | 7 | 12 |
| Extreme | 22 | 40 | 0 | 0 |
| Total | 60 | 100 | 60 | 100 |

Cumulative Impact Assessment

Other developments that are being implemented or planned that may also give rise to cultural heritage impacts in the vicinity of the Project include:

- Lae Port expansion and development of the Lae Tidal Basin (PNG Ports Corporation) – in progress.
- PNG Biomass Energy Project (Oil Search and Aligned Energy Limited) in the Markham River Valley – in progress.
- Malahang Fisheries Wharf Project (National Fisheries Authority) – proposed.

Substantial ground-disturbing works have already been undertaken in relation to the construction of the Lae Tidal Basin. As such, it is unlikely that any unrecorded cultural heritage sites have been retained intact. Given the low potential for cultural heritage sites to be impacted by construction and operation of the Project's proposed Port Facilities Area, cumulative impacts are therefore expected to be minimal to nil.

The Biomass Energy Project proposed for the Markham River Valley may have the potential to impact oral tradition and archaeological sites of the Wampar community. The proposed Infrastructure Corridor, which crosses through Wampar land, has the potential to give rise to limited cumulative impacts on the heritage of this community. However, due to their linear infrastructure nature, management measures (e.g. refining the concentrate pipeline alignment) may be undertaken to avoid or limit these impacts, should pre-construction surveys identify any further cultural heritage sites along route. Again, cumulative impacts are expected to be minimal to nil.

The Malahang Fisheries Wharf Project is a proposed fisheries wharf to provide for the berthing of purse seine tuna fishing vessels supplying freshly caught tuna to three new tuna fish processing plants and canneries at the Malahang Industrial Centre in Lae. Given the inclusion of areas immediately east Wagang Village in the present cultural heritage assessment, cumulative impacts are therefore expected to be minimal to nil.

TABLE OF CONTENTS

| | |
|--|-----|
| EXECUTIVE SUMMARY..... | i |
| TABLE OF CONTENTS..... | vii |
| 1 Introduction..... | 1 |
| 1.1 Project Description..... | 1 |
| 1.2 Context..... | 5 |
| 2 Regulatory and Industry Frameworks..... | 6 |
| 2.1 PNG Legislation..... | 6 |
| 2.1.1 National Cultural Property (Preservation) Act 1965 and National Cultural Property (Preservation) Regulations 1965..... | 6 |
| 2.1.3 National Museum and Art Gallery Act 1992..... | 7 |
| 2.1.4 War Surplus Material Act 1952..... | 7 |
| 2.1.5 Cemeteries Act 1955..... | 7 |
| 2.1.6 Compensation..... | 7 |
| 2.2 Corporate Policy and Standards..... | 8 |
| 2.2.1 Social Responsibility Policy..... | 8 |
| 2.2.2 Cultural Heritage Standard..... | 8 |
| 2.2.3 External Stakeholder Reporting Standard..... | 8 |
| 2.3 International Policies, Standards and Guidelines..... | 9 |
| 2.3.1 The Burra Charter..... | 9 |
| 2.3.2 International Council on Mining and Minerals (ICMM)..... | 9 |
| 2.3.3 International Finance Committee (IFC) Performance Standard (PS) 8..... | 9 |
| 3 Study Method..... | 11 |
| 3.1 Background to Cultural Heritage Assessment for the Wafi-Golpu Project..... | 11 |
| 3.2 Objectives of this Study..... | 11 |
| 3.3 Study Methods..... | 12 |
| 3.3.1 Baseline Assessment..... | 12 |
| 3.3.2 Impact Assessment..... | 16 |
| 3.4 Study Areas..... | 23 |
| 3.4.1 Mine Study Area..... | 23 |
| 3.4.2 Infrastructure Corridor Study Area..... | 28 |
| 3.4.3 Coastal Study Area..... | 31 |
| 4 Baseline Assessment..... | 33 |
| 4.1 Morobe Province Prehistory and History..... | 33 |

| | | |
|--------|---|----|
| 4.1.1 | Prehistory | 33 |
| 4.1.2 | History | 35 |
| 4.2 | Cultural Groups | 37 |
| 4.2.1 | Hengambu and Yanta | 37 |
| 4.2.2 | Babuaf..... | 40 |
| 4.2.3 | Wampar..... | 45 |
| 4.2.4 | Ahi..... | 46 |
| 4.3 | Cultural Heritage Site Types | 48 |
| 4.3.1 | Oral Tradition Sites | 48 |
| 4.3.2 | Archaeological Sites..... | 49 |
| 4.3.3 | Wafi-Golpu Project Site Types and Categories..... | 49 |
| 4.4 | NMAG National Site File..... | 50 |
| 4.5 | Project Area Cultural Heritage Studies..... | 52 |
| 4.5.1 | Conzinc Rio Tinto of Australia (CRA) 1996..... | 54 |
| 4.5.2 | Muke et al. (2007) | 56 |
| 4.5.3 | Hitchcock (2012)..... | 58 |
| 4.5.4 | 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program ... | 60 |
| 4.5.5 | 2015 Mine Area Infrastructure Surveys | 70 |
| 4.5.6 | 2015-2016 Northern Access Road Surveys | 75 |
| 4.5.7 | 2016 Bavaga TSF Geotechnical Program Survey | 80 |
| 4.5.8 | 2017 Infrastructure Corridor Eastern Study Area Survey..... | 82 |
| 4.5.9 | Coastal Study Area – Outfall Area | 86 |
| 4.5.10 | Desktop Assessments | 86 |
| 5 | Wafi-Golpu Project EIS Cultural Heritage Baseline Assessment Summary | 91 |
| 5.1 | Mine Study Area | 93 |
| 5.1.1 | Maximum Subsidence Zone | 93 |
| 5.1.2 | Ventilation Shaft..... | 94 |
| 5.1.3 | Watut Declines Portal Terrace Area..... | 94 |
| 5.1.4 | Nambonga Decline Portal Terrace and Portal Haul Road | 94 |
| 5.1.5 | Miapilli Waste Rock Dump and Miapilli Clay Borrow Pit..... | 95 |
| 5.1.5 | Nambonga Haul Road and Portal Haul Road..... | 95 |
| 5.1.6 | Process Plant Terrace (including the Watut process plant, raw water dam and sedimentation dam)..... | 95 |
| 5.1.7 | Waste Management Facility..... | 95 |
| 5.1.8 | Wastewater Discharge and Raw Water Make-Up Pipelines | 96 |
| 5.1.9 | Lower Papas Aggregate Source and Overburden Stockpile | 96 |

| | | |
|--------|--|-----|
| 5.1.10 | Explosives Magazine..... | 96 |
| 5.1.11 | Fere Accommodation Facility..... | 96 |
| 5.1.12 | Finchif Construction Accommodation Facility..... | 97 |
| 5.1.13 | Power Generation Facilities | 97 |
| 5.1.14 | Mt Beamena Quarry..... | 97 |
| 5.1.15 | Humphries Borrow Pit..... | 98 |
| 5.1.16 | Northern Access Road Borrow Pit..... | 98 |
| 5.1.17 | Migiki Borrow Pit..... | 98 |
| 5.1.18 | Bavaga River Gravel Extraction Area..... | 98 |
| 5.1.19 | Waime River Gravel Extraction | 98 |
| 5.1.20 | Mine Access Road at Fere | 99 |
| 5.2 | Infrastructure Corridor Study Area | 99 |
| 5.2.1 | Southern Study Area | 99 |
| 5.2.2 | Central Study Area..... | 100 |
| 5.2.3 | Eastern Study Area | 100 |
| 5.3 | Coastal Study Area | 109 |
| 5.3.1 | Port Facilities Study Area..... | 109 |
| 5.3.2 | Outfall Study Area | 109 |
| 6 | Impact assessment..... | 109 |
| 6.1 | Potential Impacts to Cultural Heritage..... | 110 |
| 6.2 | Recorded Cultural Heritage Site Significance Assessment..... | 117 |
| 6.2.1 | Archaeological Sites..... | 117 |
| 6.2.2 | Burial Sites | 122 |
| 6.2.3 | Camp Sites | 122 |
| 6.2.4 | Former Village Sites..... | 123 |
| 6.2.5 | Rockshelter Sites | 123 |
| 6.2.6 | Story Sites..... | 124 |
| 6.2.7 | Subsistence / Trade..... | 124 |
| 6.3 | Impact Assessment..... | 125 |
| 6.3.1 | Impact Assessment – Recorded Cultural Heritage Sites | 125 |
| 6.3.2 | Managing Impacts to Cultural Heritage | 130 |
| 6.3.3 | Residual Impact Assessment | 140 |
| 6.3.4 | Cumulative Impact Assessment | 146 |
| 7 | References..... | 148 |

Appendices

Appendix 1: Mine Area Cultural Heritage Site Predictive Model 153
 Appendix 2: NMAG Permits 164

Figures

Figure 1: Project location 2
 Figure 2: Project activities (overview) 3
 Figure 3: Project activities (detail) 4
 Figure 4: Mine Study Area 24
 Figure 5: Infrastructure Corridor Study Areas 29
 Figure 6: Coastal Study Area 32
 Figure 7: NSF-registered cultural heritage sites in relation to Project EIS study area 53
 Figure 8: Cultural heritage site locations recorded by CRA (1996) 55
 Figure 9: Cultural heritage site locations recorded by Muke et al. (2007) 57
 Figure 10: Cultural heritage site locations recorded by Hitchcock (2012) during pedestrian and helicopter surveys 59
 Figure 11: 2012-2013 Worksite Inspection Program study areas and recorded cultural heritage sites in relation to Project study areas 61
 Figure 12: 2013-2014 Additional Works Program study areas in relation to the Mine Study Area 64
 Figure 13: Cultural heritage sites identified during the 2013-2014 Additional Works Program in relation to the Mine Study Area 68
 Figure 14: Locations of selected Hengambu and Yanta *ples tambu* in relation to the Mine Study Area 69
 Figure 15: 2015 Mine Area Infrastructure Survey areas in relation to Project study areas 72
 Figure 16: Cultural heritage sites located within the Watut TSF study area after the 2015 Mine Area Infrastructure Surveys, in relation to Project study areas 73
 Figure 17: Cultural heritage sites located within the Fere Accommodation Facility Study Area after the 2015 Mine Area Infrastructure Surveys 74
 Figure 18: Cultural heritage sites located within the Mt Beamena Quarry Study Area after the 2015 Mine Area Infrastructure Surveys 76
 Figure 19: 2015 Northern Access Road Survey Stage 1 alignment and recorded cultural heritage sites in relation to Project study areas 77
 Figure 20: 2015 Northern Access Road Survey Stage 2 alignment and recorded cultural heritage sites in relation to Project study areas 78
 Figure 21: 2015 Northern Access Road Survey Stage 3 alignment and recorded cultural heritage sites in relation to Project study areas 79
 Figure 22: 2016 Bavaga TSF Geotechnical Program Survey locations and recorded cultural heritage sites in relation to Project study areas 81
 Figure 23: Cultural heritage site locations recorded during the 2017 Infrastructure Corridor (Eastern) Study Area surveys 84

Figure 24: Cultural heritage site extents intersecting with the Infrastructure Corridor (Eastern) Study Area 85

Figure 25: Cultural heritage site locations and extents near the Infrastructure Corridor (Eastern) and Coastal study areas – Outfall Area 87

Figure 26: Infrastructure Corridor (Southern) Study Area and previously recorded cultural heritage sites 88

Figure 27: Aerial photograph of the Port Facilities Area Study Area 90

Figure 28: Infrastructure Corridor Study Area - Cultural Heritage Sites 101

Figure 29: Detail Map 1 - Infrastructure Corridor Study Area - Cultural Heritage Sites..... 102

Figure 30: Detail Map 2 - Infrastructure Corridor Study Area - Cultural Heritage Sites..... 103

Figure 31: Detail Map 3 - Infrastructure Corridor Study Area - Cultural Heritage Sites..... 104

Figure 32: Cultural heritage survey coverage in relation to the Mine Study Area..... 105

Figure 33: Cultural heritage survey coverage in relation to the Infrastructure Corridor (Southern) Study Area 106

Figure 34: Cultural heritage survey coverage in relation to the Infrastructure Corridor (Central) Study Area 107

Figure 35: Cultural heritage survey coverage in relation to the Infrastructure Corridor (Eastern) Study Area 108

Figure 36: Impact Assessment - Cultural Heritage Sites 112

Figure 37: Detail Map 1 – Impact Assessment - Cultural Heritage Sites 113

Figure 38: Detail Map 2 – Impact Assessment - Cultural Heritage Sites 114

Figure 39: Detail Map 3 – Impact Assessment - Cultural Heritage Sites 115

Figure 40: Simulated groundwater drawdown contours (year 37) mapped against water-associated cultural heritage sites 116

Tables

Table 1: Cultural heritage criteria and ratings (based on ICOMOS 2013)..... 19

Table 2: Impact magnitude criteria 21

Table 3: Impact significance assessment matrix..... 21

Table 4: Impact significance rating characteristics 22

Table 5: Hengambu and Yanta clans, by village (source: Coffey Environments 2013) 38

Table 6: Babuaf clans, by village (source: Coffey Environments 2013)..... 40

Table 7: NSF-registered cultural heritage sites (Wasus and Nadzab 1:100,000 map sheets) 51

Table 8: Cultural heritage sites recorded by Muke et al. (2007) located in the study areas..... 58

Table 9: Cultural heritage sites recorded during the 2012-2013 Worksite Inspection Program located in Project EIS cultural heritage study areas..... 63

Table 10: Cultural heritage sites recorded during the Additional Works Phase 2 field program 65

Table 11: Cultural heritage sites recorded during the Additional Works Phase 3 field program 66

| | |
|---|-----|
| Table 12: Cultural heritage sites recorded during the 2013-2014 Additional Works Program located in EIS cultural heritage study areas | 67 |
| Table 13: All cultural heritage sites located within the 2015 Watut TSF study area | 70 |
| Table 14: Cultural heritage sites located during the 2015 Fere Accommodation Facility archaeological survey | 71 |
| Table 15: Cultural heritage sites located within the Infrastructure Corridor - Eastern Study Area.. | 83 |
| Table 16: Infrastructure Corridor - Southern Study Area – previously recorded cultural heritage sites | 86 |
| Table 17: Summary data on cultural heritage sites located within Project study areas..... | 91 |
| Table 18: Cultural heritage site significance assessment..... | 112 |
| Table 19: Impact assessment prior to mitigation (recorded cultural heritage sites)..... | 126 |
| Table 20: Impact assessment ratings by cultural heritage site type (prior to mitigation) | 129 |
| Table 21: Impact assessment ratings by Project activity (prior to mitigation) | 129 |
| Table 22: Residual impact assessment (recorded cultural heritage sites)..... | 141 |
| Table 23: Residual impact assessment summary data..... | 146 |

Plates

| | |
|--|----|
| Plate 1: Proposed infrastructure corridor topography (Southern Section) including Mine Access Road (foreground) and Watut River floodplain (background) – view W | 28 |
| Plate 2: Proposed Infrastructure Corridor topography (Central Study Area) including Watut River floodplain (L of frame) and foothills marking the lower western slope of Watut Mountain (R of frame) – view NNW..... | 30 |
| Plate 3: Proposed Infrastructure Corridor topography (Central Study Area) between the Markham River and the Highlands Highway (open grassland) – view NW..... | 30 |
| Plate 4: Proposed Infrastructure Corridor topography (Eastern Study Area) showing PNG Power Ltd transmission powerline corridor cleared area (R of frame) – view E..... | 31 |
| Plate 5: An example of Azera pottery (from Ballard and Kanasa 1993: Figure 4)..... | 42 |
| Plate 6: An example of Salamaua pottery (from Ballard and Kanasa 1993: Figure 5) | 43 |
| Plate 7: An example of Middle Watut pottery (from Ballard and Kanasa 1993: Figure 6) | 43 |
| Plate 8: Clay pot manufactured by Babuaf potter from Kapunung Village, 2007 (from Muke et al. 2007: Plate 5) | 44 |
| Plate 9: Clay pot manufactured by Babuaf potter from Kapunung Village, 2015 (Rob Skelly, 3 July 2015) | 44 |
| Plate 10: Clay pot manufactured by unknown Babuaf potter, in use during a community celebration (Rob Skelly, 3 July 2015) | 45 |

ABBREVIATIONS

| | |
|--------|---|
| ALA | Andrew Long & Associates |
| AMSL | Above Mean Sea Level |
| BP | Before Present (years) |
| CEPA | Conservation and Environment Protection Authority |
| CHMP | Cultural Heritage Management Plan |
| DSTP | Deep Sea Tailings Placement |
| E | East |
| EIS | Environmental Impact Statement |
| EL | Exploration licence |
| ENE | East-north-east |
| ESE | East-south-east |
| ha | Hectares |
| ICOMOS | International Council on Monuments and Sites |
| IFC | International Finance Corporation |
| km | Kilometres |
| m | Metres |
| ML | Mining Lease |
| N | North |
| NCC | National Cultural Commission |
| NE | North-east |
| NNE | North-north-east |
| NNW | North-north-west |
| NSF | National Site File, NMAG |
| NW | North-west |
| PNG | Papua New Guinea |
| NMAG | National Museum and Art Gallery of Papua New Guinea |
| RMU | Resource Mapping Unit |
| S | South |
| SE | South-east |
| SRI | Social Research Institute |
| SSE | South-south-east |
| SSW | South-south-west |
| SW | South-west |
| TSF | Tailings Storage Facility |
| W | West |
| WGJV | Wafi-Golpu Joint Venture |
| WGSL | Wafi-Golpu Services Limited |
| WNW | West-north-west |
| WSW | West-south-west |

GLOSSARY

| Term | |
|------------------------------------|---|
| Archaeological Site | Any place (or group of physical sites) in which evidence of prehistoric, historic or contemporary human activity is preserved, and which has been, or may be, investigated using the discipline of archaeology. No distinction is made between site types, although the specific nature of each site is elaborated in individual site descriptions. |
| Burial Site | An inhumation or ossuary containing the remains of a single individual. |
| Camp Site | The identified location of a known hunting camp or transit camp. |
| Cemetery Site | Inhumations or ossuaries containing the remains of two or more individuals. |
| Coastal Area | The Coastal Area includes the Port Facilities Area and the Outfall Area. |
| Coastal Study Area | The Coastal Study Area includes the Port Facilities Area and the Outfall Area, both buffered by an additional 50m. |
| Decline | A sloping underground mine opening excavated to provide access for services, mobile equipment and personnel from level to level or from surface. |
| Exploration/Mining Site | A place or object that preserves physical evidence in the form of equipment, structures or excavations relating to the history of exploration and mining in Papua New Guinea. |
| Former Village Site | The identified location of a named former or ancestral village. |
| Historical Site | Any place or object associated with the early period of Papua New Guinea’s colonial history. |
| Infrastructure Corridor | Comprises pipelines, roads and 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. |
| Infrastructure Corridor Study Area | Comprises the Infrastructure Corridor assuming a 50m construction right of way (25m either side of the Infrastructure Corridor centreline) buffered either side by a further 50m for a total Infrastructure Corridor Study Area width of 150m. The area is further split into three study areas: <ul style="list-style-type: none"> • Infrastructure Corridor – Southern Study Area • Infrastructure Corridor – Central Study Area • Infrastructure Corridor – Eastern Study Area |

| Term | |
|---|---|
| Infrastructure Corridor – Central Study Area | <p>A 27.8km section of the Infrastructure Corridor between the Mine Access Road-Link Road intersection in the south and the Highlands Highway near the village of Zifasing in the north. The study area is based on:</p> <ul style="list-style-type: none"> • The centreline of the Infrastructure Corridor buffered either side by 25m to create a construction right of way (ROW) • An additional 50m buffer either side of the construction ROW to create a 150m wide study area corridor |
| Infrastructure Corridor – Eastern Study Area | <p>The proposed Infrastructure Corridor between Zifasing and the village of Wagang, located on the Huon Gulf coast approximately 6km east of the Port of Lae. The study area is based on:</p> <ul style="list-style-type: none"> • The centreline of the Infrastructure Corridor buffered either side by 25m to create a construction right of way (ROW) • An additional 50m buffer either side of the construction ROW to create a 150m wide study area corridor |
| Infrastructure Corridor – Southern Study Area | <p>An 11km meandering section of the Infrastructure Corridor alignment which generally lies within 20m of the Mine Access Road and the Watut Valley Road. The study area is based on:</p> <ul style="list-style-type: none"> • The centreline of the Infrastructure Corridor buffered either side by 25m to create a construction right of way (ROW) • An additional 50m buffer either side of the construction ROW to create a 150m wide study area corridor |
| Inhumation | <p>The action or practice of burying the dead in the ground.</p> |
| Mine Area | <p>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.</p> |
| Mine Study Area | <p>The Mine Study Area includes the following specific items of infrastructure or areas of proposed impact, buffered as indicated:</p> <ul style="list-style-type: none"> • Mine subsidence zone (50m) • Ventilation shaft (100m) • Nambonga Decline Portal terrace (100m) • Miapilli waste rock dump and Miapilli clay borrow pit (50m) • Nambonga Haul Road and Portal Haul Road (50m) • Watut Decline Portal terrace and waste rock dump (100m) • Process plant terrace (100m) • Waste management facility (50m) • Wastewater discharge pipeline and raw water make-up pipeline (50m) |

| Term | |
|----------------------|---|
| | <ul style="list-style-type: none"> • Lower Papas aggregate source and overburden stockpile (50m) • Explosives magazine (100m) • Fere accommodation facility (50m) • Finchif construction accommodation facility (50m) • Power generation facilities (50m) • Mt Beamena quarry and access road (50m) • Humphries, Northern Access Road and Migiki borrow pits (50m) • Bavaga River and Waime River gravel extraction areas (50m) • Mine Access Road at Fere (50m) |
| Mission Site | The identified location of a structure or place associated with Christian mission activities during the historic period. |
| Oral Tradition Site | <p>Any one of the following cultural heritage site types:</p> <ul style="list-style-type: none"> • Burial site • Camp site • Cemetery site • Former Village site • Mission site • Rockshelter site • Story site • Subsistence/Trade site |
| Outfall System | Includes mix/de-aeration tank, seawater intake pipeline and subsea outfall pipeline. Located in the Outfall Area. |
| Outfall Area | The area encompassing the Outfall System, pipeline laydown area, choke station and parking and turnaround area. |
| Port Area | Port of Lae including the Lae Tidal Basin and surrounds. |
| Port Facilities Area | The area encompassing the proposed facilities located at the Port Area, including the concentrate filtration plant and materials handling, storage and ship loading facilities. |
| Project | The proposed construction and operation 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. |
| Project Area | <p>The land that is the subject of the proposed Project activities and Project facilities being:</p> <ul style="list-style-type: none"> • The Mine Area • The Infrastructure Corridor • The Coastal Area |

| Term | |
|--------------------------|--|
| Rockshelter Site | A cave or rockshelter identified in local oral history as being of cultural significance. |
| Story Site | Any place associated with a known story derived from local oral tradition. |
| Study Areas | Any of the three study areas as defined in Section 3.4 of this report, being: <ul style="list-style-type: none"> • Mine Study Area • Infrastructure Corridor Study Area, including: <ul style="list-style-type: none"> ♦ Southern Study Area ♦ Central Study Area ♦ Eastern Study Area • Coastal Study Area |
| Subsistence/Trade Site | A place acknowledged as significant for subsistence or trade activities (e.g. sourcing clay to produce pots). |
| Tailings | A combination of the solid material remaining after the recoverable metals and minerals have been extracted from mined ore, and any remaining process water. |
| Outfall System | Includes mix/de-aeration tank, seawater intake pipeline and subsea tailings pipeline. |
| Vulnerable groups | People who are disadvantaged as a result of one’s race, colour, sex, language, religion, political opinion or origin, gender, age, culture, literacy, sickness, physical or mental disability, economic status or dependence on unique natural resources (IFC 2012a, p.9). |
| Wafi-Golpu Joint Venture | Wafi-Golpu Joint Venture (WGJV), being an unincorporated joint venture between the WGJV Participants. |
| WGJV Participants | Wafi Mining Limited and Newcrest PNG2 Limited. |
| WWII Site | any place or object associated with Japanese or Allied military actions which preserves at least some physical remnant of that action. |

1 INTRODUCTION

1.1 Project Description

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). Related support facilities include access roads to the mine and pipelines from the mine to the Port of Lae and to new coastal facilities near the village of Wagang.

The location of the Project is shown in Figure 1. Geographically, the Project can be divided into three main areas, which together form the Project Area:

- **Mine Area.** The area encompassing the proposed block cave mine, underground access decline and nearby infrastructure, including a portal terrace and waste rock dump supporting each of the Watut and Nambonga declines, the Watut Process Plant, any power generation facilities, laydown areas, wastewater treatment facilities, 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 Infrastructure Corridor comprises pipelines, roads and 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 Port Facilities and the Outfall Area:
 - ♦ **Port Facilities Area.** The area encompassing the proposed facilities located at the Port of Lae, including the concentrate filtration plant and materials handling, storage, ship loading facilities and filtrate discharge pipeline. This area may in the future need to include fuel oil handling and storage facilities.
 - ♦ **Outfall Area.** The area encompassing the Outfall System (including mix/de-aeration tank, seawater intake pipelines and DSTP outfall pipelines), pipeline laydown area, choke station, access track and parking turnaround area.

The proposed Project layout is shown in Figure 2 and Figure 3.

Any potential future development of the Project is subject to further studies, completion of statutory processes, receipt of all necessary or desirable Government and WGJV Participant licences, permissions and approvals, including under the *Environment Act 2000* pursuant to the environmental impact assessment process; under the *Mining Act 1992*; and market and operating conditions. 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. If such changes do occur, these may trigger the need for further cultural heritage studies.

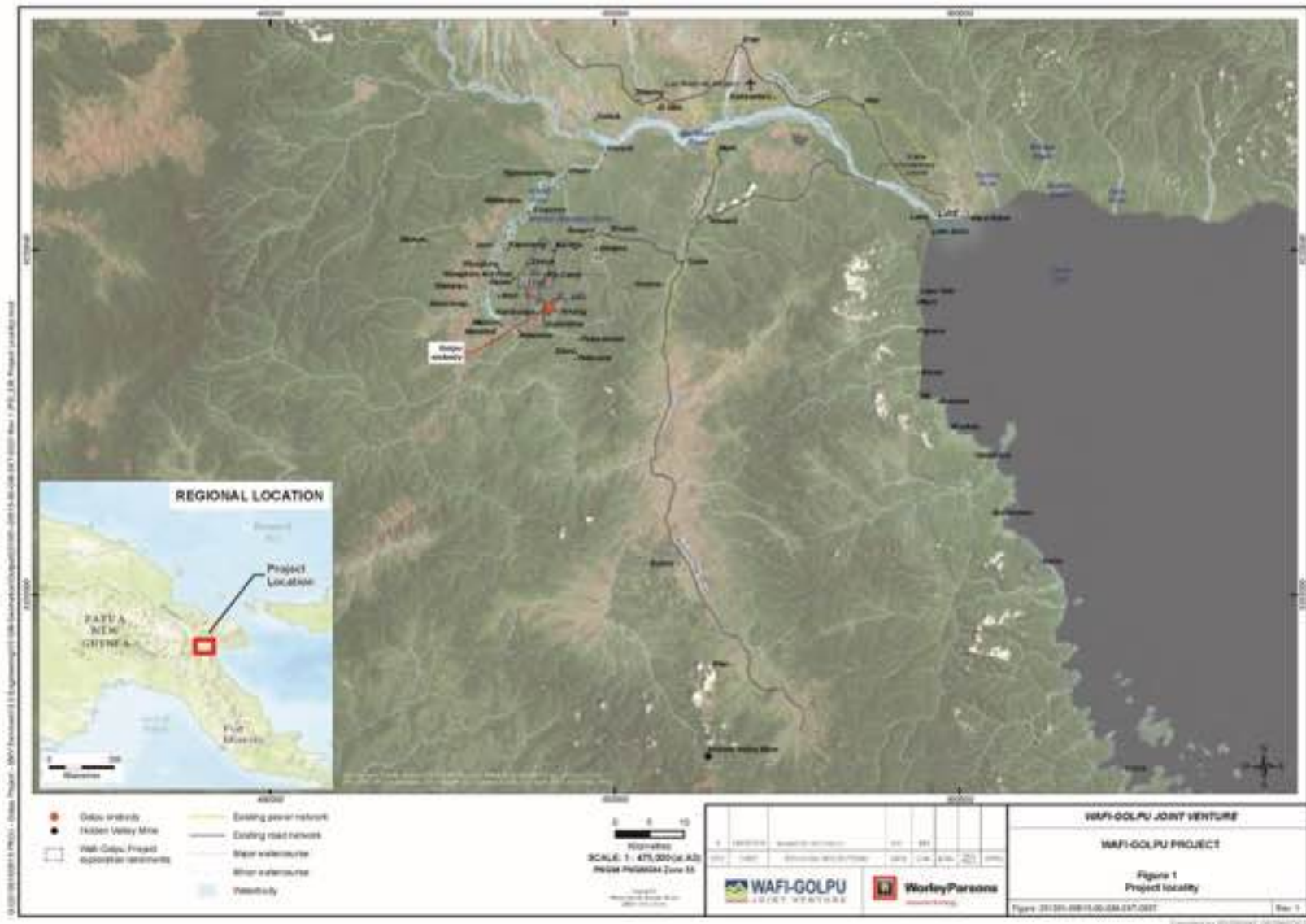


Figure 1: Project location

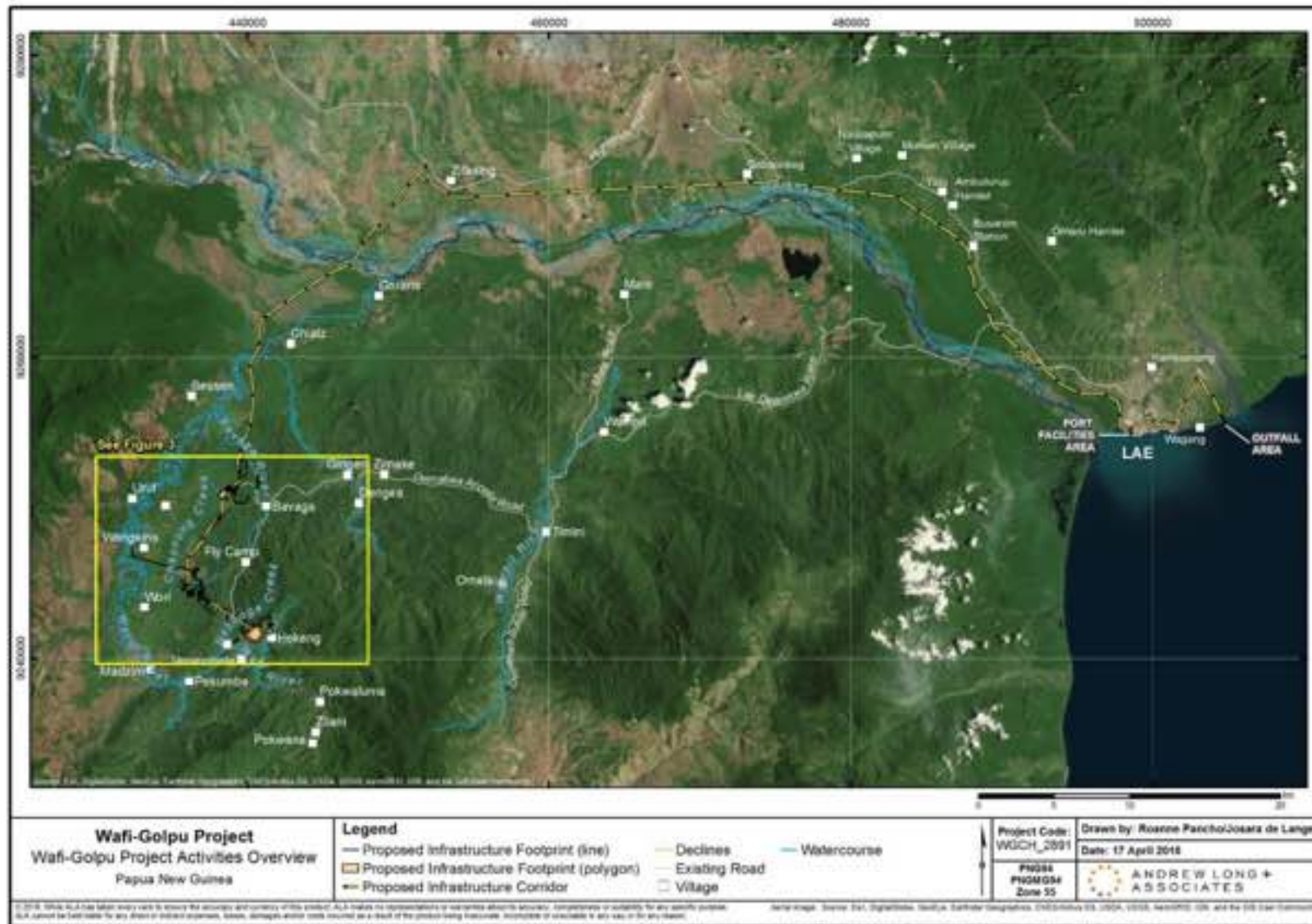


Figure 2: Project activities (overview)

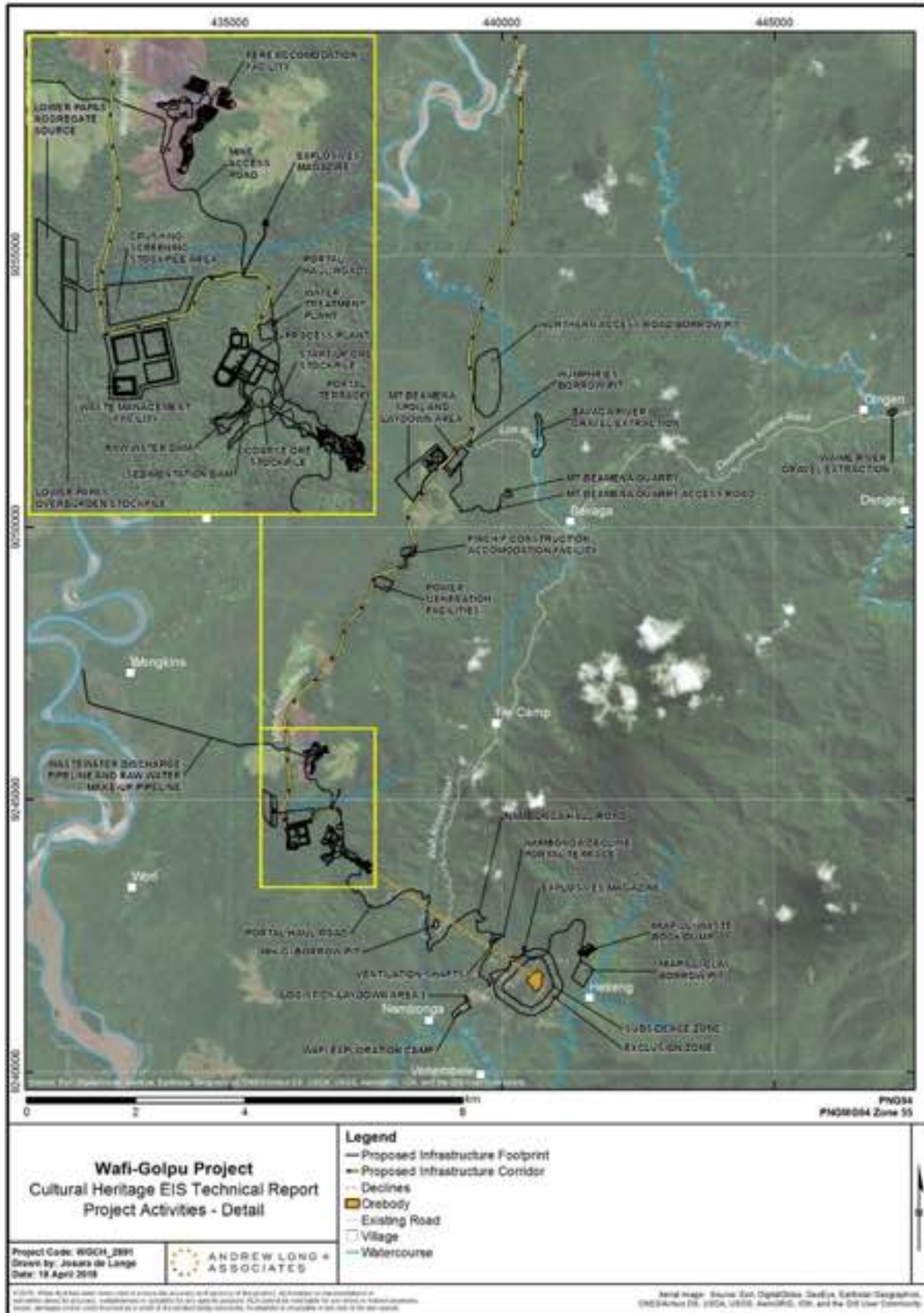


Figure 3: Project activities (detail)

1.2 Context

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 cultural heritage baseline and impact assessment study. The study areas for this report are:

- Mine Study Area
- Infrastructure Corridor Study Area, comprising three sections:
 - ♦ Southern Study Area
 - ♦ Central Study Area
 - ♦ Eastern Study Area
- Coastal Study Area

These three study areas approximately align with the three key geographic areas of the Project, however extend beyond these areas by an additional 50 to 100 metres (m) in order to identify cultural heritage sites located in close proximity to areas that will be disturbed. The cultural heritage study areas are detailed further in section 3.4.

2 REGULATORY AND INDUSTRY FRAMEWORKS

The cultural heritage assessment framework for the Project includes:

- State of PNG regulatory requirements and legislative context.
- Relevant corporate policy and standards.
- Relevant international principles, standards and guidelines for reference.

2.1 PNG Legislation

The national legislation and regulations of the State of PNG that are relevant to the protection of cultural heritage generally and to the specific range of cultural heritage site types likely to be encountered within the study area are listed below.

2.1.1 National Cultural Property (Preservation) Act 1965 and National Cultural Property (Preservation) Regulations 1965

The *National Cultural Property (Preservation) Act 1965* and *National Cultural Property (Preservation) Regulations 1965* protect moveable and immoveable cultural property, including both manufactured and natural objects that are connected with past and present traditional cultural practices.

The principal government institutions responsible for enforcing the NCPP Act are the National Museum and Art Gallery of Papua New Guinea (NMAG) and the National Cultural Commission (NCC), each of which is established under its own enabling legislation. In practice, the NMAG performs a number of the statutory functions of the NCC, including:

- Maintenance of a national cultural heritage site register.
- Issue of artefact export permits.
- Statutory body to which cultural heritage sites are reported.

The NCPP Act specifies offences and penalties that apply to the wilful destruction, damage or defacement of national cultural property, and requires anyone who discovers a:

- cave or other place in which ancient remains, human or other, are to be found; or
- carving, painting or other representation on rock or in a cave; or
- deposit of ancient pottery or historical remains; or
- place used in former times as a ceremonial or burying ground

to report the discovery to the regulatory authority.

2.1.2 National Cultural Commission Act 1994

The NCC is established under the provisions of its enabling legislation, the *National Cultural Commission Act 1994* (NCC Act). The National Cultural Commission is responsible for:

- Preserving, protecting, developing, promoting and (for approved aspects) marketing the traditional and contemporary cultures of PNG.
- Establishing and overseeing three National Cultural Institutions (the Institute of PNG Studies, the National Film Institute and the National Performing Arts Troupe).

Beyond these general functions, the NCC Act does not provide any specific role in the protection of cultural heritage sites known or likely to be found in the study area.

2.1.3 National Museum and Art Gallery Act 1992

The *National Museum and Art Gallery Act 1992* (NMAG Act) establishes the National Museum and Art Gallery of Papua New Guinea (NMAG) as the principal government institution responsible for preserving PNG's cultural heritage. The functions of the NMAG include:

- Protect and conserve the cultural and natural heritage of Papua New Guinea as required by the *Environmental Planning Act 1978*, *National Cultural Property (Preservation) Act 1965* and the *Conservation Areas Act 1978*;
- Administer the *National Cultural Property (Preservation) Act 1965* and *War Surplus Materials Act 1952* and any other Act that applies to the functions of the Museum;
- Research and document the prehistory of Papua New Guinea by archaeological surveys and excavations and manage the national archaeological collections;
- Monitor archaeological research in Papua New Guinea and issue archaeological permits for the short-term loan of archaeological material for study overseas;
- Maintain the national register of traditional and archaeological sites, locate and record prehistoric sites and monuments, and carry out the salvage of archaeological excavations as required by the *National Cultural Property (Preservation) Act 1965* and the *Environmental Planning Act 1978*;
- Identify, document and monitor the conditions of objects of national cultural significance, recommend their proclamation as national cultural property, and keep a register of national cultural property;
- Monitor the collection and export of artefacts, issuing permits and perform other duties as required by the *National Cultural Property (Preservation) Act 1965*;
- Monitor and affiliate researchers from other institutions carrying out research in the areas of the Museum's functions.

2.1.4 War Surplus Material Act 1952

This Act provides for the protection of material derived from World War II, along with the protection of historical period (contact period) properties in the context of buildings, structures, monuments, burial places and shipwrecks, and other relevant materials of historical significance to PNG.

2.1.5 Cemeteries Act 1955

The *Cemeteries Act 1955* allows for burials on private grounds to be considered cemeteries for the purposes of the Act. Section 29 of the Act allows for the exhumation of burials under certain conditions, if authorised by the Minister, a Provincial Administrator (under delegated authority from the Minister) or a coroner (subject to any law relating to coroners).

This Act is therefore relevant to the Project in that the potential exhumation of traditional burials as a Project-related impact management measure require a specific authority.

2.1.6 Compensation

Where destruction of cultural heritage sites occurs either by accident or following consultation with landowners, the PNG Valuer-General's *Compensation Schedule for Trees and Plants, All Regions* (Department of Lands 2008; see also PNG Chamber of Mines and Petroleum 2008) provides guidelines for appropriate compensation rates for 'ceremonial grounds', 'sacred sites' and 'grave sites'. These guidelines also note that:

Where there is disagreement over the authenticity, importance, or extent of any sacred site the matter should be referred to the Valuer-General, who may in turn refer the matter to an appropriately qualified person or organisation for adjudication (Department of Lands 2008: 8).

2.2 Corporate Policy and Standards

The WGJV operates under a Sustainable Business Management System that comprises policies and standards which have guided all phases of cultural heritage studies undertaken between 2012 and 2017 for the Project. The policy and standards relevant to this study include:

- Social Responsibility Policy
- Stakeholder Consultation and Involvement Standards (COM 02)
- Resettlement and Displacement of People Standard (COM 04)
- External Stakeholder Reporting Standard (COM 05)
- Cultural Heritage Standard (COM 07)
- Land Access and Compensation Standard (COM 08)

The Wafi-Golpu Joint Venture Social Responsibility Policy, External Relations Reporting Standard COM05 and Cultural Heritage Standard COM07 are of particular relevance and demonstrate WGJV commitment to the development of a cultural heritage management plan for the Project in consultation with the relevant community representatives and NMAG. These are discussed below.

2.2.1 Social Responsibility Policy

The Social Responsibility Policy illustrates WGJV's commitment to working with the communities in which WGJV operates to develop sustainable socioeconomic programs, mining and business skills development, ethical behaviour, safety, health and environmental management.

The following principles apply in achieving these outcomes in the area of cultural heritage:

- Recognising and respecting the culture, values and traditions of the communities.
- Being open and honest in describing the effects that Project activities might have on communities.
- Seeking to create lasting relationships built on mutual respect and trust.
- Encouraging partnerships to ensure community cultural heritage programs are well designed and delivered effectively.

These principles informed the development and implementation of the Project EIS cultural heritage assessment program.

2.2.2 Cultural Heritage Standard

The WGJV Cultural Heritage Standard (COM07) recognises the particular importance of cultural heritage and requires that the Project work with all villages and communities to identify areas of cultural, spiritual or historic significance. WGJV is also committed to the development of management plans in consultation with the appropriate community representatives. This includes the joint identification of areas of significance and demonstrating respect for the beliefs, customs and traditions of those with whom the Project team works.

2.2.3 External Stakeholder Reporting Standard

This standard ensures that WGJV reports in a timely, transparent and accurate manner on issues that may affect external stakeholders. This includes the provision of details of progress and status to keep external stakeholders informed of operations.

Reporting must be done sensitively and carefully taking into account the Project's commitment to recognising and respecting the culture, values and traditions of the communities. In the specific case of reporting on tangible and intangible cultural heritage, there have been occasions where landowners have not wanted their clan and other stories either made publicly available or widely distributed among WGJV personnel.

The Project therefore has taken the necessary precautions to ensure that information provided in confidence to the Project remains in confidence. This includes keeping information in secure storage with limited access.

2.3 International Policies, Standards and Guidelines

International policies, standards and guidelines specific to cultural heritage include the Burra Charter, the International Council on Mining and Minerals Principles (ICMM Principles) and the International Finance Corporation Performance Standard 8. These are discussed briefly below.

2.3.1 The Burra Charter

Australia ICOMOS (International Council on Monuments and Sites) is a non-government, not-for-profit organisation of cultural heritage professionals which was formed as a national chapter of ICOMOS International in 1976. One of the key goals of Australia ICOMOS is to promote an understanding of the cultural significance of places and raise conservation standards through education and communications.

The Australia ICOMOS Charter for Places of Cultural Significance 2013, generally referred to as the Burra Charter, is widely recognised as a benchmark standard for cultural heritage management. The Charter emphasises that the policy for managing a place must be based on an understanding of its cultural significance, which the Charter defines as the:

...aesthetic, historic, scientific, social or spiritual value for past, present or future generations. Cultural significance is embodied in the *place* itself, its *fabric, setting, use, associations, meanings, records, related places and related objects*. Places may have a range of values for different individuals or groups (Australia ICOMOS 2013: Article 1.2).

These criteria were incorporated into the EIS cultural heritage impact assessment methodology, specifically with regard to the determination of the significance of relevant cultural heritage sites.

2.3.2 International Council on Mining and Minerals (ICMM)

The ICMM is a global body which was established in 2001 as a catalyst to improve sustainable development in the mining industry. The ICMM is made up of 24 mining and metals companies and over 30 associations. Its focus is on addressing key sustainable development challenges faced by the industry. It has an established set of 10 principles covering areas such as ethical business practices and continual improvement in social performance. Member companies make public commitments to improve their sustainability performance and report against progress.

The WGJV supports the implementation of the ICMM Principles. The approach taken in the collection of cultural heritage data and implementation of the consultation program was guided by the relevant principles; which are:

- To uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities.
- To implement effective and transparent engagement and communication with our stakeholders.

WGJV Participant, Newcrest Mining Limited, is a signatory to 'Enduring Value – the Australian Mining Industry Framework for Sustainable Development', which adopts the ICMM Framework for Sustainable Development.

2.3.3 International Finance Committee (IFC) Performance Standard (PS) 8

The objectives of IFC PS 8 (Cultural Heritage) are to protect cultural heritage from the adverse impacts of Project activities, support its preservation, and promote the equitable sharing of benefits from the use of cultural heritage, regardless of whether or not it has been legally protected or previously disturbed. Performance Standard 8 provides specific guidance on a number of aspects that were taken into

consideration during the field surveys, the preparation of the impact assessment reported in the present study, and the development of recommended management measures, including:

- Protection of cultural heritage in Project design and execution
- Chance finds procedures (i.e., those found other than by deliberate search or information provided by sources)
- Consultation
- Community access
- Removal of replicable cultural heritage
- Removal of non-replicable cultural heritage

3 STUDY METHOD

3.1 Background to Cultural Heritage Assessment for the Wafi-Golpu Project

Mineral exploration commenced in the Wafi-Golpu area in the late 1970s, leading to the discovery of the Golpu mineralisation in 1990 by Conzinc Riotinto of Australia (CRA) Exploration Limited. Following a series of corporate acquisitions and mergers, Wafi Mining Limited (a subsidiary of Harmony Gold) gained ownership of the Project in 2004. In 2008, the Wafi-Golpu Joint Venture formed, after the acquisition of a 50% interest in the Project by Newcrest PNG2 Limited.

Since the first discoveries were made, the Project has been subject to a number of multi-disciplinary studies aimed at commercialising the Golpu resource. Most recently, this has included:

- Concept Study (2009)
- Pre-Feasibility Study (2012)
- Pre-Feasibility Optimisation Study (2014)
- Feasibility Study (2015)
- Feasibility Study Update (2018).

As these studies have advanced, different Project designs have been proposed and investigated. This has included the conduct of a range of cultural heritage studies, which have—through cultural heritage mapping and pedestrian archaeological surveys—examined various alternative infrastructure layouts over a number of years. As more information has been gathered on the cultural heritage sites across the Project Area, it has been used to refine infrastructure placement to avoid known sites where possible.

Two cultural heritage studies were undertaken in the Wafi-Golpu area prior to those commissioned by the WGJV. This included a CRA investigation in 1996 and the study by Muke, Kuaso and Mangi in 2007. Sites recorded during these studies have subsequently been verified in the 2012-2017 cultural heritage survey programs and incorporated into the assessment of the Project. Further details of these studies are provided in Section 4.5.

3.2 Objectives of this Study

This study has been prepared to inform the environmental impact statement (EIS) for the Project, in accordance with the requirements of the *Environment Act 2000*. The objectives of the study were to:

- Identify, describe and map any cultural heritage sites that may exist within the study areas.
- Identify potential impacts to the identified cultural heritage sites arising from Project activities.
- Propose measures that might be adopted to mitigate and manage these impacts.
- Determine the potential residual impacts expected following implementation of proposed management measures.

The report therefore comprises:

- A Baseline Assessment describing the existing cultural heritage environment in the study areas (see sections 1.2 and 3.4 for study area definitions).
- An Impact Assessment detailing the potential, actual and perceived impacts of the Project, recommended management measures to address the identified impacts, and an assessment of the residual impacts assuming implementation of the recommended measures.

3.3 Study Methods

3.3.1 Baseline Assessment

The Baseline Assessment was collated with reference to the following research activities:

- Archival and other document review
- Meetings with personnel from the PNG National Museum and Art Gallery (NMAG).
- Review of the NMAG National Site File (NSF).
- Review of all cultural heritage studies undertaken for the Wafi-Golpu Project.
- Development of a cultural heritage site predictive model for the Mine Area.
- Field surveys.
 - ♦ Pre-awareness discussions with local communities
 - ♦ Community consultation
 - ♦ Vehicle surveys
 - ♦ Pedestrian field surveys

3.3.1.1 Cultural Heritage Site Prediction Model – Mine Area

A cultural heritage site prediction model was developed by Green and Muke (2013a) for the Mine Area based on the outcomes of an earlier cultural heritage survey reported by Muke et al. (2007) (see Appendix 1 for further details). The Infrastructure Corridor and Coastal Area components of the Project layout were not included in the model due to their variable topographies and a lack of information regarding the types and locations of cultural heritage sites that may exist at these locations. The model therefore does not apply to Wampar and Ahi communities or cultural heritage sites.

The Mine Area predictive model was developed to:

- Identify the potential for patterns of cultural occupation and use of the landscape across the Mine Area.
- Assist with the development of appropriate survey strategies for the 2012-2017 cultural heritage field investigation programs described in the present study.

The predictive model incorporated a number of existing spatial datasets, including location data collected by Muke et al. (2007) for cultural heritage sites recorded within and in the vicinity of the Mine Area, and geological, landform, vegetation, ecological and topographic data derived from the Papua New Guinea Resource Information System (PNGRIS) and from 5m contour LiDAR data, both supplied in digital format by Coffey Environments.

Attributes included in the model were selected on the basis that the environmental parameters they represent would have had a modifying influence on human occupation within and use of this part of the study area, and that this influence may be detectable in variations in the distribution and density of cultural heritage sites across the Mine Area.

The locations of 67 cultural heritage sites recorded by Muke et al. (2007), broken down by site type and cultural group, were cross-referenced against six environmental variables using Excel pivot tables. These tables were then reviewed to determine if any patterns emerge that might characterise the locations of any given site type. The predictive model generated the following observations:

- In general terms, Babuaf cultural sites can occur anywhere within their present occupied range. They can also occur in elevated areas within the Watut Range in locations immediately adjacent to recorded Yanta and Hengambu cultural heritage sites.

- Similarly, in general terms Yanta and Hengambu cultural heritage sites can occur anywhere within their present occupied range. They are not limited to any specific environmental zone and can occur at a range of elevations and on a range of slopes.
- Babuaf archaeological sites are likely to be located on gently inclined slopes and ridgelines within forested mountains and foothills between 100 and 200m AMSL. They are also likely to be found within or immediately adjacent to localised areas of *kunai* grassland on the lower foothills of the Watut Range.
- Yanta and Hengambu archaeological sites are likely to occur on gently to moderately sloping ridgelines, or within rockshelters on steeply sloping valley sides.
- Babuaf burial sites and campsites are likely to be restricted to either the margins of swamps on gentle slopes or the meander floodplains of the Watut River Valley. Burials will most likely be inhumations.
- Yanta and Hengambu burials are likely to be inhumations located within the dissected mountainous terrain of the Watut and Wanion Ranges at a range of elevations between 150 and 800m AMSL but limited to gentle to moderate slopes less than 20°.
- Babuaf former villages are likely to be found across all environmental zones up to 500m AMSL but are likely to concentrate within the western portion of the Watut Range and foothills on gentle to moderate slopes and ridgelines.
- Yanta and Hengambu former villages and camps are likely to be located either on ridgelines at higher elevations, or on areas of level ground adjacent to larger watercourses.
- Babuaf story sites are likely to be found in all environmental zones across their cultural range, at all elevations and on a variety of slopes.
- Yanta and Hengambu sacred sites are likely to be smaller pools and springs, or large boulders often located adjacent to or within watercourses.

3.3.1.2 Field Surveys

All field methodologies used in the cultural heritage studies reported in the baseline assessment were guided by the WGJV Social Responsibility Policy and by international good practice with regard to methodologies for the conduct of field surveys and the development of appropriate strategies for community engagement.

Tasks common to all field investigations included the identification and recording of the current condition and state of preservation of cultural heritage sites. Field surveys were carried to investigate:

- Unknown cultural heritage sites identified through community interviews and targeted field surveys of areas that could be impacted by the development of proposed Project infrastructure.
- Cultural heritage sites previously recorded through interviews only, which also aimed to verify their locations within the areas being investigated.
- Previously recorded cultural heritage sites (e.g., those identified in CRA (1996) and by Muke et. al (2007)) located within 200m of proposed Project infrastructure and facility boundaries within the study area, to confirm their locations and to identify any changes in their condition since they were last surveyed.

The sequence and details of each component of the field methodology are described in the following sections.

Pre-awareness Discussions

Wafi-Golpu Joint Venture's Community Affairs department conducted pre-survey village awareness briefings with nominated communities to explain the purpose of the field surveys, to gain their endorsement to enter their lands and document the information gathered, and to identify individuals who would be willing to assist the field surveys by participating in interviews and acting as guides during the subsequent field surveys.

Community Consultation

Interviews were conducted by qualified archaeologists with representatives nominated by each cultural group regarding known cultural heritage sites potentially located within or near proposed Project infrastructure. The villages consulted depended upon the specific requirements of each study and the areas being investigated by that study.

A critical element in the consultation process was to ensure that all community representatives understood that field surveys were not intended to contribute to or influence ongoing disputes about land ownership. Care was taken to emphasise that the field surveys were designed to identify cultural heritage sites associated with the study areas, which would then enable WGJV to progress proposed infrastructure development in ways that avoided or managed the impact of Project activities on cultural heritage to the greatest extent practicable.

Consultation Approach

A consistent approach to consultation was developed for use in each village. The purpose was, first, to provide a general introduction regarding the purpose of the cultural heritage survey and its methods; and second, to invite individuals to participate either singularly or as a group in a focused interview. Alternatively, individuals already nominated by their community as suitable representatives were identified and invited to participate in an interview.

Men and women were always invited to attend and participate in the introductory briefing sessions and to participate in key informant interviews and subsequent field surveys.

All community interviews were conducted by qualified archaeologists with the assistance of WGJV Community Affairs staff. Interviews commenced with a brief description of the materials that would be used to record relevant cultural heritage information, such as standard 1: 100,000 topographic maps (Wasus 8184 and Nadzab 8284) or unlabelled hillshade maps of the study area derived from a Digital Elevation Model generated using 5m interval LiDAR contour data. The hillshade maps included basic location information such as village names, but they did not include any information depicting proposed Project infrastructure or operational layouts. The purpose of this was to encourage frank and open discussion about the locations of cultural heritage sites within the area of interest without the potentially biasing influence of prior knowledge of preferred Project infrastructure locations.

To enable the interview participants to orientate themselves in relation to the maps, time was allocated for the identification of key geographic landmarks in the Mine Area such as watercourses, mountains and valleys, which were labelled using their *tok ples* names directly onto the map. Once these landmarks were identified and their locations marked, it became much easier for interview participants to then indicate the approximate locations of known cultural heritage sites in relation to these mapped landmarks.

At the completion of each community interview the results were reviewed by the study team and arrangements made with relevant informants for a field inspection of all identified sites. Each site indicated during community interviews as being located anywhere within the area of interest of that particular study was inspected via pedestrian survey. Sites located outside the areas of interest were also inspected and recorded at the request of community members.

Onsite Community Consultation

Field inspections and archaeological surveys also included onsite consultation with local community representatives regarding the presence or absence of oral tradition sites within the area of interest for the particular study. Community representatives were asked to state:

- Whether the specific area of interest contained any oral tradition sites.

- Whether they had any concerns that proposed works might negatively impact on any cultural heritage sites that may be associated with the proposed work locations.

All responses from the community representatives present during these onsite consultations were noted.

Vehicular Surveys

Vehicular surveys of roads traversing the cultural heritage study areas were undertaken to provide local community representatives the opportunity to indicate, in general terms, the presence or absence of oral tradition sites. During these surveys, the study team was often accompanied on separate trips by members of different landowning groups with interests in the same area, so that they could privately pass on confidential information about their cultural heritage sites. This was particularly important for surveys conducted within the Mine Area.

Pedestrian Field Survey and Site Visit

The final step for all stages of fieldwork was to undertake direct pedestrian surveys of sites identified during community interviews and/or vehicular surveys. The sites selected for field survey included all new sites identified during community interviews, as well as sites recorded during previous field research by Muke et al. (2007) and CRA (1996), to assess their current preservation condition or to complete an archaeological reconnaissance survey if this had previously been recommended.

Wherever possible, field surveys included the formal archaeological survey of traditional gardens. These were selected based on their location within different landforms to ensure that as many different landforms as possible were sampled, and on the degree of ground surface visibility within each garden.

Archaeological Survey and Recording

The extent of the areas targeted for formal archaeological surveys were identified based on a number of factors, including:

- The nature of the infrastructure proposed for construction (e.g. area versus linear alignment).
- The outcomes of the cultural heritage site predictive model.
- Safety considerations regarding terrain.

Whenever possible, level/flat to moderately sloping ground surfaces (0°-18°) within a study's area of interest were inspected for the presence of exposures, which were then surveyed for the presence of archaeological sites. Steep slopes (19°-30°) that could be safely accessed were also inspected for the presence of exposures. Very steep or precipitous slopes (>31°) were not inspected, primarily due to concerns for the welfare and safety of survey team participants, but also based on the outcomes of the predictive model which noted that archaeological sites are unlikely to be located on steeply sloping ground surfaces.

Standard archaeological survey recording forms were completed for each environmentally variable component of the study areas. All cultural heritage sites were individually recorded using a standard site recording form, which included all information required by the NMAG National Site File form as well as additional information on environment and content. Field notes and a field diary were recorded separately. Site recording included information regarding site size and contents, the environmental context, a general description of the site, oral traditions, and preliminary observations regarding potential management recommendations.

Each cultural heritage site was assigned a unique WG (Wafi Golpu) field site number. All cultural heritage sites were photographed, and their locations recorded using a handheld GPS device standardised to the WGS84 datum and UTM Zone 55S projection. Formal cultural heritage survey tracks were also recorded using the handheld GPS. All pedestrian site visits and all systematic field surveys were conducted with the direct assistance of Community Affairs staff, and were always accompanied by relevant landowners.

Archaeological Survey and Cultural Heritage Mapping Permits

It is common practice in PNG for NMAG to require and issue permits for archaeological investigations. Enquiries relating to the need for permits for the 2012, 2013 and 2014 field surveys were lodged with the office of the Chief Government Archaeologist, NMAG prior to the commencement of each survey phase. In each instance, WGJV was advised that a permit was not required (H. Mandui, Chief Government Archaeologist (PNG), pers. comm. to Michael Green, 9 July 2012 and 25 February 2013).

In 2015, further advice regarding the requirement for a permit to conduct archaeological investigations supporting the preparation of the Project EIS was sought from NMAG (which indicated in its view a permit is required), and a permit was formally issued by Alois Kuaso, Acting Chief Government Archaeologist, NMAG on 18 May 2015 (Permit for Archaeological Research in PNG # 193 for the period 18 May to 31 July 2015). Subsequent field surveys carried out to inform Project studies were issued with relevant permits by the NMAG on:

- 12 May 2016 – Permit for Cultural Heritage Mapping in Papua New Guinea # 002 covering the period 12 May to 30 November 2016 (Northern Access Road)
- 12 May 2016 – Permit for Cultural Heritage Mapping in Papua New Guinea # 003 covering the period 12 May to 30 November 2016 (Watut TSF geotechnical drilling program)
- 18 November 2016 – Permit for Cultural Heritage Mapping in Papua New Guinea # 007 covering the period 18 November 2016 to 28 February 2017 (Bavaga TSF geotechnical drilling program)
- 18 April 2017 – Permit for Cultural Heritage Mapping in Papua New Guinea # 008 covering the period 18 April to 18 July 2017 (infrastructure corridor field program)
- 18 April 2017 – Permit for Archaeological Survey in Papua New Guinea # 216 covering the period 18 April to 18 July 2017 (infrastructure corridor field program).
- 14 July 2017 – Permit for Archaeological Survey in Papua New Guinea # 000 (Extension) covering the period 18 July to 31 December 2017.

Copies of these permits are presented in Appendix 2.

3.3.1.3 WWII Cultural Heritage Sites

The potential location of World War II cultural heritage sites within the Project area was considered during the preparation of the baseline assessment. The authors were alert to the need to record any observations relating to the presence of WWII heritage that was brought to their attention during the field surveys. The exception was the 2017 Infrastructure Corridor field program, which specifically targeted locations likely to contain historical archaeological relics associated with WWII given the extensive military actions that occurred in the lower Markham River Valley during the latter half of 1943 (see Section 4.1.2.2 below for further details).

3.3.2 Impact Assessment

The Impact Assessment method comprised the following elements:

- Development of an impact assessment framework in line with good industry practice and in consultation with WGJV.
- Assessment of the cultural heritage significance of known sites that may be impacted by the proposed Project activities described in the EIS, using criteria set out in the Burra Charter (Australia ICOMOS 2013) and guided by IFC Performance Standard 8.
- Development of practical recommendations to manage potential impacts (including avoidance where possible) to cultural heritage sites that may be directly or indirectly impacted by proposed Project activities.

- Assessment of residual impacts on cultural heritage sites assuming the implementation of management measures.
- Discussion of potential cumulative impacts, where impacts from the proposed Project have the potential to intersect or overlap with the potential impacts arising from other development proposals occurring within the Watut River and Markham River valleys and the city of Lae.

3.3.2.1 Impact Assessment Framework

The impact assessment framework used in this study incorporates the following sequential elements:

1. Identification of the cultural heritage sites to be included in the assessment. For the present study, these include all of the cultural heritage sites known to be located within the study areas at the time of baseline assessment completion.
2. Assessment of the cultural heritage significance of each site, using established, internationally recognised criteria specifically developed to identify the values of a cultural heritage site.
3. Assessment of the magnitude of the impact from proposed Project activities on cultural heritage sites, based on an assessment of the severity, geographical extent and duration of the impact.
4. Determination of the significance of a potential Project impact on identified cultural heritage sites, based on the consideration of the site's cultural heritage significance and the magnitude of the impact it is likely to experience.
5. Identification of avoidance and management measures that, if implemented, should either avoid Project impacts to cultural heritage sites altogether or reduce the significance of these impacts.
6. Determination of residual Project-related impacts to cultural heritage sites by assessing the significance of a potential impact after it has been avoided or managed based on the recommended avoidance and management measures.
7. Discussion of potential cumulative impacts, where impacts from the proposed Project have the potential to intersect or overlap with the potential impacts arising from other development proposals.

3.3.2.2 Cultural Heritage Significance

The assessment of cultural heritage significance is a fundamental component of cultural heritage management. Such assessments can assist in determining which items, sites, places, landscapes and even environments are of sufficient cultural importance that they require preservation, and if this is not possible, they can inform the development of appropriate management measures to mitigate impacts. Significance assessment establishes the assessment criteria and significance ratings to be applied to each cultural heritage site, both tangible and intangible.

A statement regarding the significance of each cultural heritage site is an essential step in the process of developing appropriate cultural heritage management recommendations. Although it may seem self-evident, it is important to state that while all known cultural heritage sites have at least some level of 'cultural heritage significance', the preservation of all cultural heritage may not be possible. In this context, *management* is not necessarily synonymous with *preservation*, and may involve disturbance or destruction, or partial disturbance through controlled above-ground, ground surface and subsurface salvage investigations where archaeological material is present.

A process for establishing cultural significance is provided in the *Australia ICOMOS Charter for Places of Cultural Significance 2013*, otherwise known as 'The Burra Charter' (Australia ICOMOS 2013; Marquis-Kyle & Walker 2004). Article 1.2 of the Burra Charter (as at 26 November 1999) states that:

- *Cultural significance* means aesthetic, historic, scientific, social or spiritual value for past, present or future generations.

- Cultural significance is embodied in the *place* itself, its *fabric, setting, use, associations, meanings, records, related places* and *related objects*.
- Places may demonstrate a range of these significance criteria for different individuals or groups.

An accompanying Practice Note entitled *Understanding and assessing cultural significance* provides further definition of these significance criteria (ICOMOS 2013: 3-4).

Aesthetic: Refers to the sensory and perceptual experience of a place—that is, how we respond to visual and non-visual aspects such as sounds, smells and other factors having a strong impact on human thoughts, feelings and attitudes (Kerr 1990:10). Aesthetic qualities may include the concept of beauty and formal aesthetic ideals. Expressions of aesthetics are culturally influenced. Despite the poorly defined nature of aesthetic significance, it remains one of the most important criteria for official registration of heritage sites in many parts of the world (e.g. Schapper 1993).

Historic: Intended to encompass all aspects of history—for example, the history of aesthetics, art and architecture, science, spirituality and society. It therefore often underlies other values. A place may have historic value because it has influenced, or has been influenced by, an historic event, phase, movement or activity, person or group of people. It may be the site of an important event. For any place the significance is likely to be greater where the evidence of the association or event survives at the place, or where the setting is substantially intact, than where it has been changed or evidence does not survive. However, some events or associations may be so important that the place retains significance regardless of such change or absence of evidence.

Scientific: Refers to the information content of a place, or its ability to reveal something about the past using scientific techniques such as archaeology. The relative scientific value of a place is likely to depend on the importance of the information or data involved, on its rarity, quality or representativeness, and its potential to contribute further important information about the place itself or a type or class of place or to address important research questions. To establish potential, it may be necessary to carry out some form of testing or sampling. For example, in the case of an archaeological site, this could be established by a test excavation.

Social: Refers to the associations that a place has for a particular community or cultural group and the social or cultural meanings that it holds for them. Places of social significance are usually important in maintaining a community's integrity and *sense of place*; that is, a sense of belonging to a particular area as a distinctive cultural group (Hall and McArthur 1993:8). For many peoples, Indigenous archaeological sites (e.g. burials) and European-Indigenous contact sites (e.g. missions, plantations) have strong social significance. Archaeological sites with materials deemed to be markers of the prior presence of the cultural groups may also assume a strong social significance during land ownership disputes.

Spiritual: Refers to the intangible values and meanings embodied in or evoked by a place which give it importance in the spiritual identity, or the traditional knowledge, art and practices of a cultural group. Spiritual value may also be reflected in the intensity of aesthetic and emotional responses or community associations and be expressed through cultural practices and related places. The qualities of the place may inspire a strong and/or spontaneous emotional or metaphysical response in people, expanding their understanding of their place, purpose and obligations in the world, particularly in relation to the spiritual realm.

For the purposes of the present study, the cultural heritage significance of each site was determined based on an assessment of each of the above significance criteria. In keeping with the principles of the Burra Charter, the aesthetic, historic, scientific, social and spiritual values of each cultural heritage site were individually assessed and rated as being either low, medium or high according to the scheme set out in Table 1, which incorporates specific guidelines outlined in the Practice Note produced by ICOMOS (2013: 3-4). Criteria differentiating low, medium and high aesthetic, historic, social and spiritual value were developed based on professional experience and information obtained during the community consultations.

The overall significance rating derived for each cultural heritage site was based on the highest rating recorded across the range of significance criteria. For example, if a site is rated as holding high social value, medium spiritual value and low aesthetic, historical and scientific value, the overall significance rating allocated to that site is high because of its high social value.

Equal weight was given to all five criteria when determining the overall significance of each cultural heritage site. The potential to variably weight the degree of contribution of each criterion was initially considered but not pursued owing to the subjective nature of the factors used to determine aesthetic, historic, social and spiritual value.

Table 1: Cultural heritage criteria and ratings (based on ICOMOS 2013)

| Cultural Heritage | | |
|--------------------------|--|--|
| Criteria | Examples | Rating |
| Aesthetic | The place may be distinctive within its setting and/or inspire an artistic or cultural response. It may be represented in art, photography, literature, folk art, folk lore, mythology or other imagery or cultural arts | <p>Aesthetic value rated as follows:</p> <ul style="list-style-type: none"> • Low whereby the site and/or its setting, including vista, has little or no visual appeal. • Medium whereby the site and/or its setting, including vista, has moderate visual appeal. • High whereby the site and/or its setting, including vista, has high visual appeal. |
| Historic | The place may be associated with an important event or theme in history, or a particular person or cultural group important to the history of the local area, state or nation | <p>Historical value rated as follows:</p> <ul style="list-style-type: none"> • Low for sites which are not associated with any known historical event, person or theme. • Medium for sites which are associated with a moderately significant historical event, person or theme at either the local and/or provincial and/or national level. • High for sites which are associated with a highly significant historical event, person or theme at either the local and/or provincial and/or national level. |
| Scientific | Through the use of scientific techniques such as archaeology, the place has the potential to reveal new information or understandings about people, places, processes or practices | <p>Ratings for scientific value take into account</p> <ul style="list-style-type: none"> • Site contents (e.g., size and patterning of site where 0 = no materials remaining, 1 = small number of artefacts with limited diversity (0-10 artefacts), 2 = larger number but limited range of artefacts, 3 = large and diverse range of artefacts). • Site condition (0 = destroyed, 1 = deteriorated, 2 = fair to good, 3 = excellent). • site representativeness (1 = common, 2 = occasional, 3 = rare). <p>The rating for overall significance is calculated based on the cumulative score for site contents, site condition and site representativeness where:</p> <ul style="list-style-type: none"> • Low (cumulative score 1-3). • Medium (cumulative score 4-6). • High (cumulative score 7 or greater). |

| Cultural Heritage | | |
|-------------------|--|--|
| Criteria | Examples | Rating |
| Social | The place may be an important local marker or symbol or contribute to the identity of a particular cultural group | <p>Social value rated as follows:</p> <ul style="list-style-type: none"> • Low for sites which do not appear to have any clear social connection at either the local and/or provincial and/or national level. • Medium for sites which have a moderately significant social connection for a cultural group at either the local and/or provincial and/or national level. • High for sites which have a highly significant social connection for a cultural group at either the local and/or provincial and/or national level. |
| Spiritual | The place may contribute to the spiritual identify or belief system of a cultural group and/or may be important to maintaining the spiritual health and wellbeing of a culture or group. | <p>Spiritual value rated as follows:</p> <ul style="list-style-type: none"> • Low for sites which do not appear to have any clear spiritual connection with a cultural group at either the local and/or provincial and/or national level. • Medium for sites which have a moderately significant spiritual connection for a cultural group at either the local and/or provincial and/or national level. • High for sites which have a highly significant spiritual connection for a cultural group at either the local and/or provincial and/or national level. |

3.3.2.3. Impact Magnitude

The magnitude of an impact on a cultural heritage site is an assessment of: 1) the geographical extent of the impact; 2) the duration of the impact; and 3) the severity of the impact. The magnitude of the impact is determined before and after the application of management measures.

Impact magnitude criteria developed specifically for the cultural heritage impact assessment are presented in Table 2.

Given that the three impact magnitude criteria identified above may not all apply equally in terms of their severity in any given instance, an overall impact magnitude rating was calculated based on the cumulative score for each criterion, as follows:

- Low (cumulative score ≤ 3)
- Medium (cumulative score between 4 and 6)
- High (cumulative score ≤ 7)

Table 2: Impact magnitude criteria

| Consequence Category | Nil | Low (Rating 1) | Medium (Rating 2) | High (Rating 3) |
|----------------------|-----------|--|--|---|
| Severity | No impact | Loss of up to one third of site contents. Site condition rating decreases by one rating point. Site representativeness rating unchanged. Minor community reaction; attracts stakeholder concern at a local level. | Loss of up to two thirds of site contents. Site condition rating changes by two rating points. Site representativeness rating decreases. Substantial community reaction; results in stakeholder concern at local and provincial levels. | Loss of greater than two thirds of site contents. Site condition rating changes by three rating points. Site representativeness rating decreases. Major community reaction; results in stakeholder concern at a national or international level (i.e., media, shareholder, government, international NGO concern). |
| Extent | No impact | Impact damages less than one third of site. No loss of access to site. | Impact damages up to two thirds of site and/or access to site restricted. | Impact damages greater than two thirds of site and/or permanent loss of access to site. |
| Duration | No impact | Temporary or short-term impact or loss of access to site limited to Project construction phase. | Medium-term impact or loss of access to site will alleviate within life of Project. | Long-term (extends beyond the life of the Project) or permanent impact or loss of access to site. |

Source: Developed by Andrew Long and Associates Pty Ltd for the Wafi-Golpu Project EIS Baseline and Impact Assessment Technical Report

3.3.2.4 Assessing Impact Significance

The matrix used to assess the significance of a Project-related impact on a cultural heritage site is presented in Table 3. The significance of an impact is determined by assessing the significance of a cultural heritage site in relation to the overall magnitude of the expected impact on that site.

Table 3: Impact significance assessment matrix

| | | Cultural Heritage Significance | | |
|------------------|-------------------|--------------------------------|----------|----------|
| | | High | Medium | Low |
| Impact Magnitude | Negative – High | Extreme | Major | Moderate |
| | Negative – Medium | Major | Moderate | Minor |
| | Negative – Low | Moderate | Minor | Minimal |

Characteristics for each impact significance rating are presented in Table 4.

Table 4: Impact significance rating characteristics

| Impact Significance | Characteristics |
|---------------------|--|
| Extreme | <ul style="list-style-type: none"> • Likely to result in major widespread community and stakeholder concern at the local, provincial and/or national/international level. • Affects the majority of the people in the area of influence. • The effect is very intense with people experiencing a rapid rate of change. The effect is immediate and/or endures for, and beyond, the duration of the activity or Project phase. • The effect significantly disrupts a cultural group’s spiritual connection to land and in turn their spiritual identity and/or spiritual health and wellbeing. • Archaeological site conditions are destroyed such that potential understandings about people, places, processes or practices associated with the Project area are irrevocably lost. |
| Major | <ul style="list-style-type: none"> • Likely to result in a strong community and stakeholder reaction at the local, provincial and/or national level. • Affects a large number of people in the area of influence. • The effect is intense with people experiencing a relatively rapid rate of change. • The effect starts in a short time and/or endures for, and potentially beyond, the duration of the activity or Project phase. • The effect disrupts a cultural group’s spiritual connection to land and in turn their spiritual identity and/or spiritual health and wellbeing. • The effect disrupts a cultural group’s social connection to land which contributes to their cultural identity. • Archaeological site condition is damaged such that the ability to derive potential understandings about people, places, processes or practices associated with the Project area is reduced. |
| Moderate | <ul style="list-style-type: none"> • Could attract community and stakeholder concerns voiced at local and provincial levels. • Affects a moderate number of people in the area of influence. • The effect is moderate with people experiencing a moderate rate of change. • The effect is gradual and/or endures for the duration of the activity or Project phase. • The impact affects a cultural group’s spiritual connection to land and in turn their spiritual identity. • The impact affects a cultural group’s social connection to land which contributes to their cultural identity. • Archaeological site condition is damaged such that the ability to derive potential understandings about people, places, processes or practices associated with the Project area is somewhat reduced. |
| Minor | <ul style="list-style-type: none"> • May result in community and stakeholder concern voiced in a localised area. • Affects a small number of people in the area of influence. • The effect is not very intense with people experiencing a slow rate of change. • The effect is delayed, medium-term and/or confined to the duration of the activity or Project phase. • A cultural group’s spiritual or social connection to the land, and therefore spiritual or cultural identity, is largely undisturbed or maintained. • Archaeological site condition is largely undisturbed resulting in little effect on the ability to derive understandings about people, places, processes or practices. |
| Minimal | <ul style="list-style-type: none"> • Unlikely to create any concern in the community and among Project stakeholders. • Affects a very small number of people in the area of influence. • The effect is not intense with people experiencing a very slow rate of change. • The effect is immediate or delayed, short-term and/or confined to the duration of the activity or Project phase. • A cultural group’s spiritual or social connection to the land is preserved resulting in little effect or maintenance of their spiritual or cultural identity. |

| Impact Significance | Characteristics |
|---------------------|---|
| | <ul style="list-style-type: none"> Archaeological site condition is preserved resulting in little effect on the ability to derive understandings about people, places, processes or practices. |

3.4 Study Areas

The study areas for this assessment were identified based on the proposed location of all Project activities and associated infrastructure as outlined in Section 1.1. These align with the three major Project components – the Mine Area, the Infrastructure Corridor and the Coastal Area, however extend beyond these areas by an additional 50 to 100 metres (m) in order to identify cultural heritage sites located in close proximity to areas that will be disturbed.

3.4.1 Mine Study Area

The Mine Study Area comprises the Project disturbance footprint of the infrastructure and facilities shown in Figure 4 with a 50 to 100m buffer in addition to the footprint. Infrastructure and facilities are listed below and include, from south to north:

- Mine subsidence zone
- Ventilation shaft
- Nambonga Decline Portal terrace
- Miapilli waste rock dump and clay borrow pit
- Nambonga Haul Road and Portal Haul Road
- Watut Decline Portal terrace and waste rock dump
- Process plant terrace (including the Watut process plant, raw water dam and sedimentation dam)
- Waste management facility
- Wastewater discharge pipeline and raw water make-up pipeline
- Lower Papas aggregate source and overburden stockpile
- Explosives magazine
- Fere accommodation facility
- Finchif construction accommodation facility
- Power generation facilities
- Mt Beamena Quarry and access road
- Humphries, Northern Access Road and Migiki borrow pits
- Bavaga River and Waime River gravel extraction areas
- Mine Access Road at Fere

3.4.1.1 Mine Subsidence Zone

Underground mining of the Golpu ore body will result in an area of ground surface subsidence, which has the potential to impact on cultural heritage sites within this zone. This component of the mine study area includes the projected maximum extent of the area of subsidence buffered by an additional 50m.

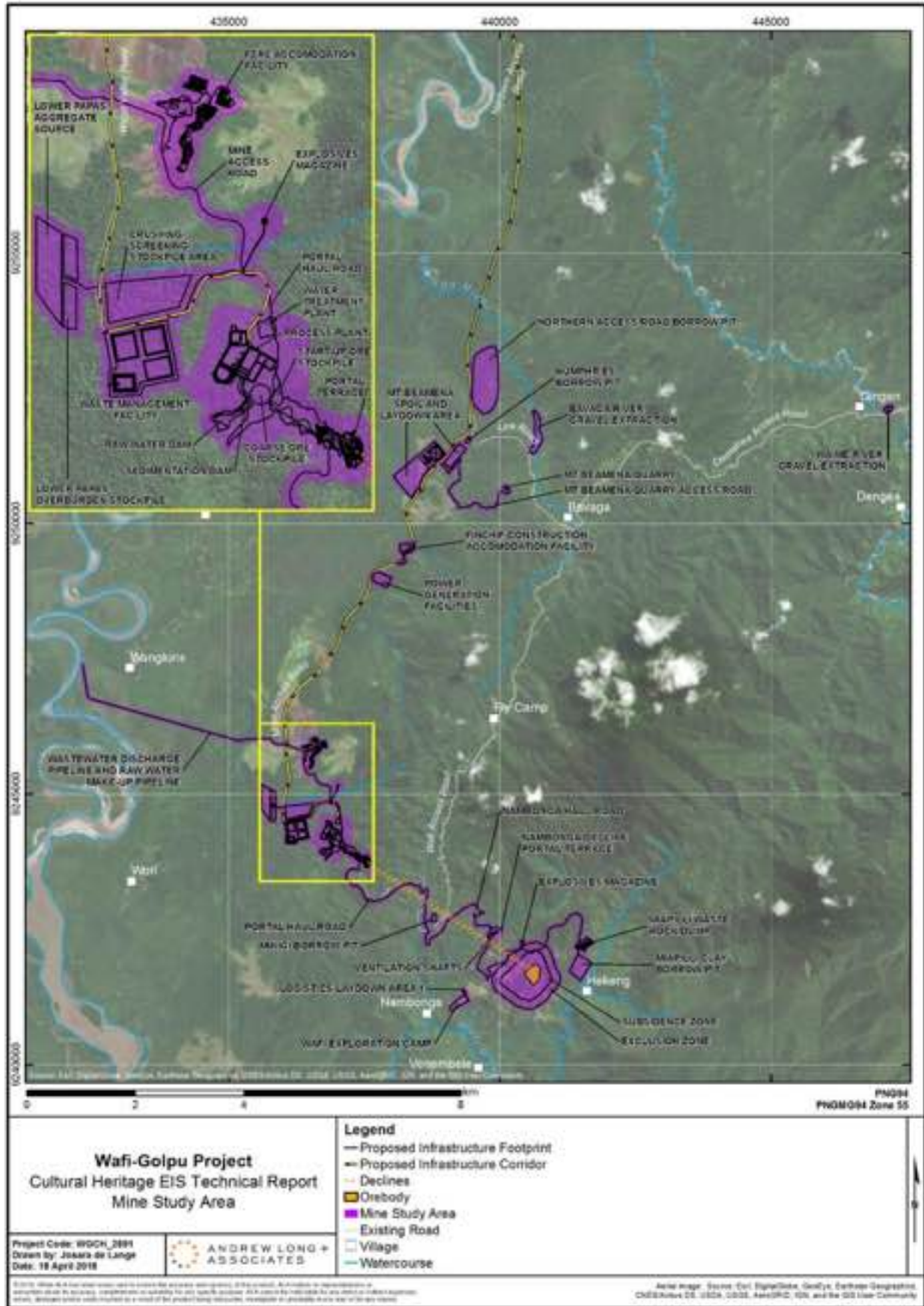


Figure 4: Mine Study Area

3.4.1.2 Ventilation Shaft

The ventilation shaft would be constructed and operated in support of the operation of twin underground declines connecting the mine portal with the Golpu orebody. The proposed location of the shaft is on the lower margin of the north western flank of Mount Golpu, overlooking Nambonga Creek. This shaft component of the Mine Study Area includes the construction and operational footprint of the proposed ventilation shaft, and an access road connecting the worksite to the existing Wafi Access Road, all buffered by an additional 100m.

3.4.1.3 Watut Decline Portal Terrace and Waste Rock Dump

Due to the steep terrain around the planned decline portals, the proposed Watut Decline portal terrace will be built on the side of the Boganchong Creek valley to form a marshalling area for the underground activities. It will include a geotechnically-stable, steeply-angled high wall from which to commence construction of the entrance (portal) to the declines. The Watut Decline Portal is located between 230mASL and 250mASL.

The high wall will necessitate the excavation of approximately 300,000 cubic metres (m³) of material, which will be used for construction of the Watut Decline Portal terrace and Mine Access Road.

The proposed waste rock dump, which is constrained by the valley in which it will be located, has been designed to be approximately 1,400m long and an average of 135m wide, with a maximum vertical height of approximately 45m at the downstream end.

The co-located Watut Decline Portal terrace and waste rock dump component of the mine study area includes the proposed construction footprint of all infrastructure associated with the portal terrace (except for the existing Portal Access Road) and the operational footprint of the waste rock dump, buffered by an additional 100m.

3.4.1.4 Nambonga Decline Portal Terrace

In addition to the Watut Declines, a second decline, the Nambonga Decline, has been incorporated into the design. The proposed location of the Nambonga Decline is on the north western flank of Mount Golpu, overlooking Nambonga Creek. The Nambonga Decline Portal terrace will be constructed to provide a consolidated location for infrastructure associated with the Nambonga Decline. As far as practicable, development of facilities associated with the Nambonga Decline makes use of existing facilities, tracks and pads.

This component of the mine study area includes the projected maximum extent of the Nambonga Decline portal terrace, buffered by an additional 100m.

3.4.1.5 Miapilli Waste Rock Dump and Clay Borrow Pit

Waste rock from the Nambonga Decline will be stored within the Miapilli Waste Rock Dump located in the Yor Creek catchment. The footprint of the Miapilli waste rock dump will be approximately 5ha and will be constructed to a nominal height of 10m.

Clay required to encapsulate potentially acid-forming material in the Miapilli waste rock dump may be sourced from the Miapilli clay borrow pit, located in proximity to the waste rock dump.

These components of the mine study area include the projected maximum extent of the Miapilli waste rock dump and Miapilli clay borrow pit.

3.4.1.6 Nambonga Haul Road and Portal Haul Road

Raw materials required for the construction of the Nambonga Decline will be hauled along the upgraded Portal Haul Road, while waste rock from the construction of the Nambonga Decline will be hauled along the upgraded Nambonga Haul Road.

These components of the mine study area include the haul roads buffered by an additional 50m.

3.4.1.7 Process Plant Terrace

The proposed process plant terrace, comprising the Watut Process Plant and related ancillary facilities, would potentially be situated on low foothills west of Mount Golpu. This component of the Mine Study Area includes the construction and operational footprint of the proposed Watut Process Plant, related ancillary facilities, the coarse ore stockpile and raw water and sedimentation dams, buffered by an additional 100m.

3.4.1.8 Waste Management Facility

The waste management facility will be located to the west of the process plant terrace and will include facilities for general waste, hazardous waste and timber waste management. It will include a designated cell for sewage treatment plant solids. This component of the Mine Study Area includes all facilities contained within a proposed perimeter fence, buffered by an additional 50m.

3.4.1.9 Wastewater Discharge Pipeline and Raw-Water Make-up Pipeline

During the construction of the declines and initial block cave development, a proposed wastewater discharge pipeline would transport water from the portal terrace across the floor of the floodplain to the Watut River. A raw-water make-up pipeline is proposed in the same corridor. During mine operations, this pipeline will supply the Watut Process Plant with water from the Watut River in instances where mine water is unable to meet Project demand. This component of the Mine Study Area is buffered either side of the proposed centreline of the pipeline alignment by 50m.

3.4.1.10 Lower Papas Aggregate Source and Overburden Stockpile

Aggregate required to establish the Nambonga Decline will be sourced from Lower Papas and trucked to a nearby crushing and screening plant for processing and stockpiling. These components of the mine study area include the aggregate source and overburden stockpile area buffered by an additional 50m.

3.4.1.11 Explosives Magazine

An explosives magazine would potentially be situated in low foothills south of the Fere grasslands, midway between the Fere accommodation facility and the process plant terrace. The explosives magazine will be linked to the Mine Access Road via a subsidiary access road. This component of the Mine Study Area includes the construction and operational footprint of the proposed explosives magazine and access road, buffered by an additional 100m on the facility and 20m either side of the centreline of the access road.

3.4.1.12 Fere Accommodation Facility

Project personnel who need accommodation at the site are expected to be housed at the Fere Accommodation Facility located on the eastern side of the Watut River, on *kunai* grassland-covered foothills immediately east of the Mine Access Road. It is proposed the facility will have its own potable water treatment plant and solid waste management facilities with sewage handled through the Plant Terrace sewage treatment plant and will be linked to the Mine Access Road via a subsidiary access road. The Fere Accommodation Facility component of the Mine Study Area includes the proposed construction and operational footprint of the facility and access road, buffered by an additional 50m on the facility and 20m either side of the centreline of the access road.

3.4.1.13 Finchif Construction Accommodation Facility

WGJV proposes to expand the current Finchif 1 camp along each side of the existing Watut Valley Road with existing, WGJV-owned buildings. The expanded camp will leverage off the capacity of the current services including sewage, water supply and power generation. This component of the Mine Study

Area includes the proposed construction and operational footprint of the facility buffered by an additional 50m.

3.4.1.14 Power Generation Facilities

New facilities for local power generation will be situated adjacent to the eastern side of the existing Watut Valley Road, approximately 600m southwest of the proposed Finchif Construction Accommodation Facility. This component of the Mine Study Area includes the proposed construction and operational footprint of the facility buffered by an additional 50m.

3.4.1.15 Humphries and Northern Access Road Borrow Pits and Mt Beamena Quarry

Hard rock is required for various Project facilities, e.g., concrete aggregates, retaining walls and road construction. This rock is expected to be sourced from quarries, borrow pits and gravel extraction sites from rivers within the Project Area. This may include the proposed Humphries and Northern Access Road borrow pits and the Mt Beamena Quarry. This component of the Mine Study Area includes the proposed full extent of the borrow pit and quarry impact footprints and associated spoil, laydown and administration areas and access roads, all buffered by an additional 50m.

3.4.1.16 Bavaga River and Waime River Gravel Extraction Areas

Gravel is required for use in the concrete batch plant, the preparation of gabion baskets, and for the gravel wearing course on road alignments. This gravel may be sourced from a new site adjacent to the Bavaga River, or from the existing Waime River gravel extraction area located adjacent to the Demakwa Access Road near the village of Gingen. The gravel extraction component of the Mine Study Area includes the proposed full extent of the extraction area footprints buffered by an additional 50m.

3.4.1.17 Mine Access Road at Fere

The existing Watut Valley Road currently commences at its intersection with Link Road in the north, and then traverses the Watut River floodplain close to the western foothills of the Watut. The Watut Valley Road then crosses these foothills at Fere Range (Plate 1), approximately 700m east of the village of Papas, before descending back onto the floodplain and then turning eastwards towards the proposed process plant terrace.

In future, the Watut Valley Road will be renamed the Mine Access Road between Link Road and the point where the proposed wastewater discharge and raw water make-up pipelines will intersect with the existing Watut Valley Road. The portion of the existing road between this intersection point and its termination at the process plant terrace will continue to be called Watut Valley Road.

A proposed 1.6km long access road will depart from the Mine Access Road/Watut Valley Road intersection and run southeast across the Fere grasslands to link up with access roads leading to the Fere Accommodation Facility and the explosives magazine and will re-join the Watut Valley Road approximately 350m north of the process plant terrace. This new access road will become part of the Mine Access Road.

This proposed 1.6km section of the Mine Access Road at Fere is included as a component of the Mine Study Area. It includes the centreline of the access road buffered either side by 50m.



Plate 1: Proposed infrastructure corridor topography (Southern Section) including Mine Access Road (foreground) and Watut River floodplain (background) – view W

3.4.2 Infrastructure Corridor Study Area

For the purposes of the present study, the proposed Infrastructure Corridor Study Area comprises three sections identified as:

- The Southern Study Area (terrestrial tailings, concentrate and fuel pipelines and the Mine Access Road)
- The Central Study Area (terrestrial tailings, concentrate and fuel pipeline and the Northern Access Road)
- The Eastern Study Area (terrestrial tailings, concentrate and fuel pipeline).

Each of these study areas included a 50m wide construction right of way (25m either side of the Infrastructure Corridor centreline) buffered either side by a further 50m for a total Infrastructure Corridor Study Area width of 150m.

The split of the Infrastructure Corridor Study Area into Southern, Central and Eastern components reflects the progressive nature of field studies, with the Southern, Central and Eastern study areas being studied in 2012-2014, 2015-2016 and 2017 respectively. Further details of these studies are provided in section 4.5 below.

3.4.2.1 Southern Study Area

The Southern Study Area includes an 11km meandering section of the Infrastructure Corridor alignment which generally lies within 20m of the Mine Access Road and the Watut Valley Road as mapped in Figure 5. It includes the existing roads and the proposed concentrate, terrestrial tailings and fuel pipelines.

3.4.2.2 Central Study Area

The Central Study Area includes a 27.8km section of the Infrastructure Corridor between the Mine Access Road-Link Road intersection in the south and the Highlands Highway near the village of Zifasing in the north. It includes the proposed Northern Access Road to the Highlands Highway, as well as the concentrate, terrestrial tailings and fuel pipelines to the point at which the Infrastructure Corridor intersects the existing PNG Power transmission line corridor, approximately 2.2km west of Zifasing.



Figure 5: Infrastructure Corridor Study Areas

Within the Central Study Area, the southern third would traverse floodplains associated with the Watut, Bavaga and Waime Rivers, with the southern end lying adjacent to foothills descending from the Watut Range (Plate 2). The Infrastructure Corridor would then traverse open, level grasslands between the Watut and Markham rivers, before crossing the Markham River and finally heading northeast across level grassland plains and lightly forested floodplains (Plate 3).



Plate 2: Proposed Infrastructure Corridor topography (Central Study Area) including Watut River floodplain (L of frame) and foothills marking the lower western slope of Watut Mountain (R of frame) – view NNW.



Plate 3: Proposed Infrastructure Corridor topography (Central Study Area) between the Markham River and the Highlands Highway (open grassland) – view NW

1.6.1.3 Eastern Study Area

The Eastern Study Area includes the proposed Infrastructure Corridor between Zifasing and the village of Wagang, located on the Huon Gulf coast approximately 6km east of the Port of Lae.

Between the villages of Zifasing and Yalu, the Infrastructure Corridor is proposed to follow the existing PNG Power Ltd transmission powerline corridor (Plate 4). From Yalu, the Infrastructure Corridor will deviate from the PNG Power transmission line, heading southeast through partially cleared forest and gardens, and along the upper terrace of the Markham River floodplain, to a point just north of the Port of Lae. Here, the concentrate and fuel pipelines will split off to terminate at or near the Port Facilities Area at the Port of Lae, with the Infrastructure Corridor continuing through Lae to the proposed Outfall Area, located between Wagang and mouth of the Busu River.



Plate 4: Proposed Infrastructure Corridor topography (Eastern Study Area) showing PNG Power Ltd transmission powerline corridor cleared area (R of frame) – view E

3.4.3 Coastal Study Area

The proposed Coastal Study Area includes the footprints of the Port Facilities Area, located at the Port of Lae, and the Outfall Area, located approximately 1.6km east of the village of Wagang, buffered by an additional 50m (Figure 6).

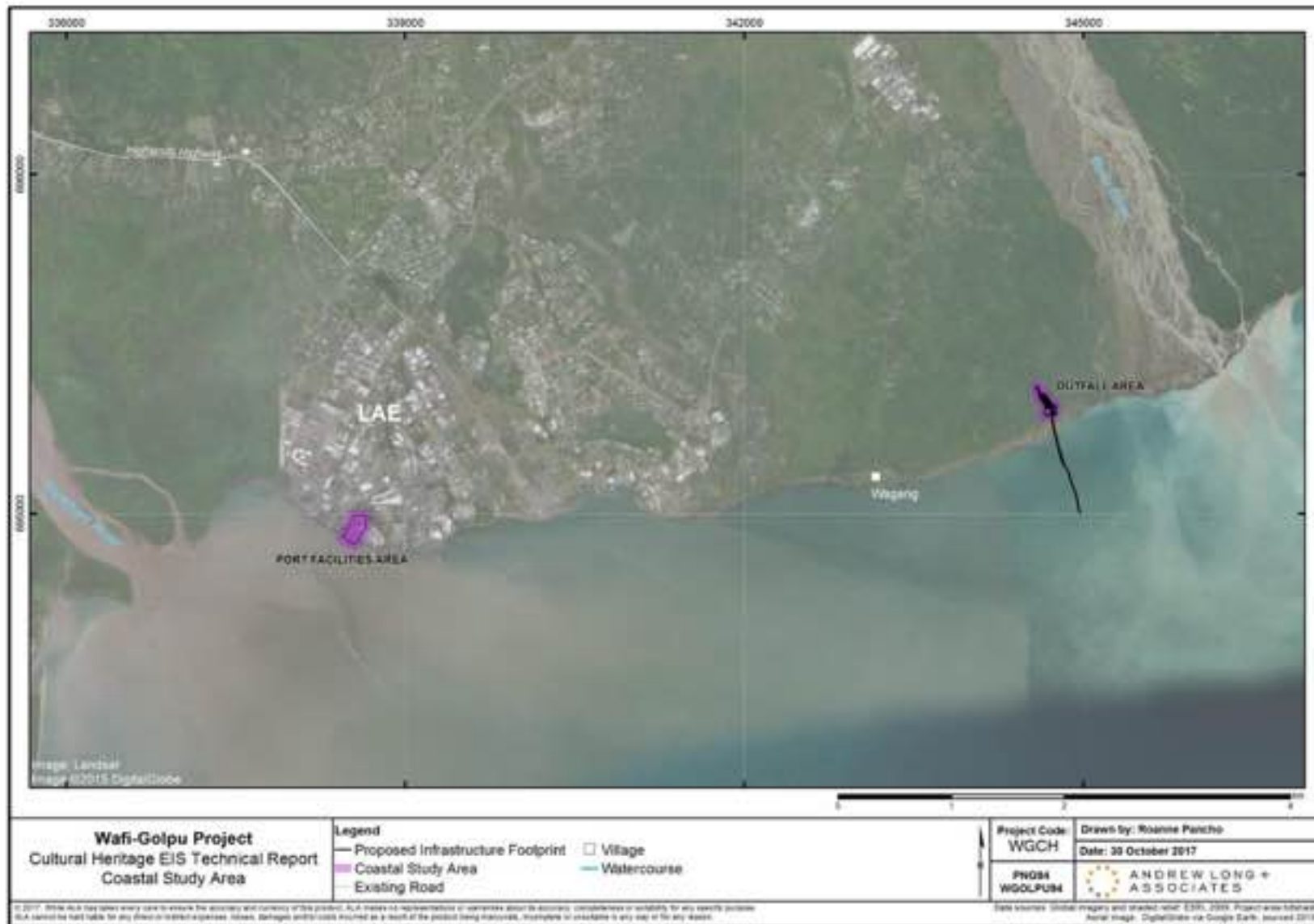


Figure 6: Coastal Study Area

4 BASELINE ASSESSMENT

4.1 Morobe Province Prehistory and History

4.1.1 Prehistory

4.1.1.1 Language

The cultural groups occupying the three cultural heritage study areas all speak languages belonging to the Austronesian group of language families, which generally includes:

- Indigenous Taiwanese.
- The majority ethnic groups of East Timor, Indonesia, Malaysia, the Philippines, Brunei, Madagascar, Micronesia, and Polynesia.
- The non-Papuan speaking peoples of Melanesia, including parts of mainland PNG.

The arrival of Austronesian languages in the Pacific region is often associated with the earliest archaeological evidence (at around 3,500 years before present (BP)) for a colonising group that has become known as the Lapita People, whose main cultural signature is a distinctive, highly decorated dentate-stamped pottery (Sand 2010).

Within PNG, Austronesian languages are generally located in the Bismarck Archipelago and along the northern mainland coast. The Buang-Mumeng and Markham language families (collectively referred to as the Huon Gulf Language Group) represent the largest Austronesian-speaking incursion into the interior of mainland New Guinea, a move that probably displaced existing non-Austronesian speaking communities (Ballard and Kanasa 1993: 9).

4.1.1.2 Markham Valley Archaeological Research

There have been few previous archaeological investigations in mainland Morobe Province and none that are specific to the study areas, other than those undertaken for the Project.

From a regional perspective, the most informative archaeological evidence comes from archaeological sites containing pottery sherds that originated from pots made at manufacturing villages in the Markham Valley. The origins of Markham Valley pottery can be traced to the earliest Lapita ceramic traditions in the Oceanic region (Denham et al. 2012: 39). Historically, pottery manufacture in PNG has gone well beyond domestic requirements with pottery exchange relationships being fundamental to structuring social interactions and the development of cultural institutions such as, for example, the *kula*, *hiri* and Vitiaz Strait exchange networks (Lilley 1987; Malinowski 1922; Oram 1982). Although the archaeological history of the Markham River Valley is understood largely based on pottery remains, it is important to note that people came to the area well before pottery was available and that there is evidence of human activity in Morobe Province dating to at least 40,000 years ago (Groube *et al.* 1986).

The only previous archaeological investigations in the Markham River Valley region were carried out by Specht and Holzkecht in 1969. They documented 12 archaeological sites and used evidence from these sites to construct a cultural sequence for the region spanning the past 800 years (Specht and Holzkecht 1971). Specht and Holzkecht (1971) identified four archaeological site types during their investigations:

1. **Settlement Sites.** Containing concentrations of cultural artefacts (pottery sherds and stone artefacts), culturally altered landscapes and culturally altered vegetation assemblages.
2. **Burial Sites.** Burial sites were found in association with burial trees or rock overhangs. Burial sites do not necessarily contain human remains. Burial sites may be identified where the possessions of the deceased such as clay pots and/or stone tools have been stored.

3. **Garden Sites.** Cooking pots were carried to gardens and discarded when they broke leaving irregular pottery sherd scatters of varying densities.
4. **Trade Routes.** Trade routes were identified based on artefact scatters that had accumulated along conduits between trade locations.

Pottery originating from production centres in the Markham River Valley was exchanged through social networks extending into the Atzera Range and the Eastern Highlands (see Coutts 1967: 485). However, the identification of archaeological sites in locations such as these is difficult due to surficial processes that can cause such sites to become hidden beneath the ground surface within decades, and older archaeological sites may be covered by thick sediment accumulations (see Löffler 1977: 86-89, 100, 172).

4.1.1.3 Markham River Valley Ceramic Sequences

Markham River Valley pottery made during the ethnographic period belongs to what is today known as the Azera² ceramic tradition. The attributes of ceramic traditions (e.g. decoration and vessel form) change through time and based on changes in ceramic traditions a ceramic chronology has been presented for the Markham River Valley pottery making industries (Specht and Holzkecht 1972). The Markham River Valley ceramic chronology has been extrapolated to the region more generally and refined through cross-referencing ceramic traits with those found at other culturally related locations (e.g. Lilley 2004; Watson 1993).

The Markham River Valley ceramic sequence commences with ceramic ‘Style B’ which was later replaced by ceramic ‘Style A’,³ a tradition with much in common with recent Azera pottery (Specht and Holzkecht 1972: 61-64). Style B vessels are more rounded and deeper than those of Style A. Style B rims are abruptly everted and vessel lips usually have notched decoration. The internal rim surfaces of Style B vessels are never decorated. Decorative techniques used for Style B are: linear-incision, punctuation, appliqué and on rare occasions, dentate stamping. Body decorations include rows of punctations, chevrons, incised triangles and incised hatching.

By comparison with Style B, Style A pots are ‘squat globular’ vessels with only slightly everted rims. Lip-notched decorations are very common in Style A. Body decorations on Style A most often consist of bands of incised or dentate-stamped pendant-shaped triangles. Watson (1993: 311) suggests that stylistic changes in the Markham River Valley show a diminution in decorative designs through time however, her view does not correlate with recent stylistic innovation recorded in the region (see May and Tuckson 1982: 126-151).

Specht and Holzkecht (1972) suggest that Style A replaced Style B approximately 800 years ago. However, their chronology is based on purportedly Azera-type pottery from archaeological contexts at the Aibura site in the Eastern Highlands, which is dated to around 770 years before present (BP) (White 1967: 196, 216). Using the outcomes from one dated Highlands site to infer a stylistic change elsewhere in the Markham River Valley is speculative at best and, given that the radiocarbon dates derived from the Aibura site were unreliable (Spriggs 1989: 604), a commencement date of some 800 years ago for Style A in the Markham River Valley remains unsubstantiated.

² Ethnographically-described ceramic traditions from the Markham River Valley have been variously called Adzera and Azera traditions (‘Adzera’ is used by Fischer 1962; Watson 1993; Specht and Holzkecht 1972; ‘Azera’ is used by Holzkecht 1957; Hooley 1971; May and Tuckson 1982). For consistency, the more commonly used term Azera is used here when referring to ethnographically-described pottery made in the Markham River Valley.

³ Note that the Specht and Holzkecht (1972) specifically listed Style B as preceding Style A.

Aiming to shed light on the antiquity of the two-phase (Style B – Style A) ceramic sequence, Lilley (2004: 93) correlates changes in ceramic traditions in the Vitiav region between 800 and 650 years ago with the transition from Style B to Style A. Lilley (2004) draws a parallel between the end of Style B with the end of ‘Type X’ pottery known from the Vitiav region and dated there to between 800 and 650 years ago⁴. Lilley (2004) also suggests that a series of volcanic eruptions between 800 and 650 years ago in the Morobe region may have stimulated demographic shifts and changes to cultural alignments which in turn could explain regional changes in ceramic traditions.

In summary, although there is evidence for stylistic change in ceramic production in the Markham River Valley that may be associated with a more widespread cultural shift, it is not well understood in terms of its spatial and chronological dynamics. The implications of any ceramic archaeological materials that may be identified in Project-related cultural heritage study areas will have to be carefully assessed regarding the identification of the likely cultural group(s) that may have been responsible for their manufacture.

4.1.2 History

4.1.2.1 Missionary Activities

Lutheran missionary Johann Flierl arrived at Finschhafen 90 km northeast of Lae in 1886 to commence missionary work in the region. Missionary activities expanded in the early part of 20th century with G. Schmutterer establishing a Lutheran mission at Lae in 1911 and the near neighbouring Malahang Mission during the same period (Hayter 2012, Sack 1976). Today, the Malahang Mission is in an industrial area on the outskirts of Lae a short distance from Wagang village. Lutheran missionaries based at Malahang also built an airstrip to service the mission which became an important military asset during WWII.

4.1.2.2 WWII Heritage

During the 1930s, in response to the requirements for heavy equipment by gold mining operations in the Morobe area, Lae airport handled more airfreight tonnage than any other airport in the world (Dunn 2014: 8). Consequently, when Japanese forces invaded New Guinea in 1942, Lae airport became a key logistical facility servicing Japanese forces. Malahang airstrip was disused at the time and had fallen in to disrepair; however, Japanese forces upgraded the airstrip to further serve their military requirements. Many aircraft were lost in Morobe Province during WWII and it is important to note that despite extensive post-war investigations, the remains of many planes have not been found and undiscovered crash sites likely exist in highland regions such as the Atzera Mountains west of Lae (see Dunn 2014).

During March 1942, as part of an overall strategy to establish bases in the South Pacific, the Japanese captured Lae and established major bases in Lae and the small port town of Salamaua, located 35km to the south of Lae (Bullard 2007). Prior to this, Lae had been made the capital of Australian-mandated New Guinea.

In June 1943, the United States Army 871st Airborne Engineers established a secret forward airfield at Tsile (Bencheng), approximately 12km west of the Mine Area, to advance operations to recapture Lae. A support strip was also established at Maralina. Japanese forces, upon discovering the airfield, launched pre-emptive attacks on Tsile on 15-16 August 1943, inflicting casualties but little damage to the airfield (Gamble 2013). Subsequent Allied bombing attacks launched from Tsile on Japanese airfields at Wewak on 17-18 August 1943 caused heavy damage to many Japanese aircraft and facilities and resulted in Japanese forces finally losing their air superiority over New Guinea (Gamble 2013).

In September 1943, Allied forces launched ‘Operation Postern’ to liberate Lae and Salamaua. The operation involved two converging advances on Lae in an attempt to circle and capture the town. The first advance

⁴ Lilley and Specht (2007) revised the end date for Type X pottery to c. 500 cal BP.

involved an amphibious assault with US Navy destroyer artillery support to the east of the Lae. The assault was unopposed on land, but the Allies were attacked from the sky by Japanese bombers. Approximately 100 Allied forces naval and army personnel lost their lives (Johnston 2002).

The second advance involved an airborne landing near Nadzab, 50km to the west of Lae. On the morning of 5 September 1943, 302 aircraft from eight different Allied airfields in PNG rendezvoused over Tsile Tsile before proceeding down the Watut Valley, turning to the right over the Markham River Valley, and approaching Nadzab, where they made an unopposed parachute drop and successfully secured the Nadzab Airfield, cutting off any possible Japanese retreat into the Markham River Valley (Kenney 1949).

Australian forces advanced along a pre-war road linking Nadzab with Lae. The Nadzab-Lae road was intersected by a trail that passed through Yalu, and a contingent of Australian troops encountered retreating Japanese forces near Yalu.

The assault was a success, and Allied forces re-captured Lae on 15 September 1943. After Lae was secured, Australian forces advanced westward and recaptured the Malahang airstrip on 15 December 1943 (Miller 1959: 210). The Salamaua-Lae campaign preceded the strategically important Huon Peninsula campaign, which enabled the Allies to establish air and naval bases for future operations (Johnston 2002).

Two assessments of unexploded ordnance risk were undertaken for the Project in 2015 and 2017. This included:

- G-tek Australia Pty Limited (G-tek) (2015) – Areas investigated by G-tek overlapped the following study areas:
 - Mine Study Area, including the maximum subsidence zone and the Watut Process Plant.
 - Infrastructure Corridor Central Study Area.
- Gap Explosive Ordnance Detection Pty Ltd (Gap EOD) (2017) – Areas investigated by Gap EOD included 46 geotechnical test pit locations and eight borehole locations within the Infrastructure Corridor Eastern Study Area.

G-tek Australia Pty Ltd (2015) – Mine Study Area, South Study Area, Central Study Area

The assessment was conducted through onsite inspection, interviews with local communities and PNG government officials, and a review of files held by the National Archives of Australia, the Australian War Memorial and the Defence National Unexploded Ordnance Office. G-tek also reviewed historical aerial photographs and local council and historical society records.

The assessment recorded the following observations of relevance to the study areas:

- Allied forces utilised the Watut Valley to the west of the Mine Study Area during the air advances to capture the Nadzab Airfield and Lae in 1943. There are potential WWII aircraft crash sites to the south of the existing Wafi Exploration Camp.
- Fighting between Japanese and Allied forces occurred east of Nadzab during the Allied advance from Nadzab to Lae. There is no evidence to indicate activities occurred in proximity to the Central Section of the proposed concentrate pipeline alignment.

Gap EOD (2017) – Eastern Study Area

The assessment was conducted using an UltraTEM II multi-component, multi-sensor mobile system that allows for ultra-high definition digital mapping. The system can detect deep buried ordnance items in a wide variety of geological conditions, provides accurate estimates of object position and depth, and produces auditable digital recording of all data. The system was configured with a 2x2 m transmit loop and 4 three-component receivers with a spacing of 0.5 m. The unit was positioned using a Trimble R10 GPS system with UHF base station corrections obtained from a second Trimble R10.

Metallic items were detected within or near many of the areas surveyed, however in most cases, the metallic items were identified as scrap. In the case of larger metallic items, certainty as to whether the items detected are unexploded ordnance or scrap metal can only be obtained through physical inspection; therefore, test pits were relocated to areas identified as clear of anomalies. Inspections for sonic borehole #3 and test pits #56, #65, #66 and #69 identified metallic items with the potential to be unexploded ordnance. Of these, GapEOD considered the items detected at sonic borehole #3 most likely to be unexploded ordnance.

The WGJV’s agreed protocol with the PNG Government is to report suspected finds of unexploded ordnance to the Morobe Provincial Disaster and Emergency Services Office, who in turn will liaise with the PNG Defence Force to undertake further investigations and clearance activities. On 3 July 2017, WGJV provided this notification to the Disaster Office in relation to the finds at sonic borehole #3.

4.2 Cultural Groups

The Wafi-Golpu Project study areas are primarily occupied by five cultural groups:

- Babuaf: a pottery-producing group who speak a Middle Watut language belonging to the Watut group of the Markham Family of the Huon Gulf language chain (Mine Study Area and Infrastructure Corridor South and Central study areas).
- Hengambu and Yanta: separate Mumeng-speaking groups within the South Huon Gulf language chain whose collective origins potentially lie to the south-east of the Mike Area (Mine Study Area).
- Wampar: one of three language subgroups in the Lower Markham language group belonging to the Markham family of the Huon Gulf language group (Infrastructure Corridor Central and Eastern study areas)).
- Ahi: comprising Aribwaungg-speaking communities and Bukawa-speaking communities in the vicinity of Lae township:
 - ♦ Aribwaungg (also known as Aliwang): one of five languages in the Busu subgroup of the Lower Markham language group belonging to the Markham family of the Huon Gulf language group (Infrastructure Corridor Eastern Study Area).
 - ♦ Bukawa (or Kawac): a North Huon Gulf language distinct from the languages spoken in the Markham River Valley (Infrastructure Corridor Eastern Study Area).

The following section briefly describes the language affiliations, ethnography and ethnohistory of these five cultural groups.

4.2.1 Hengambu and Yanta

The following section explores the historically complex and rich cultural and linguistic relationships that exist between the Hengambu and Yanta cultural groups, and between the Hengambu and other closely related groups that collectively differentiate them from the Yanta.

Local people identifying as members of the Hengambu cultural group currently reside within four main villages – Gingen, Bavaga, Fly Camp (Levilevon) and Hekeng – located to the north and east of the Mine Study Area.

Local people identifying as members of the Yanta cultural group currently reside within six main villages – Venembele, Nambonga, Pekumbe, Pokwaluma, Zilani and Pokwana – located to the south and south-east of the mine study area.

The Hengambu and Yanta speak slightly different versions of a single dialect (Gorakor) of the Mumeng language, with over 95% of shared cognates (Adams and Lauck 1985; Ballard and Kanasa 1993). They share this language with three nearby communities identified as the Towangola, Omalai and Bupu (which along with the Hengambu are collectively referred to as the Hahiv), as well as the Gurakor and Timini communities located on the Lae-Bulolo Highway. According to Ballard (1992), *hahiv* translates loosely as ‘we of the *kunai*

grasslands (*ha = kunai, hiv = we*), referring to the ancestral homeland of the Hahiv in the grasslands around Mumeng (Ballard 1992: 5).

As Mumeng-speakers, Hengambu and Yanta are more closely related to Buang-speakers of the Snake River valley, approximately 30km south-east of the Mine Study Area, than they are to their immediate Babuaf neighbours living on the Watut River floodplain.

Apart from social mapping work carried out by Chris Ballard in the early 1990s (Ballard 1992; Ballard and Kanasa 1993), very little information is available regarding the ethnography and ethno-history of the Hengambu and Yanta. What is known demonstrates that, prior to European contact, Hengambu and Yanta settlements consisted of large, heavily fortified villages situated on defensive ridges. The selection of these locations was the result of almost constant warfare; other factors such as access to water or level land for gardening were apparently secondary considerations. At times of peace, however, people dispersed to hunting camps at lower altitudes where they would spend periods of up to several months hunting, trapping and harvesting local fruit and nut resources. These hunting camps also served as fixed bases from which male hunters would journey for periods of up to several weeks on wider foraging trips. People only returned to their fortified villages when fighting resumed (Ballard and Kanasa 1993: 12).

Ballard noted that the Hengambu and Yanta settlement pattern he observed is most likely the product of interaction with colonial authorities, missionaries and, more recently, mining projects (Ballard and Kanasa 1993: 12). This view is reinforced by a recent socioeconomic household survey conducted within the Project area (Coffey Environments 2012), which noted that many of the local communities were established within the past 30 years. Primary reasons identified for the movement of villages to localities within the mine study area were access to education and health facilities, access to better land and roads, employment opportunities, family and clan connections and marriage.

Formal gardens are maintained within the immediate vicinity of villages and hamlets, with individual households maintaining between three and five gardens as the primary source of food (Coffey Environments 2012). In the past, gardens were restricted to the vicinity of the main defensive villages at higher altitudes. Forests in the lower altitudes were deliberately kept free of gardens and settlements to encourage the proliferation of game (Ballard and Kanasa 1993: 13). Major garden crops grown in the area today include banana, sweet potato and taro (Coffey Environments 2012). The most important food crop across the region is currently sweet potato (*Ipomoea batatas*), but it is likely that yam (*Dioscorea spp.*) was traditionally of greater economic and ritual importance (Ballard and Kanasa 1993: 14).

Domesticated animals include pigs, dogs, and chickens (Coffey Environments 2013), although the latter were introduced by missionaries in the 1920s (Ballard and Kanasa 1993). Hunting still plays a significant role in the local economy, with wild pigs, cuscus, cassowary, tree kangaroos, wallaby, wild fowl, echidna, bandicoot, lizards, bats and rats all hunted on a regular basis and comprising an important source of meat protein (Coffey Environments 2013). Dietary aquatic species include a variety of fish, eels and prawns (Coffey Environments 2013).

According to Ballard, the Yanta structure themselves across three clans called Mapelu, Ngevima and Vunu, while the Hengambu structure themselves across three clans called Heambe, Vemago and Mapelu (Ballard and Kanasa 1993). Recent investigations by Coffey Environments (2013) identifies six Yanta clans and six Hengambu clans (Table 5).

Table 5: Hengambu and Yanta clans, by village (source: Coffey Environments 2013)

| Cultural Group | Clan Name | Villages where present |
|----------------|-----------|------------------------|
| Hengambu | Elmun | Gingen, Bavaga, Hekeng |
| | Demago | Gingen, Bavaga, Hekeng |
| | Heambi | Gingen |

| Cultural Group | Clan Name | Villages where present |
|----------------|-----------|--|
| Hengambu | Guago | Gingen, Bavaga, Fly Camp, Hekeng |
| | Gabor | Bavaga |
| Yanta | Wan’o | Fly Camp |
| | Vunu | Venembele, Nambonga, Pekumbe, Pokwaluma, Zilani, Pokwana |
| | Ngevima | Venembele, Pekumbe, Pokwaluma, Zilani, Pokwana |
| | Mapulu | Venembele, Pekumbe, Pokwaluma, Zilani, Pokwana |
| | Buno | Nambonga |
| | Ngwevinga | Pokwaluma |
| | Buke | Zilani |

The fact that Buno, Ngwevinga and Buke clans are each present in only a single Yanta village suggests that they were only recently established as separate lineages. The presence of only two clans in Nambonga (Vunu and Buno) indicates that this Yanta village was also recently established, which is in accord with the results of the 2012 socioeconomic survey which noted that Nambonga was established within the last 10 years (Coffey Environments 2016).

The situation regarding the identified Hengambu clans is less clear. Only one of the clans named by Ballard (Heambe) was identified during by Coffey Environments Australia (2013), and then only within a single village (Gingen). This suggests the possibility that the other two Hengambu clans identified previously by Ballard (Vemago and Mapelu) were either misidentified, or (more likely) have undergone a series of fissions to create the five new clans identified by Coffey Environments Australia (2013).

Ballard and Kanasa (1993: 17) note that clans are not neatly distributed in residential settlements, with one or more clans resident in one settlement only (an observation again borne out by the 2012 socioeconomic survey). They also note that Mapelu is separately identified as a clan in both Hengambu and Yanta kinship structures – this is possibly a legacy of a recent common origin, which is also suggested by the fact that both groups speak the same Mumeng language dialect (Gurakor).

Three cultural groups neighbouring the Hengambu (Towangola, Bupu and Omalai) also speak the Gurakor dialect. According to Ballard (1992), the four groups should be collectively treated as a cultural entity known as the Hahiv; based on comments made to the authors by members of these same four groups during community interviews, they continue to assert their membership of this cultural entity. Hengambu, Towangola, Bupu and Omalai were four major villages used as census points by the colonial administration. The Hahiv originally comprised a limited number of clans which were distributed across these four ‘census villages’. As an example, members of the Ngevevungu (described as an Omalai clan by Ballard (1992: 9)) are found in what were originally called Hengambu, Omalai and Bupu villages.

In 1992, the Hahiv were distributed across the following villages (Ballard 1992):

- Hengambu – Hekeng, Bavaga, Gingen and Fly Camp
- Towangola – Dengea, Lapu and Luani
- Omalai – Zimake and Omalai
- Bupu – Munyu, Waratong and Bikgu

Yanta and Hengambu oral histories describe a series of origin and migration stories for various clans (Ballard and Kanasa 1993). According to these stories, both groups originated from settlements in the Mumeng valley (Nguandeno in the case of Hengambu and the other Hahiv clans, Nuwalange or Ngualango in the case of the Yanta). They then moved into the headwaters of the Wafi, Supgo and Waime river catchments south-east of

the central Project area, from which they dispersed to numerous locations over time, with various clans establishing and then abandoning village settlements at regular intervals.

Ballard suggests that this initial migration from the Mumeng valley could have occurred over 200 years ago, while the later dispersals across the region may have happened as recently as the 1910s or 1920s, only just preceding European contact (Ballard and Kanasa 1993: 24, 28, Figures 8 and 9). The location of Yanta and Hengambu ancestral villages in the Mumeng valley accords well with the linguistic evidence, which suggests a recent common origin for all Mumeng-speakers.

2.2.2 Babuaf

Local people identifying as members of the Babuaf cultural group currently reside within six main villages – Madzim, Wori, Wongkins, Kapunung, Ziriruk and Papas – located to the west of the Mine Study Area on the eastern Watut River floodplain.

The Babuaf speak an Austronesian language that has been labelled by Holzkecht (1989) as Middle Watut (sometimes also referred to as Central Watut). Villages speaking this language were identified by Holzkecht (1989) as including Babwaf [sic]/Madzim (eastern Watut River floodplain), and Mararena and Bencheng (Tsile Tsile) (western Watut River floodplain). Together with North Watut and South Watut, Holzkecht collectively classifies the Watut languages as a separate language sub-group within the Markham family of the Huon Gulf group.

Very little ethnographic research has been conducted on the Babuaf (Muke et al. 2007). Published work of possible relevance is likely to be that undertaken on South Watut-speakers, including German anthropologist Hans Fischer’s work in the 1950s (Fischer 1962, 1963, 1968, 1969), and a one week visit in 1990 by a Summer Institute of Linguistics team (Landweer and Reitmaier 1990).

A socioeconomic survey undertaken in 2012 (Coffey Environments 2013) identified two primary Babuaf clans (Table 6).

Table 6: Babuaf clans, by village (source: Coffey Environments 2013)

| Cultural Group | Clan Name | Villages where present |
|----------------|-----------|----------------------------------|
| Babuaf | Wafes | Madzim, Wori, Wongkins, Kapunung |
| | Lerom | Madzim, Wori, Wongkins, Kapunung |

The community at Ziriruk was established after severe floods in 2012, predominantly by people from Wori.

According to Tovue (1989), the Babuaf claim that their ancestors originally lived just below Wafi Exploration Camp on Mount Golpu, and later moved to several locations on the eastern floodplain of the Watut River and the western foothills of the Watut Range. They then crossed the river to live at Efafan Creek further upstream on the Watut River. Muke et al (2007: 40) recorded a Babuaf migration story that accords to some extent with that reported by Tovue (1989), but which also includes details of relevance to portions of the Mine Study Area:

The oral history of the Babwaf [sic] starts at Songkok Wajum. This is located on the upper reaches of the ridge that begins at Mt Golpu, along a range called Aluma. It is somewhere along the ridge to the north of Miadenge...

From Songkok Wajum the Babwaf moved and settled at Linsesibal, the place that is now known to the Hengambu and on the maps as Bavaga. From there they moved to Babul...From Babul they came to the southwest and settled at Fere, [a] vast tract of grassland...From Fere they moved down to Muguso...From Muguso they moved to Mari...At Mari, the Wafis [sic] and Lerom clan fought over a dispute that was started by women over garden boundaries.

The Wafis migrated to the top of the ridge at Buasas'ono, the first high peak on the ridge above the confluence of the Wafi and Watut rivers. The Wafis broke into two groups whilst living there; one migrated to Madzim, the location of the present day Babwaf. The other group migrated to Warengarang and from there they shifted to Zugwangzenk. From Zugwangzenk they moved downhill to the banks of the Wagon Creek. The first missionaries arrived and moved them to Babwaf. From Babwaf, they moved to the present day Wongkins and Kapungung villages.

The Lerom clan moved to Morebarokwarok and then moved to Moajof (washed away by the Watut River). From Moajof, they moved onto Namemenpan and then onto Wamo. From Wamo they separated into three groups and settled in three different settlements: Jimum Wagon, Lago Mafadaram and Ngausung. Then they congregated at Lerom village. The first missionary came while they were living at that village (pers. comm. Yudah Utin 2007).

Muke et al. (2007) note that the Babuaf were probably distributed across a much wider area than the four villages in which they are located today, and that the impacts of Lutheran missionaries in the 1920s and 1930s, who encouraged them to congregate into fewer, larger settlements, has contributed significantly to their present geographic distribution.

Babuaf communities are one of only a few cultural groups within Morobe Province reported to have been pottery producers (Muke et al. 2007). Clay pots were progressively replaced by metal pots during the second half of the 20th century and there are very few Watut pottery makers left today. Although pottery manufacture has been in decline for two-three generations, Watut pottery remains a fundamental part of Babuaf cultural identity. The pieces of pottery left behind by ancestors are decorated in ways recognised by Babuaf village elders today and although these decorative traditions likely date to only the past six or seven generations (Oram 1977: 75), their historical roots are much older (see Tcschopik 1950). Regardless of their antiquity, pieces of pottery found at oral tradition and archaeological sites connect present-day Babuaf communities in the Watut River Valley with their ancestral past.

This observation is of some importance owing to the relative durability of ceramic sherds compared to the wide range of organic materials commonly used in the production of many economic utensils, which decay at a much faster rate. The presence of sherds in archaeological sites can therefore act as a cultural marker of the prior occupation of a site by specific pottery-producing cultural groups, who can be identified based on differences in raw materials, production technologies, and design. The simple presence or absence of pottery within a site may be sufficient to identify prior occupation by a pottery-producing group, as opposed to occupation by a cultural group with no evidence of producing pottery.

Ballard and Kanasa note (1993: 11), however, that intact pots and sherd fragments are found throughout the Watut, Wampit and Snake River Valleys, even though, historically, there have only been a limited number of pottery-making villages within the region. They concluded that any pottery found at current and abandoned village sites in areas occupied by the Hengambu and the Yanta are likely to have been traded in from three centres of production: the Azera area near Kaiapit in the Upper Markham River Valley, the Salamaua area on the coast south of Lae, and the Wawos villages of the Middle Watut. They based this observation on statements by Yanta and Hengambu informants that they never made pots, and that they used bamboo for cooking until they crossed over the range in to the Wafi watershed and began to trade with pot-producing communities.

Pottery from the three centres of production identified by Ballard and Kanasa (1993) is mostly distinguished based on shape (May and Tuckson 1982: 134-151):

- Azera pots are small, with flatter bottoms and a flattened, flared or 'everted' rim (Plate 5).
- Salamaua pots are usually larger with a pointed base and slight inward curve of the body as it nears the rim (Plate 6). The most common form of decoration consists of applied 'nubbins' in a line around the rim.
- Watut pottery can be divided into two main types:

- Pottery from Lower Watut Villages (including Madzim, a Babuaf village), which are very similar to Azera wares although the pots are shallower, more spherical and the bases are usually rounder. The neck area is less deep, and the everted lip is set off as a distinctive part of the vessel. Decoration consists of scalloped or toothed indentations on the lip and simple rows of parallel lines or herringbone motif on the neck area.
- Pottery from Middle Watut villages which is deep with a sharply pointed base and ellipsoid body with a sharply defined shoulder and a restricted neck which flares outward with a direct rim (Plate 7).

According to Ballard, the Hengambu could not have had access to Middle Watut pots prior to European contact because all possible trading routes were blocked by the Yanta (Ballard and Kanasa 1993: 11-12). The Yanta, on the other hand, apparently traded dog and cuscus teeth, *bilums* and woven bracelets in return for Wawos pots further to the south.

The fact that Babuaf communities are traditional pot-makers is supported by interviews with Babuaf community leaders and the recorded manufacture and decoration of clay pots by a Kapunung Village resident in 2007 (Muke et al. 2007: 42) and 2015. The two pots manufactured in 2007 and 2015 are illustrated in Plate 8 and Plate 9, and a clay pot manufactured locally by an unnamed Babuaf potter is illustrated in Plate 10.



Plate 5: An example of Azera pottery (from Ballard and Kanasa 1993: Figure 4)



Plate 6: An example of Salamaua pottery (from Ballard and Kanasa 1993: Figure 5)



Plate 7: An example of Middle Watut pottery (from Ballard and Kanasa 1993: Figure 6)



Plate 8: Clay pot manufactured by Babuaf potter from Kapunung Village, 2007 (from Muke et al. 2007: Plate 5)



Plate 9: Clay pot manufactured by Babuaf potter from Kapunung Village, 2015 (Rob Skelly, 3 July 2015)



Plate 10: Clay pot manufactured by unknown Babuaf potter, in use during a community celebration (Rob Skelly, 3 July 2015)

4.2.3 Wampar

The Wampar inhabit the alluvial plains of the lower Markham River Valley, mostly along the southern floodplain of the Markham River. There are at least ten major villages including Zifasing, Chiatz, Mare, Wampit, Gabensis, Tararan, Gabsongkeg, Ganef, Nasuapum, Mararumi and Munum. Wampar communities are also situated at Kokok, Ngarubaring and Mafanazo villages. According to their origin stories, the Wampar previously occupied the hilly Watut country to the south, including the area around Mount Golpu (Fischer 1976; Sack 1976; see also Holzkecht 1974).

The Wampar were referred to for many years as Laewomba or Lahewomba (Sack 1976). However, Holzkecht (1989: 35) notes that name Wampar is now widely accepted – the people call themselves Ngaing Wampar ‘Wampar people’ and call their language *Dzob Wampar* ‘Wampar talk’.

Wampar is identified by Holzkecht (1989) as a member of the Lower Markham language sub-group, part of the Markham family of the Huon Gulf group. According to the people of Chiatz and Mare villages, they, along with the people of Wampit, speak a different dialect to the Wampar people living north of the Markham River (Hitchcock 2012). Further, they identify as a distinct sub-group of the Wampar, the Wampar Saab, in contrast to the remaining members of their language group which they refer to as Wampar Fofon (Hitchcock 2012). This is at odds with Holzkecht’s comment that there is only one variety of Wampar, and that it is spoken without dialectical variation (Holzkecht 1989: 36).⁵

Every Wampar person belongs to a clan and a patrilineal lineage; the latter is the main landholding group (Hitchcock 2012). Members of the same clan can be found in different Wampar villages, but these would likely be people of genealogically unrelated patrilineages. The clan names refer to various plants and animals, and other plants and animals are said to belong to a clan, or to be associated with it in a special way.

⁵ Holzkecht’s observation is a further example of the study area’s cultural and linguistic complexity.

The economy is a mix of subsistence production and simple commodity (cash crop) production (Hitchcock 2012). Many people maintain gardens, in which the staple, bananas (*Musa spp.*), are grown. Secondary crops include sweet potatoes (*Ipomoea batatas*), taro (*Colocasia esculenta*) and coconuts (*Cocos nucifera*). All households raise pigs, and some men hunt game including wild pigs, bandicoots and cuscus. The production of cocoa (*Theobroma cacao*) and betel nut (*Areca catechu*) for sale is the main income earning activity for village people.

Within areas belonging to patrilineages, ancestral spirits have special places known as *rop* (Hitchcock 2012). The pre-contact religion of the Wampar included beliefs (*mamafe*) which were everywhere, although they were thought to concentrate in special places. Spirits were often believed to be the cause of sickness.

Among the Wampar there is an oral tradition called *dzob a mamafe*, comprising many stories which account for the coming into being of aspects of Wampar culture or the environment (Hitchcock 2012). Some of these stories refer to cultural heritage story sites (e.g. story beings that turned into stones). Many stories also refer to place names and a general movement northward down the Watut River to the Markham River Valley, providing some evidence for Wampar migration history.

Oral traditions of the Wampar people indicate that their ancestors originally resided in the area now occupied by South Watut speakers (Holzknecht (1989). According to these traditions, the Wampar succeeded in clearing the Lower Watut and lower Markham River valleys of their original inhabitants, displacing many groups in the process. This movement into the Markham Valley appears, from genealogical evidence, to have taken place no more than 200 years ago and was still in progress at the time of first European contact in the late 1890s and early 1900s.

4.2.4 Ahi

Several communities in and around Lae identify themselves socially, culturally and politically as Ahi. Originally, Ahi was the name given by Bukawa-speaking communities at Kamkumung and Butibam in Lae to Aribwatsa-speaking people who, along with their Aribwaungg-speaking neighbours, fled their homeland areas to the northwest in the Markham River Valley due to incursions by the Wampar (Holzknecht 1989:39-40; pers. comm. 7 December 2017). After peace was established during the German colonial period, the Aribwaungg returned to their home territory, but the Aribwatsa remained in the Lae area and were eventually incorporated into Butibam village and learned to speak Bukawa. According to Holzknecht (1989: 40), the Aribwatsa language is no longer spoken and has effectively been lost.

More recently, several village communities in and around Lae have come together through political, economic and social organisations (Armitage 2002; The National 2010, 2015), and now identify themselves as Ahi. The Ahi include village communities at Butibam, Hengali, Kamkumung, Yanga, Wagang and Yalu. Originally, the languages spoken by the communities at Butibam, Hengali, Kamkumung, Yanga and Wagang was either Bukawa (also known as Kawac) or Yomkawa, which are probably components of a single dialect chain identified by Holzknecht as Bukawa (Holzknecht, pers. comm. 7 December 2017). Bukawa is a North Huon Gulf language distinct from the languages spoken in the Markham River Valley.

Village communities in and around Yalu speak Aribwaungg, one of five languages in the Busu subgroup of the Lower Markham language group belonging to the Markham family of the Huon Gulf language group.

Aribwaungg

Aribwaungg-speaking communities are centred around Yalu, which is situated on a southern flank of the Atzera Mountain Range, 17km northwest of Lae.

The Yalu community is made up of eight small settlements (hamlets) including Ambuturup and Omaru; Yalu is the largest village. Yalu villagers engage in subsistence gardening and grow cocoa (*Theobroma cacao*) and betel nut (*Areca catechu*) as cash crops that are sold in Lae. In 2009, the population in the Yalu area numbered some 2,500-3,000 people identifying as belonging to 13 major clans (Timkam, Konzorong,

Ngalukumbun, Chupeng, Alivis, Ngalumbas, Ngalunuf, Ngalutumb, Ngaluwasuw, Mimin, Siwon, Zam and Waril).

According to Bennet (2009), most Yalu villagers speak Aliwang, although Waing and Kabwum languages as well as others are used in the area. Holzkecht (1989) notes that the people of Yalu refer to themselves as *Aribwaungg*, which means ‘the shield up high’, which was apparently an exhortation to young warriors to hold their fighting shields up to protect themselves from their opponent’s spears. According to Holzkecht, the people refer to their language as *Anan Aribwaungg* ‘Aribwaungg speech’ (Holzkecht 1989: 39).

Oral traditions trace Yalu ancestral origins to a ‘tribe’ called the Ngalunuf who lived in the mountains near the headwaters of the Yalu River. From there the Ngalunuf relocated to Nalung’ulis, located near a Wampar ancestral village called Nasuapum (Sack 1976; Bennet 2009). Based on oral traditions recorded by Lutheran missionaries in the early part of the 20th century, Sack (1976: 88) suggests that an ancestral migration to Yalu was likely just one of a series of migrations from inland locations and that the migratory wave toward Yalu occurred late in the regional migratory sequence. As well as potentially distant inland locations, Yalu ancestral villages known in oral traditions include Olinganalin (No.2) and Kabatsits, which were located ‘on a hillside near Yalu’ (Sack 1976: 99).

Lutheran missionaries began documenting oral traditions in the Huon Gulf area after establishing missions in coastal locations in the early part of the 20th century. While missionary accounts can be fraught with factual uncertainty and contain sensationalised stories, Sack (1976) notes there is ample evidence contained in the oral traditions recorded by missionaries to suggest that inter-tribal warfare escalated in the decades immediately prior to the colonial period. This warfare likely caused significant declines in population numbers in the Markham River Valley, Atzera Mountains and on the Lae coast. The principal protagonists were the Wampar people from the Markham River Valley who regularly raided villages, massacring populations and causing survivors to seek refuge elsewhere (Stürzenhofecker 1912: 29 cited in Sack 1976: 75). Wampar raiding in the Watut River Valley caused groups to relocate to the Yalu area and attacks at Kabatsits (near Yalu) forced several groups including the Aribwaungg to move on to the Lae coast. The Aribwaungg were not always welcomed in the Lae area (although Holzkecht (1989: 39) notes that they were welcomed by Bukawa-speaking relatives in Kamkumung and other coastal villagers) and moved back and forth between the coast and their traditional homelands until the raiding ceased (Sack 1976: 37).

Oral history accounts indicate a major flood in the Markham River Valley around the middle of the 19th century. The flood destroyed villages and gardens causing a famine and village relocations to higher ground (Hogbin 1951). In addition, diseases introduced by Europeans decimated local populations and many villages were permanently abandoned during the second half of the 19th century (Stürzenhofecker 1929: 13 cited in Sack 1976: 79). This suggests that regional populations were larger prior to the missionary period and that there are likely many short-term ancestral village sites located in the Atzera Mountains and foothills.

Bukawa (Kawac)

Bukawa-speaking communities are identified as those communities which traditionally spoke Bukawa (also known as Kawac or Bugawac) prior to missionary influences in the late 19th century and the introduction of Yabem, a closely related language which was used by the missionaries as a lingua franca (Eckermann 2007: 1).

The main Bukawa community identifying traditional lands within the Project Area is located at Wagang Village on the outskirts of Lae on the Huon Gulf coast, approximately 6km east of the Markham River and 3km west of the Busu River.

Oral traditions indicate that present-day Wagang Village was established in the early 1900s (Muke and Skelly 2017). It was only after the arrival of missionaries that the three major Wagang clans (Wagangbu, Ambessi and Mabalum) came together in a single village. The first Wagang village (Wagang 1) was founded by ‘Wakang’ (also known as Wagang) around 500 years ago and was situated to the northeast of the present-day village (Sack 1976: 102). During WWII, Wagang 1 (today the site of Alanghu Village) was abandoned

when people sought refuge west of the Busu River. After WWII, villagers moved back to Wagang 1 and relocated to present-day Wagang around 1950. The community apparently moved nearer to the coast to maintain better access to coastal resources.

Wagang oral traditions recall Aribwaung people making incursions on to Wagang land to escape raids by the Wampar. It was only after the attacks ceased during the missionary period that they could return permanently to their traditional lands in the Atzera Mountains.

4.3 Cultural Heritage Site Types

Cultural heritage is often considered in terms of the tangible and intangible ways that people create, express and preserve their heritage. As would be expected, tangible and intangible heritage varies from culture to culture. For the purposes of the present assessment, tangible and intangible are defined as follows:

- Tangible heritage includes moveable or immovable objects, property, sites, structures or groups of structures, which have archaeological, paleontological, historical, cultural, artistic values, or religious values.
- Tangible heritage also includes unique natural features or tangible objects that embody cultural values, such as lakes, ponds, outcrops, rocks and waterfalls.
- Intangible forms of culture heritage include (but are not limited to) knowledge, innovations, religious ceremonies, values, beliefs, and the continuing practice of traditional lifestyles.

Previous studies investigating the potential for extractive industry projects to impact on cultural heritage in PNG typically distinguish between two classes of tangible cultural heritage: oral tradition sites and archaeological sites.

4.3.1 Oral Tradition Sites

Oral tradition sites are places of intrinsic contemporary cultural significance or are associated with specific forms of contemporary cultural knowledge (this aspect being tangible). They are identified primarily on the basis that people alive today possess knowledge of these places (including their location, the stories behind them and the reasons why they are of cultural importance), and that the places exist as physical entities in the landscape.

While some of these places may contain physical (i.e. tangible) evidence of the human behaviours that relate to them, it is not an essential requirement for the place to be identified as a cultural heritage site – the fact that people have an extant oral tradition that identifies the place as being associated with a cultural activity or belief (i.e. intangible heritage) is sufficient. In PNG, these may include (but are not limited to) the following:

- Places associated with ceremonial or ritual activities.
- Places where spirits dwell, both ancestral (*tumbuna*) and spirit (*masalai*).
- Hunting camps, former settlements and clan origin places.
- Burials and cemeteries.
- Sites associated with warfare.
- Places where people lived or undertook important social or economic activities.

Research into the cultural heritage and social structures of the groups situated in the study areas has identified a rich cultural repertoire of oral tradition sites including isolated burials and larger cemeteries, campsites and former villages, story sites related to origin stories and magic places and *masalai* (supernatural beings that inhabit specific places and usually distinguished by a particular natural feature).

4.3.2 Archaeological Sites

An archaeological site is a place (or group of physical sites) in which evidence of prehistoric, historic or contemporary human activity is preserved, and which has been, or may be, investigated using the discipline of archaeology. Archaeological sites may range from those with few or no remains visible above ground, to buildings and other structures still in use. In PNG, many archaeological sites typically include a range of manufactured materials such as pottery and stone or wooden artefacts, or evidence for human intervention in the landscape (e.g. fortifications, drainage ditches or mounded gardens). Archaeological site types in PNG include (but are not limited to):

- Artefact scatters.
- Occupation sites, including open settlement sites and caves or rock shelters.
- Economic sites, including stone quarries, clay source, former gardens and sago processing sites.
- Ossuary sites and marked graves and cemeteries.

Some archaeological sites still have significance for local people. For example, a rockshelter or cave used as an ossuary usually has continuing cultural significance to members of the clans which used them, or in rare cases continue to visit them. Simultaneously, these sites are of archaeological interest in terms of understanding traditional mortuary practices, as well as contemporary conceptions of those places and practices.

In other instances, ancient archaeological sites may be encountered that have no contemporary cultural significance for local people, i.e. a cave or open site that bears evidence of past human occupation, but which has no associated contemporary oral tradition. Following discovery, the site may acquire a new cultural significance to local communities because it now needs a place within their worldview (Hitchcock 2012). For example, a site with evidence of thousands of years of human occupation may become a source of pride for local people.

4.3.3 Wafi-Golpu Project Site Types and Categories

For the purposes of the present study, the terms ‘cultural heritage’ and ‘cultural heritage sites’ are used to collectively refer to both oral tradition sites and archaeological sites. However, the criteria outlined above differentiating these two site classes should be borne in mind regarding the following review of previous studies, and the methodologies used to investigate these site classes.

A distinction between archaeological and oral tradition sites is recognised in all previous studies undertaken for the Wafi-Golpu Project. However, whereas one study simply identifies ‘sacred’ sites, another differentiates five site types that might all conceivably be included under the general heading of ‘sacred’, i.e. spirit, story, origin, skull house and spirits of the dead. Similarly, one study includes all archaeological sites within a single ‘archaeological’ site type, whereas another differentiates between three archaeological site subcategories (caves and rockshelters, transit camps, and material culture sites). This variation in site typology is largely the result of methodological refinements that progressively came into effect over the five years of the cultural heritage program.

The following typology has been used in this report to encapsulate and define the variety of cultural heritage site types identified across the Project areas during the earlier studies described in Section 4.5 below. It effectively standardises the typologies used in these studies, enabling all cultural heritage sites to be included in the baseline assessment.

Oral Tradition Sites

- *Burial*: an inhumation or ossuary containing the remains of a single named individual.
- *Camp*: the identified location of a known hunting camp or transit camp site.
- *Cemetery*: inhumations or ossuaries containing the remains of two or more named individuals.
- *Former Village*: the identified location of a named former or ancestral village.

- *Mission*: the identified location of a structure or place associated with Christian mission activities during the historic period.
- *Rockshelter*: a cave or rockshelter identified in local oral history as being of cultural significance.
- *Story*: any place associated with a known story derived from local oral tradition.
- *Subsistence/Trade*: a place acknowledged as significant for subsistence or trade activities (e.g. sourcing clay for the production of pots).

Archaeological Sites

- *Archaeological*: any place (or group of physical sites) in which evidence of prehistoric, historic or contemporary human activity is preserved, and which has been, or may be, investigated using the discipline of archaeology; no distinction is made between site types (although the specific nature of each site is elaborated in individual site descriptions).

Historical and WWII Sites

The potential for historical cultural heritage sites relating to the colonial period to be located within the study areas was considered during the preparation of the baseline assessment presented in the present study. Historical site types were categorised as either:

- *WWII*: any place or object associated with Japanese or Allied military actions which preserves at least some physical remnant of that action.
- *Exploration/Mining*: a place or object that preserves physical evidence in the form of equipment, structures or excavations relating to the history of exploration and mining in Papua New Guinea.
- *Historical*: any other place or object associated with the early period of Papua New Guinea's colonial history.

4.4 NMAG National Site File

One of the statutory functions of the PNG National Museum and Art Gallery (NMAG) is to maintain a catalogue known as the National Site File (NSF), which lists all cultural heritage sites recorded across PNG and then registered by the NMAG.

The NSF was initially reviewed by Hitchcock as part of his research for a proposed Project facility at Markham Gap (Hitchcock 2012), to determine if any registered cultural heritage sites were located within the general vicinity of the Project. At that time the NSF listed 13 cultural heritage sites on the Wasus and Nadzab 1: 100,000 topographic map sheets, which cover all components of the current Project layout. The closest cultural heritage site was KHR, an artefact assemblage recorded in 1980 comprising six ceramic sherds at a location situated west of the Watut River, 4.4km northwest of the wastewater discharge/raw water make-up pipeline study area.

Many of the cultural heritage sites recorded by Muke et al. (2007) during fieldwork for the Wafi-Golpu Project in 2006 and 2007 (see Section 2.4.1.2 below for further details) were subsequently added to the NSF in 2014-15 by staff at the NMAG, and their details (including NSF site codes) forwarded to the authors. Unfortunately, an application by the authors to the NMAG in October 2015 and again in December 2015 for a more comprehensive review of the NSF did not receive approval from the NMAG at that time and therefore could not be incorporated into this study.

Table 7 lists 52 cultural heritage sites registered on the NSF's Wasus and Nadzab 1: 100,000 topographic map sheets in 2015. This list includes some, but not all, of the cultural heritage sites recorded by Muke et al. (2007). These latter sites are cross-referenced against their original field codes, as well as Wafi-Golpu Project cultural heritage site codes which were generated specifically for the present study.

Table 7: NSF-registered cultural heritage sites (Wasus and Nadzab 1:100,000 map sheets)

| NSF Code | Field Code | Wafi-Golpu Project Site No. | Site Name | Site Description |
|----------|------------|-----------------------------|----------------------------------|--------------------------|
| KEY | | | | NMAG artefact collection |
| KFJ | | | Gitua | NMAG artefact collection |
| KHR | | | | NMAG artefact collection |
| KAB | | | Paveling'gne | Cemetery |
| KAE | | | Mamangage | Cemetery |
| KAG | | | | Cemetery |
| KHF | | | | NMAG artefact collection |
| KHT | | | | NMAG artefact collection |
| KIE | | | Burantem | NMAG artefact collection |
| KMH | | | | Cemetery |
| KNA | | | Bugik | Cemetery |
| KDB | H001 | WG033 | Hengambu | Former Village |
| KDC | H002 | WG034 | Miadenge | Former Village |
| KDD | H003 | WG035 | Hekeng | Cemetery |
| KDE | H004 | WG036 | Kasona (Bavaga) River camp site | Campsite |
| KDF | H005 | WG037 | Relingu Creek camp site | Campsite |
| KDG | H006 | WG038 | Piluma | Cemetery |
| KDH | Y001 | WG054 | Pekumbe # 1 | Former Village |
| KDI | Y002 | WG055 | Pekumbe # 2 | Former Village |
| KDJ | Y003 | | Demange | Story |
| KDK | B001 | WG001 | Babul | Campsite |
| KDL | B002 | WG002 | Babul | Archaeological |
| KDM | B003 | WG003 | Fere 'raun wara' | Story |
| KDN | B004 | WG004 | Bengipangnapong | Campsite |
| KDO | B005 | WG005 | Babul Creek | Story |
| KDP | B006 | WG006 | Singnono | Former Village |
| KDQ | B007 | WG007 | Kapungung | Cemetery |
| KDR | B008 | WG008 | Wames | Archaeological |
| KDS | B009 | WG009 | Linse | Former Village |
| KDT | B010 | WG010 | Babul Mt | Former Village |
| KDV | B011 | WG011 | Jililuk | Subsistence/Trade |
| KDW | B012 | WG012 | Jililuk (Hot spring) | Story |
| KDX | B013 | WG013 | Womul | Archaeological |
| KDZ | B014 | WG014 | Muguso (also Banang na marliong) | Archaeological |
| KEA | B015 | WG015 | Muguso (also Banang na marliong) | Archaeological |
| KEB | B016 | WG016 | Madzim | Cemetery |
| KEC | B017 | WG017 | Zetzang Creek | Former Village |
| KEF | B018 | WG018 | Bulis Dobona | Story |
| KEG | B019 | WG019 | Wanak' ono Mt | Former Village |
| KEH | B020 | WG020 | Walongaso | Former Village |
| KEI | B021 | WG021 | Gong'o kangjo | Story |
| KEJ | B022 | WG022 | Mangom | Former Village |

| NSF Code | Field Code | Wafi-Golpu Project Site | | Site Description |
|----------|------------|-------------------------|-------------|------------------|
| | | No. | Site Name | |
| KEK | B023 | WG023 | Old Madzim | Former Village |
| KEL | B024 | WG024 | Yangzakain | Mission |
| KEM | B025 | WG025 | Wantemongok | Former Village |
| KEN | B026 | WG026 | Sibal | Story |
| KEO | B027 | WG027 | Mari | Archaeological |
| KEQ | B028 | WG028 | Mungolung | Former Village |
| KER | B029 | WG029 | Fere A | Archaeological |
| KES | B030 | WG030 | Fere B | Archaeological |
| KET | B031 | WG031 | Fere C | Archaeological |
| KEW | B032 | WG032 | Sel | Archaeological |

4.5 Project Area Cultural Heritage Studies

Prior to a series of cultural heritage investigations undertaken in relation to the Project over the last 20 years, the prehistory of the study areas was relatively unknown. As far as can be determined, no archaeological sites have been dated anywhere in the wider Markham or Watut river regions. However, it is likely that there has been a human presence in the Watut River Valley and adjacent ranges from at least 40,000 BP, given early dates for human colonization on the Huon Peninsula in Morobe Province at around 44,000 BP (Groube et al. 1986; Allen and O’Connell 2003), and in the Eastern Highlands at Kosipe at 44,000-49,000 BP (Summerhayes et al. 2010).

Twelve cultural heritage studies have been completed in support of exploration and development of the Project (Alo 2016; CRA 1996; Green and Muke 2013a and 2013b; Green and Sepe 2013, 2014 and 2017; Hitchcock 2012; Muke et al. 2007; Muke et al. 2015; Muke, Ipang and Mond 2016; Muke and Skelly 2017; Skelly, Muke, Sepe and Green 2017). The results of these studies are presented below.

In some instances, the same cultural heritage site was recorded in more than one assessment. In these instances, the site has been counted only once and attributed to the study providing the most detailed information (including verified locational data).

Social mapping work undertaken by Ballard on the Yanta and the Hengambu (Ballard and Kanasa 1993) also refers to cultural heritage sites (mostly burials and former villages) identified by those communities as being of cultural importance. However, given the absence of precise locational data and the more recent cultural heritage studies involving the Hengambu and the Yanta to identify sites in proximity to proposed Project activities, these sites are not formally reviewed here.

An additional 21 burial, cemetery, former village and story sites recorded by Ballard (1992) for the Towangola, Bupu and Omalai are not presented here as they relate to locations well outside the cultural heritage EIS study areas and will not be impacted by the Project.

To avoid potential confusion arising from the use of multiple site coding systems derived from the NMAG’s National Site File and studies completed by CRA (1996), Muke et al. (2007) and Hitchcock (2012), the individual site catalogues presented in these reports were cross-referenced and then aligned by assigning each site with a unique Wafi Golpu (WG) site number, which is used as the primary site identifier throughout the remainder of the present study. This same WG coding system was applied to all sites identified during fieldwork carried out for the Project between 2012 and 2017.

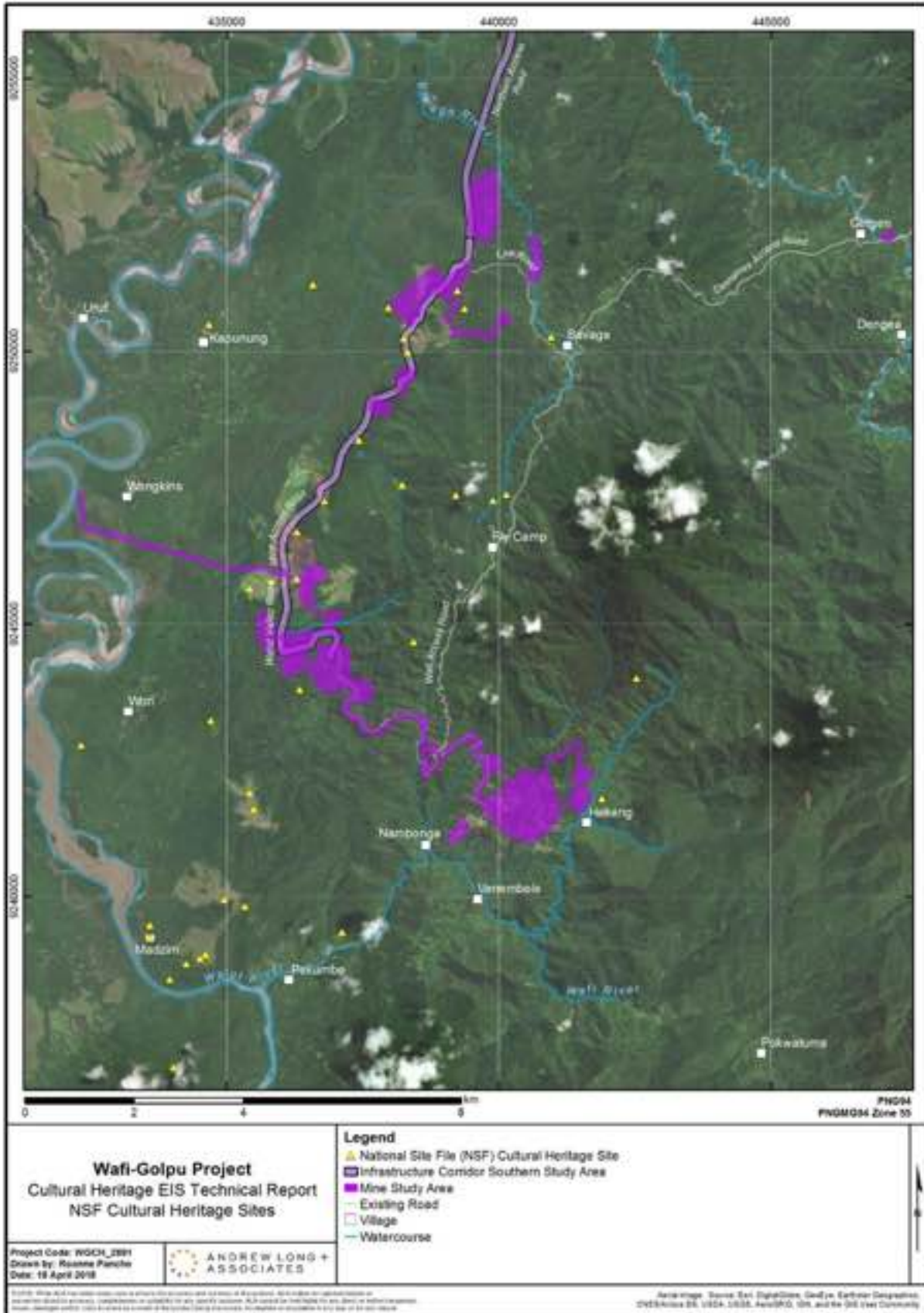


Figure 7: NSF-registered cultural heritage sites in relation to Project EIS study area

The WG cultural heritage site coding system was also employed during the preparation of site catalogues by ALA and SRI during the 2012-2017 field programs reported elsewhere in the present study.

4.5.1 Conzinc Rio Tinto of Australia (CRA) 1996

Prior to WGJV's involvement in the Project, brief descriptions of cultural heritage sites appear to have been derived from fieldwork undertaken on behalf of CRA by the PNG University of Technology. It has not been possible to locate any further information regarding the background to the survey or the methodologies used to compile the information. For this reason, these site descriptions and accompanying data were considered as unverified for the purposes of the present study.

The 28 cultural heritage sites referenced in the 1996 CRA investigations include 16 story sites, nine burial sites, two cemetery sites and one former village. Twenty of these sites were revisited and rerecorded during later fieldwork by Muke et al. (2007) due to their proximity to the proposed Project development. Information regarding the nature, location and significance of these sites was updated based on this more recent fieldwork.

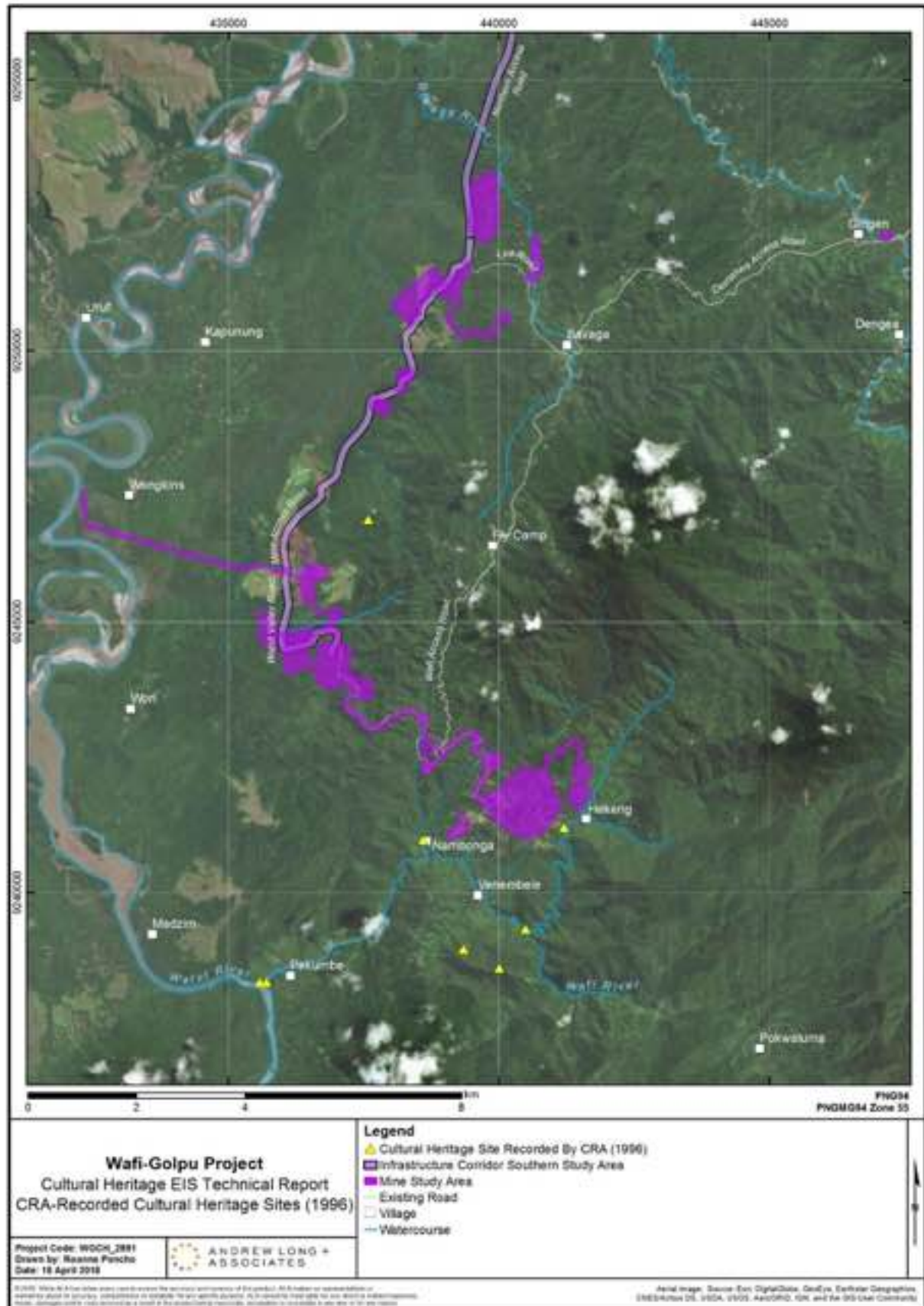


Figure 8: Cultural heritage site locations recorded by CRA (1996)

4.5.2 Muke et al. (2007)

The first formal cultural heritage baseline and impact assessment associated with the Project was completed in 2007 (Muke et al. 2007). Fieldwork methodologies employed during this study included:

- Interviews with Babuaf, Yanta and Hengambu communities to identify known oral tradition sites.
- Field verification and recording of sites identified during community interviews.
- Field verification and recording of the cultural heritage sites relevant to the survey area referenced in Ballard and Kanasa (1993) and CRA (1996).
- Systematic archaeological surveys of key locations that had the potential to be impacted by proposed exploration activities (according to the Project layout at that time).

Accounting for overlap, 64 cultural heritage sites recorded with GPS coordinates have been attributed to Muke et al. (2007). These are mapped in relation to the study areas in Figure 9. Most of the cultural heritage sites recorded by Muke et al. (2007) were oral tradition sites (n=51 or 80%). These include 18 story sites (26.6%), 15 former village sites (23.4%), 9 burial/cemetery sites (14.1%), six campsites (9.3%), one rockshelter (1.6%), one mission site (1.6%) and one subsistence/trade site (1.6%). Archaeological sites (n=13 or 20.3%) comprise only one-fifth of all recorded cultural heritage sites and tend to be limited to ground surface scatters of decorated and undecorated ceramic sherds and flaked stone artefacts (although limited numbers of stone mortars, pestles, grindstones and ground-edge axes were also recorded).

Over half of the cultural heritage sites recorded by Muke et al. (2007) are located on the lower western flanks of the Watut Range and adjoining eastern margin of the Watut River floodplain, in areas currently occupied by the Babuaf. Most of these cultural heritage sites are concentrated within areas of anthropogenic *kunai* grassland and adjoining sago swamp, which Muke et al. (2007: 84) identified as cultural landscapes containing rich evidence for a range of interrelated spiritual, ethnohistorical, settlement and technological behaviours. The remaining cultural heritage sites are located within heavily dissected ranges to the east, and include former villages and campsites situated on elevated ridgelines, and story sites mostly focused on rivers, creeks, springs and lakes.

Individual burials and larger cemetery sites occur in both the eastern ranges and the western foothills and floodplain.

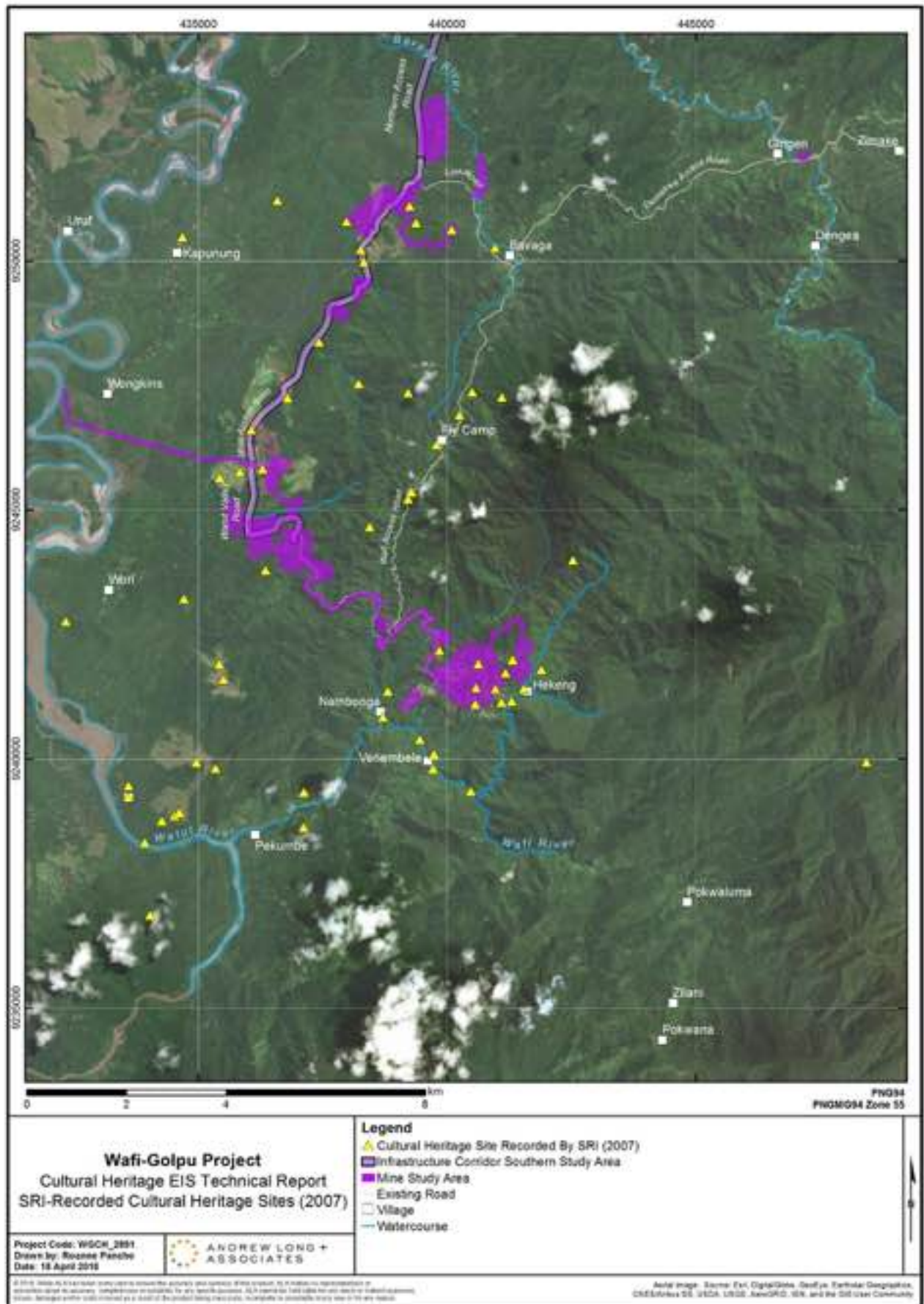


Figure 9: Cultural heritage site locations recorded by Muke et al. (2007)

Many of the cultural heritage sites investigated by Muke et al. (2007) contain a variety of economic or ethnobotanic plant species whose presence was taken as an indication of previous human activity at these locations. These include bamboo, banana, betel nut (*buai*), breadfruit, casuarina, cordylines (*tanget*), croton, fig, *galip* (Tahitian chestnut), *marita* (pandanus) and various forms of *tulip* (*Gnetum nemon* – trees with edible leaves).

Twenty of the 28 cultural heritage sites listed by CRA (1996) were visited and re-recorded by Muke et al (2007). Given the standardised recording methodology used during the 2007 fieldwork by SRI, these 20 sites are now considered to be verified for the purposes of the present study.

Ten of the cultural heritage sites recorded by Muke et al. (2007) are located within the study areas (Table 8).

Table 8: Cultural heritage sites recorded by Muke et al. (2007) located in the study areas

| Site No. | Site Name | Site Type | EIS Cultural Heritage Study Area |
|----------|---|----------------|----------------------------------|
| WG001 | Babul Camp Site | Camp | Infrastructure Corridor (South) |
| WG002 | Babul Archaeological Site | Archaeological | Infrastructure Corridor (South) |
| WG003 | Fere Sacred Site | Story | Infrastructure Corridor (South) |
| WG008 | Wames Archaeological Site | Archaeological | Mt Beamena Quarry |
| WG026 | Sibal Sacred Site | Story | Mt Beamena Quarry |
| WG031 | Fere C Archaeological Site | Archaeological | Mine Access Road at Fere |
| WG040 | Gwavengo/Ngendakghoma II Rockshelter Site | Rockshelter | Maximum Subsidence Zone |
| WG043 | Mea Gova Biangova Sacred Spring Site | Story | Maximum Subsidence Zone |
| WG045 | Beavemo Burial Site | Burial | Maximum Subsidence Zone |
| WG059 | Ngendakghoma I Rockshelter | Camp | Maximum Subsidence Zone |

4.5.3 Hitchcock (2012)

Hitchcock (2012) indicates that Wampar communities identify and claim a range of cultural heritage sites in and near components of the study area. However, Hitchcock’s assessment focused on community interviews and was only occasionally supported by field and helicopter surveys. These sites, which mostly included oral tradition sites (burials, former villages, subsistence/trade sites and story sites), as well as former villages and caves with a potential to preserve surface or sub-surface archaeological deposits, were recorded during an investigation of the Project’s (then) preferred tailings storage facility (TSF) at Markham Gap, south of the Markham River and east of the Watut-Markham river confluence.

One hundred and twenty-one cultural heritage sites were recorded by Hitchcock during community interviews. Of these, five were physically inspected during pedestrian surveys, and a further 18 sites were overflowed by helicopter and their locations recorded using GPS. The locations of these 23 verified cultural heritage sites, which include eight burial sites, 11 story sites, one former village, one cemetery site, one exploration/mining site and one subsistence/trade site, are mapped in relation to the study areas in Figure 10. Twenty-two of the 23 verified cultural heritage sites are situated at least 350m from all Project EIS cultural heritage study area components. WG121 (Magense, a burial site) is situated within the Northern Access Road Borrow Pit study area.

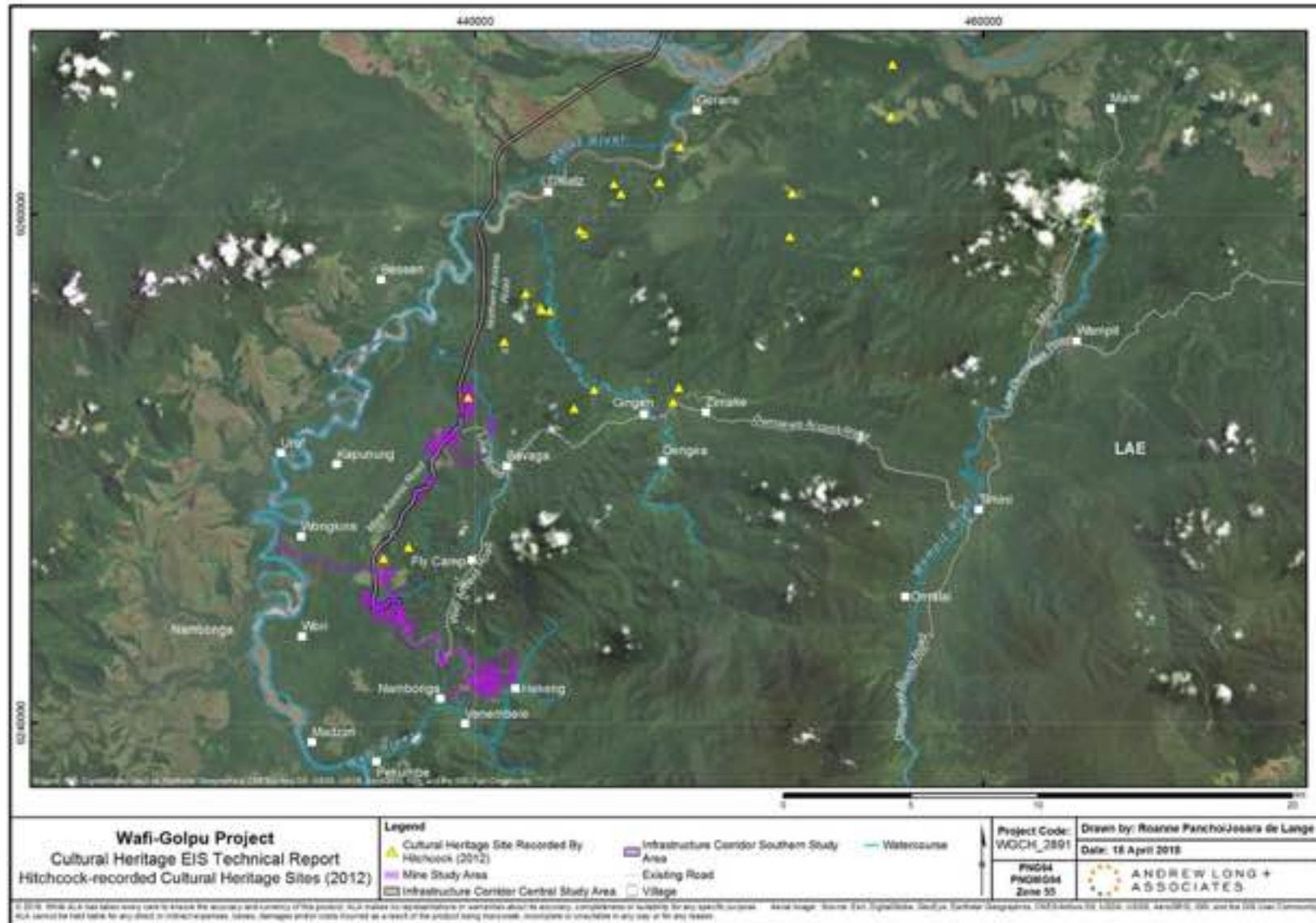


Figure 10: Cultural heritage site locations recorded by Hitchcock (2012) during pedestrian and helicopter surveys

The locations of the remaining 98 sites were either indicated on topographic maps by village representatives during community interviews or had no location data recorded against them. On this basis, these sites have been considered as unverified for the purposes of the present study and are not included in the baseline or impact assessment.

4.5.4 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program

Cultural heritage studies undertaken in support of the Project during 2012-2014 were completed as part of an overarching Project Pre-Feasibility Optimisation Study. This study included:

1. A two-phased Worksite Inspection Program (2012-2013 – Green and Muke 2013a; see also Green, Muke and Skelly 2017a).
2. A three-phased Additional Works Program (2013-2014 – Green and Muke 2013b; Green and Sepe 2013 and 2014; see also Green, Muke and Skelly (2017b) and Green, Sepe and Skelly 2017a and 2017b).

The cultural heritage field survey methodologies incorporated the same principals across both programs:

- Initial community consultation to explain the field program's purpose, objectives and proposed methodology and seek endorsement for the fieldwork to be undertaken.
- Onsite study area inspections and archaeological surveys.
- Onsite community consultation to confirm the presence or absence of oral tradition sites within the study areas.

4.5.4.1 Worksite Inspection Program (2012-2013)

Worksite inspections were undertaken over two stages of fieldwork (Stages 1 and 2) commencing in July 2012 and finishing in March 2013 (Green and Muke 2013a; Green, Muke and Skelly 2017a). The purpose of the Worksite Inspection Program was to:

- Update previously recorded cultural heritage site coordinates as required using GPS and other mapping technologies;
- Assess the condition and state of preservation of previously recorded cultural heritage sites; and
- Identify and map new cultural heritage sites.

The areas assessed during the Worksite Inspection Program are mapped in relation to the cultural heritage study areas in Figure 11.

Stage 1

Four new cultural heritage sites (WG074 Mango Coffee Garden, WG075 Mango (Mazim) Original Cemetery, WG076 Hepiabengu Campsite and WG077 Bavgi 1 Campsite) were recorded and two previously recorded cultural heritage sites (WG022 Mangom Settlement Site and WG023 Madzim Historic Settlement Site) were re-recorded during the Stage 1 field program.

The two former village sites (WG022 and WG023) and two campsites (WG076 and WG077) either had direct evidence of, or the potential to contain, archaeological materials or deposits. The range of archaeological materials identified at WG022 included ceramic sherds and a stone adze. Burnt wooden house posts were identified at WG076.

All former villages and campsites recorded during the Stage 1 field program were characterised by the presence of economic plants or other ethnobotanical species. *Cordyline* spp. (*tanget*), often referred to as an 'indicator plant' as it is planted deliberately as a sign of human habitation, was present at every site.

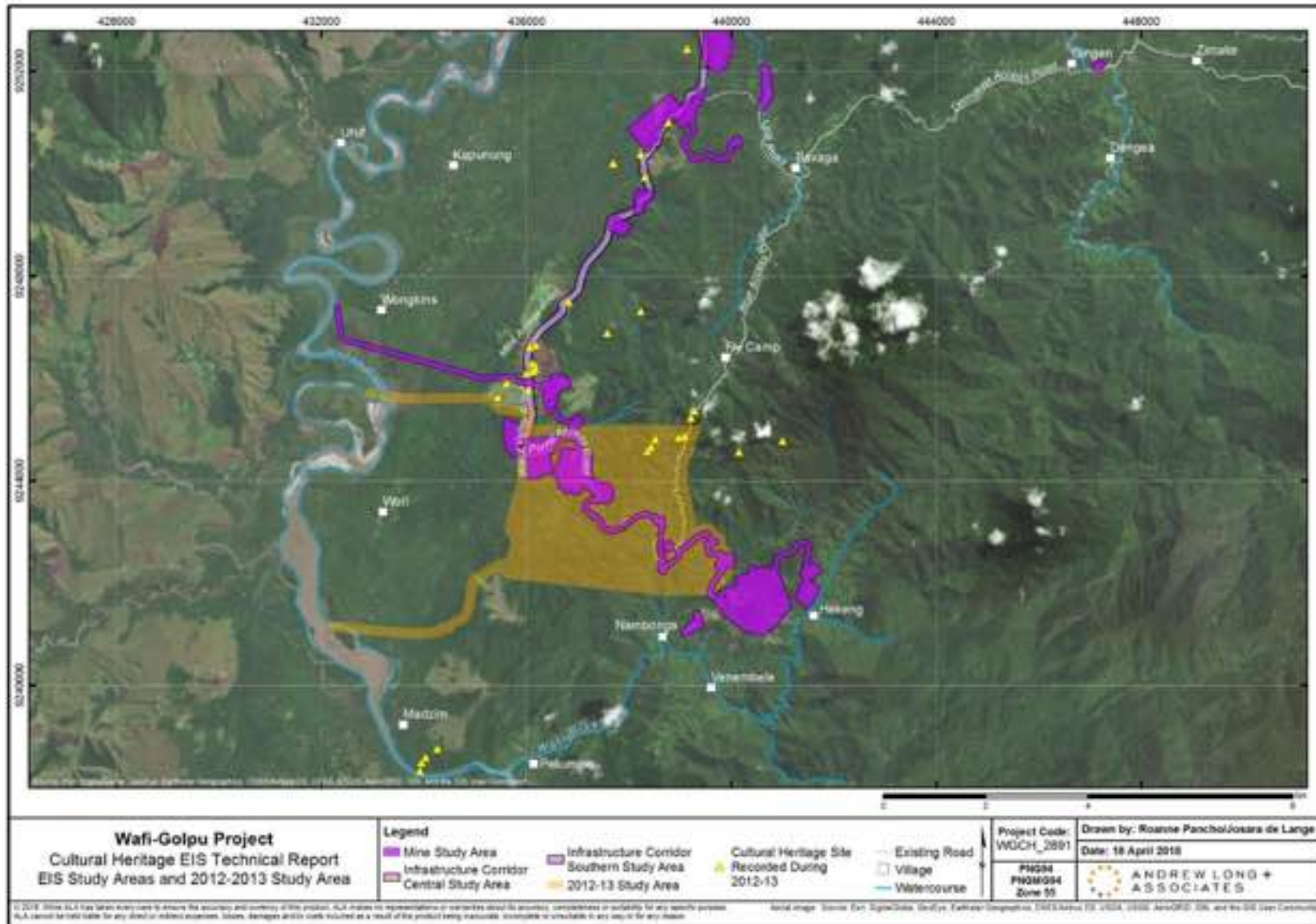


Figure 11: 2012-2013 Worksite Inspection Program study areas and recorded cultural heritage sites in relation to Project study areas

Sites WG022, WG023 and WG075 represent a sequence of Babuaf village establishment and abandonment related to present-day Madzim village. According to Babuaf informants, most of the families currently living in Madzim village originally lived much closer to the banks of the Watut River at WG023, in an area generally referred to as *Mango*. The nearby cemetery recorded at WG075 was established during occupation of WG023 but apparently fell into disuse after WG023 was abandoned in the 1920s when the Watut River flooded its banks. Despite the subsequent relocation of the village from WG023 to WG022, the cemetery at WG075 continued to be sporadically used until the early 1990s. The relocated village at WG022 was occupied until the 1970s when the present site of Madzim village was established.

Stage 2

Twenty new cultural heritage sites were recorded, and six previously recorded cultural heritage sites were rerecorded during the Stage 2 field program. These included:

- 10 archaeological sites (WG202 Buasus 1, WG210 Fere D, WG211 Fere E, WG212 Fere F, WG213 Fere G, WG214 Fere H, WG215 Fere I, WG216 Fere J, WG217 Fere K and WG218 Fere L).
- One burial site (WG047 Mungi Burial Site).
- Three campsites (WG064 Zulalu Campsite, WG077 Bavgi 1 Campsite and WG206 Mungi Bavgi 1 Campsite).
- Two former villages (WG205 Mungi 2 and WG208 Babul Village 1).
- 10 story sites (WG003 Fere Sacred Site, WG048 Mungi Lepa Sacred Pool Site, WG073 Kebun Nun, WG207 Nomonum 1, WG209 Mugus Badzim 1, WG219 Mia Veni 1, WG220 Nong 1, WG222 Zenapu 1, WG223 Bimalun 1 and WG224 Bipu 1).

The 10 archaeological sites recorded during the Stage 2 field program were identified during opportunistic inspections along the Watut Valley Road and adjoining vehicle tracks south of its intersection with Link Road. All but one site (WG202) were located on slightly elevated anthropogenic *kunai* grasslands within an area known as *Fere* by the Babuaf community. Site WG202 is located on elevated *kunai* grassland approximately 2km further north, at a location known as *Buasus* by the Babuaf community.

Three archaeological sites (WG029 Fere A Archaeological Site, WG030 Fere B Archaeological Site and WG031 Fere C Archaeological Site) and one story site (WG003 Fere Sacred Site) were recorded at *Fere* by Muke et al. (2007) during their 2007 assessment. These four sites are located within 500m of the nine *Fere* archaeological sites recorded during the Stage 2 field program.

The close proximity of these 13 cultural heritage sites reinforces the archaeological significance of these lower slope *kunai* grasslands and raises the potential for complex cultural interrelationships between co-located archaeological and oral tradition sites.

The two former village sites and three campsites recorded during Stage 2 of the Worksite Inspection Program all either had direct evidence of (WG077 and WG208), or the potential to contain (WG064, WG077 and WG206), archaeological materials or deposits. The range of archaeological materials identified at WG208 included decorated and undecorated ceramic sherds and flaked stone artefacts manufactured from a variety of raw materials. A Hengambu informant consulted during the field program brought out for inspection two small ground edge stone axe heads that he had collected from WG077.

Summary

A total of 31 cultural heritage sites were inspected and recorded during the Worksite Inspection Program, including 10 archaeological sites, one burial site, four camp sites, one cemetery site, four former village sites, 10 story sites and one subsistence/trade site. These sites are mapped in relation to components of the Mine Study Area and Infrastructure Corridor South Study area in Figure 11.

Seven cultural heritage sites recorded during the 2012-2013 field program are located in, or have mapped extents which overlap with, the Infrastructure Corridor South Study Area (Table 9).

Table 9: Cultural heritage sites recorded during the 2012-2013 Worksite Inspection Program located in Project EIS cultural heritage study areas

| Site No. | Site Name | Site Type | EIS Cultural Heritage Study Area |
|----------|-----------------|----------------|----------------------------------|
| WG202 | Buusus 1 | Archaeological | Infrastructure Corridor (South) |
| WG207 | Nomonum 1 | Story | Infrastructure Corridor (South) |
| WG208 | Babul Village 1 | Former Village | Infrastructure Corridor (South) |
| WG209 | Mugus Badzim 1 | Story | Infrastructure Corridor (South) |
| WG214 | Fere H | Archaeological | Infrastructure Corridor (South) |
| WG215 | Fere I | Archaeological | Infrastructure Corridor (South) |
| WG216 | Fere J | Archaeological | Infrastructure Corridor (South) |

No historical WWII sites were identified during the Worksite Inspection Program.

4.5.4.2 Additional Works Program (2013-2014)

The Additional Works Program was carried out over three phases of fieldwork (August-September 2013, November-December 2013 and February-June 2014), and included cultural heritage assessments of the following proposed infrastructure locations according to the Project layout in use at that time:

- Point locations on and around Mount Golpu including stream gauging stations and drill sites (August-September 2013).
- Bounded areas on and around Mount Golpu including proposed shaft pads, plant sites, waste rock dumps and borrow pits (August-September 2013 and November-December 2013).
- The Demakwa Access Road (February-June 2014).
- The Portal Access Road (February-June 2014).
- The Watut Process Plant (February-June 2014).
- The proposed Buvu TSF site (February-June 2014) (not subsequently progressed).

Relevant sections of the areas assessed during the Additional Works Program are mapped in relation to the Mine Study Area in Figure 12.

Phase 1

Ten oral tradition sites were recorded during the Phase 1 field program, including:

- One former village site (WG063 Ngamboko Settlement Site) – previously recorded by Muke et al. (2007).
- One cemetery (WG072 Taelabuo and Abraham Grave Site) – previously recorded by CRA (1996).
- Three burial sites (WG226 Glen Yanna Paul Burial, WG227 Glenda Robert Burial and WG228 Jennifer Jerry Yanna Burial).
- Three story sites (WG229 Ngandoyeng, WG231 Nea and WG232 Denge 1).
- One historical site (WG225 Wafi River Wire Bridge).
- One camp site (WG230 Golpu Oktau).

No archaeological sites or historical WWII sites were recorded during the Phase 1 field program.

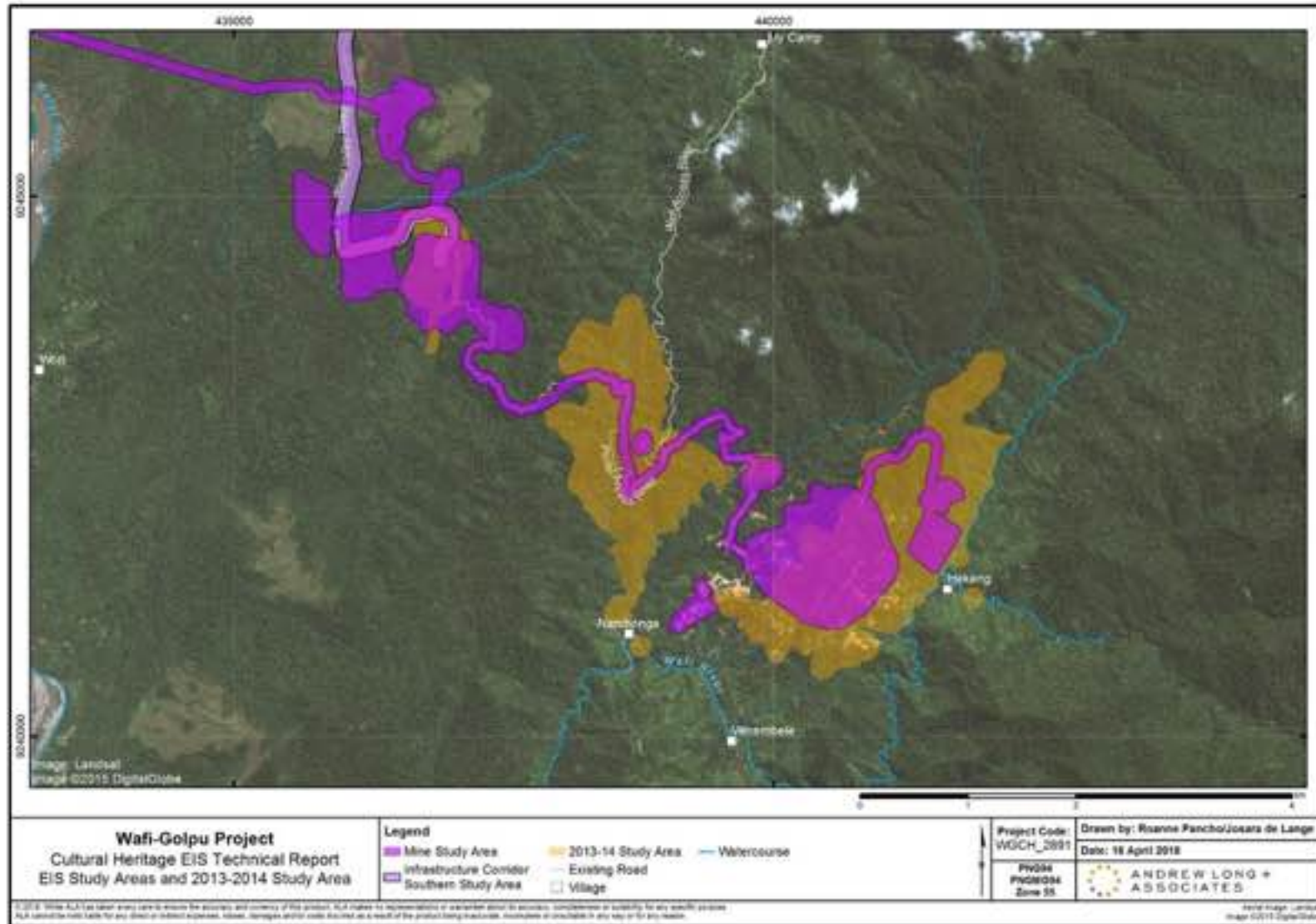


Figure 12: 2013-2014 Additional Works Program study areas in relation to the Mine Study Area

Phase 2

Twenty-four cultural heritage sites were recorded during the Phase 2 field program (Table 10), including 23 oral tradition sites and one archaeological site. The total number of sites recorded during Phase 2 included nine newly recorded sites and 15 re-recorded sites.

No historical WWII sites were identified during the Phase 2 field program.

Table 10: Cultural heritage sites recorded during the Additional Works Phase 2 field program

| Site No. | Site Name | Site Type |
|----------|--------------------------------------|----------------|
| WG039 | Biningdak Rockshelter | Story |
| WG040 | Gwavengo/Ngendakghoma II Rockshelter | Rockshelter |
| WG041 | Tongova Sacred Stone | Story |
| WG042 | Biangova Sacred Stone | Story |
| WG043 | Mea Gova Biangova Sacred Spring | Story |
| WG044 | Mea Gova Tongova Sacred Spring | Story |
| WG045 | Beavemo Burial | Burial |
| WG052 | Duvini I Sacred Stone | Story |
| WG053 | Duvini II Sacred Stone | Story |
| WG056 | Ngendakmeluk I Sacred Stone | Story |
| WG057 | Ngendakmeluk II Sacred Stone | Story |
| WG058 | Ngendakmeluk III Sacred Stone | Story |
| WG059 | Ngendakghoma I Rockshelter | Camp |
| WG060 | Mia Yo Sacred Spring | Story |
| WG066 | Kelerel Grave Site | Burial |
| WG229 | Ngandoyeng | Story |
| WG233 | Venembele Rockshelter | Camp |
| WG234 | Mia Yo A | Story |
| WG235 | Mia Yo B | Story |
| WG236 | Mia Yo C | Story |
| WG237 | Ngeluk Babangee | Story |
| WG238 | Mia Yo D | Story |
| WG239 | Zokotun Ridge 1 | Archaeological |
| WG240 | Mia Ngema Dusaya | Camp |

Phase 3

Thirty-nine new cultural heritage sites were recorded during the Phase 3 field program (Table 11), including 36 oral tradition sites and three archaeological sites.

No historical WWII sites were identified during the Phase 3 field program.

The area investigated during the Phase 3 field program overlaps significantly with components of the Mine Study Area (process plant terrace (85%); maximum subsidence zone (75%); and ventilation shafts (65%)) (Figure 12).

Table 11: Cultural heritage sites recorded during the Additional Works Phase 3 field program

| Site No. | Site Name | Site Type |
|-----------------|--------------------------------|----------------------|
| WG241 | Zenapu 2 | Camp |
| WG242 | Miakatua Buli Campsite | Camp |
| WG243 | Venzumandia Wawo | Former Village |
| WG244 | Bavaga Cemetery 1 | Cemetery |
| WG245 | Bavaga Cemetery 2 | Cemetery |
| WG246 | Dengiakwa | Story |
| WG247 | Kendik 1 | Former Village |
| WG248 | Kendik 3 | Former Village/Story |
| WG249 | Gingen Story Site 1 | Story |
| WG250 | Petere Seiy Burial | Burial |
| WG251 | Anna Giamalu Burial | Burial |
| WG252 | Kipuo Tai Burial | Burial |
| WG253 | Zindaga Burial | Burial |
| WG254 | Gingen Cemetery | Cemetery |
| WG255 | Zimake Cemetery 1 | Cemetery |
| WG256 | Zimake Story Site 1 | Story |
| WG257 | Zimake Masalai Tree 1 | Story |
| WG258 | Zimake Cemetery 2 | Cemetery |
| WG259 | Zimake Archaeological Site 1 | Archaeological |
| WG260 | Vivala Campsite/Petev Campsite | Camp |
| WG261 | Sangia Story Site | Story |
| WG262 | Bipu Story Site | Story |
| WG263 | Bukamun Story Site | Story |
| WG264 | Zindaga River Story Site | Story |
| WG265 | Demakwa Archaeological Site 1 | Archaeological |
| WG266 | Kendik Story Site 1 | Story |
| WG267 | Vak Story Site | Story |
| WG268 | Keisigi Story Site | Story |
| WG269 | Gumbaginu Story Site | Story |
| WG270 | Pelgu Settlement Site | Former Village |
| WG271 | Gurakor Cemetery 1 | Cemetery |
| WG272 | Biawowa Burial | Burial |
| WG273 | Velin Campsite | Camp |
| WG274 | Gurakor Masalai Site | Story |
| WG275 | Papas Archaeological Site 1 | Archaeological |
| WG276 | Anga Masalai Tree | Story |
| WG277 | Ontang Garden Site | Story |
| WG278 | Ningiakwa Campsite | Camp |
| WG279 | Geng Story Site | Story |

Summary

A total of 73 cultural heritage sites (56 newly recorded sites and 17 re-recorded sites) were identified during the 2013-2014 Additional Works Program. These include four archaeological sites, 10 burial sites, nine camp sites, seven cemetery sites, five former village sites, one historical site, one rockshelter site and 36 story sites. These sites are mapped in relation to components of the Mine Study Area in Figure 13.

Nine cultural heritage sites recorded during the 2012-2013 field program are located in cultural heritage study areas (Table 12).

Table 12: Cultural heritage sites recorded during the 2013-2014 Additional Works Program located in EIS cultural heritage study areas

| Site No. | Site Name | Site Type | EIS Cultural Heritage Study Area |
|----------|--------------------------------------|-------------|------------------------------------|
| WG040 | Gwavengo/Ngendakghoma II Rockshelter | Rockshelter | Maximum Subsidence Zone |
| WG043 | Mea Gova Biangova Sacred Spring | Story | Maximum Subsidence Zone |
| WG045 | Beavemo Burial | Burial | Maximum Subsidence Zone |
| WG059 | Ngendakghoma I Rockshelter | Camp | Maximum Subsidence Zone |
| WG231 | Nea | Story | Migiki Borrow Pit |
| WG238 | Mia Yo D | Story | Maximum Subsidence Zone |
| WG261 | Sangia Story Site | Story | Waime River Gravel Extraction Area |
| WG276 | Anga Masalai Tree | Story | Infrastructure Corridor (South) |
| WG277 | Ontang Garden Site | Story | Process Plant Terrace |

No historical WWII sites were identified during the Worksite Inspection Program.

Hengambu and Yanta *Ples Tambu* Sites

The Additional Works Program identified many locations which are considered by the Yanta and Hengambu communities to be *ples tambu*. *Ples tambu* are usually areas of forest roamed by *masalai*, malevolent spirits who generally cause trouble to people who disturb them or cause harm to the natural landscape features and objects within which they live. However, any place identified by the local community as being dangerous may be considered as *ples tambu*.

Yanta oral traditions identify several watercourses draining the south-eastern flank of Mount Golpu as *ples tambu*, with some of them inhabited by *masalai*. Known as *mia yo*, the Yanta believe that water flowing through these ephemeral draining lines is magically tainted, and it is not permissible to drink from them – people who do fall ill and sometimes die.

The Hengambu identify a considerable proportion of the south-eastern flank of Mount Golpu as a *ples tambu* associated with a male and a female *masalai* who reside at WG041 Tongova Sacred Stone Site and WG042 Biangova Sacred Stone Site. This same area also has oral traditions regarding people who become ill after gardening or procuring resources in sacred places referred to as *mea goa*, particularly WG043 Mea Gova Biangova Sacred Spring Site and WG044 Mea Gova Tongova Sacred Spring Site.

Five Yanta *mia yo* sites and four Hengambu *ples tambu* sites situated on the south-eastern flank of Mount Golpu are mapped in relation to components of the Mine Study Area in Figure 14.

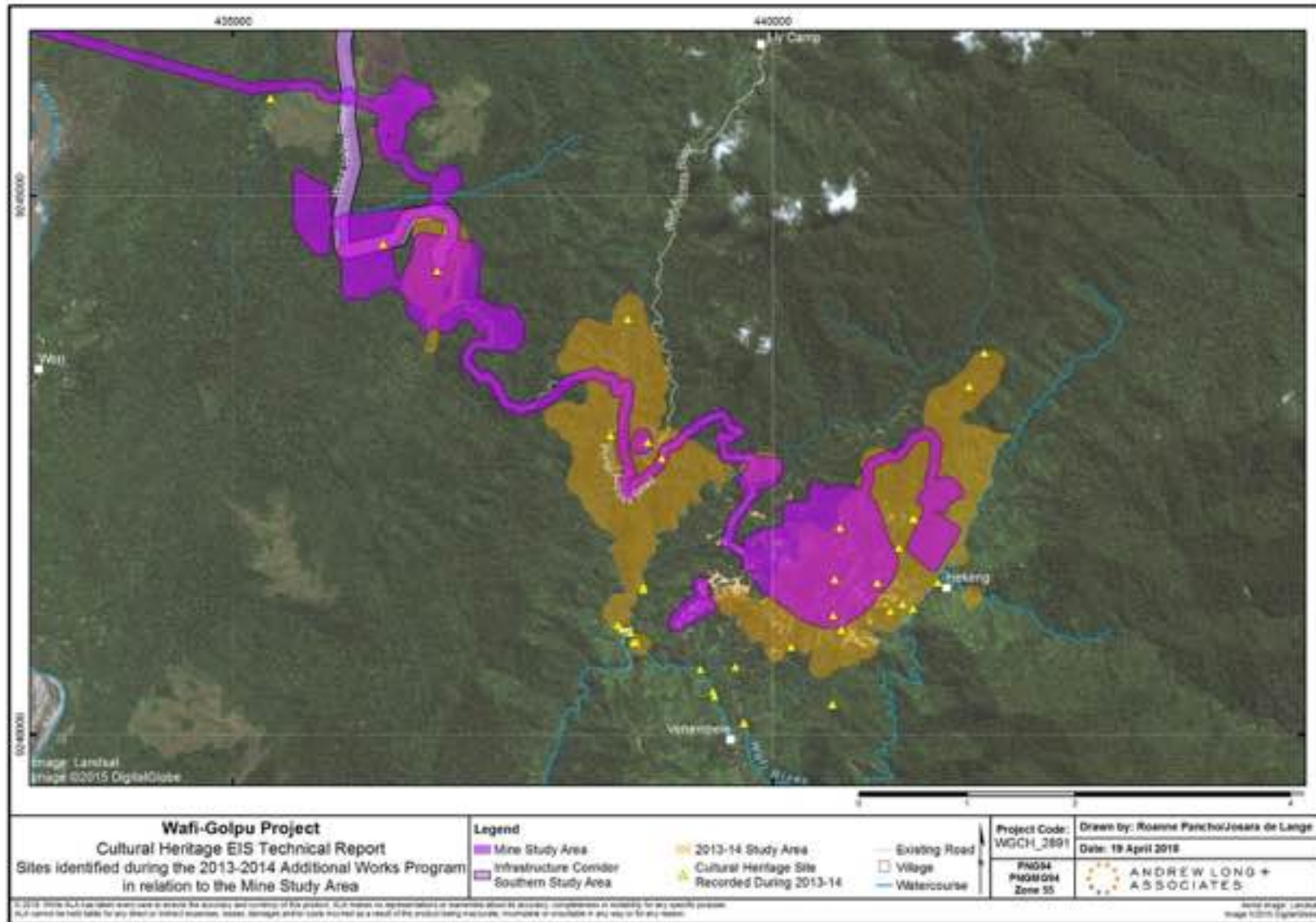


Figure 13: Cultural heritage sites identified during the 2013-2014 Additional Works Program in relation to the Mine Study Area

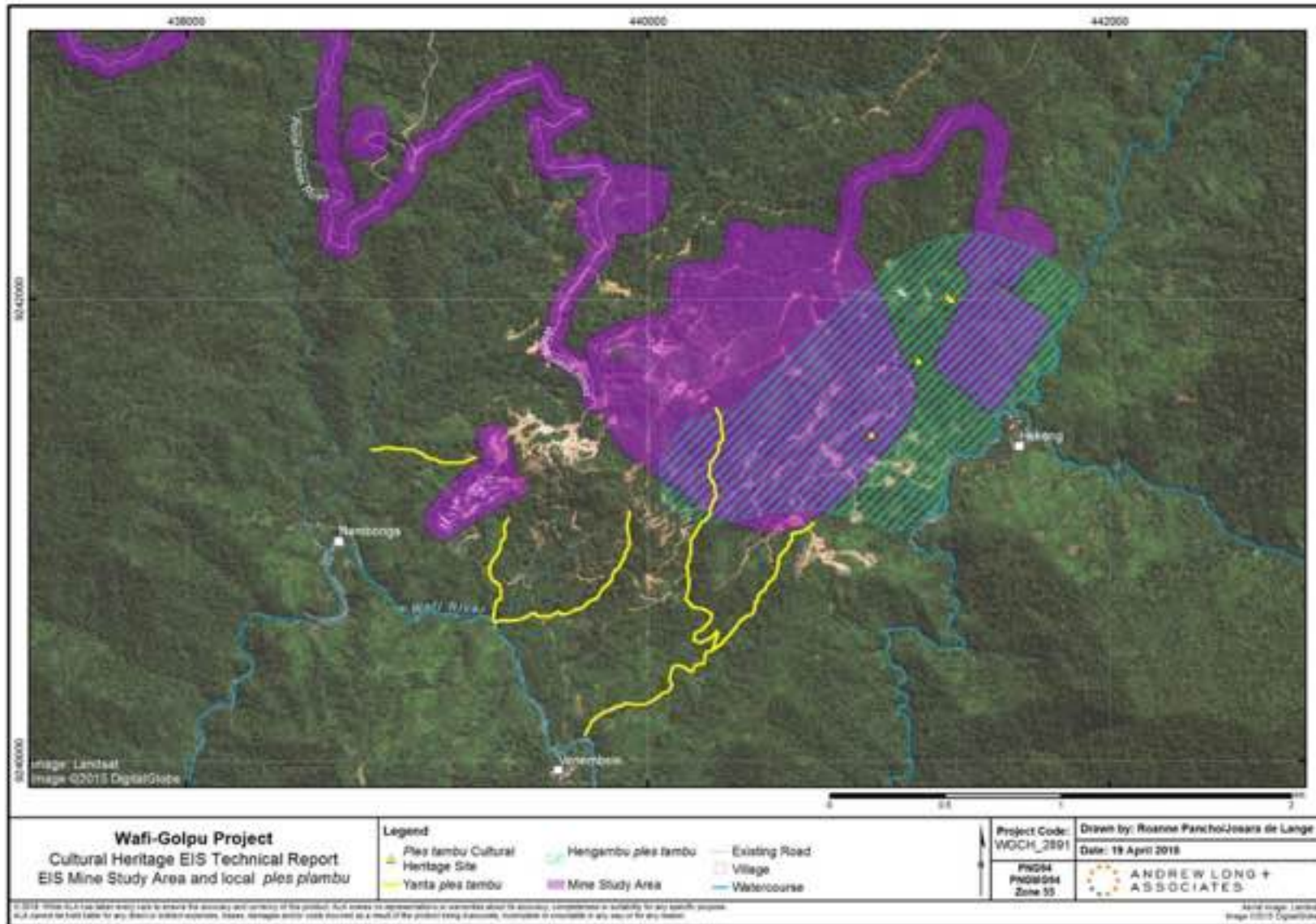


Figure 14: Locations of selected Hengambu and Yanta *ples tambu* in relation to the Mine Study Area

4.5.5 2015 Mine Area Infrastructure Surveys

Cultural heritage studies undertaken in support of the Project during 2015 (Green and Sepe 2017; NMAG Permit for Archaeological Research in PNG # 193) were completed as part of an overarching Project Feasibility and EIS Studies Program. The 2015 Mine Area Infrastructure Surveys were undertaken during two phases of fieldwork between May and July 2015 and included:

- a potential terrestrial tailings storage facility (TSF) on the Watut River floodplain (the Watut TSF);
- the Fere Accommodation Facility study area;
- the Mt Beamena Quarry study area.

These infrastructure locations surveyed are mapped in relation to the Project study areas in Figure 15.

4.5.5.1 Watut TSF

During 2015-2016, WGJV investigated the feasibility of constructing a tailings storage facility (TSF) on the Watut River floodplain, west of the proposed process plant terrace.

Twenty-seven cultural heritage sites were identified within the Watut TSF study area during the 2015 Mine Area Infrastructure Surveys (Figure 16). These are listed in Table 13 and include 23 archaeological sites, two story sites and two former villages. No historical WWII sites were recorded during the survey.

Four cultural heritage sites (WG031, WG216, WG276 and WG309) are located within Project study areas (Figure 16).

Babuaf elders stressed the high level of importance that the Babuaf community attaches to the ancestral Mari Village site. They are aware of the presence of archaeological materials at this location, especially the decorated ceramic sherds.

Table 13: All cultural heritage sites located within the 2015 Watut TSF study area

| Site No. | Site Name | Site Type |
|----------|-----------------------------|---|
| WG013 | Womul Archaeological Site | Archaeological (isolated stone artefact) |
| WG027 | Mari Archaeological Site | Archaeological (stone artefact and ceramic sherd scatter) |
| WG029 | Fere A Archaeological Site | Archaeological (stone artefact and ceramic sherd scatter) |
| WG030 | Fere B Archaeological Site | Archaeological (stone artefact and ceramic sherd scatter) |
| WG031 | Fere C Archaeological Site | Archaeological (stone artefact and ceramic sherd scatter) |
| WG216 | Fere J | Archaeological (isolated stone artefact) |
| WG217 | Fere K | Archaeological (stone artefact and ceramic sherd scatter) |
| WG218 | Fere L | Archaeological (dense stone artefact and ceramic sherd scatter) |
| WG275 | Papas Archaeological Site 1 | Archaeological (ceramic sherd scatter) |
| WG276 | Anga Masalai Tree | Story |
| WG286 | Watut TSF 1 | Archaeological (isolated ceramic sherd) |
| WG287 | Watut TSF 2 | Archaeological (isolated ceramic sherd) |
| WG288 | Watut TSF 3 | Archaeological (isolated ceramic sherd) |
| WG289 | Watut TSF 4 | Archaeological (ceramic sherd scatter) |
| WG290 | Watut TSF 5 | Archaeological (ceramic sherd scatter) |
| WG291 | Watut TSF 6 | Archaeological (ceramic sherd scatter) |
| WG292 | Watut TSF 7 | Archaeological (stone artefact and ceramic sherd scatter) |
| WG293 | Watut TSF 8 | Archaeological (ceramic sherd scatter) |

| Site No. | Site Name | Site Type |
|----------|-------------------------|--|
| WG294 | Watut TSF 9 | Archaeological (ceramic sherd scatter) |
| WG295 | Watut TSF 10 | Archaeological (ceramic sherd scatter) |
| WG296 | Watut TSF 11 | Archaeological (ceramic sherd scatter) |
| WG297 | Watut TSF 12 | Archaeological (ceramic sherd scatter) |
| WG298 | Watut TSF 13 | Archaeological (2x ceramic sherds) |
| WG299 | Watut TSF 14 | Archaeological (2x ceramic sherds) |
| WG309 | WCSAR-1 | Former Village |
| WG310 | Mudju Afas Masalai Site | Story |
| WG313 | Mari Settlement Site | Former Village |

4.5.5.2 Fere Accommodation Facility

The area investigated for the Fere Accommodation Facility during the 2015 Mine Area Infrastructure Surveys is identical to that included in the Mine Study Area for the present study.

There were no cultural heritage sites recorded within this area prior to the 2015 survey.

Formal archaeological surveys of this area involved Babuaf community representatives and were conducted during the period 27 June to 4 July 2015. The field investigation included pedestrian surveys and a subsurface testing program using hand augers designed to identify soil profiles and to test for the presence of subsurface archaeological deposits.

The area investigated during the 2015 field program was intentionally larger than the Fere Accommodation Facility footprint, in order to gain a more comprehensive understanding of the cultural heritage sites likely to be associated with the *Fere* grasslands, and to assist WGJV in their ongoing planning for the proposed accommodation facility.

Eight archaeological sites containing low-density surface scatters of pottery sherds and stone artefacts were recorded during the archaeological survey (Table 14). No historical WWII sites were recorded during the survey.

Table 14: Cultural heritage sites located during the 2015 Fere Accommodation Facility archaeological survey

| Site No. | Site Name | Site Type |
|----------|-----------|---|
| WG300 | WSC1-1 | Archaeological (2 stone artefacts) |
| WG301 | WSC1-2 | Archaeological (1 ceramic body sherd) |
| WG302 | WSC1-3 | Archaeological (3 stone artefacts in disturbed context) |
| WG303 | WSC1-4 | Archaeological (1 ceramic rim sherd and 1 body sherd) |
| WG304 | WSC1-5 | Archaeological (1 ceramic body sherd) |
| WG305 | WSC2-1 | Archaeological (1 ceramic body sherd) |
| WG306 | WSC2-2 | Archaeological (3 ceramic body sherds) |
| WG307 | WSC2-3 | Archaeological (1 stone axe-adze) |

Thirty-one auger probes with a diameter of 120mm were manually bored across the extended study area to maximum depths varying between 540mm and 2m. None of the probes contained cultural heritage materials.

The sites listed in table 14 are situated within the Fere Accommodation Facility component of the Mine Study Area (Figure 17).

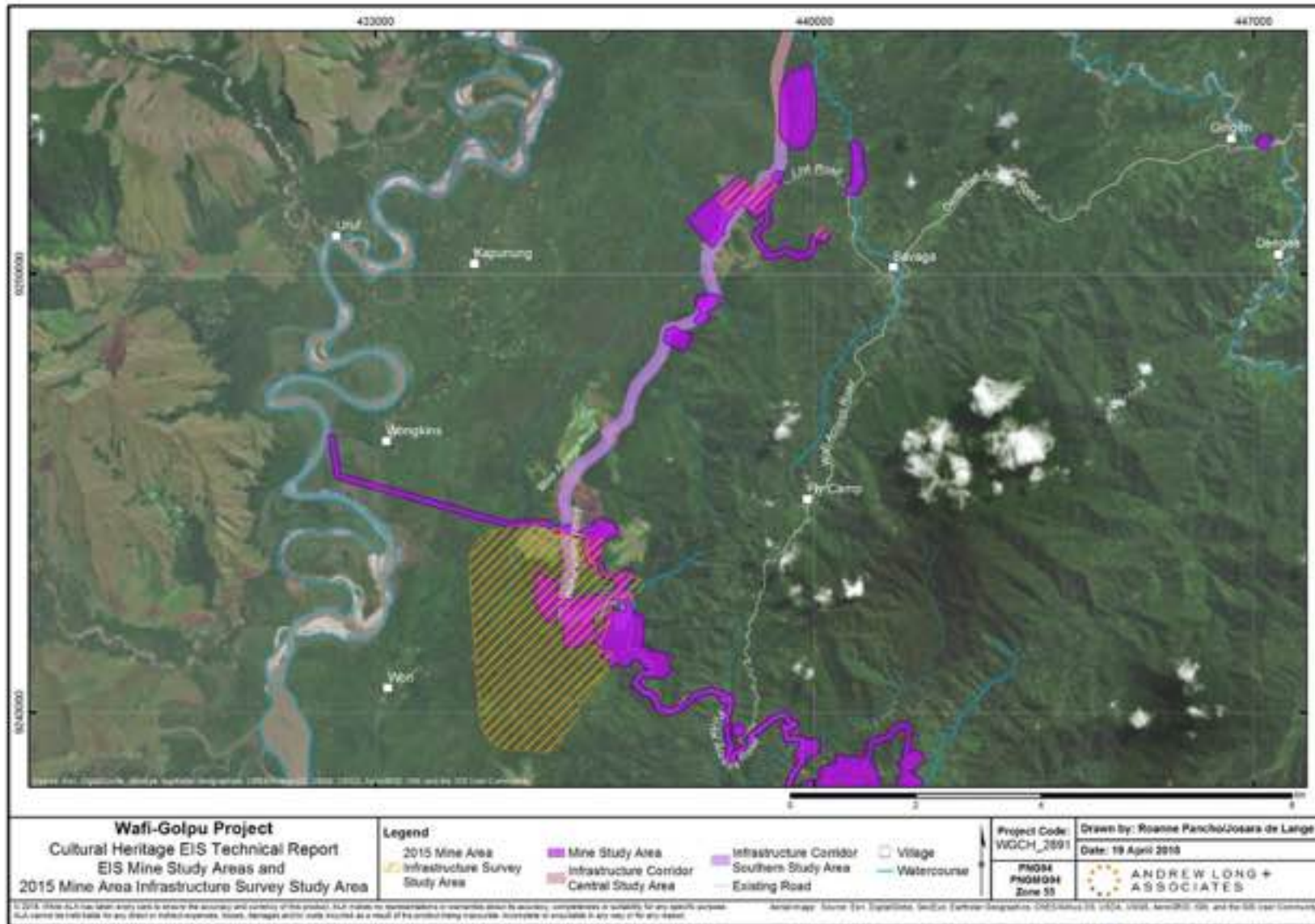


Figure 15: 2015 Mine Area Infrastructure Survey areas in relation to Project study areas

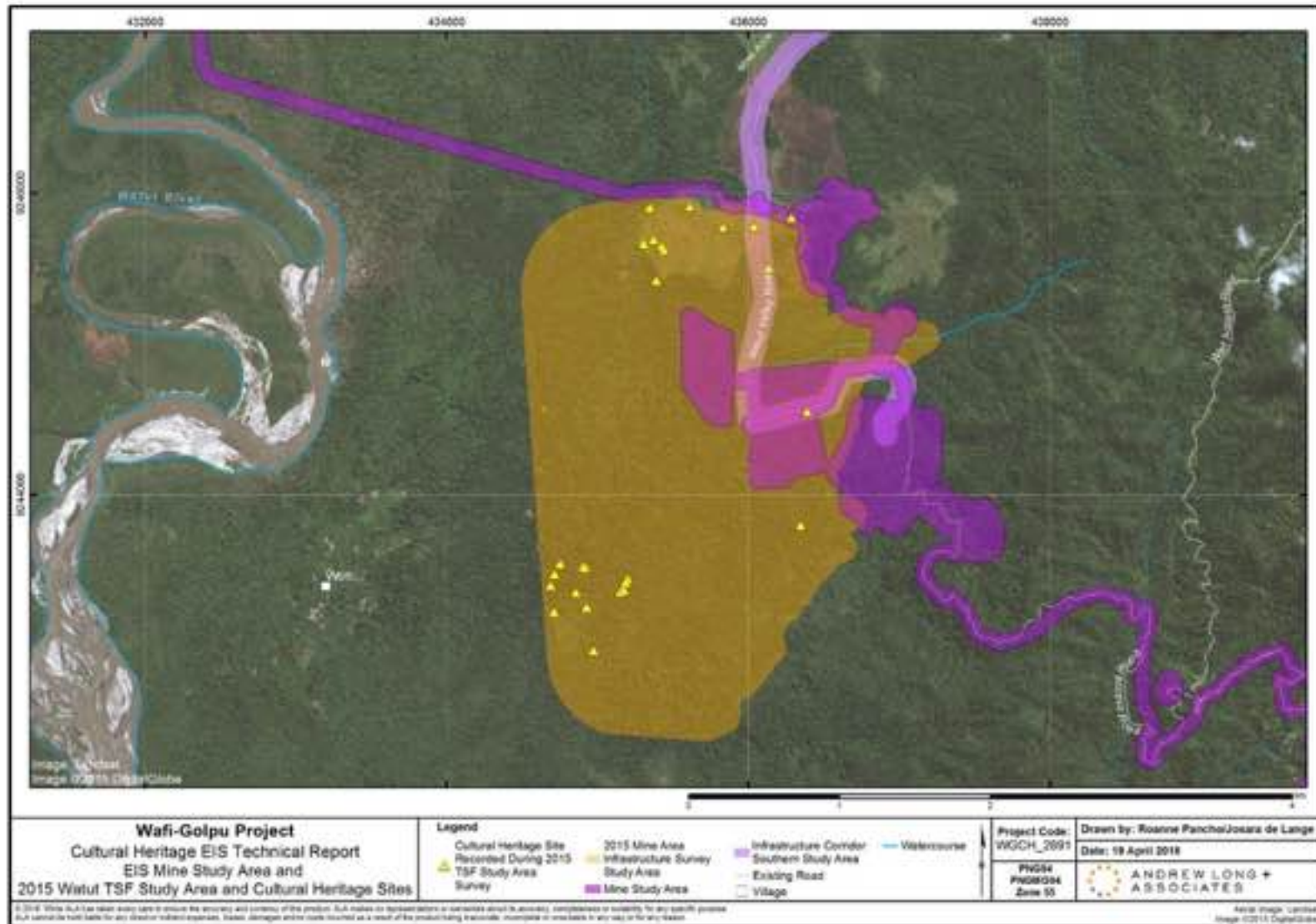


Figure 16: Cultural heritage sites located within the Watut TSF study area after the 2015 Mine Area Infrastructure Surveys, in relation to Project study areas

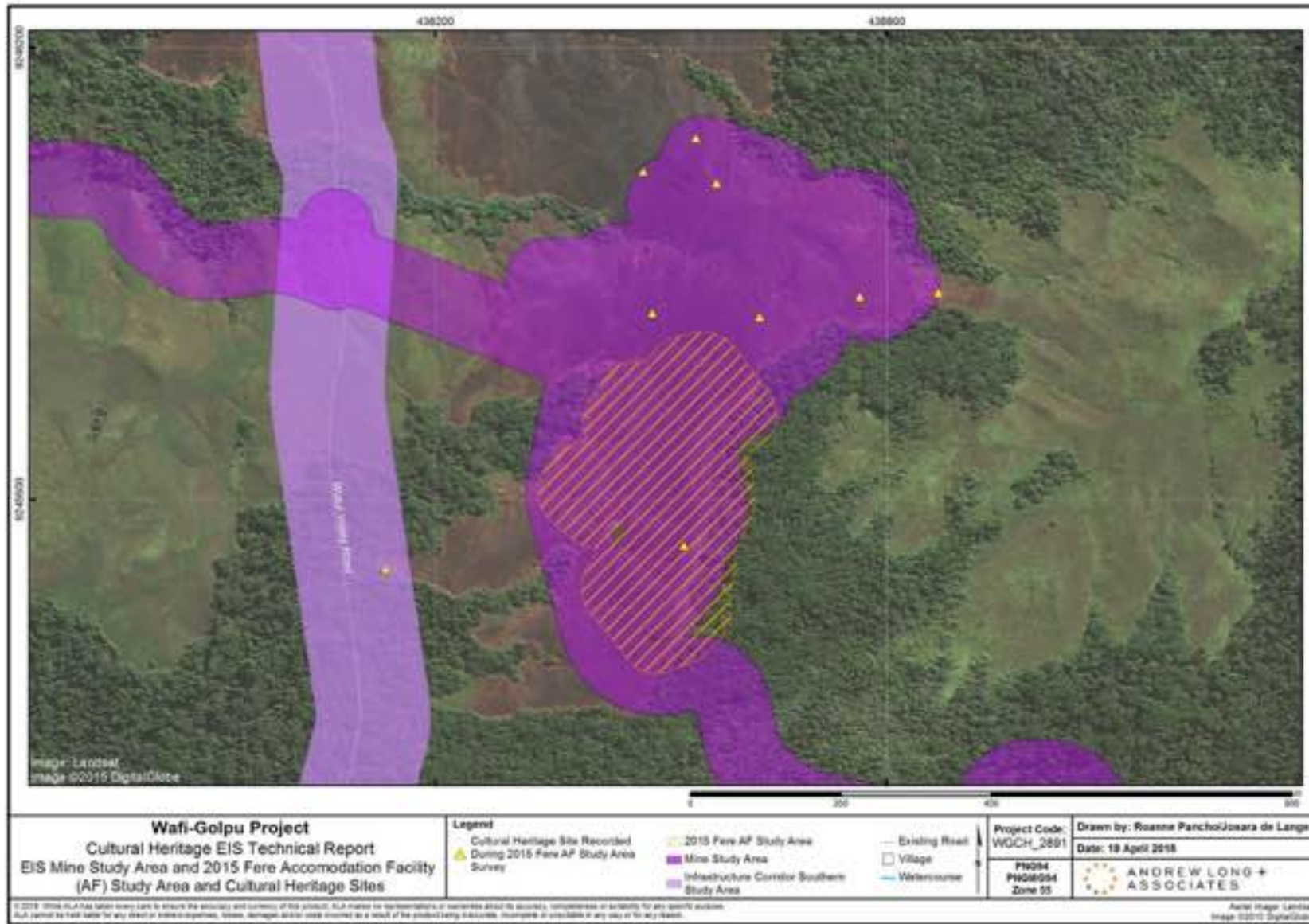


Figure 17: Cultural heritage sites located within the Fere Accommodation Facility Study Area after the 2015 Mine Area Infrastructure Surveys

Babuaf elders stressed the high level of importance that the Babuaf community attaches to the cultural landscape at *Fere*. They are aware of the presence of archaeological materials at this location, especially the decorated ceramic sherds.

4.5.5.3 Mt Beamena Quarry

The area investigated for the Mt Beamena Quarry during the 2015 Mine Area Infrastructure Surveys is identical to that included in the Mine Study Area for the present study.

One oral tradition site (WG026 Mt Sibal Sacred Site, a story site) was previously recorded within this area by Muke et al. (2007), on the crest of a low hill. According to Muke et al. (2007), the Hengambu and the Babuaf both have oral traditions which include this location. The Babuaf identify the site as a former village, while the Hengambu identify the area as a place where the spirits of the dead reside.

The proposed location of the Mt Beamena Quarry was assessed during an archaeological survey conducted on 7 July 2015. Related components including the access track, proposed stockpile and laydown areas and the nearby Humphries Borrow Pit, have not yet been the subject of formal cultural heritage pedestrian surveys.

One oral tradition site (WG026) was confirmed as being situated within the Mt Beamena Quarry component of the Mine Study Area (Figure 18). No archaeological or historical WWII sites were identified during the survey.

4.5.6 2015-2016 Northern Access Road Surveys

Cultural heritage investigations of several alignments proposed for the Northern Access Road were undertaken during three stages of fieldwork between May 2015 and October 2016 (Muke et al. 2015; Muke, Ipang and Mond 2016; Green and Sepe 2017; NMAG Permit for Cultural Heritage Mapping in Papua New Guinea # 002 and Permit for Archaeological Research in PNG # 193), based on proposed infrastructure corridor alignments that were current at the time of the field surveys.

4.5.6.1 Northern Access Road Stage 1

Stage 1 of the Northern Access Road Surveys assessed an original alignment for the proposed road situated to the east of the Central Study Area of the present study (Figure 19). Stage 1 was completed over three surveys conducted on 23-29 May, 1 June and 4 July 2015 (Green and Sepe 2017), and surveyed the entire alignment from its start point in the south at the Mine Access Road-Link Road intersection to its end point in the north where it intersects the Highlands Highway.

The Stage 1 survey recorded 15 oral tradition sites (Figure 19), which included 10 story sites (WG101, WG102, WG103, WG105, WG161, WG280, WG281, WG282, WG284 and WG285), three former villages (WG116, WG285 and WG312), one cemetery site (WG117) and one camp site (WG283). No archaeological or historical WWII sites were identified during the survey.

None of the cultural heritage sites recorded during the Northern Access Road Stage 1 survey are located within the cultural heritage study areas assessed in this report.

4.5.6.2 Northern Access Road Stage 2

Stage 2 of the Northern Access Road Surveys assessed a revised alignment for the proposed road that closely approximates the present study's Central Study Area between its start point in the south at the Mine Access Road-Link Road intersection and a point approximately 1km northwest of the Markham River (

). However, the remainder of the Stage 2 survey alignment to its termination at the Highlands Highway deviated to the east of Central Study Area. Pedestrian cultural heritage surveys investigating the Stage 2 survey alignment north of the Markham River and south of the Watut River were conducted on 23 September to 1 October and 23 October to 24 November 2015 (Muke et al. 2015; Muke, Ipang and Mond 2016).

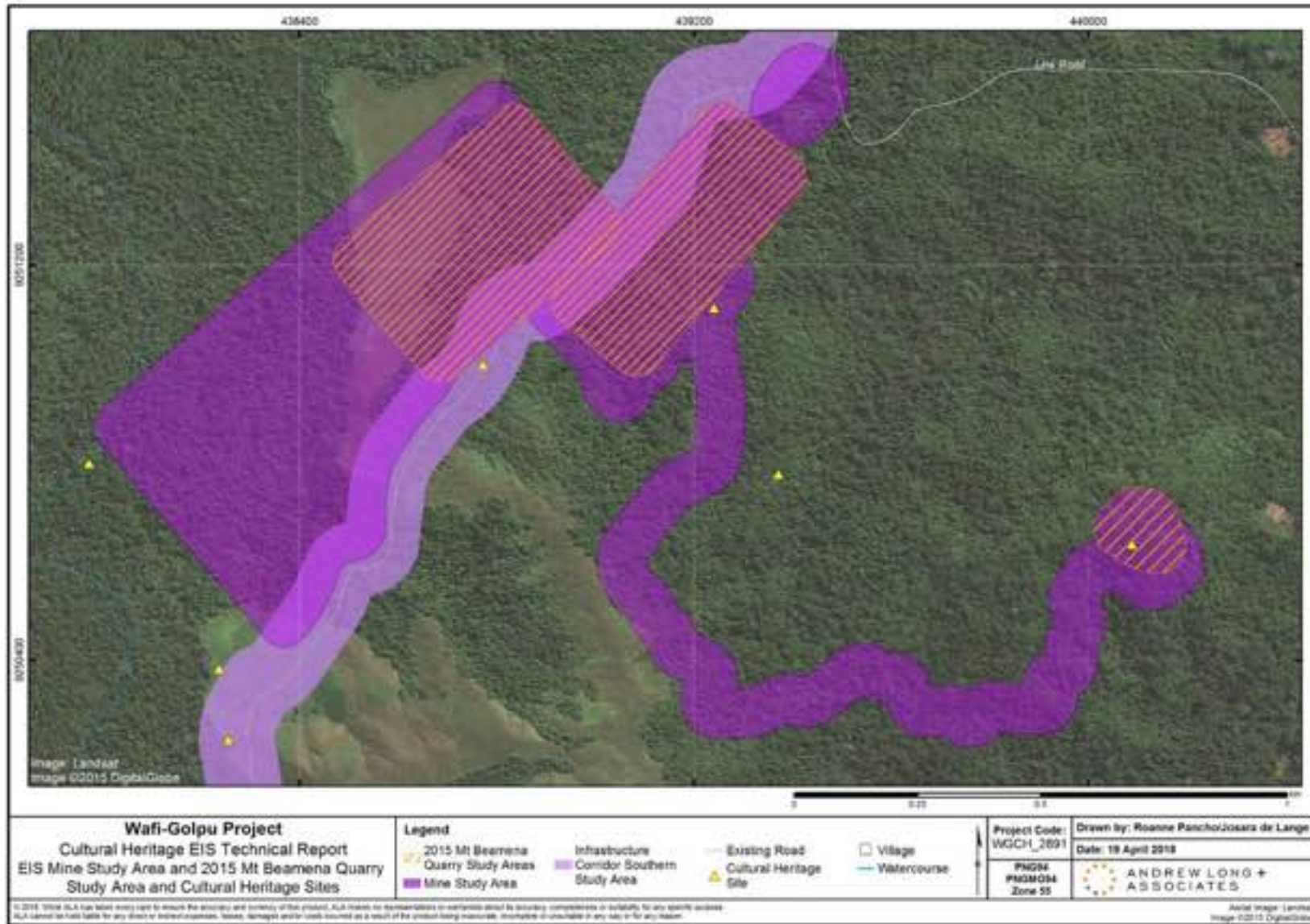


Figure 18: Cultural heritage sites located within the Mt Beamena Quarry Study Area after the 2015 Mine Area Infrastructure Surveys

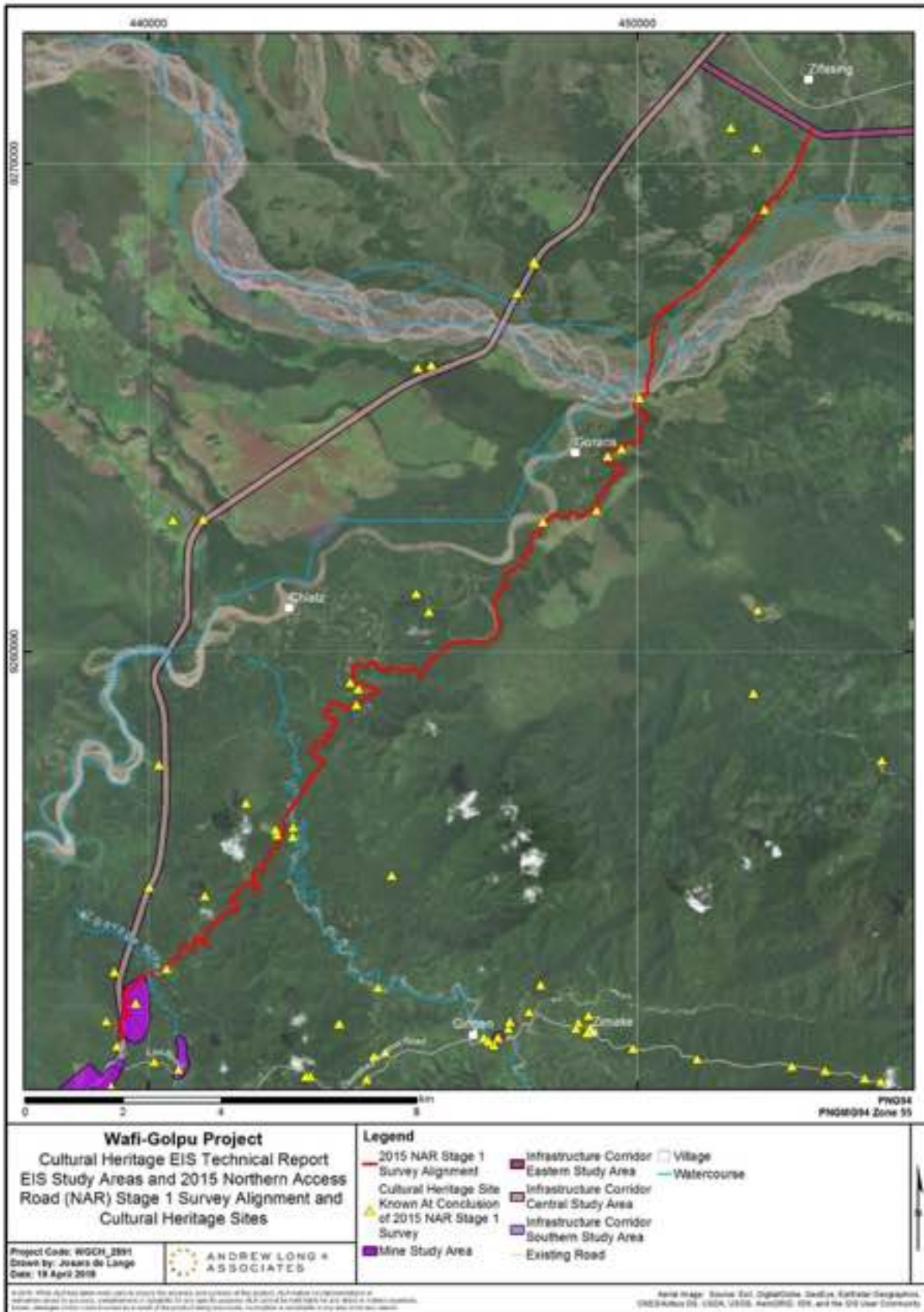


Figure 19: 2015 Northern Access Road Survey Stage 1 alignment and recorded cultural heritage sites in relation to Project study areas

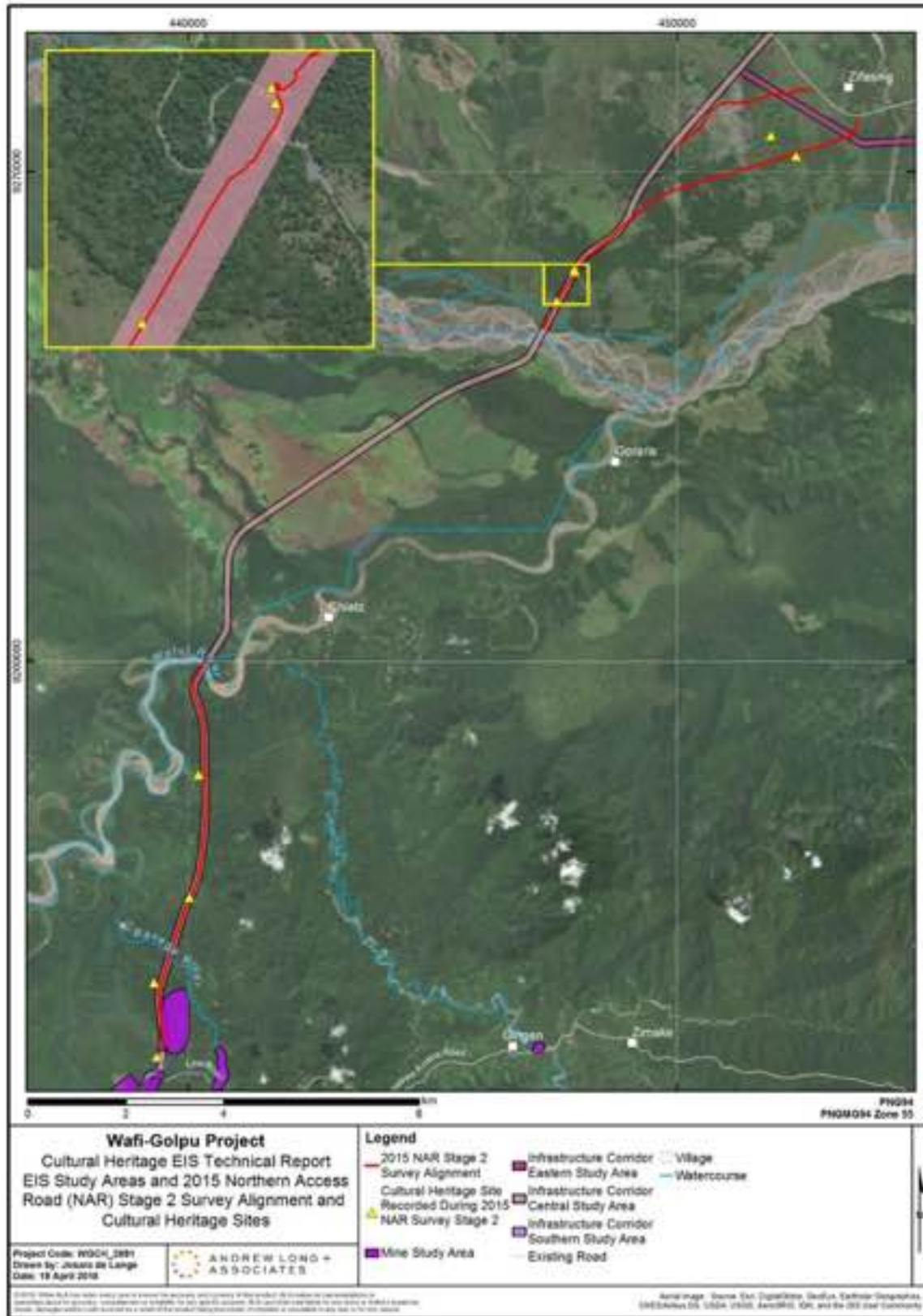


Figure 20: 2015 Northern Access Road Survey Stage 2 alignment and recorded cultural heritage sites in relation to Project study areas

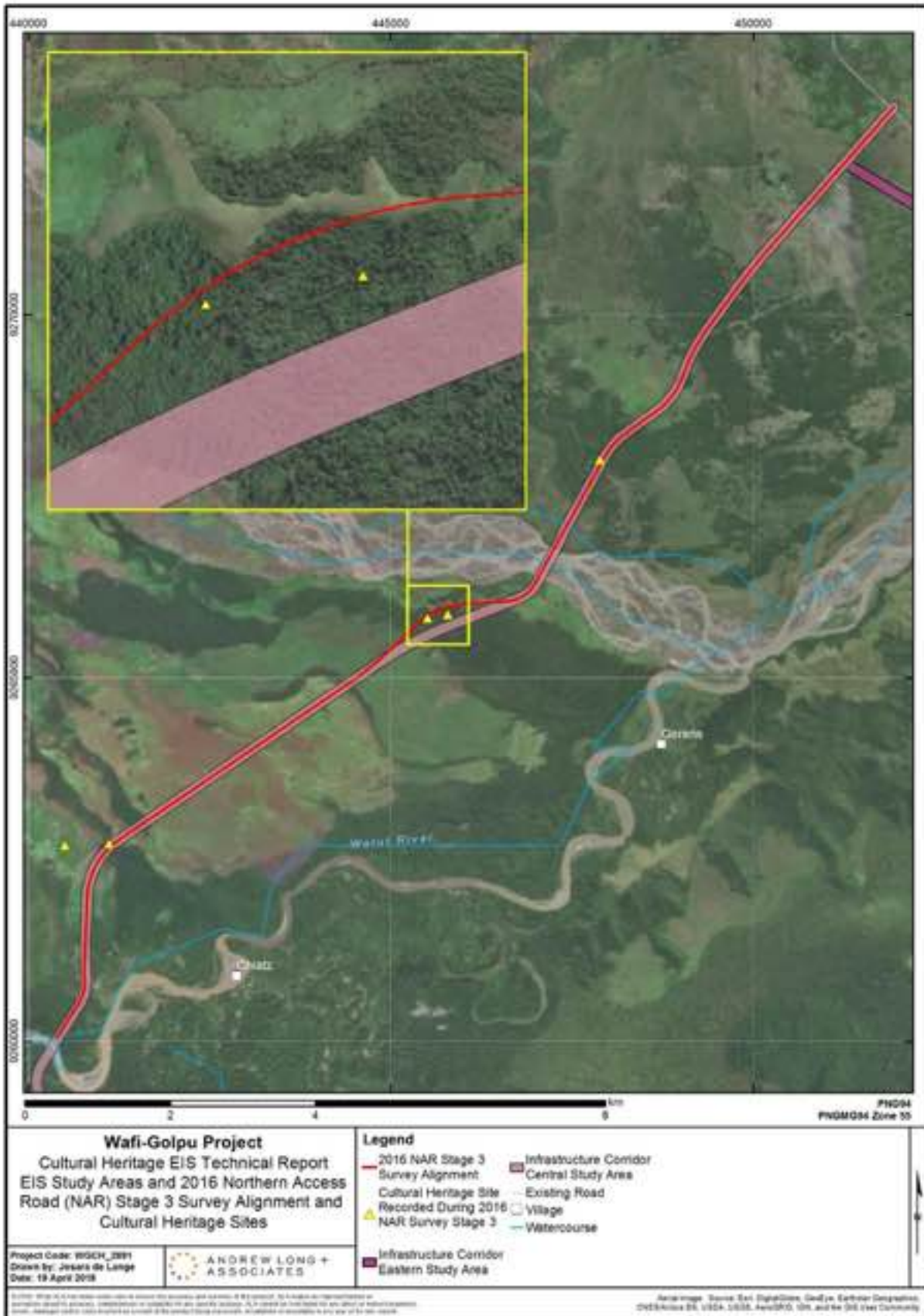


Figure 21: 2015 Northern Access Road Survey Stage 3 alignment and recorded cultural heritage sites in relation to Project study areas

The Stage 2 pedestrian survey recorded nine cultural heritage sites, including six story sites (WG314, WG317, WG319, WG320, WG321 and WG322), two former villages (WG315 and WG316) and one WWII historical archaeological site (WG318).

It should be noted that the site coordinates recorded for story sites WG314, WG317, WG319, WG320, WG321 and WG322 are point locations where the areas of bushland or rainforest associated with these sites intersected the Central Study Area survey track. The actual extent of some of these cultural heritage places is potentially much larger. WG315 and WG316 are also located within the Central Study Area.

4.5.6.3 Northern Access Road Stage 3

Stage 3 of the Northern Access Road Surveys assessed two sections of the proposed alignment which were current at the time of the survey (Figure 21):

- A section commencing at the Highlands Highway and following a new unsealed road that had been recently constructed by the Local Level Government to the north bank of the Markham River.
- A section commencing at the south bank of the Markham River and ending at the north bank of the Watut River.

Stage 3 pedestrian cultural heritage surveys were conducted on 8-10 June 2016 (Markham River-Watut River section) and 17 June 2016 (Markham River-Highlands Highway section) (Muke, Ipang and Mond 2016). With the exception of a 2.5km section of the 2016 alignment which deviated slightly to the north, the alignments assessed during the Stage 3 surveys overlap completely with the Central Study Area (Figure 21). The deviation is attributable to the fact that the Stage 3 surveys identified an important Wampar cultural heritage site (WG325 Fansun Story Site) that would have intersected with the alignment as it was originally proposed. Consequently, based on advice from heritage consultants at the Social Research Institute, the Infrastructure Corridor was shifted 300m south of this cultural heritage site.

The Stage 3 surveys identified five cultural heritage sites (Figure 21), including one burial site (WG327 in the Markham River-Highlands Highway section), two story sites (WG323 and WG325), one camp site (WG326) and one WWII historical archaeological site (WG324) in the Markham River-Watut River section.

Two cultural heritage sites (WG323 and WG327) intersect with the Central Study Area (Figure 19).

4.5.7 2016 Bavaga TSF Geotechnical Program Survey

Cultural heritage investigations undertaken in 2016 for a potential terrestrial TSF that would be situated near Bavaga assessed proposed geotechnical borehole sites at five locations, as well as associated access roads (Alo 2016; NMAG Permit for Cultural Heritage Mapping in Papua New Guinea # 007) (Figure 22).

Pedestrian cultural heritage surveys undertaken from 25 November to 5 December 2016 identified three new story sites (WG349, WG350 and WG351) (Figure 22). No archaeological or historical WWII sites were identified during the survey.

One cultural heritage place – WG351 Spirit Tree Site (a story site) – is located within the buffered component of the Bavaga River Gravel Extraction Area study area.

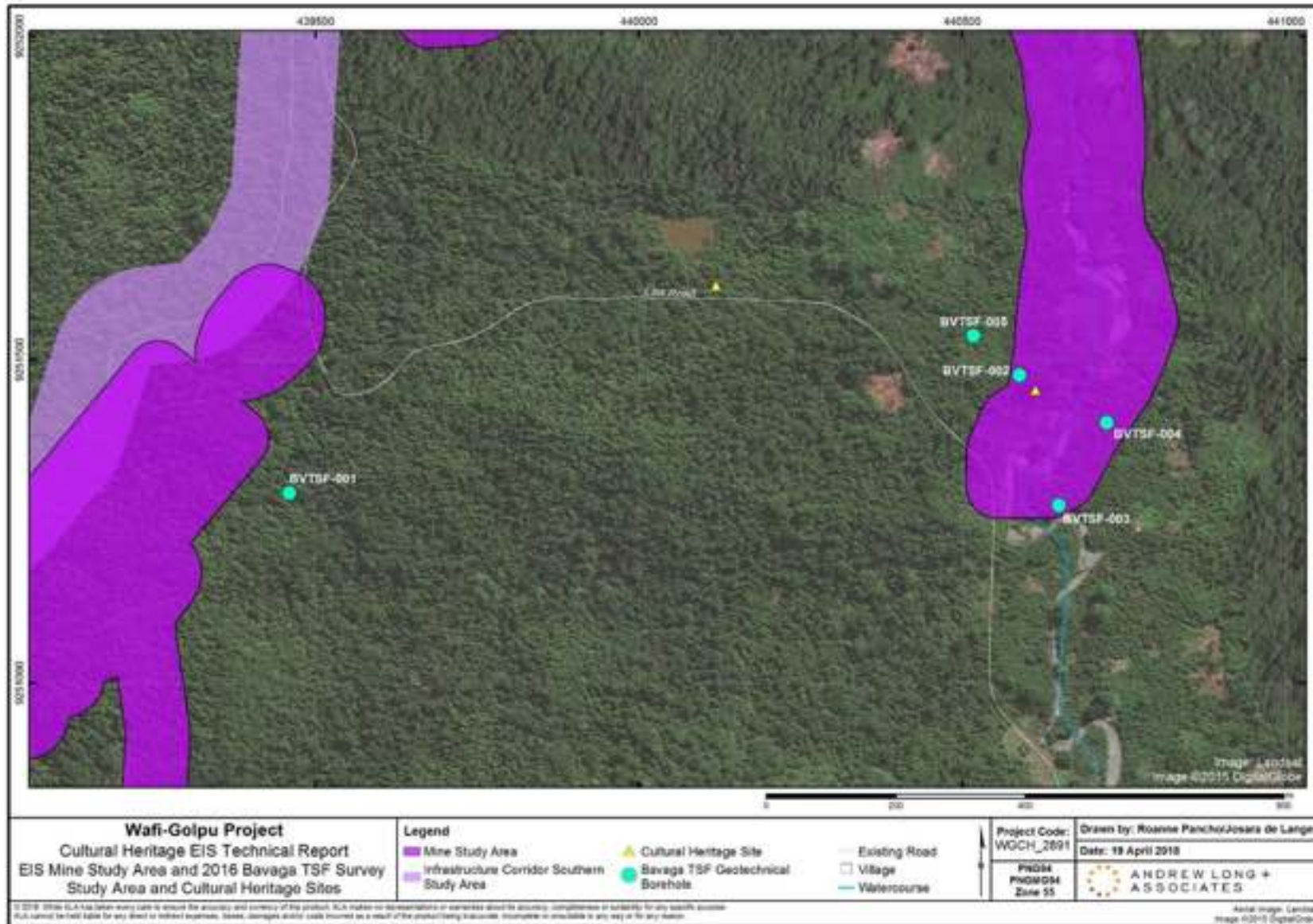


Figure 22: 2016 Bavaga TSF Geotechnical Program Survey locations and recorded cultural heritage sites in relation to Project study areas

4.5.8 2017 Infrastructure Corridor Eastern Study Area Survey

Cultural heritage assessments of the Eastern Study Area between Zifasing and the Huon Gulf coast at Wagang and the Port of Lae were undertaken during four stages of fieldwork from 7 May to 2 June, 5-25 July, 28 July to 13 August and 19 August to 3 September in 2017 (Muke and Skelly 2017; Skelly, Muke, Sepe and Green 2017; NMAG Permit for Cultural Heritage Mapping in Papua New Guinea # 008 and Permit for Archaeological Survey in Papua New Guinea #216). The cultural heritage mapping and archaeological survey programs assessed several potential alignments that were being considered at the time, including a deviation from the Central Study Area at Yalu that crossed the Atzera Range to follow the exiting PNG Power transmission corridor into Lae's northern suburbs. This alignment option is not being taken further by the Project, and therefore has not been included in the Eastern Study Area.

The pedestrian surveys completed during this period covered the entire Eastern Study Area, except for the urban section of the alignment commencing at the Port Facility study area and then following Mangola Street, Markham Road, Butibam Road and Independence Drive. The Eastern Study Area includes a range of undeveloped, semi-rural, rural and urban environments.

In addition to the cultural heritage mapping and archaeological survey program, archaeologists undertaking this work also inspected the locations of three drilled boreholes, 41 mechanically excavated test pits and six manually excavated auger holes that were being undertaken along the Infrastructure Corridor between the villages of Zifasing and Wagang as part of a geotechnical investigation program for the Wafi-Golpu Project Feasibility Study Update. The purpose of the inspections was to determine if works at these locations had the potential to disturb cultural heritage sites and to gain an insight into the likelihood of discovering subsurface materials during the Project construction phase. Of the 50 assessed locations, 16 were inspected during a UXO-clearance program prior to excavations commencing, 11 were inspected during test pit excavations, and 17 were inspected after test pit excavations had been completed. The six auger locations were also inspected during UXO clearance and while the augers were being bored. No cultural heritage sites were identified during the geotechnical monitoring program.

Nineteen new cultural heritage sites were recorded during the 2017 Infrastructure Corridor Eastern Study Area survey. These included (Figure 23):

- Seven story sites (WG330, WG334, WG335, WG336, WG338, WG342 and WG344)
- One former settlement site (WG333)
- Seven archaeological sites, including six WWII historic sites (WG331, WG332, WG337, WG339, WG340, WG341 and WG346)
- Three cemetery sites (WG343, WG345 and WG348)
- One burial site (WG347)

Eight cultural heritage sites intersect with the Eastern Study Area. These sites are listed in Table 15, and their locations and/or estimated extents⁶ are mapped in relation to the study area in Figure 24.

Table 15: Cultural heritage sites located within the Infrastructure Corridor - Eastern Study Area

| Site No. | Site Name | Site Type |
|----------|------------------------------------|----------------------------------|
| WG334 | Mutufom Story Site | Story (spirit site) |
| WG335 | Fiafan Story Site | Story (spirit site) |
| WG336 | Umironon Story Site | Story (subsistence site) |
| WG337 | Orogwanginpup Settlement Site | Former Village |
| WG338 | Ngaroperem Story Site | Story (spirit site) |
| WG339 | WWII Clinic Archaeological Site | Archaeological (WWII historical) |
| WG341 | Kafag Airfield Archaeological Site | Archaeological (WWII historical) |
| WG346 | Tanam Airfield Archaeological Site | Archaeological (WWII historical) |

⁶ The physical extent of each of each site determined by onsite survey and inspection of aerial photographs.

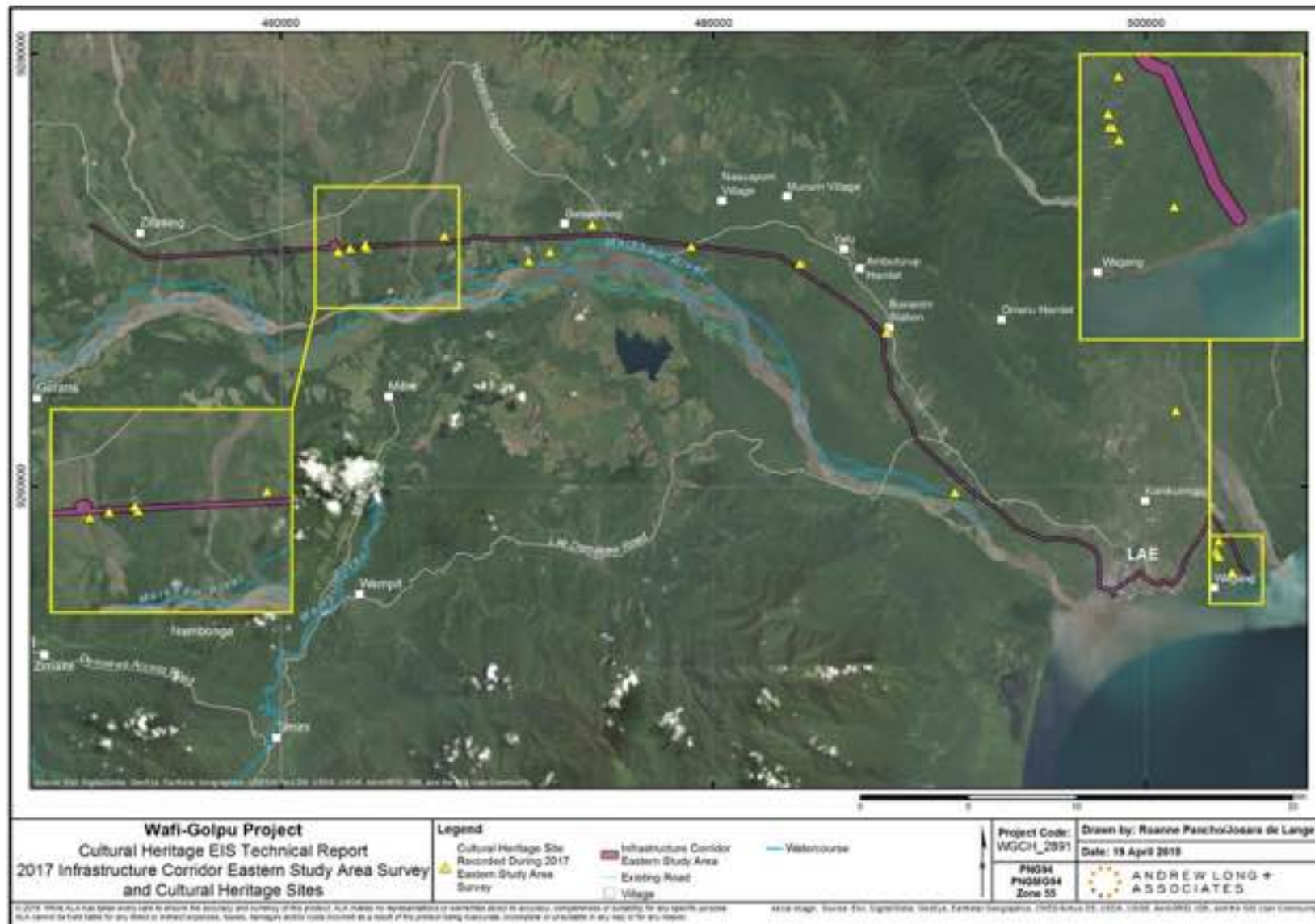


Figure 23: Cultural heritage site locations recorded during the 2017 Infrastructure Corridor (Eastern) Study Area surveys

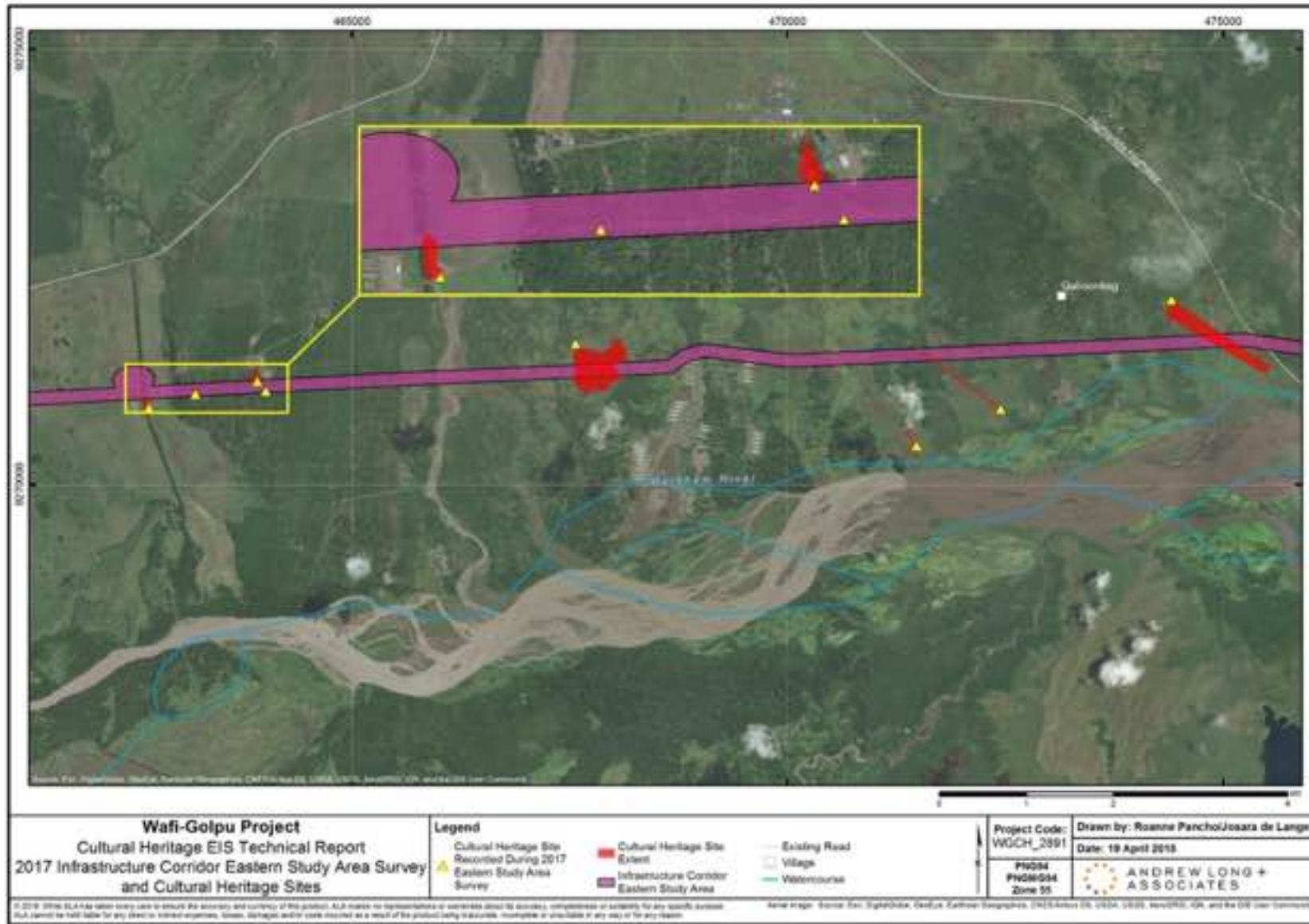


Figure 24: Cultural heritage site extents intersecting with the Infrastructure Corridor (Eastern) Study Area

4.5.9 Coastal Study Area – Outfall Area

The original Infrastructure Corridor alignment investigated during the 2017 Eastern Study Area survey placed the coastal crossing of the terrestrial tailings pipeline, and the location of the Outfall Area including the mix/de-aeration tank, approximately 450m west of its current alignment. This location was assessed during the 2017 survey, which identified a significant story site (WG324 Hungkwangpup Story Site) associated with a strong oral tradition maintained by the residents of Wagang Village, approximately 1.1km further to the west. The boundaries of this story site were carefully mapped during the 2017 field program with the assistance of Wagang representatives, who requested that no ground disturbing impacts occur within the boundaries of the site.

To address this request, the WGJV consequentially redesigned the Project layout for the Outfall Area, moving it to its current location, which is at least 100m from the nearest boundary of WG324 (Figure 25).

4.5.10 Desktop Assessments

4.5.10.1 Infrastructure Corridor Southern Study Area

Most of the Infrastructure Corridor Southern Study Area, which generally follows the existing Watut Valley Road offset by approximately 20m, has not yet been assessed through cultural heritage field surveys. The exception is the southernmost 1.4km which overlaps with a section of the Watut Valley Road (previously named the Portal Access Road in this section), which was surveyed by Green and Sepe (2014) during the 2013-2014 Additional Works Program (see Section 4.5.4.2 above for further details).

Based on a review of relevant reports (Green and Muke 2013a; Green and Sepe 2014; Muke et al. 2007), thirteen cultural heritage sites are located within the Southern Study Area (Table 16 and Figure 26).

Table 16: Infrastructure Corridor - Southern Study Area – previously recorded cultural heritage sites

| Site No. | Site Name | Site Type | Archaeological Materials |
|-----------------|---------------------------|-----------------------|--------------------------------|
| WG001 | Babul Camp Site | Camp | |
| WG002 | Babul Archaeological Site | Archaeological | Ceramic sherds |
| WG003 | Fere Sacred Site | Story | |
| WG202 | Buasus 1 | Archaeological | Stone artefacts/Ceramic sherds |
| WG207 | Nomonum 1 | Story | |
| WG208 | Babul Village 1 | Former Village | |
| WG209 | Mugus Badzim 1 | Story | |
| WG214 | Fere H | Archaeological | Stone artefacts/Ceramic sherds |
| WG215 | Fere I | Archaeological | Stone artefacts |
| WG216 | Fere J | Archaeological | Stone artefacts |
| WG308 | Fere Clay Source Site | Subsistence/ Trade | Clay source |
| Babul Village 1 | Babul Village 1 | Babul Village 1 | |
| WG319 | Wames Story Site | Story | |

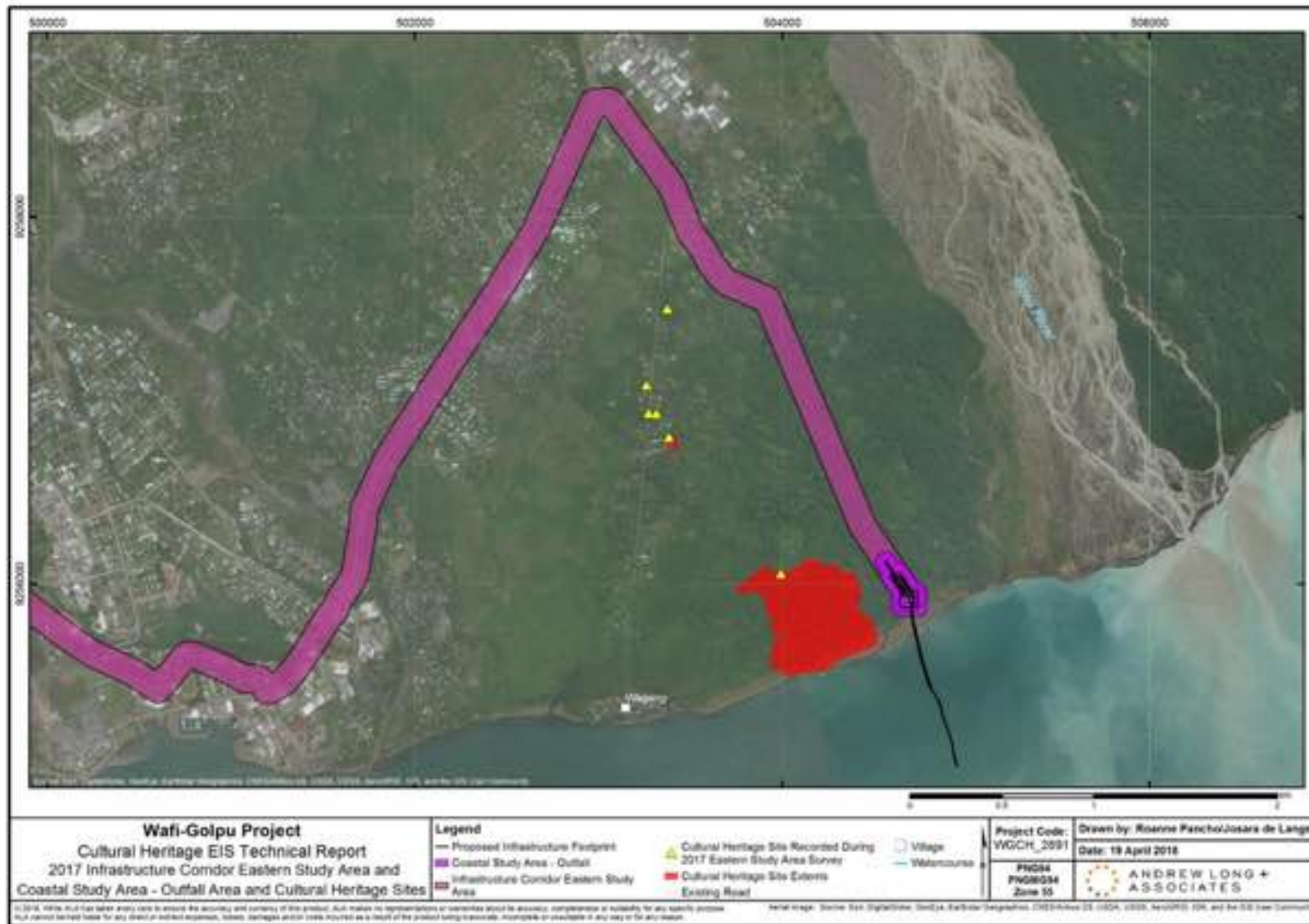


Figure 25: Cultural heritage site locations and extents near the Infrastructure Corridor (Eastern) and Coastal study areas – Outfall Area

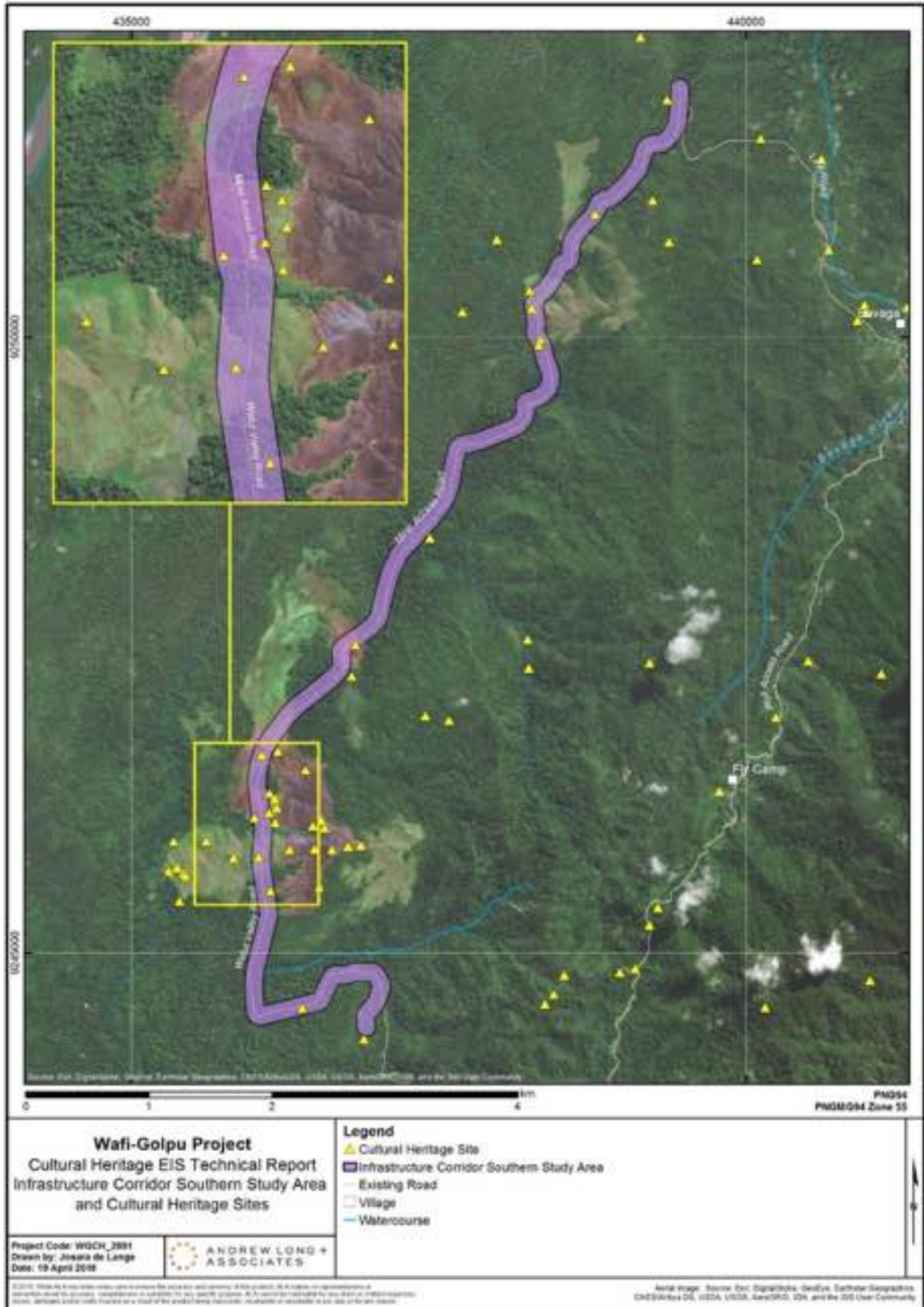


Figure 26: Infrastructure Corridor (Southern) Study Area and previously recorded cultural heritage sites

Regarding these sites, it is important to note that:

- Archaeological sites WG202, WG214, WG215 and WG216 were identified during brief inspections along the Watut Valley Road and were not formally surveyed by Green and Muke (2013a).
- Story sites WG207 and WG209 were recorded in response to specific requests from Babuaf community leaders to record these locations and were not identified as a result of comprehensive cultural heritage surveys.

4.5.10.2 Coastal Study Area – Port Facilities Area

The proposed location of the Port Facilities Area is near Berth 6 Tanker Wharf within the Port of Lae. Construction of the original port facilities would have resulted in significant ground disturbance over many years. The location has been used as an active maritime port facility for many years, and currently includes several built structures and locations for shipping container storage. Unconstructed ground surfaces appear to be mostly covered either by concrete or asphalt (Figure 27).

The assessment of cultural heritage was therefore based on satellite photography covering this study area. Given the disturbance history briefly outlined above, the potential for any cultural heritage sites that may have previously been present within this study area to be retained intact and/or to be impacted by construction and operations within the Project's proposed Port Facilities Area is considered to be extremely low.



Figure 27: Aerial photograph of the Port Facilities Area Study Area

5 WAFI-GOLPU PROJECT EIS CULTURAL HERITAGE BASELINE ASSESSMENT SUMMARY

Those areas subject to formal cultural heritage field surveys from 2012-2017 are mapped in relation to the Project EIS cultural heritage study areas in Figure 32 to Figure 35. As previously noted, many of the cultural heritage sites identified by CRA (1996) and Muke et. al (2007) and located in the cultural heritage study area were re-inspected and their presence and condition confirmed during the 2012-2014 surveys.

The extent of survey coverage for each cultural heritage study area and the potential for additional cultural heritage sites to be located within these areas, is summarised below.

Table 17 lists 60 cultural heritage sites identified during the baseline assessment as being located within or intersecting the study areas. The table differentiates sites located within proposed worksite construction, right of way or impact footprints from those identified within study area buffers. The sites are listed sequentially, and the sequence is reproduced on each page of the table and listed against different components of the overall cultural heritage study area.

Table 17: Summary data on cultural heritage sites located within Project study areas

| Site No. | Site Name | Site Type | Location | | |
|----------|---|----------------|------------|----------|-------------------|
| | | | Study Area | Worksite | Study Area Buffer |
| WG001 | Babul Camp Site | Camp | IC | • | |
| WG002 | Babul Archaeological Site | Archaeological | IC | • | |
| WG003 | Fere Sacred Site | Story | IC | • | |
| WG005 | Babul Sacred Swamp Site | Story | MBQ | • | • |
| WG008 | Wames Archaeological Site | Archaeological | MBQ | • | |
| WG026 | Sibal Sacred Site | Story | MBQ | • | • |
| WG031 | Fere C Archaeological Site | Archaeological | MARF | • | |
| WG040 | Gwavengo/Ngendakghoma II Rockshelter Site | Rockshelter | MSZ | • | |
| WG043 | Mea Gova Biangova Sacred Spring Site | Story | MSZ | • | |
| WG045 | Beavemo Burial Site | Burial | MSZ | • | |
| WG059 | Ngendakghoma I Rockshelter | Camp | MSZ | • | |
| WG121 | Magense | Burial | NARBP | • | |
| WG202 | Buusus 1 | Archaeological | IC | | • |
| WG207 | Nomonum 1 | Story | IC | • | |
| WG208 | Babul Village 1 | Former Village | IC | • | • |
| WG209 | Mugus Badzim 1 | Story | IC | • | |
| WG214 | Fere H | Archaeological | IC | | • |
| WG215 | Fere I | Archaeological | IC | | • |
| WG216 | Fere J | Archaeological | IC | • | |
| WG229 | Ngandoyeng | Story | MSZ | • | |
| WG231 | Nea | Story | MBP | | • |
| WG238 | Mia Yo D | Story | MSZ | • | • |

| Site No. | Site Name | Site Type | Location | | |
|----------|------------------------------------|-------------------|------------|----------|-------------------|
| | | | Study Area | Worksite | Study Area Buffer |
| WG241 | Zenapu 2 | Camp | NPHR | • | |
| WG261 | Sangia | Story | WRGEA | • | |
| WG264 | Zindaga River Story Site | Story | WRGEA | • | • |
| WG276 | Anga Masalai Tree | Story | WMF | | • |
| | | | IC | • | |
| WG277 | Ontang Garden Site | Story | PPT | • | |
| WG300 | WCS1-1 | Archaeological | FAF | • | |
| WG301 | WCS1-2 | Archaeological | FAF | • | |
| WG302 | WCS1-3 | Archaeological | FAF | | • |
| WG303 | WCS1-4 | Archaeological | FAF | • | |
| WG304 | WCS1-5 | Archaeological | FAF | • | |
| WG305 | WCS2-1 | Archaeological | FAF | • | |
| WG306 | WCS2-2 | Archaeological | FAF | | • |
| WG307 | WCS2-3 | Archaeological | FAF | | • |
| WG308 | Fere Clay Source Site | Subsistence/Trade | IC | | • |
| WG309 | WCSAR-1 | Former Village | IC | | • |
| WG314 | Kakarak Story Site | Story | IC | • | • |
| WG315 | Kobabarong Settlement Site | Former Village | IC | • | • |
| WG316 | Kokok Settlement Site | Former Village | IC | • | • |
| WG319 | Wames Story Site | Story | IC | • | • |
| | | | HBP | • | • |
| | | | NARBP | • | • |
| | | | MBQ | • | • |
| WG320 | Nufgarak Story Site | Story | IC | • | • |
| WG321 | Ngalulase Story Site | Story | IC | • | • |
| WG322 | Fobias Story Site | Story | IC | • | • |
| WG323 | Taganek Story Site | Story | IC | • | • |
| WG327 | Litia Burial Site | Burial | IC | | • |
| WG334 | Mutufom Story Site | Story | IC | | • |
| WG335 | Fiafan Story Site | Story | IC | | • |
| WG336 | Umironon Story Site | Story | IC | | • |
| WG337 | Orogwanginpup Settlement Site | Former Village | IC | | • |
| WG338 | Ngaroperem Story Site | Story | IC | • | • |
| WG339 | WWII Clinic Archaeological Site | Archaeological | IC | • | • |
| WG341 | Kafag Airfield Archaeological Site | Archaeological | IC | • | • |

| Site No. | Site Name | Site Type | Location | | |
|----------|------------------------------------|----------------|------------|----------|-------------------|
| | | | Study Area | Worksite | Study Area Buffer |
| WG346 | Tanam Airfield Archaeological Site | Archaeological | IC | • | • |
| WG351 | Spirit Tree Site | Story | BRGEA | | • |

Footnotes to Table 17

| | | | |
|----|---|----|---|
| 1 | MSZ – Mine Subsidence Zone | 11 | MBP – Migiki Borrow Pit |
| 2 | VS – Ventilation Shafts | 12 | HBP – Humphries Borrow Pit |
| 3 | PTA – Portal Terrace Area | 13 | NARBP – Northern Access Road Borrow Pit |
| 4 | PPT – Process Plant Terrace | 14 | MBQ – Mt Beamena Quarry |
| 5 | WMF – Waste Management Facility | 15 | BRGEA – Bavaga River Gravel Extraction Area |
| 6 | WDRWP – Wastewater Discharge/Raw Water Make-up Pipeline | 16 | WRGEA – Waime River Gravel Extraction Area |
| 7 | EM – Explosives Magazine | 17 | MARF – Mine Access Road at Fere |
| 8 | FAF – Fere Accommodation facility | 18 | IC – Infrastructure Corridor |
| 9 | FCAF – Finchif Construction Accommodation Facility | 19 | CA – Coastal Area – including Port Facilities Area and Outfall Area |
| 10 | PGF – Power Generation Facility | 20 | NPHR – Nambonga and Portal haul roads, |

5.1 Mine Study Area

A total of 32 sites are located partially or wholly within the Mine Study Area (Figure 32). These are discussed below with regard to the specific mining components associated with their location.

5.1.1 Maximum Subsidence Zone

- Eight sites are located within the maximum subsidence zone:
 - four story sites
 - one rockshelter
 - one archaeological site
 - one camp site
 - one burial site.
- The rockshelter site, three story sites, the archaeological site and the camp site are located within the proposed maximum subsidence zone.
- One oral tradition site intersects with the study area buffer zone.
- The majority of the maximum subsidence zone study area overlaps with the area investigated during the Additional Works Phase 1 and 2 components of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. This area was comprehensively surveyed in 2013 and the outcomes of the earlier surveys are relevant to the present study area.
- There is a low potential for unrecorded archaeological sites to be located within the maximum subsidence zone study area.
- There is a very low potential for unrecorded oral tradition sites to be located within the maximum subsidence zone study area.

5.1.2 Ventilation Shaft

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The majority of the ventilation shafts study area overlaps with the area investigated during the Additional Works Phase 1 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. This area was comprehensively surveyed in 2013 and the outcomes of the earlier survey are relevant to the present study area.
- There is a low potential for unrecorded archaeological or oral traditions sites to be located within the ventilation shafts study area.

5.1.3 Watut Declines Portal Terrace Area

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The proposed locations of the portal terrace and waste rock dump have not yet been the subject of a formal cultural heritage pedestrian survey.
- The portal terrace and waste rock dump study area is wholly contained within the 2012-2013 Worksite Inspection Program study area, and overlaps with a portion of the area investigated during the Additional Works Phase 3 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. On this basis, the outcomes of the earlier surveys are relevant to the present study area.
- Given the heavily dissected nature of the terrain (which previous surveys in similar environments have demonstrated as being unlikely to contain cultural heritage sites), and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a low potential for unrecorded oral tradition sites to be located within the portal terrace and waste rock dump study area.

5.1.4 Nambonga Decline Portal Terrace and Portal Haul Road

- There are two sites located within the proposed worksite, specifically the Portal Haul Road;
 - One camp site
 - One story site
- Both sites are within the construction zone
- The proposed locations of the portal terrace and waste rock dump have not yet been the subject of a formal cultural heritage pedestrian survey.
- The portal terrace and waste rock dump study area is wholly contained within the 2012-2013 Worksite Inspection Program study area, and overlaps with a portion of the area investigated during the Additional Works Phase 3 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. On this basis, the outcomes of the earlier surveys are relevant to the present study area.
- 95% of the portal terrace study area overlaps with areas investigated during the 2012-2013 Worksite Inspection Program and the 2013-2014 Additional Works Program. On this basis, the outcomes of the earlier surveys are relevant to the present study area.
- Given the heavily dissected nature of the terrain (which previous surveys in similar environments have demonstrated as being unlikely to contain cultural heritage sites), and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a low potential for unrecorded oral tradition sites to be located within the portal terrace area.

5.1.5 Miapilli Waste Rock Dump and Miapilli Clay Borrow Pit

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The waste rock dump and clay borrow pit study area is wholly contained within the 2013-2014 Additional Works Program study area. On this basis, the outcomes of the earlier surveys are relevant to the present study area.
- Given the heavily dissected nature of the terrain (which previous surveys in similar environments have demonstrated as being unlikely to contain cultural heritage sites), and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a low potential for unrecorded oral tradition sites to be located within the portal terrace area.

5.1.5 Nambonga Haul Road and Portal Haul Road

- There is one cultural heritage site identified within Portal Haul Road study area buffer zone.
- There are no cultural heritage sites identified within the Nambonga Haul Road worksite or study area buffer zone.
- The Portal Haul Road study area is wholly contained within the the 2012-2013 Worksite Inspection Program study area. The Nambonga Haul Road study area largely overlaps with the 2013-2014 Additional Works Program study area. On this basis, the outcomes of the earlier surveys are relevant to the present study area.
- Given the heavily dissected nature of the terrain (which previous surveys in similar environments have demonstrated as being unlikely to contain cultural heritage sites), and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a low potential for unrecorded oral tradition sites to be located within the portal terrace area.

5.1.6 Process Plant Terrace (including the Watut process plant, raw water dam and sedimentation dam)

- One oral tradition site is located within the proposed worksite.
- There are no cultural heritage sites identified within the study area buffer zone.
- 85% of the process plant terrace study area overlaps with portions of the area investigated during the Additional Works Phase 3 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. On this basis, the outcomes of the earlier survey are relevant to the present study area.
- Given the nature of the terrain and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a low potential for unrecorded oral tradition sites to be located elsewhere within the process plant terrace study area.

5.1.7 Waste Management Facility

- One cultural heritage site is located within the proposed worksite or study area buffer zone.
- 100% of the waste management facility study area overlaps with the Watut TSF study area investigated during the 2015 Mine Area Infrastructure Surveys. The Watut TSF study area was comprehensively surveyed and the outcomes of the survey are relevant to the present study area.
- There is a low potential for unrecorded archaeological or oral traditions sites to be located within the waste management facility study area.

5.1.8 Wastewater Discharge and Raw Water Make-Up Pipelines

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The proposed alignment of the wastewater discharge pipeline has not yet been the subject of a formal cultural heritage pedestrian survey.⁷
- Given the location of this study area on the Watut River floodplain and the lower slopes of the *kunai* grassland foothills at *Fere*, and the fact that cultural heritage sites have previously been recorded elsewhere on the floodplain and the *Fere* grasslands, there is a moderate to high potential for unrecorded oral tradition and archaeological sites to be located elsewhere within the wastewater discharge pipeline/raw water make-up pipeline study area.

5.1.9 Lower Papas Aggregate Source and Overburden Stockpile

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The proposed Lower Papas aggregate source and overburden stockpile is wholly contained within the Watut TSF study area, which was comprehensively assessed during the 2015 Mine Area Infrastructure Surveys. It also borders on the area investigated during the 2012-2013 Worksite Inspection Program. On this basis, the potential for the worksite to contain cultural heritage sites additional to those identified within the Watut TSF study area is considered to be low.

5.1.10 Explosives Magazine

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The proposed location of the explosives magazine has not yet been the subject of a formal cultural heritage pedestrian survey.
- The proposed explosives magazine worksite is wholly contained within the Watut TSF study area, which was comprehensively assessed during the 2015 Mine Area Infrastructure Surveys. On this basis, the potential for the explosives magazine worksite to contain cultural heritage sites additional to those identified within the Watut TSF study area is considered to be low.

5.1.11 Fere Accommodation Facility

- Eight archaeological sites are located within the proposed worksite associated with the Fere Accommodation Facility.
- Five of these sites are within the worksite itself and three are within the buffer zone
- Formal archaeological sample survey methodologies (area and transect) were employed on the *kunai* grassland foothills comprising the study area during the 2015 Mine Area Infrastructure Surveys. Archaeological sites comprising low density artefact scatters containing either ceramic sherds (including decorated and undecorated) or stone artefacts (including flaked and ground-edge) were identified across the extended study area investigated at that time.
- On this basis, there is a moderate to high potential for unrecorded archaeological sites to be located within the proposed worksite.

⁷ All infrastructure areas not previously surveyed will be identified and the need for their survey prior to construction commencing included as a management measure under the provisions of the Project cultural heritage management plan.

- Given the strong community consultation focus employed during the 2015 Mine Area Infrastructure Surveys, there is only a very low potential for unrecorded oral tradition sites to be located elsewhere within the Fere Accommodation Facility study area.

5.1.12 Finchif Construction Accommodation Facility

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The proposed location of the extended Finchif Construction Accommodation Facility has not yet been the subject of a formal cultural heritage pedestrian survey.
- Cultural heritage sites were briefly recorded along the existing Watut Valley Road north and south of the study area during previous field programs, including the 2007 SRI field program and the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program.
- Based on this observation and the outcomes of the predictive modelling exercise (refer Section 3.3.1.1), which noted that Babuaf, Hengambu and Yanta cultural heritage sites can occur almost anywhere within their present occupied range, there is a moderate potential for additional cultural heritage sites (particularly oral tradition sites) to exist within the Finchif Construction Accommodation Facility study area.

5.1.13 Power Generation Facilities

- There are no cultural heritage sites identified within the proposed worksite or study area buffer zone.
- The proposed location of the power generation facilities has not yet been the subject of a formal cultural heritage pedestrian survey.
- Cultural heritage sites were briefly recorded along the existing Watut Valley Road north and south of the study area during previous field programs, including the 2007 SRI field program and the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program.
- Based on this observation and the outcomes of the predictive modelling exercise (refer Section 3.3.1.1), which noted that Babuaf, Hengambu and Yanta cultural heritage sites can occur almost anywhere within their present occupied range, there is a moderate potential for cultural heritage sites (particularly oral tradition sites) to have existed within the power generation facilities study area. It should be noted, however, that this location is currently used as a laydown area, which was cleared of vegetation and levelled during its preparation. It is therefore extremely unlikely that any unrecorded cultural heritage sites which may have been located in the study area prior to this disturbance have been retained intact.

5.1.14 Mt Beamena Quarry

- Three sites are located within the proposed worksite.
 - Two story sites
 - One archaeological site
- Two sites are situated within the construction zone; the archaeological site and a story site.
- A further story site (WG005) has an indeterminate extent and it is unclear as to whether this site is within the construction zone.
- The proposed location of the Mt Beamena Quarry and associated laydown and quarry stockpile areas and access roads were assessed during cultural heritage surveys undertaken as part of the 2015 Mine Area Infrastructure Survey and 2015-2016 Northern Access Road Survey programs. Given the focus on community consultation and the nature of the terrain, there is little potential for additional oral tradition or archaeological sites to be located in the Mt Beamena quarry study area.

5.1.15 Humphries Borrow Pit

- There are no cultural heritage sites identified within the proposed worksite.
- The proposed location of the Humphries borrow pit was included in a cultural heritage survey investigating the Northern Access Road corridor during the 2015-2016 Northern Access Road Survey program.
- Given the focus on community consultation and the nature of the terrain, there is little potential for additional oral tradition or archaeological sites to be located in the Humphries borrow pit study area.

5.1.16 Northern Access Road Borrow Pit

- One burial site is located within the proposed worksite.
- Although the western margin of the proposed worksite was investigated during cultural heritage surveys undertaken as part of the 2015 Mine Area Infrastructure Survey program, the majority of the Northern Access Road borrow pit study area has not yet been the subject of a formal cultural heritage pedestrian survey.
- Given the outcomes of previous community consultation and the location of the study area in relation to other recorded cultural heritage places, there is a moderate potential for additional oral tradition or archaeological sites to be located in the Northern Access Road borrow pit study area.

5.1.17 Migiki Borrow Pit

- There is one oral tradition site (a story site) located within the study area buffer zone.
- 100% of the Migiki borrow pit study area overlaps with portions of the area investigated during the Additional Works Phase 1 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. On this basis, the outcomes of the earlier survey are relevant to the present study area.
- Given the nature of the terrain, the fact that the borrow pit has been operating since at least 2012, and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a very low potential for unrecorded archaeological or oral tradition sites to be located elsewhere within the Migiki borrow pit study area.

5.1.18 Bavaga River Gravel Extraction Area

- There is one oral tradition site (a story site) is located within the study area buffer zone.
- There are no cultural heritage sites identified within the proposed worksite.
- The proposed location of the Bavaga River gravel extraction area has not yet been the subject of a formal cultural heritage pedestrian survey.
- Given the outcomes of previous community consultation and the location of the study area in relation to recorded cultural heritage places, there is a low to moderate potential for oral tradition sites to be located in the Bavaga River gravel extraction area study area.
- Given the location of the study area on an active river floodplain that is regularly inundated, there is a low potential for unrecorded archaeological sites to be located in the proposed Bavaga River gravel extraction area study area.

5.1.19 Waime River Gravel Extraction

- There are two oral tradition sites (story sites) located within the proposed worksite.

- Approximately 50% of the Waime River gravel extraction area study area overlaps with portions of the area investigated during the Additional Works Phase 3 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. On this basis, the outcomes of the earlier survey are relevant to the present study area.
- Given that the borrow pit has been in operation since at least 2014, and the strong community consultation focus employed during the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program, there is a low potential for unrecorded archaeological or oral tradition sites to be located elsewhere within the Waime River gravel extraction area study area.

5.1.20 Mine Access Road at Fere

- One archaeological site is located within the proposed worksite.
- No cultural heritage sites have been identified within the study area buffer.
- The proposed location of the Mine Access Road at Fere has not yet been the subject of a formal cultural heritage pedestrian survey.
- The northern half of the study area lies immediately adjacent to the Fere Accommodation Facility study area. Formal archaeological sample survey methodologies (area and transect) were employed on the *kunai* grassland foothills comprising the study area during the 2015 Mine Area Infrastructure Surveys. Archaeological sites comprising low density artefact scatters containing either ceramic sherds (including decorated and undecorated) or stone artefacts (including flaked and ground-edge) were identified across the extended study area investigated at that time.
- Cultural heritage sites were briefly recorded along the existing Watut Valley Road immediately north of the study area during earlier field programs, including the 2007 SRI field program and the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program.
- On this basis, there is a moderate to high potential for unrecorded archaeological sites to be located within the proposed worksite.
- Given the community consultation focus employed during the 2015 Mine Area Infrastructure Surveys, there is only a low potential for unrecorded oral tradition sites in this area.

5.2 Infrastructure Corridor Study Area

A total of 29 sites are located partially or wholly within the Infrastructure Corridor Study Area. These are discussed below with regard to the specific mining components associated with their location. It should be noted that due to the Infrastructure Corridor Study Area and Mine Study Area overlapping in some locations, four of these sites are also located in the Mine Study Area.

5.2.1 Southern Study Area

- A total of 13 sites are oral tradition sites and one archaeological site are located in the Southern Study Area (Figure 33):
 - 5 archaeological sites
 - 1 camp site
 - 2 former village
 - 4 story sites
 - 1 subsistence/ trade site.
- Of these, 8 are located in the proposed construction right of way while the remaining 5 are located within the study area buffer.

- The southernmost ~2km overlaps with portions of the area investigated during the Additional Works Phase 3 component of the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program. On this basis, the outcomes of the earlier survey are relevant to the present study area.
- With regard to the remainder of the Southern Study Area, cultural heritage sites were briefly recorded in the vicinity of and within the area during previous field programs, including the 2007 SRI field program and the 2012-2014 Project Pre-Feasibility Optimisation Cultural Heritage Studies Program.
- Based on this observation and the outcomes of the predictive modelling exercise (refer Section 3.3.1.1), which noted that Babuaf, Hengambu and Yanta cultural heritage sites can occur almost anywhere within their present occupied range, there is a moderate potential for additional cultural heritage sites (particularly oral tradition sites) to exist elsewhere within the Southern Study Area.

5.2.2 Central Study Area

- A total of eight sites are located within the Central Study Area (Figure 34):
 - 1 burial
 - 2 former villages
 - 5 story sites.
- All of these sites are located in the proposed construction right of way.
- The Central Study Area was comprehensively investigated during the 2015-2016 Northern Access Road Survey program.
- Given the strong focus on community consultation and the high degree of survey coverage, there is little potential for additional, as yet unidentified oral tradition or archaeological sites to be located in the Central Study Area.

5.2.3 Eastern Study Area

- A total of eight sites are located within the Eastern Study Area (Figure 35):
 - 4 story sites
 - 4 archaeological sites.
- Of these three are located within the construction right of way and five are within the buffer zone.
- The Eastern Study Area was comprehensively investigated during the 2017 Infrastructure Corridor Eastern Study Area survey.
- Given the strong focus on community consultation and the high degree of survey coverage, there is little potential for additional, as yet unidentified oral tradition or archaeological sites to be located in Eastern Study Area.

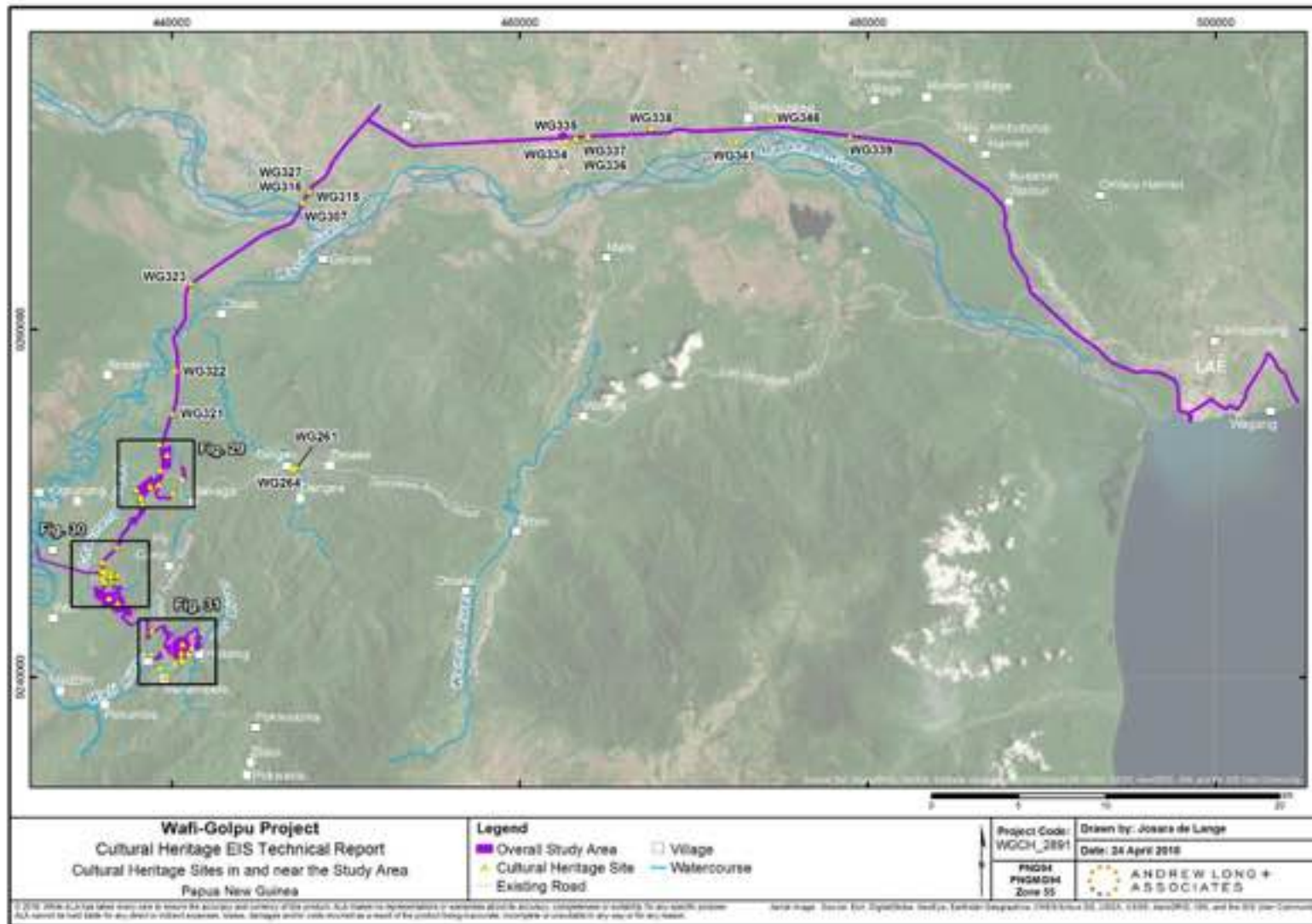


Figure 28: Infrastructure Corridor Study Area - Cultural Heritage Sites

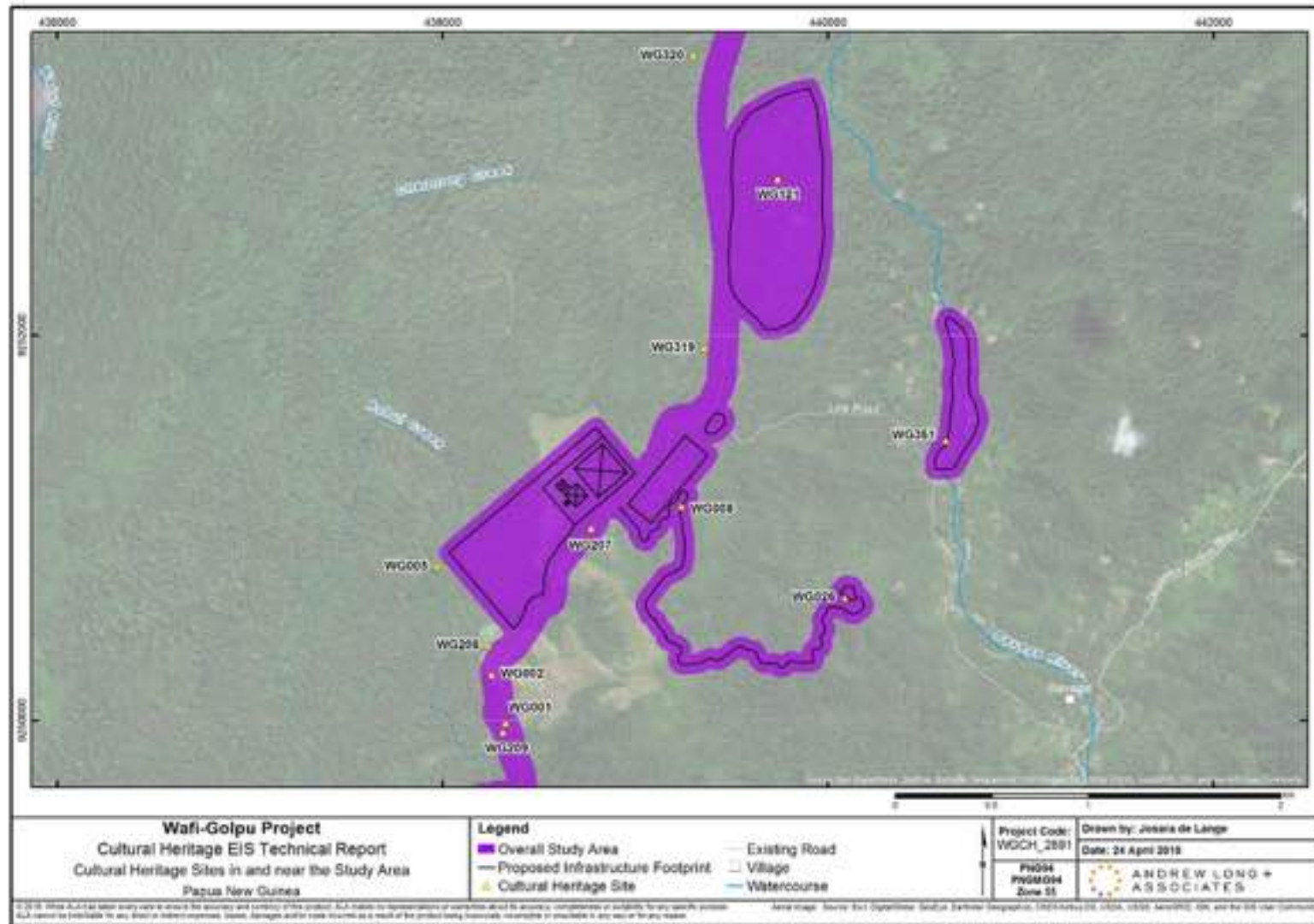


Figure 29: Detail Map 1 - Infrastructure Corridor Study Area - Cultural Heritage Sites

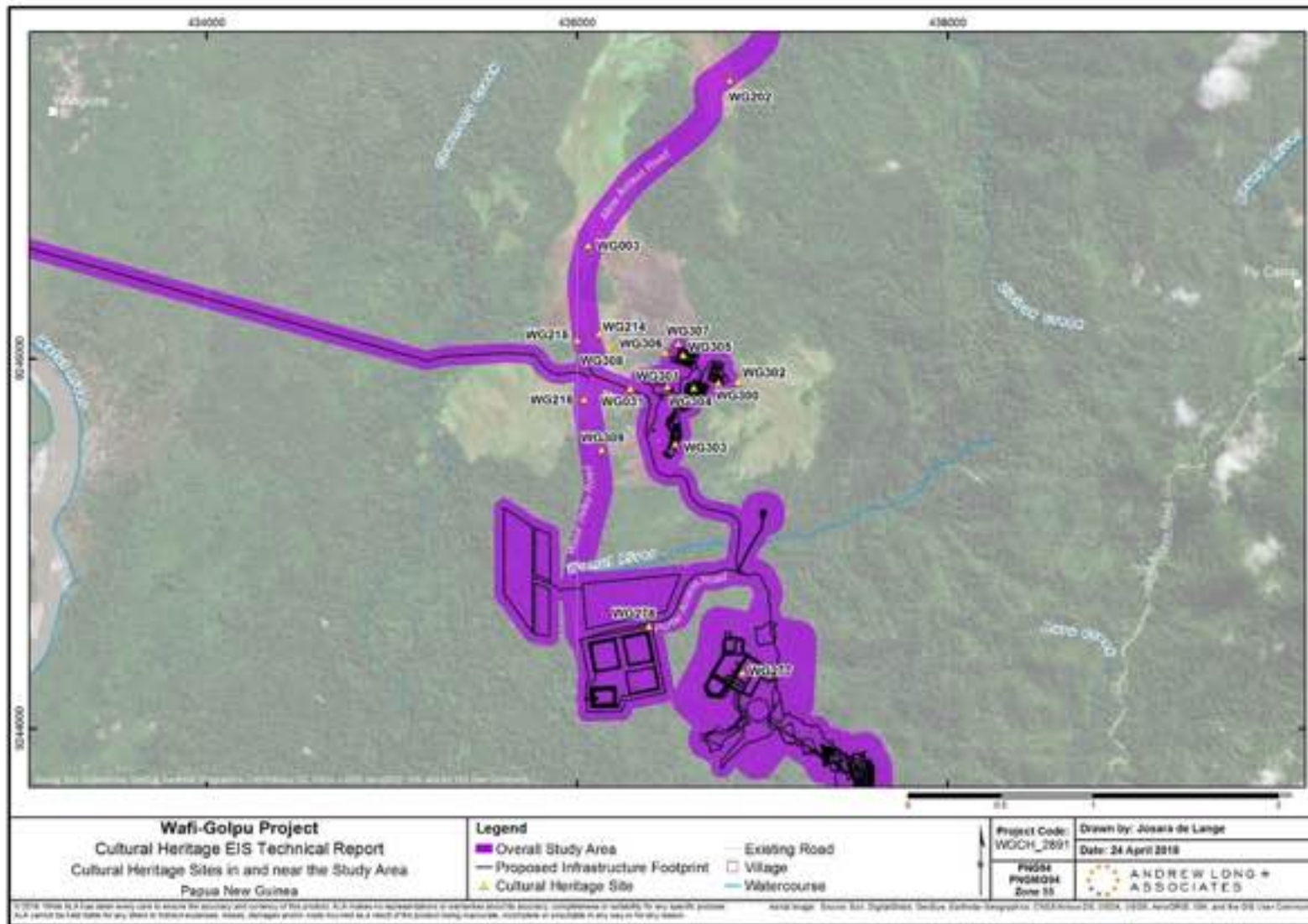


Figure 30: Detail Map 2 - Infrastructure Corridor Study Area - Cultural Heritage Sites

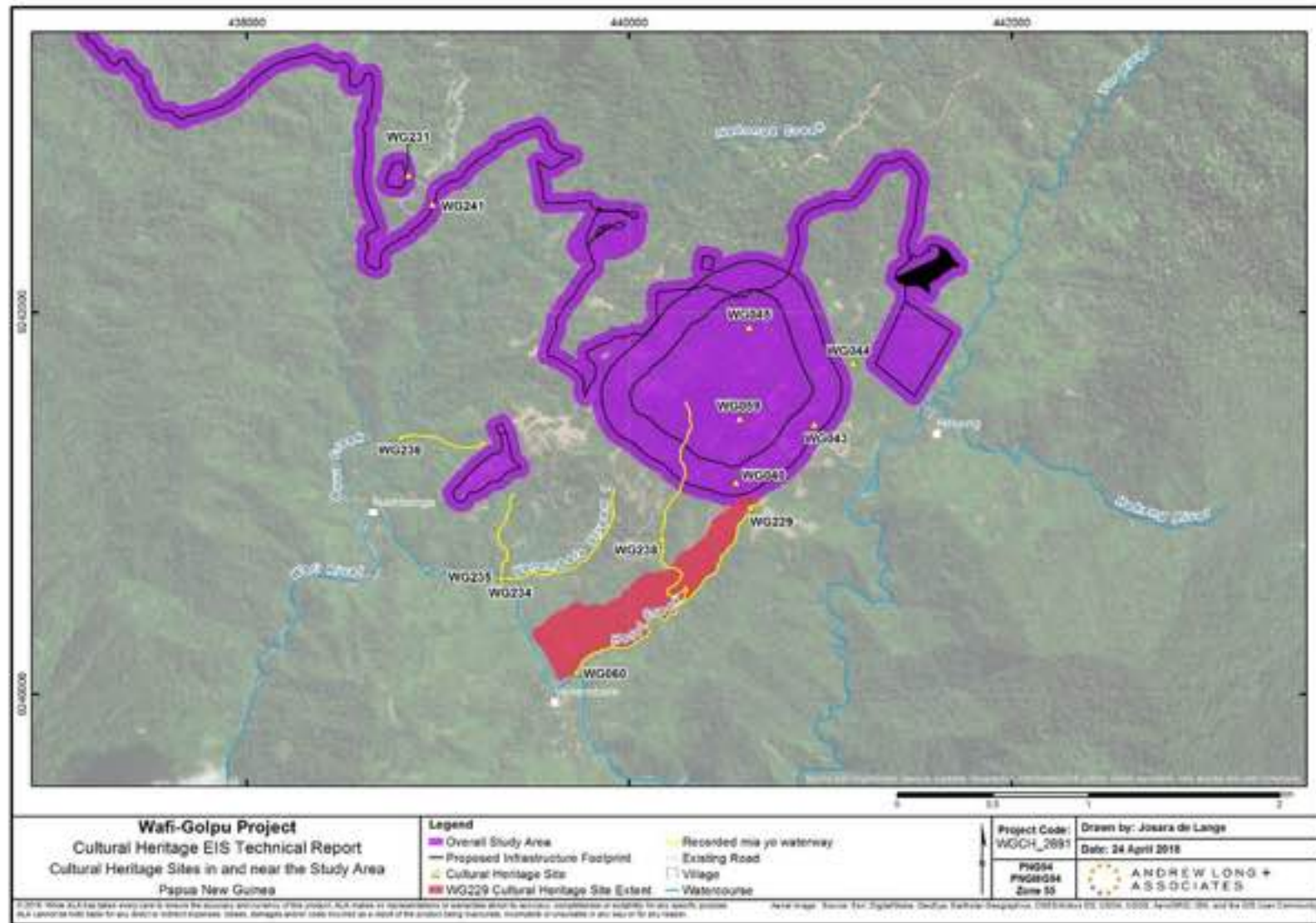


Figure 31: Detail Map 3 - Infrastructure Corridor Study Area - Cultural Heritage Sites

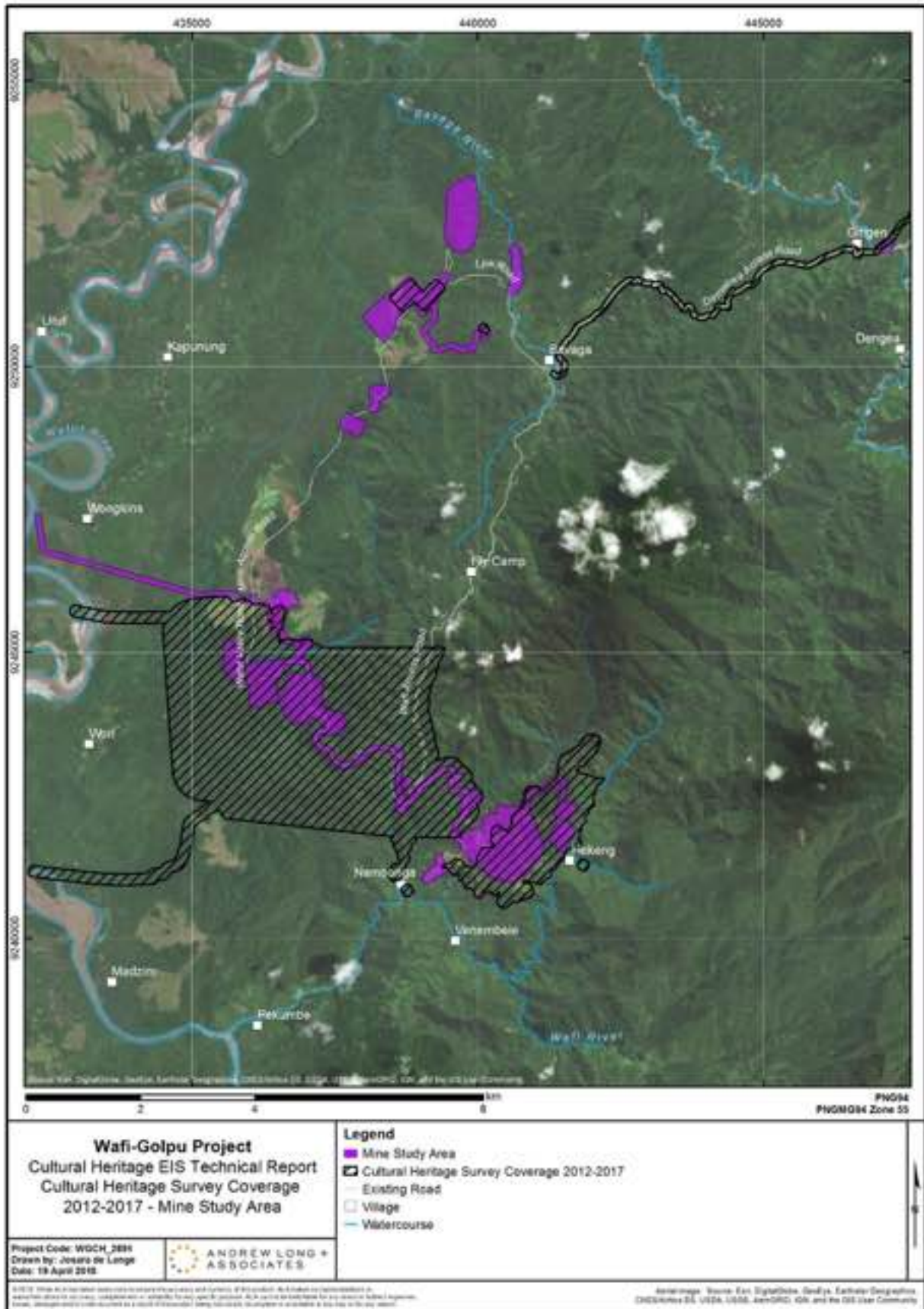


Figure 32: Cultural heritage survey coverage in relation to the Mine Study Area

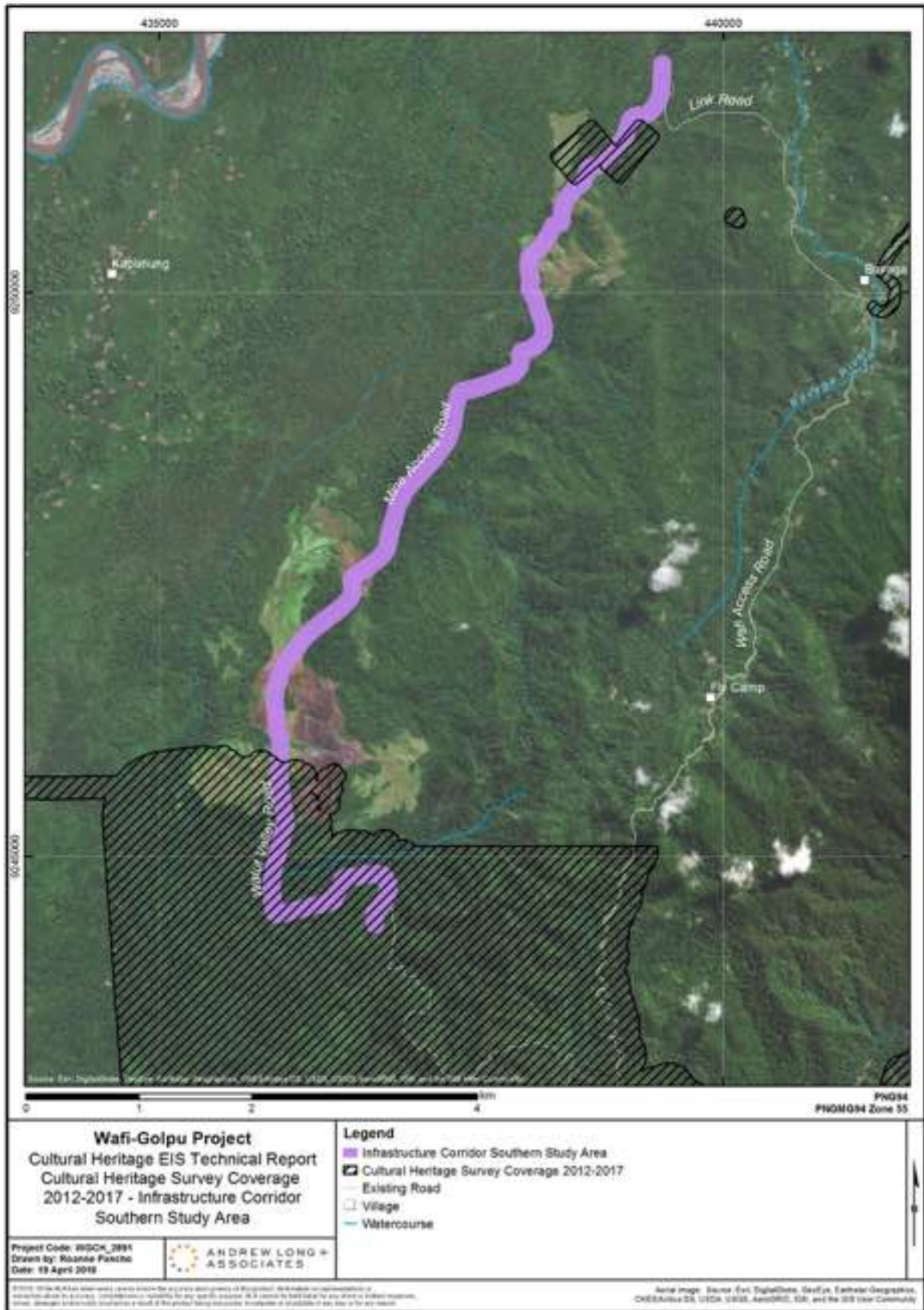


Figure 33: Cultural heritage survey coverage in relation to the Infrastructure Corridor (Southern) Study Area

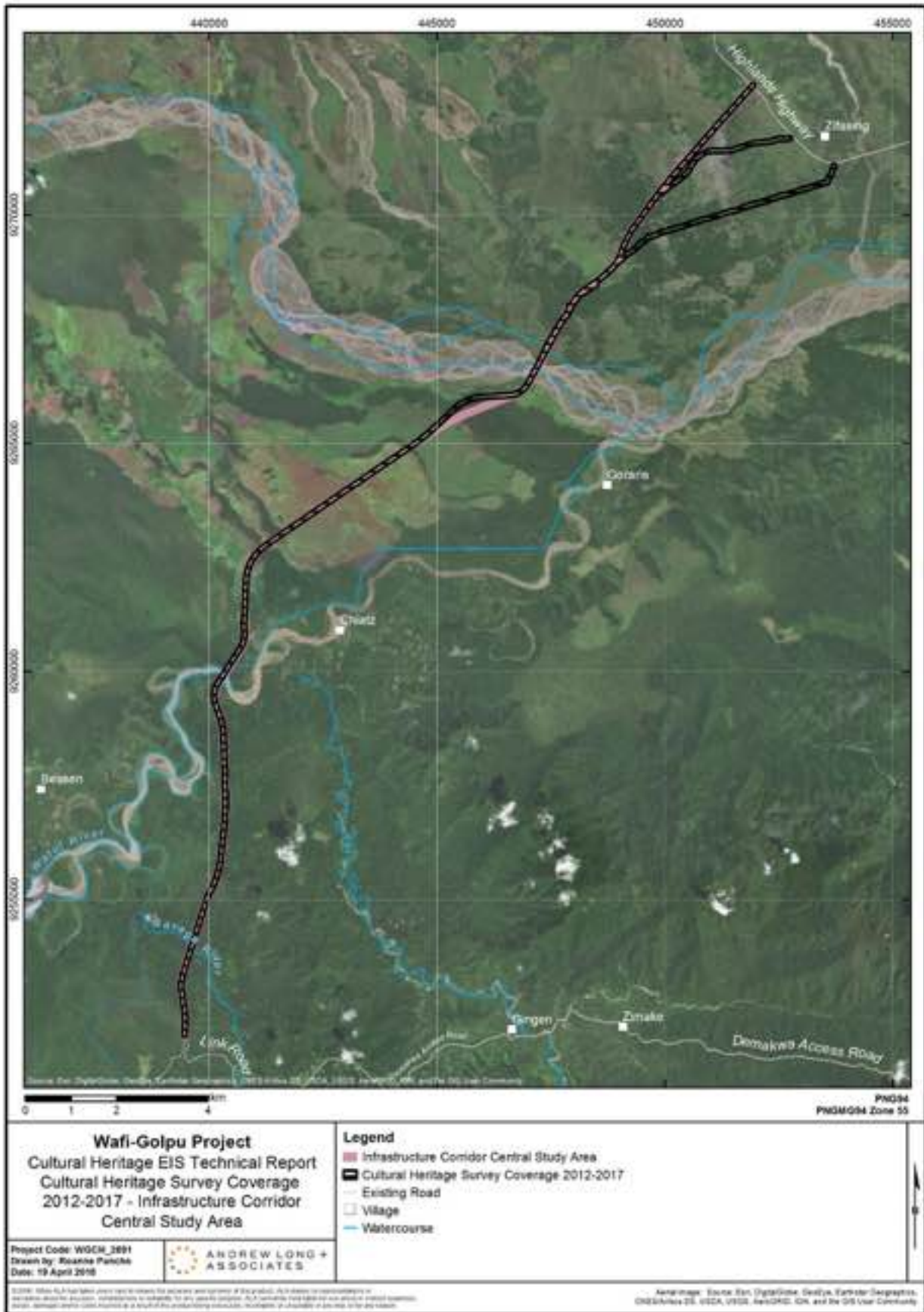


Figure 34: Cultural heritage survey coverage in relation to the Infrastructure Corridor (Central) Study Area

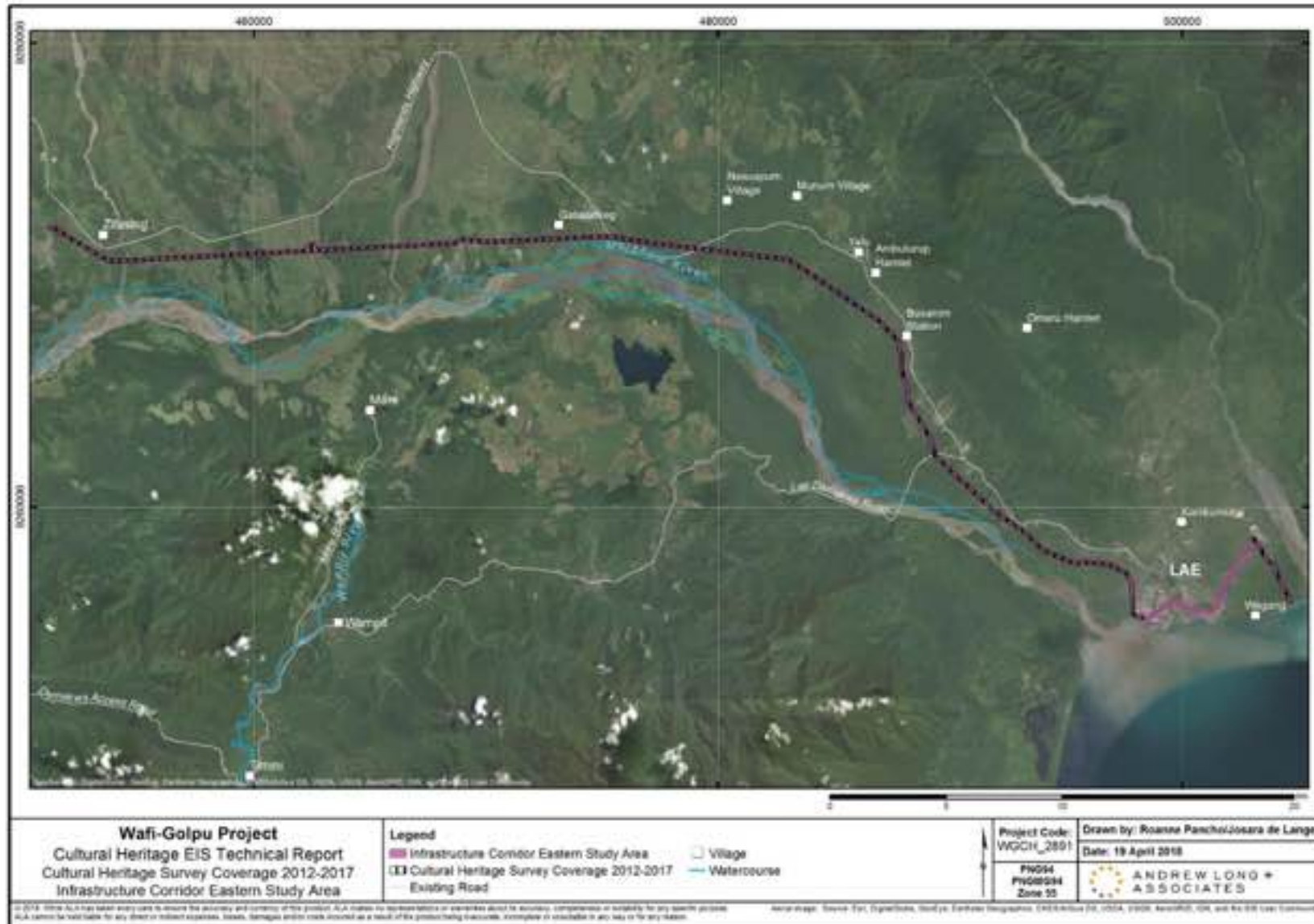


Figure 35: Cultural heritage survey coverage in relation to the Infrastructure Corridor (Eastern) Study Area

5.3 Coastal Study Area

5.3.1 Port Facilities Study Area

- There are no cultural heritage sites previously recorded within the proposed worksite or study area buffer.
- Although the Port Facilities study area was not subject to a cultural heritage field survey, ground surfaces within the study area have been significantly disturbed as a result of the construction and continued operation of the Port of Lae over many years. It is therefore extremely unlikely that any unrecorded cultural heritage sites which may have been located in the study area prior to this disturbance have been retained intact.

5.3.2 Outfall Study Area

- There are no cultural heritage sites identified in the worksite or study area buffer.
- The general location of the Outfall Study Area was comprehensively investigated during the 2017 Infrastructure Corridor Eastern Study Area survey.
- Given the focus on community consultation and the survey coverage, there is little potential for additional, as yet unidentified oral tradition or archaeological sites to be located in the Outfall Study Area.

6 IMPACT ASSESSMENT

6.1 Potential Impacts to Cultural Heritage

Tangible and intangible cultural heritage sites identified within the study areas have the potential to be impacted by Project activities as a result of:

- Direct disturbance due to on-ground works including vegetation clearance, topsoil stripping, subsoil excavation, the creation of borrow pits, spoil and waste rock dumps, and ground subsidence caused by underground mining.
- Direct disturbance due to the movement of Project employees and contractors and their vehicles (e.g. erosion, unauthorised removal of artefacts).
- Indirect disturbance due to associated population growth that increases the movement of people and vehicle traffic.
- Physical modifications to the land resulting in the destruction of some sites and their loss from living memory and, hence, from oral tradition.
- Disturbance to ecosystems through environmental impacts on landform and soils, water resources and hydrology, and biodiversity, which have the potential to affect cultural heritage sites that are identified on the basis of these extant systems (e.g. *ples tambu* story sites associated with water).
- Restricted physical access of communities to cultural heritage sites on account of Project activities and operational requirements. This includes the proposed resettlement of Hekeng, Nambonga and Venembele villages which are located in the Special Mining Lease (SML) 10 application area.

The baseline assessment presented in Sections 4 and 5 considered the potential for Project-related activities to directly impact cultural heritage sites within the study areas as defined in Section 3.4. The baseline assessment determined that these activities have the potential to impact on the cultural heritage sites listed in Table 19 and depicted in Figure 36, 37, 38 and 39.

In general, the construction phase of the Project will result in the greatest level of impact to cultural heritage sites due to extensive vegetation clearance and ground surface disturbance, a significant increase in the size of the construction-related workforce, and an increase in vehicle traffic. These factors would increase the potential for direct and indirect impacts on cultural heritage.

Cultural heritage sites located directly above and in the immediate vicinity of the Golpu orebody will be unavoidably impacted as a result of the mining process. The Wafi-Golpu Joint Venture (WGJV) proposes to extract ore using an underground 'block caving' method, which will likely result in subsidence of the ground surface above the extracted ore block. The depth of the subsidence zone generally relates to the mass of rock removed by mining while its lateral extent reflects both the surface topography, subsurface structures (e.g., faults) and the lateral extent of the orebody below. As a result, any cultural heritage sites located within the subsidence zone, including story sites associated with topographic and environmental features such as areas of forest considered as *ples tambu*, rockshelters, boulders, creeks and springs, would be unavoidably impacted.

In addition to these impacts, research carried out on behalf of WGJV by Worley Parsons (2016) and updated by Piteau Associates (2017) indicates that operational dewatering of the declines and the block caves during the life of the mine may potentially result in:

- The partial de-watering of aquifers above and near the declines, with potential impacts on groundwater users (e.g., springs used by local people) and groundwater dependant ecosystems.
- The interception of groundwater flow which would have under natural conditions discharged into the surface drainages, provided baseflow to the creeks and rivers, or contributed to deeper regional groundwater flow.

A reduction in groundwater levels may reduce groundwater baseflow to springs and surface watercourses. The predicted extent of groundwater drawdown due to inflows into the mine's block caves at the end of mining (year 37) (the peak year of groundwater drawdown) is depicted in Figure 40.

In addition to WG043 Mea Gova Biangova Sacred Spring Site and WG238 Mia Yo D, which were included in the original suite of 55 sites to be included in the impact assessment (Table 17), a further five oral tradition sites (WG044 Mea Gova Tongova Sacred Spring Site, WG060 Mia Yo Sacred Spring Site, WG234 Mia Yo A, WG235 Mia Yo B and WG236 Mia Yo C) identified by the Hengambu or the Yanta based on their association with water, are located within the simulated dewatering zone and therefore have the potential to be impacted by this aspect of the Project's operation. On this basis, these five cultural heritage sites have also been included in the cultural heritage impact assessment.

The villages which lie within the Special Mining Lease (SML) 10 application area that are intended to be resettled include Hekeng, Nambonga and Venembele. Furthermore, a number of protocols are likely to be agreed with communities with regard to access to and the use of land within SML 10 after villages are resettled. This resettlement program has the potential to restrict communities' physical access to, and the regularity of their engagement with, cultural heritage sites. This is likely to include some graves and cemeteries. There may be a need to resettle individual households along the Infrastructure Corridor if route adjustments are not possible during detailed design.

A full appreciation of cultural heritage impacts associated with resettlement activities is subject to further consultation with the affected villages during 2018-2019 and, as such, is not detailed further in this impact assessment. Importantly, future consultation with the affected villages will identify actions that will need to take place to address these impacts. It is expected that agreed actions will be recorded as part of resettlement agreements with communities and also reflected in future updates to the Project's Cultural Heritage Management Plan (see section 6.3.2).

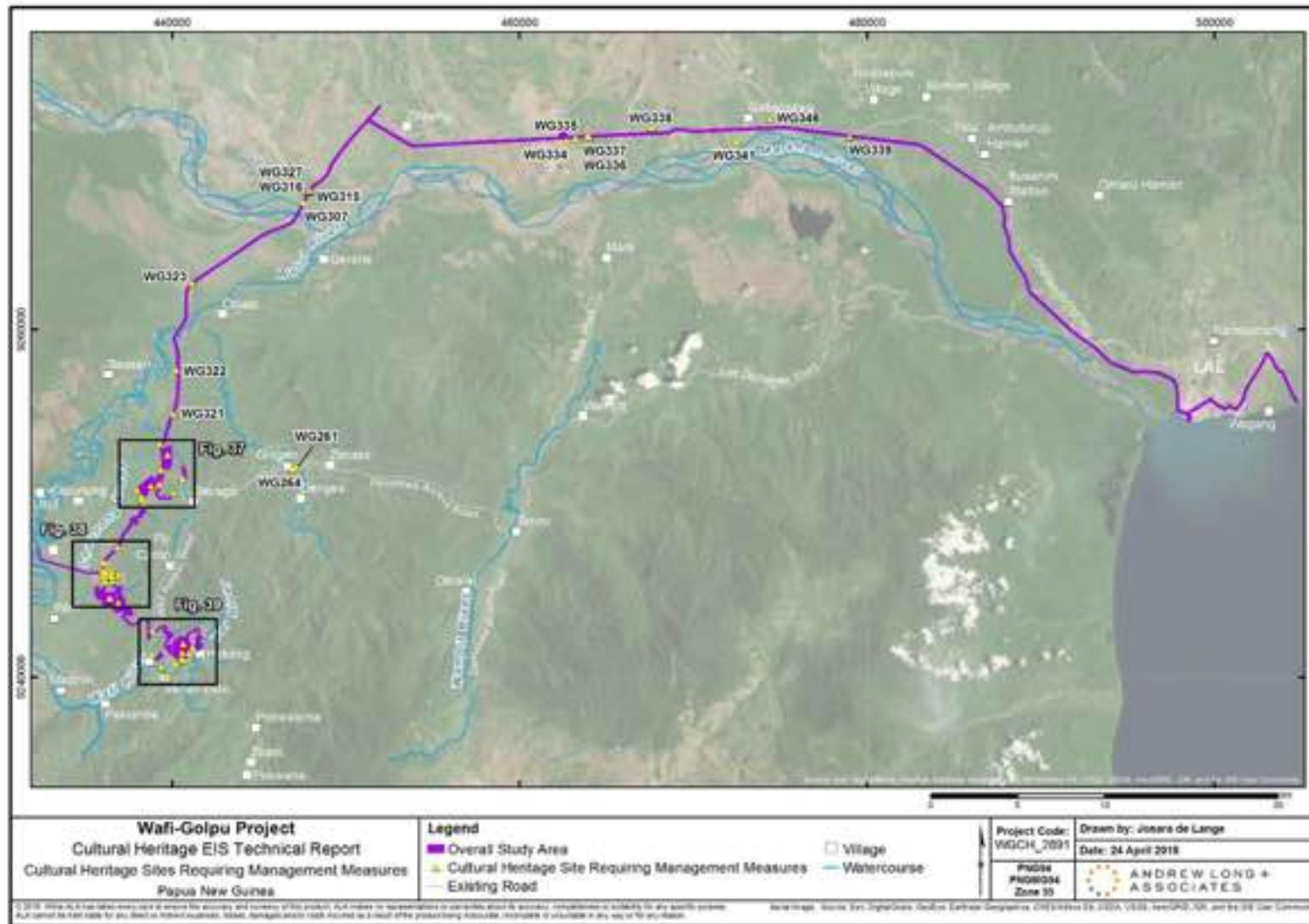


Figure 36: Impact Assessment - Cultural Heritage Sites

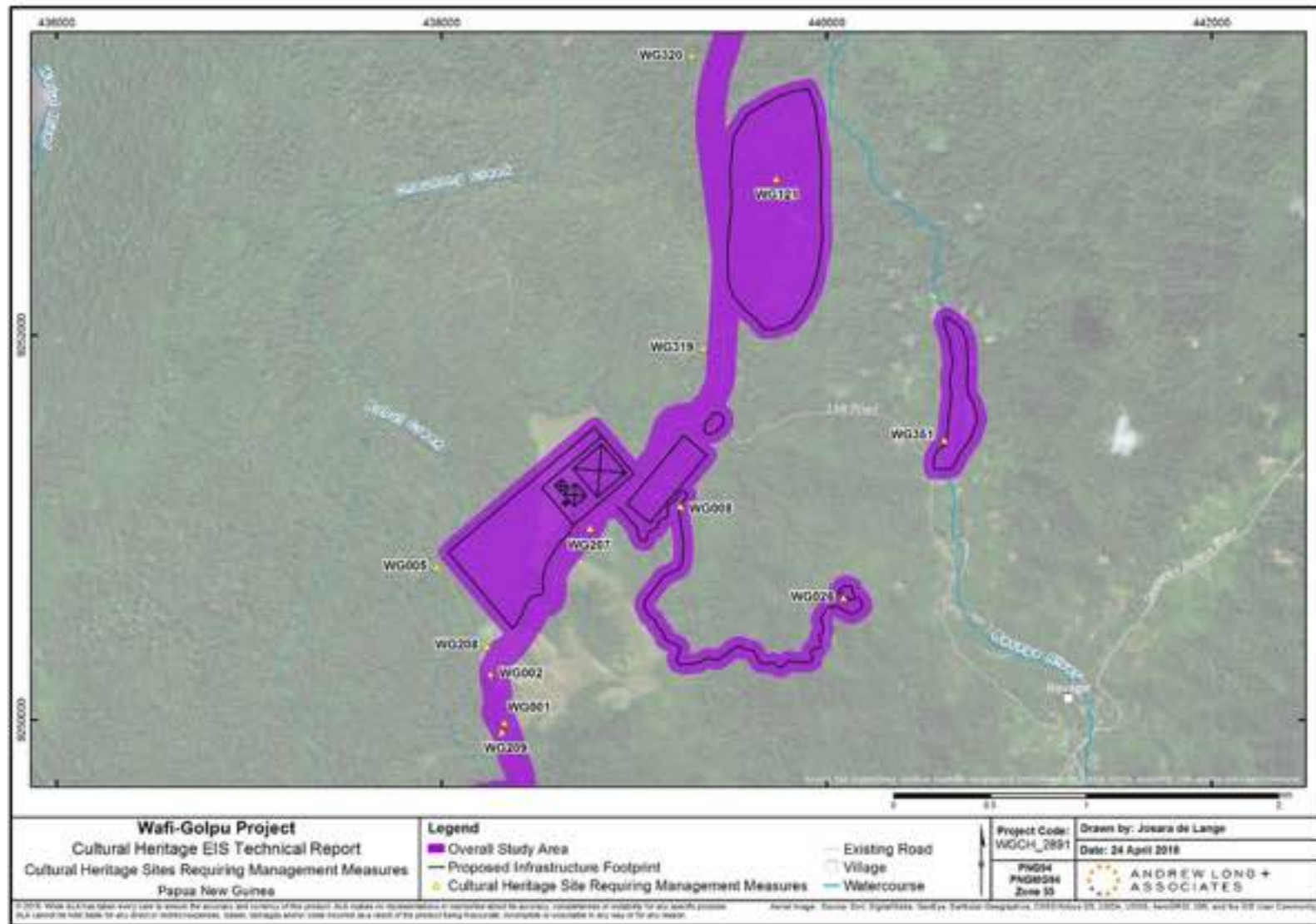


Figure 37: Detail Map 1 – Impact Assessment - Cultural Heritage Sites

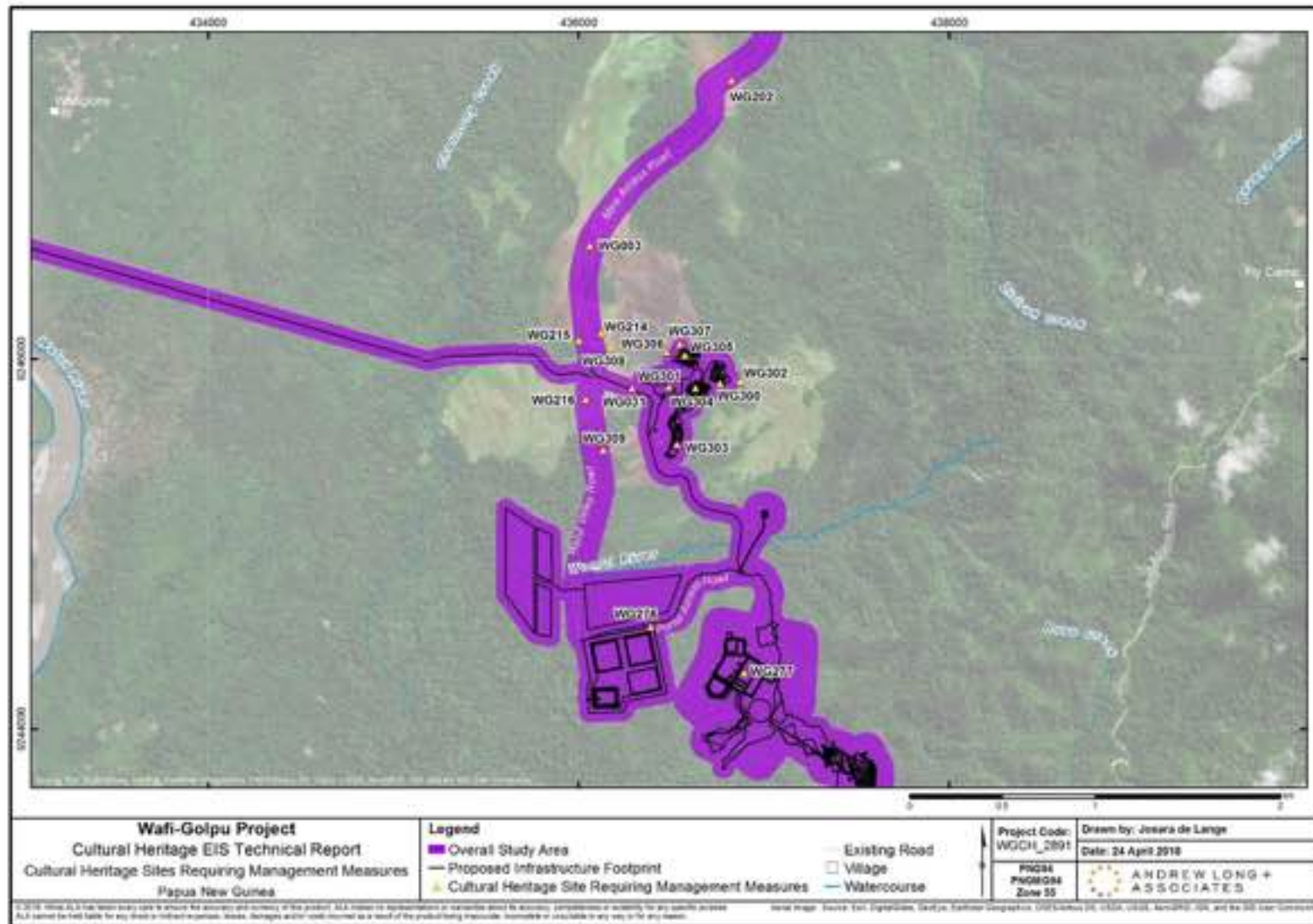


Figure 38: Detail Map 2 – Impact Assessment - Cultural Heritage Sites

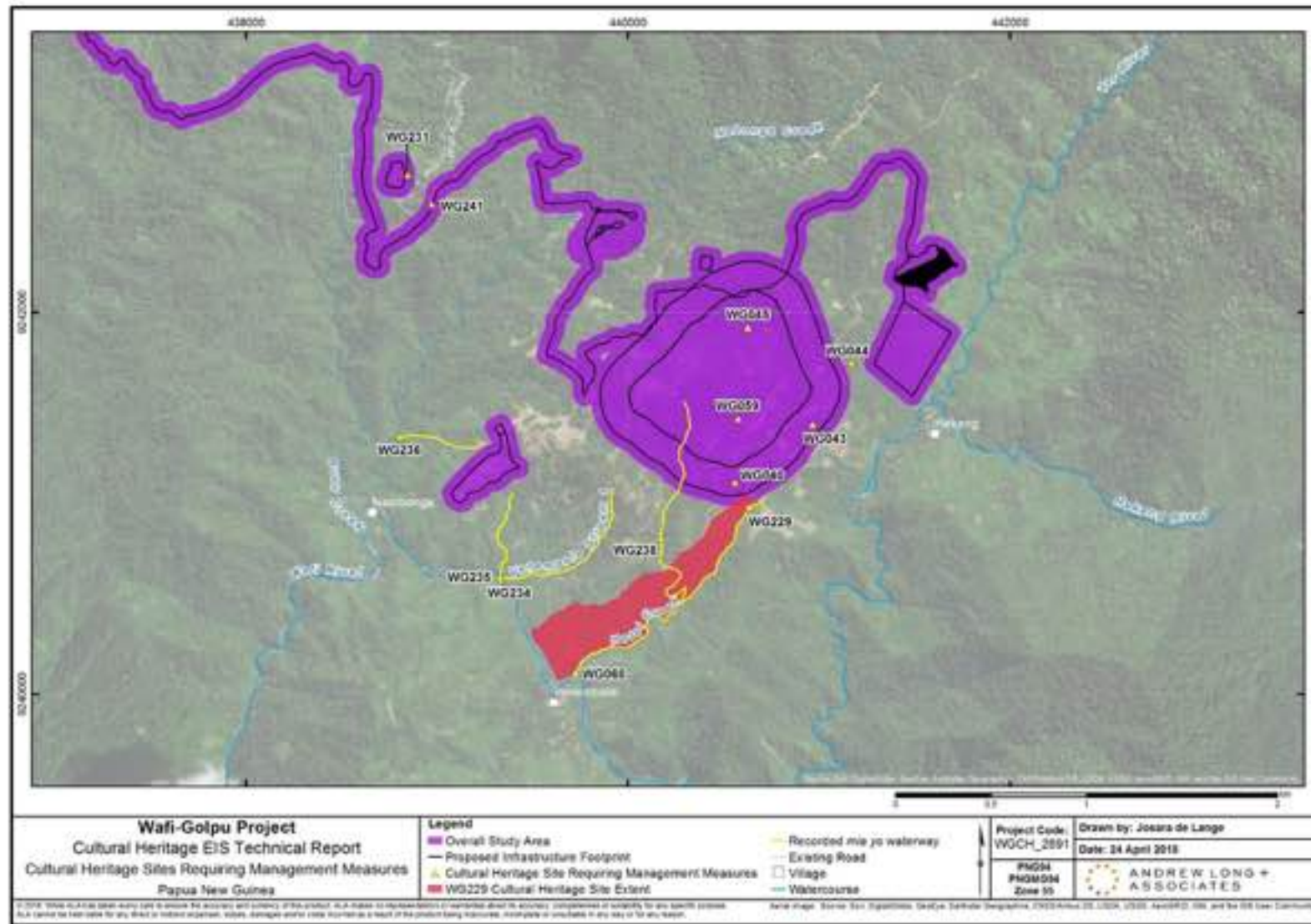


Figure 39: Detail Map 3 – Impact Assessment - Cultural Heritage Sites

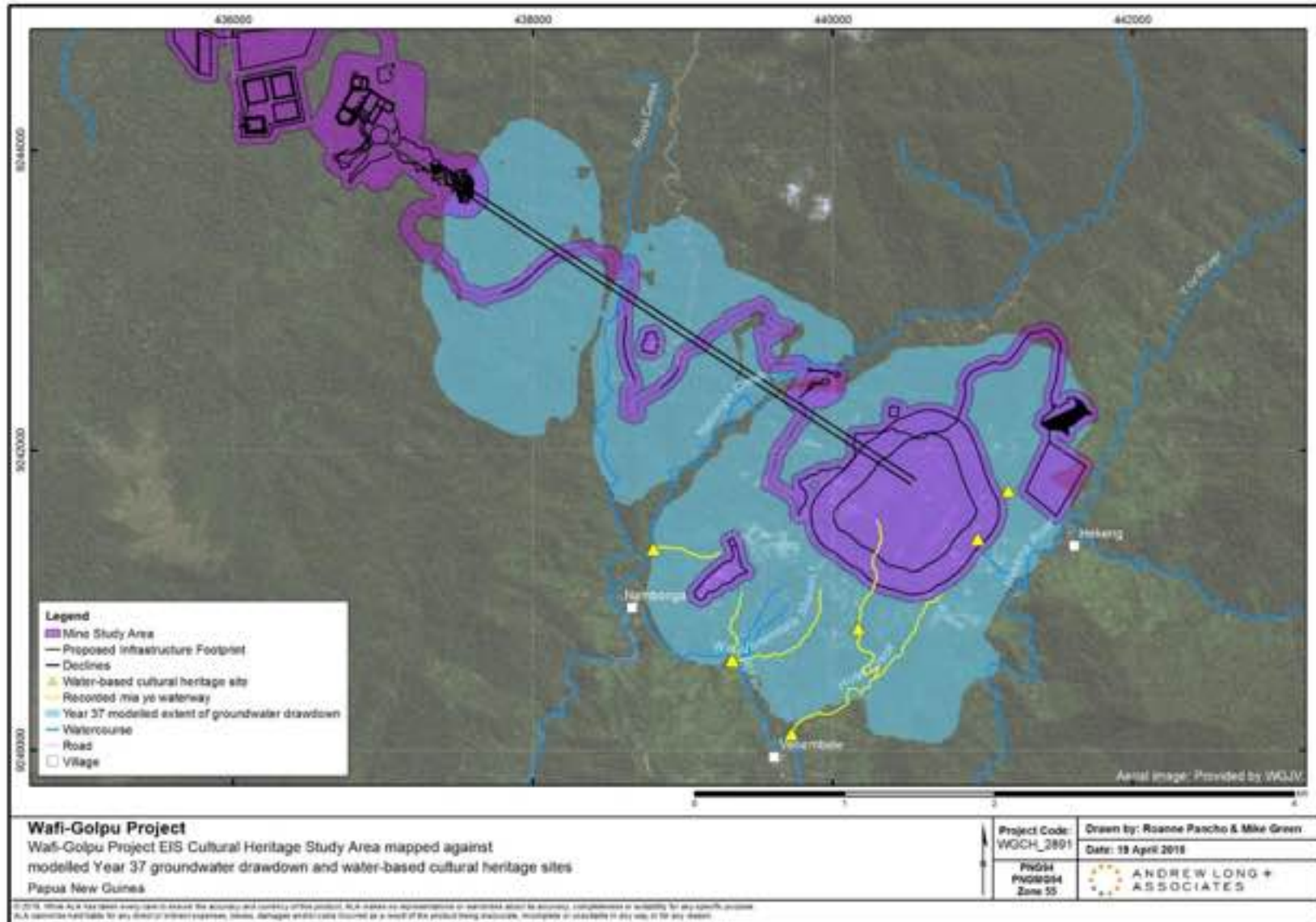


Figure 40: Simulated groundwater drawdown contours (year 37) mapped against water-associated cultural heritage sites

6.2 Recorded Cultural Heritage Site Significance Assessment

The significance of each of the 60 cultural heritage sites included in the impact assessment was determined using the criteria and rating scales outlined in Section 3.3.2.2. The overall significance rating derived for each cultural heritage site was based on the highest rating recorded across the range of criteria.

The results of the recorded cultural heritage site significance assessment are presented in Table 18.

Table 18: Cultural heritage site significance assessment

| Site No. | Site Name | Site Type | Significance Criteria | | | | | | | | | Significance Rating (highest criterion) |
|----------|---|----------------|-----------------------|------------|-------------------------|------|------|-------|--------|-----------|---------|---|
| | | | Aesthetic | Historical | Scientific ¹ | | | | Social | Spiritual | | |
| | | | | | Cont | Cond | Repr | Total | | | Overall | |
| WG001 | Babul Camp Site | Camp | Low | Low | --- | --- | --- | --- | Low | Medium | Low | Medium (Social) |
| WG002 | Babul Archaeological Site | Archaeological | Medium | Low | 1 | 1 | 2 | 4 | Medium | High | Low | High (Social) |
| WG003 | Fere Sacred Site | Story | High | Low | --- | --- | --- | --- | Low | High | High | High (Aesthetic, Social, Spiritual) |
| WG005 | Babul Sacred Swamp Site | Story | Low | Low | --- | --- | --- | --- | Low | Low | Medium | Medium (Spiritual) |
| WG008 | Wames Archaeological Site | Archaeological | Medium | Low | 1 | 1 | 2 | 4 | Medium | High | Low | High (Social) |
| WG026 | Sibal Sacred Site | Story | Medium | Low | --- | --- | --- | --- | Low | High | High | High (Social, Spiritual) |
| WG031 | Fere C Archaeological Site | Archaeological | Medium | Low | 3 | 1 | 2 | 6 | Medium | High | Low | High (Social) |
| WG040 | Gwavengo/Ngendakghoma II Rockshelter Site | Rockshelter | High | High | --- | --- | --- | --- | Low | High | Medium | High (Aesthetic, Historical, Social) |
| WG043 | Mea Gova Biangova Sacred Spring Site | Story | Low | Low | --- | --- | --- | --- | Low | Medium | High | High (Spiritual) |
| WG044 | Mea Gova Tongova Sacred Spring Site | Story | Low | Low | --- | --- | --- | --- | Low | Medium | High | High (Spiritual) |
| WG045 | Beavemo Burial Site | Burial | Medium | Medium | 3 | 2 | 3 | 8 | High | High | Low | High (Scientific, Social) |
| WG059 | Ngendakghoma I Rockshelter | Camp | Medium | Low | --- | --- | --- | --- | Low | Medium | Medium | Medium (Aesthetic, Social, Spiritual) |
| WG060 | Mia Yo Sacred Spring Site | Story | Low | Low | --- | --- | --- | --- | Low | Low | High | High (Spiritual) |
| WG121 | Magense | Burial | Low | Low | 3 | 2 | 3 | 8 | High | High | Low | High (Scientific, Social) |
| WG202 | Buasus 1 | Archaeological | High | Low | 3 | 2 | 2 | 7 | High | High | Low | High (Aesthetic, Scientific, Social) |
| WG207 | Nomonum 1 | Story | Low | High | --- | --- | --- | --- | Low | Medium | Medium | High (Historical) |
| WG208 | Babul Village 1 | Archaeological | Low | Low | 3 | 2 | 2 | 7 | High | High | Low | High (Scientific, Social) |
| WG209 | Mugus Badzim 1 | Story | Low | Medium | --- | --- | --- | --- | Low | Low | Medium | Medium (Historical, Spiritual) |
| WG214 | Fere H | Archaeological | Medium | Low | 2 | 2 | 2 | 6 | Medium | High | Low | High (Social) |
| WG215 | Fere I | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | Low | High | Low | High (Social) |
| WG216 | Fere J | Archaeological | Medium | Low | 1 | 1 | 2 | 4 | Medium | High | Low | High (Spiritual) |
| WG229 | Ngandoyeng | Story | Low | High | --- | --- | --- | --- | Low | Medium | Low | High (Historical) |
| WG231 | Nea | Story | Medium | Low | --- | --- | --- | --- | Low | Low | Medium | Medium (Aesthetic, Social) |
| WG234 | Mia Yo A | Story | Low | Low | --- | --- | --- | --- | Low | Low | High | High (Spiritual) |
| WG235 | Mia Yo B | Story | Low | Low | --- | --- | --- | --- | Low | Low | High | High (Spiritual) |
| WG236 | Mia Yo C | Story | Low | Low | --- | --- | --- | --- | Low | Low | High | High (Spiritual) |
| WG238 | Mia Yo D | Story | Low | Low | --- | --- | --- | --- | Low | Low | High | High (Spiritual) |

| Site No. | Site Name | Site Type | Significance Criteria | | | | | | | | | Significance Rating (highest criterion) | |
|----------|------------------------------|-------------------|-----------------------|------------|-------------------------|------|------|-------|--------|-----------|---------|---|-------------------------------|
| | | | Aesthetic | Historical | Scientific ¹ | | | | Social | Spiritual | | | |
| | | | | | Cont | Cond | Repr | Total | | | Overall | | |
| WG241 | Zenapu 2 | Camp | Low | Low | --- | --- | --- | --- | --- | Low | Low | Low | Low (All) |
| WG261 | Sangia | Story | Low | High | --- | --- | --- | --- | --- | Low | Medium | Low | High (Historical) |
| WG264 | Zindaga River Story Site | Story | Medium | Low | --- | --- | --- | --- | --- | Low | Low | Medium | Medium (Aesthetic, Spiritual) |
| WG276 | Anga Masalai Tree | Story | Medium | Low | --- | --- | --- | --- | --- | Low | High | Medium | High (Social) |
| WG277 | Ontang Garden Site | Story | Low | Medium | --- | --- | --- | --- | --- | Low | Low | Low | Medium (Historical) |
| WG300 | WSC1-1 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG301 | WSC1-2 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG302 | WSC1-3 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG303 | WSC1-4 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG304 | WCS1-5 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG305 | WCS2-1 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG306 | WCS2-2 | Archaeological | Medium | Low | 1 | 1 | 1 | 3 | --- | Low | High | Low | High (Social) |
| WG307 | WCS2-3 | Archaeological | Medium | Low | 1 | 1 | 3 | 5 | Medium | High | Low | High (Social) | |
| WG308 | Fere Clay Source Site | Subsistence/Trade | Low | Low | 1 | 3 | 3 | 7 | High | High | Low | High (Scientific, Social) | |
| WG309 | WCSAR-1 | Former Village | Low | Low | --- | --- | --- | --- | --- | Low | Low | Low | Low (All) |
| WG314 | Kakarak Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Low | Low | Low (All) |
| WG315 | Kobabarong Settlement Site | Former Village | Low | Medium | --- | --- | --- | --- | --- | Low | Low | Low | Medium (Historical) |
| WG316 | Kokok Settlement Site | Former Village | Low | Medium | --- | --- | --- | --- | --- | Low | Low | Low | Medium (Historical) |
| WG319 | Wames Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Low | High | High (Social) |
| WG320 | Nufgarak Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Low | High | High (Social) |
| WG321 | Ngalulase Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Low | High | High (Social) |
| WG322 | Fobias Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Low | High | High (Social) |
| WG323 | Taganek Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Medium | Medium | Medium (Social, Spiritual) |
| WG327 | Litia Burial Site | Burial | Medium | Low | 3 | 2 | 3 | 8 | High | Medium | Low | High (Scientific) | |
| WG334 | Mutufom Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Medium | Medium | Medium (Social, Spiritual) |
| WG335 | Fiafan Story Site | Story | Low | Low | --- | --- | --- | --- | --- | Low | Medium | Medium | Medium (Social, Spiritual) |
| WG336 | Umironon Story Site | Story | Medium | Low | --- | --- | --- | --- | --- | Low | High | Low | High (Social) |
| WG337 | Orogwangepup Settlement Site | Former Village | Low | High | 3 | 2 | 3 | 8 | High | High | Low | High (Historical, Scientific, Social) | |

| Site No. | Site Name | Site Type | Significance Criteria | | | | | | | | | Significance Rating (highest criterion) |
|----------|------------------------------------|----------------|-----------------------|------------|-------------------------|------|------|-------|--------|-----------|---------|---|
| | | | Aesthetic | Historical | Scientific ¹ | | | | Social | Spiritual | | |
| | | | | | Cont | Cond | Repr | Total | | | Overall | |
| WG338 | Ngaroperem Story Site | Story | Low | Low | --- | --- | --- | --- | Low | Low | Medium | Medium (Spiritual) |
| WG339 | WWII Clinic Archaeological Site | Archaeological | Low | Medium | 1 | 1 | 3 | 5 | Medium | Medium | Low | Medium (Historical, Social) |
| WG341 | Kafag Airstrip Archaeological Site | Archaeological | Low | Medium | 1 | 1 | 3 | 5 | Medium | Medium | Low | Medium (Historical, Social) |
| WG346 | Tanam Airfield Archaeological Site | Archaeological | Low | Medium | 1 | 1 | 3 | 5 | Medium | Medium | Low | Medium (Historical, Social) |
| WG351 | Spirit Tree Site | Story | Low | Low | --- | --- | --- | --- | Low | Low | Low | Low (All) |

1

Cont: Contents

Cond: Condition

Repr: Representativeness

6.2.1 Archaeological Sites

Nineteen recorded archaeological sites were included in the impact assessment.

| Site Number | Site Name |
|-------------|------------------------------------|
| WG002 | Babul Archaeological Site |
| WG008 | Wames Archaeological Site |
| WG031 | Fere C Archaeological Site |
| WG202 | Buasus 1 |
| WG214 | Fere H |
| WG215 | Fere I |
| WG216 | Fere J |
| WG300 | WCS1-1 |
| WG301 | WCS1-2 |
| WG302 | WCS1-3 |
| WG303 | WCS1-4 |
| WG304 | WCS1-5 |
| WG305 | WCS2-1 |
| WG306 | WCS2-2 |
| WG307 | WCS2-3 |
| WG337 | Orogwanginpup Settlement Site* |
| WG339 | WWII Clinic Archaeological Site |
| WG341 | Kafag Airstrip Archaeological Site |
| WG346 | Tanam Airfield Archaeological Site |

*Note this site is also regarded as a Former Village and is formally recorded in this manner.

Sixteen of the archaeological sites were rated as being of high cultural heritage significance, and three were rated as being of medium cultural heritage significance.

Sixteen of the archaeological sites are located within lands currently occupied by Babuaf communities. Eight of these sites are situated on the *Fere* grasslands, previously identified by Muke et al. (2007) as a significant cultural landscape with a rich repertoire of archaeological and oral tradition sites.

A further five of these sites are situated in the infrastructure corridor area, and one is located along the Mount Beamena Quarry access road.

The remaining four archaeological sites are within lands currently occupied by the Wampar communities and are located within the Infrastructure Corridor Study Area. These include a settlement site, two historical WWII airfields and the foundations of a WWII clinic which straddles the Infrastructure Corridor Eastern Study Area.

Aesthetic values across the archaeological sites were assessed in terms of their vistas. Sites situated within rainforest environments or on floodplains with low visibility were rated as low, while sites located on elevated *kunai* grasslands were rated as medium.

Historical values were generally rated as low, the exception being the three historical WWII archaeological sites which were rated as medium based on their association with the war.

Scientific values across the archaeological sites ranged from low to high, based on variable patterns of contents versus condition versus representativeness. Three sites were rate of high scientific significance. It should be noted that WG337 Orogwanginpup Settlement Site, although formally reported as a former village, also contains significant evidence for stratified archaeological deposits and has been rated as being of high scientific significance.

Social values were rated as high for all archaeological sites located at *Fere* based on the outcomes of community consultation with Babuaf representatives. Social values were rated medium for the three WWII historical airfields, again based on the importance these locations have for the local communities.

Spiritual values were uniformly rated as low for all nineteen archaeological sites.

6.2.2 Burial Sites

Three recorded burial sites were included in the impact assessment:

| Site Number | Site Name |
|-------------|---------------------|
| WG045 | Beavemo Burial Site |
| WG121 | Magense |
| WG327 | Litia Burial Site |

All three were rated as being of high cultural heritage significance based primarily on their high scientific and social significance.

WG045 was rated as medium on the basis of its aesthetic value (WG045 is located near the top of Mount Golpu), and high on the basis of its scientific value given the significant nature of its contents, it's relatively intact nature, and the rarity of burial sites on Mount Golpu (the latter probably a result of very steep to precipitous midslope ground surfaces in combination with thin topsoils).

WG045 was rated as having medium historical value, given that Beavemo is a named ancestor who is closely associated with a significant Hengambu oral tradition that links this site with other cultural heritage sites located on the south-eastern flank of Mount Golpu (WG040 and WG229).

Social value was rated as high for WG045 given the strong connection that Hengambu communities across the Project area have for the oral traditions associated with this site.

WG121 was identified by Hitchcock (2012) during interviews with Wampar community informants and its location recorded using GPS during a helicopter survey (see Section 2.4.1.3 for further details). Hitchcock notes in his report (2012: 55, Appendix 6) that the site comprises a burial situated within a former village, and that ceramic sherds had previously been observed at the location. Although little is presented in Hitchcock's report that can be used to assess the individual criteria associated with this cultural heritage site, it has been assessed as being of high scientific significance given its contents.

WG327 Litia Burial Site was identified within the ancestral Wampar village of Kokok (WG16). The site, which is situated close to the banks of river and is identified by a ring of small stones arranged around the margin of the grave, which is then surrounded by ethnobotanical plants including *tanget*, marks the burial of a Chuaif clan woman named Litia who died in 2009. The site has been rated as being of medium aesthetic significance based on its location near the river, and medium social significance given its construction and the fact it is still tended. The site has been rated as being of high scientific significance given its contents.

Spiritual value was rated as low for all three burial sites.

6.2.3 Camp Sites

Three recorded camp sites were included in the impact assessment:

| Site Number | Site Name |
|-------------|----------------------------|
| WG001 | Babul Camp Site |
| WG059 | Ngendakghoma I Rockshelter |
| WG241 | Zenapu 2 |

Both WG001 and WG059 were rated as being of moderate cultural heritage significance. WG241 was rated as being of low cultural heritage significance.

The three campsites were generally rated as having low or low-medium aesthetic, historical and scientific value. WG001 and WG059 were rated as having medium social value based on the stated connections that Babuaf and Yanta communities have separately with these places, and WG059 was also rated as having medium spiritual value given that Yanta hunters sometimes practiced magic at this location.

6.2.4 Former Village Sites

Five recorded sites were included in the impact assessment:

| Site Number | Site Name |
|-------------|--------------------------------|
| WG208 | Babul Village 1* |
| WG309 | WCSAR-1 |
| WG315 | Kobabarong Settlement Site |
| WG316 | Kokok Settlement Site |
| WG337 | Orogwanginpup Settlement Site* |

* Note these sites are also regarded as archaeological sites. WG208 is formally recorded as an archaeological site.

WG208 Babul Villiage 1 and WG337 Orogwanginpup Settlement Site were rated as being of high cultural heritage significance, WG315 Kobabarong Settlement Site and WG316 Kokok Settlement Site were rated as being of moderate cultural heritage significance, and WG309 WCSAR-1 was rated as being of low cultural heritage significance.

The five village sites listed above were rated as having low aesthetic value given their locations in or on the fringe of dense rainforest or, in the case of WG337, an oil palm plantation. All were rated as being of low spiritual value.

Historical significance ratings ranged from low to high, depending on the degree of prominence accorded these sites in local clan histories. Social significance was generally rated as low, the exception being WG337 which was described by Wampar representatives as being an important place that should be preserved from further impacts.

Scientific values were rated as either low or high – WG309, WG315 and WG316 were rated as low given the absence of evidence for archaeological materials, and WG337 was rated as high given the visible presence of dense, stratified archaeological deposits within the location of the former village.

6.2.5 Rockshelter Sites

One rockshelter site, WG040 Gwavengo/Ngendakghoma II Rockshelter Site, was included in the impact assessment, and was rated as being of high cultural heritage significance.

The site was rated as having a high aesthetic value given its location on the south-eastern flank of Mount Golpu overlooking the range to the east, and a high historical value given its association with a Hengambu oral tradition that links the site with a number of named ancestors who were involved in an historically significant expedition (the details of which are woven into a rich narrative), and with other sites located in the vicinity (WG045 Beavemo Burial Site and WG229 Ngandoyeng Story Site). The site was rated as having high social value for both the Hengambu and Yanta communities, and medium spiritual value for the Hengambu.

The scientific value of this site was rated as low based on the fact that archaeological materials were not identified at the site during the cultural heritage survey. However, the site has potential scientific value given that it was used by both Hengambu and Yanta hunters as an overnight camp and may retain cultural heritage materials in subsurface contexts based on the presence of intact sediments on the floor of the rockshelter

6.2.6 Story Sites

Twenty-nine recorded story sites were included in the impact assessment:

| Site Number | Site Name | Site Number | Site Name |
|-------------|--------------------------------------|-------------|--------------------------|
| WG003 | Fere Sacred Site | WG261 | Sangia Story Site |
| WG005 | Babul Sacred Swamp Site | WG264 | Zindaga River Story Site |
| WG026 | Sibal Sacred Site | WG276 | Anga Masalai Tree |
| WG043 | Mea Gova Biangova Sacred Spring Site | WG277 | Ontang Garden Site |
| WG044 | Mea Gova Tongova Sacred Spring Site | WG314 | Kakarak Story Site |
| WG060 | Mia Yo Sacred Spring Site | WG319 | Wames Story Site |
| WG207 | Nomonum 1 | WG320 | Nufgarak Story Site |
| WG209 | Mugus Badzim 1 | WG321 | Ngalulase Story Site |
| WG229 | Ngandoyeng | WG322 | Fobias Story Site |
| WG231 | Nea | WG323 | Taganek Story Site |
| WG234 | Mia Yo A | WG334 | Mutufom Story Site |
| WG235 | Mia Yo B | WG335 | Fiafan Story Site |
| WG236 | Mia Yo C | WG336 | Umironon Story Site |
| WG238 | Mia Yo D | WG338 | Ngaroperem Story Site |
| | | WG351 | Spirit Tree Site |

Of these, 17 (59%) are rated as being of high cultural heritage significance, 10 (34%) were rated as being of medium cultural heritage significance and two (7%) were rated as being of low cultural heritage significance. Story sites attributed to the Babuaf, Hengambu, Yanta and Wampar cultural groups are all represented in the impact assessment.

Although there are some exceptions, significance criteria were generally rated as being either low or medium across the aesthetic, historical and social criteria, but were uniformly low for scientific value (reflecting the absence of material culture or other archaeological signatures).

Aesthetic values ranged from low to high across the story sites, which were largely rated on the basis of their vistas and environmental settings and the nature of the sites themselves. For example:

- WG003 Fere Sacred Site was rated as having high aesthetic value based on the fact that it comprises a lake situated within slightly elevated *kunai* grasslands overlooking the Watut River floodplain.
- WG231 Nea and WG276 Anga Masalai Tree was assessed as having medium aesthetic value based on the size and age of the trees.

Historical values also ranged from low to high depending on their association with named individuals or events. WG207 Nomonum 1 was rated as having high historical value based on a Babuaf oral tradition that links this site with the death of an MMJV employee during construction of the Watut Valley Road.

Social values ranged from low to high, depending on the strength of the connections that contemporary communities have with these places. WG276 Anga Masalai Tree, WG003 Fere Sacred Site and WG026 Sibal Sacred Site were rated as having high social value for Babuaf communities based on the stated intention to use these places when educating their children about traditional values and lifeways.

Spiritual values also varied from low to high across the 29 story sites, depending on the degree of prominence with which each site features in the ritual or spiritual life of the local communities.

6.2.7 Subsistence / Trade

One Subsistence / Trade site, WG308 Fere Clay Source Site, was included in the impact assessment, and was rated as being of high cultural heritage significance based on scientific and social criteria.

6.3 Impact Assessment

6.3.1 Impact Assessment – Recorded Cultural Heritage Sites

The significance of an impact on a cultural heritage site was determined according to the impact assessment matrix presented in Section 3.3.2.4, which considered:

- The significance of an individual recorded cultural heritage site; and
- The magnitude of the impact of proposed Project activities on the site.

The initial impact assessment assumed that all cultural heritage sites located in the buffer zones within the cultural heritage study areas have a 100% chance of being impacted by Project activities in the absence of any cultural heritage management measures.

The results of the impact assessment on the 60 recorded cultural heritage sites included in the impact assessment are presented in Table 19. The potential for impacts to recorded cultural heritage sites was assessed as ranging from minor to extreme, **prior to mitigation**.

The absence of any minimal impact ratings is due to the fact that none of the impact magnitudes were assessed as low, which is itself the result of a consistent rating for the duration of the expected impacts as either long-term (extending beyond the life of the Project) or permanent. This to be expected given the nature of the potential impacts as outlined above.

Summary data on the distribution of minor, moderate, major and extreme cultural heritage site impact significance ratings by site type is presented in Table 20.

All 60 cultural heritage sites have the potential to be impacted by Project activities included in the EIS. Of these, prior to mitigation:

- 24 sites (40%) are likely to experience an extreme impact.
- 21 sites (35%) are likely to experience a major impact.
- 13 sites (22%) are likely to experience a moderate impact.
- 2 sites (3%) is likely to experience a minor impact.

Summary data on the distribution of minor, moderate, major and extreme cultural heritage site impact assessment ratings broken down by relevant cultural heritage study areas is presented in Table 21.

Table 19: Impact assessment prior to mitigation (recorded cultural heritage sites)

| Site No. | Site Name | Site Type | EIS Study Area | Nature of Impact | Cultural Heritage Significance | Impact Magnitude | Impact Significance |
|----------|---|---------------------------------|----------------|---|--------------------------------|------------------|---------------------|
| WG001 | Babul Camp Site | Camp | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG002 | Babul Archaeological Site | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG003 | Fere Sacred Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG005 | Babul Sacred Swamp Site | Story | MBQ | Vegetation clearing; ground disturbance (surface and subsurface) | Low | High | Moderate |
| WG008 | Wames Archaeological Site | Archaeological | MBQ | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG026 | Sibal Sacred Site | Story | MBQ | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG031 | Fere C Archaeological Site | Archaeological | MARF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG040 | Gwavengo/Ngendakghoma II Rockshelter Site | Rockshelter | MSZ | Loss of ground surface and substrate through subsidence | High | High | Extreme |
| WG043 | Mea Gova Biangova Sacred Spring Site | Story | MSZ | Loss of ground surface and substrate through subsidence; groundwater drawdown | High | High | Extreme |
| WG044 | Mea Gova Tongova Sacred Spring Site | Story | GWD | Groundwater drawdown | High | High | Extreme |
| WG045 | Beavemo Burial Site | Burial | MSZ | Loss of ground surface and substrate through subsidence | High | High | Extreme |
| WG059 | Ngendakghoma I Rockshelter | Camp | MSZ | Loss of ground surface and substrate through subsidence | Medium | High | Major |
| WG060 | Mia Yo Sacred Spring Site | Story | GWD | Groundwater drawdown | High | High | Extreme |
| WG121 | Magense | Burial | NARBP | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG202 | Buasus 1 | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG207 | Nomonum 1 | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG208 | Babul Village 1 | Archaeological / Former Village | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG209 | Mugus Badzim 1 | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG214 | Fere H | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG215 | Fere I | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG216 | Fere J | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG229 | Ngandoyeng | Story | MSZ | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG231 | Nea | Story | MBP | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | High | Major |
| WG234 | Mia Yo A | Story | GWD | Groundwater drawdown | High | High | Extreme |
| WG235 | Mia Yo B | Story | GWD | Groundwater drawdown | High | High | Extreme |
| WG236 | Mia Yo C | Story | GWD | Groundwater drawdown | High | High | Extreme |

| Site No. | Site Name | Site Type | EIS Study Area | Nature of Impact | Cultural Heritage Significance | Impact Magnitude | Impact Significance |
|----------|----------------------------|-------------------|----------------|---|--------------------------------|------------------|---------------------|
| WG238 | Mia Yo D | Story | MSZ | Loss of ground surface and substrate through subsidence; groundwater drawdown | High | High | Extreme |
| WG241 | Zenapu 2 | Camp | NPHR | Vegetation clearing; ground disturbance (surface and subsurface) | Low | Medium | Minor |
| WG261 | Sangia Story Site | Story | WRGEA | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG264 | Zindaga River Story Site | Story | WRGEA | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | High | Major |
| WG276 | Anga Masalai Tree | Story | WMF, IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG277 | Ontang Garden Site | Story | PPT, IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | High | Major |
| WG300 | WSC1-1 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG301 | WSC1-2 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG302 | WSC1-3 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG303 | WSC1-4 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG304 | WSC1-5 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG305 | WSC2-1 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG306 | WSC2-2 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG307 | WSC2-3 | Archaeological | FAF | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG308 | Fere Clay Source Site | Subsistence/Trade | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG309 | WCSAR-1 | Former Village | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Low | High | Moderate |
| WG314 | Kakarak Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Low | Medium | Minor |
| WG315 | Kobabarong Settlement Site | Former Village | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG316 | Kokok Settlement Site | Former Village | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG319 | Wames Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG320 | Nufgarak Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG321 | Ngalulase Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG322 | Fobias Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG323 | Taganek Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG327 | Litia Burial Site | Burial | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | High | Extreme |
| WG334 | Mutufom Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG335 | Fiafan Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG336 | Umironon Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |

| Site No. | Site Name | Site Type | EIS Study Area | Nature of Impact | Cultural Heritage Significance | Impact Magnitude | Impact Significance |
|---|------------------------------------|---|----------------|--|--------------------------------|--|---------------------|
| WG337 | Orogwanginpup Settlement Site | Former Village / Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | High | Medium | Major |
| WG338 | Ngaroperem Story Site | Story | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG339 | WWII Clinic Archaeological Site | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | High | Major |
| WG341 | Kafag Airstrip Archaeological Site | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG346 | Tanam Airfield Archaeological Site | Archaeological | IC | Vegetation clearing; ground disturbance (surface and subsurface) | Medium | Medium | Moderate |
| WG351 | Spirit Tree Site | Story | BRGEA | Vegetation clearing; ground disturbance (surface and subsurface) | Low | High | Moderate |
| MSZ – Mine Subsidence Zone | | MBP – Migiki Borrow Pit | | EM – Explosives Magazine | | PFA – Port facilities Area | |
| PTA – Portal Terrace Area | | HBP – Humphries Borrow Pit | | FAF – Fere Accommodation facility | | GWD – Ground Water drawdown | |
| PPT – Process Plant Terrace | | NARBP – Northern Access Road Borrow Pit | | FCAF – Finchif Construction Accommodation Facility | | WRGEA – Waime River Gravel Extraction Area | |
| WMF – Waste Management Facility | | MBQ – Mt Beamena Quarry | | PGF – Power Generation Facility | | IC – Infrastructure Corridor | |
| WDRWP – Wastewater Discharge/Raw Water Make-up Pipeline | | BRGEA – Bavaga River Gravel Extraction Area | | MARF – Mine Access Road at Fere | | NPHR – Nambonga and Portal haul roads | |

Table 20: Impact assessment ratings by cultural heritage site type (prior to mitigation)

| Impact Rating | Site Type | | | | | | Subsistence/ Trade |
|---------------|------------------|--------|------|------------------|-------------|-------|--------------------|
| | Archaeological * | Burial | Camp | Former Village * | Rockshelter | Story | |
| Minor | | | 1 | | | 1 | |
| Moderate | 2 | | 1 | 3 | | 7 | |
| Major | 8 | | 1 | 1 | | 11 | |
| Extreme | 9 | 3 | | | 1 | 10 | 1 |

* Note that multiple component sites are only represented by their primary component.

Table 21: Impact assessment ratings by Project activity (prior to mitigation)

| Impact Rating | Project EIS activity | | | | | | | | | | | | | |
|---------------|----------------------|-----|---------|---------|-----|-----|-----|-------|------|-------|--------|----|-------------------|------|
| | MSZ | GWD | PPT/ IC | WMF /IC | FAF | MBP | MBQ | NARBP | MARF | BRGEA | WRGE A | IC | HBP/NARBP/ MBQ/IC | NPHR |
| Minor | | | | 1 | | | | | | | | 1 | | 1 |
| Moderate | | | | | | 1 | | | | 1 | | 11 | | |
| Major | 2 | | 1 | | | 1 | 1 | | | | 1 | 14 | 1 | |
| Extreme | 4 | 5 | | 1 | 8 | | 1 | 1 | 1 | | 1 | 2 | | |

In summary, prior to mitigation:

- Over half of the impacts to cultural heritage that would occur during construction of roads and pipelines within the Infrastructure Corridor are considered to be major, and in one case extreme, based on a mixed range of cultural heritage significance ratings associated with long-term to permanent Project impacts.
- Impacts to cultural heritage arising from mine-related subsidence and groundwater drawdown (GWD in Table 21) would mostly be extreme due to the permanent loss of highly significant Yanta and Hengambu cultural heritage sites with high scientific, historical and/or social value, and the long-term (possibly permanent) loss of highly significant Yanta cultural heritage sites with high spiritual value.
- Impacts to cultural heritage sites that would occur during the operation of the Mt Beamena Quarry and the Northern Access Road borrow pit would be extreme due to the permanent loss of WG026 and WG121.
- Impacts to the eight sites that would occur during construction of the Fere Accommodation Facility would be major due to the permanent loss of this site, which the Babuaif consider to be of high social value.
- Impacts to cultural heritage sites that would occur during the operation of the Bavaga River gravel extraction area would be moderate due to the permanent loss of WG351.
- Ongoing works at the Migiki borrow pit and the Waime River gravel extraction area have the potential to impact WG231 and to further impact WG262.
- Impacts to the cultural heritage sites that would occur during construction of the process plant terrace and waste management facility will be either major or extreme.

6.3.2 Managing Impacts to Cultural Heritage

6.3.2.1 General

The assessment of cultural heritage significance is a fundamental component of heritage management. It informs which items, sites, places, landscapes and other features should be avoided or preserved. If avoidance/preservation is not possible due, for example, to engineering requirements or other technical constraints, appropriate management measures can then be developed that mitigate adverse impacts to the greatest extent practicable.

The significance assessment process underpins heritage site protection by establishing a structure within which various types (assessment criteria) and levels (significance ratings) of heritage value can be identified and allocated, as outlined in Section 3.3.2.2.

Based on the outcomes of the cultural heritage consultations and fieldwork reported in Section 4 and the subsequent significance assessment process reported in Section 6.2, WGJV has developed a Cultural Heritage Management Plan designed to:

- Promote the conservation and management of cultural heritage sites within and near all proposed Project-related disturbance areas.
- Establish management measures that reduce the level of impact and outline the implementation of the recommended management measures detailed in Section 3.3 below for recorded cultural heritage sites.
- Develop and implement a cultural awareness program for all non-local national and expatriate employees and contractors.
- Require pre-construction cultural heritage clearance surveys along any previously unsurveyed sections of linear infrastructure corridors, and within the facility footprints of previously unsurveyed areas, to identify any further cultural heritage sites.
- Specify salvage activities (whether it be surface artefact collections or subsurface archaeological excavations) including but not limited to:
 - Appropriate salvage methods to be implemented prior to ground disturbing Project activities taking place.
 - Establishing specific measures for the exhumation of any human remains that may be unearthed as chance finds or during cultural heritage salvage investigations.
- Where the recording of oral traditions is recommended, engage a professional anthropologist and complete fieldwork prior to ground disturbing Project activities taking place.
- Require the development and implementation of a Chance Finds Protocol with clear processes for reporting, investigation and management of cultural heritage chance finds discovered during Project-related activities.
- Maintain a cultural heritage site database and update the database as new information becomes available. The database will inform planning and design and will assist in the implementation of recommended management measures (including the precise locations of sites wherever possible, particularly those to be avoided).
- Require engagement with men and women in local communities regarding:
 - The content of the Cultural Heritage Management Plan, including the community engagement methods that will be employed in recognition of community values.
 - The development of culturally appropriate methods for the practical management of cultural heritage sites that are to be protected from impacts.
 - The development of appropriate management measures in relation to their oral tradition sites. Culturally appropriate responses to the management of sites and

places that would be unavoidably impacted by Project activities may include avoidance, exhumation/relocation of the site and traditional ceremonies (that should precede the commencement of Project activities).

The relationship between living people and the spirit world is complex and often very personal for many communities in PNG. Individuals, families, clans and sometimes entire village communities will communicate with *masalai* or ancestral spirits as required when passing through a *ples tambu*, or even just going about their daily business. Unexplained deaths, sickness, accidents and poor luck are often attributed to *masalai*, and people will often call out to them or leave offerings of food or other gifts to appease them in order for them to be able to enjoy both their lives and their environment.

It is not unusual for many communities across PNG to conduct ceremonies prior to disturbing any place considered to be a *ples tambu* or the home of *masalai* or ancestral spirits, to enable the future works to proceed safely and without delay. These ceremonies may, for example, request that *masalai* and other malevolent beings remove themselves completely from the area and find a new home away from the works area. Alternatively, the ceremony may ask these beings to simply stay away from men and women while they go about their business, and not harm them in any way.

These concepts were explained on many occasions by members of all the cultural groups associated with the Project, and in almost every instance the requirement for some kind of ceremony was supported by examples whereby in the past, local community members, PNG Nationals from other parts of the country, and even expatriates, have disturbed the forest within *ples tambu* or *ples masalai*, always with disastrous or, in at least one instance, fatal results.

Some of the story sites that would be impacted by Project activities involve detailed oral traditions regarding specific places and geographic features (e.g. *mia yo* and *mea gova* sites) or named *masalai* (e.g. *Tongova* and *Biangova*), and the ways in which these places and spirits interact with the human world. Measures to mitigate the effects of unavoidable Project impacts to these significant spirit sites should include opportunities for the relevant local clans to conduct appropriate ceremonies tailored to their specific need, prior to the works proceeding. They should also include the full recording of the associated oral traditions by qualified professionals, so that the local community can retain detailed knowledge of these stories in the absence of the physical prompts that the sites themselves provide.

However, other *ples tambu* story sites that would be impacted by Project activities are more generic or nonspecific and are identified simply on the basis of the misadventures that befall local villagers due to the presence of unnamed *masalai*. In cases such as these, especially where the *ples tambu* involves a large area of which only a portion would be disturbed by Project activities, it may be sufficient to limit the management measure to include an offer of support for appropriate clan ceremonies without the need for detailed oral history recording, although this should be confirmed after discussions with the relevant local communities.

As noted above, a full appreciation of impacts associated with resettlement activities is subject to further consultation with the affected villages and, as such, is not detailed in this impact assessment. Planned activities to identify and address potential impacts include:

- Consultation with affected villages to identify how communities physical access to cultural heritage sites may be impacted.
- Consultation with relevant villages to identify impacts to cultural heritage sites that may be present in areas selected for the establishment of new villages and associated infrastructure.
- Identify and agree actions to address these impacts, including protocols for accessing sites.
- Record and implement the agreed actions as part of resettlement agreements and the Project's Cultural Heritage Management Plan, as appropriate.

6.3.2.2 Site-Specific Management Measures

The potential to avoid impacts to each of the recorded cultural heritage sites included in the impact assessment through infrastructure relocation or realignment was carefully considered. In each instance, rated cultural heritage site significance and a consideration of the impact of the loss of each site to PNG's cultural heritage at the local, provincial and national level was assessed against the nature of the proposed infrastructure or mining activity that would impact on it, and whether avoidance through infrastructure relocation or realignment was possible given technical, safety, environmental, terrain and economic constraints.

Given the essential nature of the preferred mining technique adopted by WGJV for the Project (underground declines and block caving), and the potential loss of groundwater associated with this process, impacts to cultural heritage sites within the mine's maximum subsidence zone and the groundwater drawdown area have been treated as unavoidable. It should be noted, however, that ongoing monitoring will be undertaken during Project construction and operation to verify whether ground surface subsidence and groundwater drawdown occur in the manner predicted by the Wafi-Golpu Environmental Impact Statement (WGJV, 2018).

With regard to the process plant terrace, the development of appropriate management measures proceeded on the assumption that decisions to locate this critical component of the Project, as mapped in the current proposed Project layout, had already taken into account all constraining factors as outlined in Section 6.1, including the potential for impacts to cultural heritage, and that on this basis (cultural heritage considerations aside) cultural heritage site impact avoidance through infrastructure relocation was not a feasible option.

The roads and pipelines comprising the Infrastructure Corridor as currently proposed would be constructed along a linear alignment, and given the width of the corridor investigated, there is some capacity for realignment during detailed design at locations where the currently mapped alignment would impact on recorded cultural heritage sites. However, in each instance, the need for realignment will ultimately be weighed against the nature and significance of the cultural heritage site, the nature and effect of the unmitigated impact, and the potential for other management or mitigation measures to reduce the impact to an acceptable level.

The following proposed management measures have been developed drawing on the baseline assessments described in Sections 4 and 5, and the results of the impact assessment reported in Section 6.3.1. They also include a careful consideration of previous management recommendations proposed for cultural heritage sites investigated by the Social Research Institute in 2007 (Muke et al. 2007), and where relevant to the current Project configuration, these proposals have been incorporated into the site-specific management measures outlined below.

It should be noted that:

- The WG site numbers listed below are not sequential as not all the sites reviewed in the baseline assessment would be impacted by Project-related proposed activities.
- Where recording of relevant oral traditions is recommended, such would be (a) undertaken with the agreement of the affected community, (b) related by appropriate community representative(s) as determined by the community, and (c) recorded in languages as determined by the community. The affected community would determine the disclosure provisions as the stories are their intellectual property.
- Where salvage collection of artefacts is recommended, representatives of the affected community should be engaged to assist.

Proposed management measures for each site are set out below. It is recommended that these are discussed with men and women in relevant local communities and agreed prior to implementation.

WG001 Babul Camp

- Recording of oral traditions by an anthropologist prior to construction within the Infrastructure Corridor.

WG002 Babul Archaeological Site

- Collection of surface artefacts by an archaeologist prior to construction within the Infrastructure Corridor.
- If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to construction within the Infrastructure Corridor.

WG003 Fere Sacred Site

- Recording of oral traditions and confirmation of the site's boundary by anthropologist prior to construction within the Infrastructure Corridor.
- Avoidance through minor adjustments to infrastructure corridor alignment and / or erecting barriers if practicable.

WG005 Babul Sacred Swamp Site

- Recording of oral traditions by an anthropologist prior to ground surface subsidence.
- Assist with culturally appropriate ceremonies as required prior to the construction of the declines.

WG008 Wames Archaeological Site

- Collection of surface artefacts by an archaeologist prior to the construction and operation of the Mt Beamena Quarry.
- If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to the construction and operation of the Mt Beamena Quarry.

WG026 Sibal Sacred Site

- Recording of oral traditions by an anthropologist prior to the commencement of operations at the Mt Beamena Quarry.

WG031 Fere C Archaeological Site

- Confirmation of the site's boundary by an archaeologist prior to construction of the Mine Access Road at Fere.
- Collection of an agreed proportion of surface artefacts by an archaeologist prior to the construction of the Mine Access Road at Fere.
- If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to the construction of the Mine Access Road at Fere.

WG040 Gwavengo/Ngendakghoma II Rockshelter Site

- If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to commencement of mining operations.
- Recording of oral traditions by an anthropologist prior to construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to the construction of the declines.

WG043 Mea Gova Biangova Sacred Spring Site

- Recording of oral traditions by an anthropologist prior to construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to the construction of the declines.

WG044 Mea Gova Tongova Sacred Spring Site

- Recording of oral traditions by an anthropologist prior to construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to the construction of the declines.

WG045 Beavemo Burial Site

- Appropriate legal and cultural exhumation and relocation of human remains prior to ground surface subsidence at this location should this be requested by the relevant landowners.
- Recording of oral traditions by an anthropologist.

WG059 Ngendakghoma I Rockshelter

- Assist with culturally appropriate ceremonies as required prior to the construction of the declines.

WG060 Mia Yo Sacred Spring Site

- Recording of oral traditions by an anthropologist prior to ground surface subsidence.
- Assist with culturally appropriate ceremonies as required prior to the construction of the declines.

WG121 Magense

- Confirmation of the site's location by an archaeologist prior to the commencement of operations at the Northern Access Road borrow pit.
- Appropriate legal and cultural exhumation and relocation of human remains prior to the commencement of operations at the Northern Access Road borrow pit should this be requested by the relevant landowners.
- Recording of oral traditions by an anthropologist.

WG202 Buasus 1

- Confirmation of the site's boundary by an archaeologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG207 Nomonum 1

- Recording of oral traditions by an anthropologist prior to construction within the Infrastructure Corridor.
- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG208 Babul Village 1

- Collection of surface artefacts by an archaeologist prior to construction within the Infrastructure Corridor.

- If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to construction within the Infrastructure Corridor.
- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor

WG209 Mugus Badzim 1

- Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings

WG215 Fere H

- Confirmation of the site's boundary by an archaeologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG215 Fere I

- Confirmation of the site's boundary by an archaeologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG216 Fere J

- Collection of surface artefacts by an archaeologist prior to construction within the Infrastructure Corridor.

WG229 Ngandoveng

- Recording of oral traditions by an anthropologist prior to the construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to construction of the declines.

WG231 Nea

- Recording of oral traditions by an anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors during the continued operation of the Migiki borrow pit.
- Reference to site protection strategy in daily toolbox meetings.

WG234 Mia Yo A

- Recording of oral traditions by an anthropologist prior to the construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to construction of the declines.

WG235 Mia Yo B

- Recording of oral traditions by an anthropologist prior to the construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to construction of the declines.

WG236 Mia Yo C

- Recording of oral traditions by an anthropologist prior to the construction of the declines.

- Assist with culturally appropriate ceremonies as required prior to construction of the declines.

WG238 Mia Yo D

- Recording of oral traditions by an anthropologist prior to the construction of the declines.
- Assist with culturally appropriate ceremonies as required prior to construction of the declines.

WG241 Zenapu 2

- Recording of oral traditions by an anthropologist.

WG261 Sangia

- Recording of oral traditions by an anthropologist.

WG264 Zindaga River Story Site

- Recording of oral traditions by an anthropologist.

WG276 Anga Masalai Tree

- Recording of oral traditions by an anthropologist.
- Assist with culturally appropriate ceremonies as required prior to construction of the waste management facility or construction within the Infrastructure Corridor.

WG277 Ontang Garden Site

- Assist with culturally appropriate ceremonies as required prior to construction of the process plant terrace.

WG300 WSC1-1

- Collection of the recorded surface artefacts by an archaeologist prior to construction of the Fere Accommodation Facility.
 - In the event that additional surface artefacts are identified, an appropriate proportion of these surface artefacts, as recommended by the archaeologist in consultation with WGJV, are to be collected.

WG301 WSC1-2

- Collection of the recorded surface artefacts by an archaeologist prior to construction of the Fere Accommodation Facility.
 - In the event that additional surface artefacts are identified, an appropriate proportion of these surface artefacts, as recommended by the archaeologist in consultation with WGJV, are to be collected.

WG302 WSC1-3

- Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings

WG303 WSC1-4

- Collection of the recorded surface artefacts by an archaeologist prior to the construction of the Fere Accommodation Facility.
 - In the event that additional surface artefacts are identified, an appropriate proportion of these surface artefacts, as recommended by the archaeologist in consultation with WGJV, are to be collected.

WG304 WSC1-5

- Collection of the recorded surface artefact by an archaeologist prior to construction of the Fere Accommodation Facility.
 - In the event that additional surface artefacts are identified, an appropriate proportion of these surface artefacts, as recommended by the archaeologist in consultation with WGJV, are to be collected.

WG305 WSC2-1

- Collection of the recorded surface artefact by an archaeologist prior to construction of the Fere Accommodation Facility.
 - In the event that additional surface artefacts are identified, an appropriate proportion of these surface artefacts, as recommended by the archaeologist in consultation with WGJV, are to be collected.

WG306 WSC2-2

- Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings.

WG307 WSC2-3

- Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings

WG308 Fere Clay Source Site

- Identification of site boundary; erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Management of erosion and sediment during road and pipeline construction in the Infrastructure Corridor.

WG309 WSCAR-1

- Confirmation of the site's boundary by an anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG314 Kakarak Story Site

- Recording of oral traditions by an anthropologist.
- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor

WG315 Kobabarong Settlement Site

- Recording of oral traditions by an anthropologist.
- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG316 Kokok Settlement Site

- Recording of oral traditions by an anthropologist.
- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG319 Wames Story Site

- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor or operation of the Humphries borrow pit, Northern Access Road borrow pit or the Mt Beamena Quarry.

WG320 Nufgarak Story Site

- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor

WG321 Ngalulase Story Site

- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG322 Fobias Story Site

- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG323 Taganek Story Site

- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG327 Litia Burial Site

- Confirmation of the site's boundary by an archaeologist or anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.

WG334 Mutufom Story Site

- Confirmation of the site's boundary by an anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.

WG325 Fiafan Story Site

- Confirmation of the site's boundary by an anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG326 Umiroron Story Site

- Confirmation of the site's boundary by an anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG337 Orogwanginpup Settlement Site

- Confirmation of the site's boundary by an archaeologist.

- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to construction within the Infrastructure Corridor.
- Reference to site protection strategy in daily toolbox meetings.

WG338 Ngaroperem Story Site

- Assist with culturally appropriate ceremonies as required prior to construction within the Infrastructure Corridor.

WG339 WWII Clinic Archaeological Site

- Prior to construction within the Infrastructure Corridor:
 - ♦ Assessment of the nature and extent of this site by an historical archaeologist.
 - ♦ If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to construction within the Infrastructure Corridor.

WG341 Kafag Airstrip Archaeological Site

- Prior to construction within the Infrastructure Corridor:
 - ♦ Assessment of the nature and extent of this site by an historical archaeologist.
 - ♦ If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to construction within the Infrastructure Corridor.

WG346 Tanam Airfield Archaeological Site

- Prior to construction within the infrastructure corridor:
 - ♦ Assessment of the nature and extent of this site by an historical archaeologist.
 - ♦ If deemed an appropriate response by the archaeologist in consultation with WGJV, salvage excavation consistent with the method outlined in section 6.3.2.3 prior to construction within the Infrastructure Corridor.

WG351 Spirit Tree Site

- Confirmation of the site's location by an anthropologist.
- Erection of a suitable barrier or other measures such as cultural awareness training to prevent access by Project employees and contractors prior to operations commencing within the Bavaga River Gravel Extraction Area.
- Reference to site protection strategy in daily toolbox meetings.

6.3.2.3 Salvage Method

- Salvage works that are recommended prior to the commencement of construction activities at a site must be agreed by WGJV and the affected community representative(s) (or NMAG, as appropriate).
- Representatives of the affected community should be engaged to assist the salvage program.
- Salvage excavation at a cultural heritage site must be supervised by a suitably qualified archaeologist and conducted in a manner consistent with good industry practice.
- Salvage excavation should commence with a 1m² (i.e., a 1m x 1m) salvage pit. The depth of the salvage pit is to be determined and agreed onsite by the archaeologist and WGJV in consultation with the affected community representative(s).

- Where an archaeological deposit uncovered or partially uncovered in the 1m² salvage pit is determined to be of high significance, i.e., due to content, condition and representativeness, the salvage may be extended as agreed with WGJV and the affected community representatives.
- It may be necessary to determine the site extent. In this case, a site boundary establishment program shall be proposed by the archaeologist and undertaken subject to the agreement of WGJV and then with the affected community representative(s).
- Following the determination of site extent, if harm avoidance is achievable, no further salvage excavation is required.
- Guidance on custodianship of recovered materials will be determined by the NMAG in consultation with affected communities.

6.3.3 Residual Impact Assessment

Residual impacts are those potential impacts that remain after the application of the proposed management measures described above. The results of a residual impact assessment on each of the 60 recorded cultural heritage sites included in the impact assessment are presented in Table 22.

In every instance where a recorded cultural heritage site would be impacted by Project activities, the application of the proposed management measures outlined in Section 6.3.2.2 reduced the magnitude of the impact by at least one rating level, and in most instances by two or more rating levels. The net result is that no recorded cultural heritage site would experience an impact rated as greater than major, with the number of impacts rated as extreme reduced from 24 (prior to implementation of management measures) to zero (following the implementation of management measures).

Summary information on the impact ratings to recorded cultural heritage sites before and after the application of management measures is presented in Table 23.

Table 22: Residual impact assessment (recorded cultural heritage sites)

| Site No. | Site Name | Site Type | EIS Study Area | Inside Worksite or ROW? (Y/N) | Impact Significance | Proposed Avoidance and Impact Management Measures | Residual Impact Magnitude | Cultural Heritage Significance | Residual Impact Significance |
|----------|---|----------------|----------------|-------------------------------|---------------------|--|---------------------------|--------------------------------|------------------------------|
| WG001 | Babul Camp Site | Camp | IC | Y | Moderate | Recording of oral traditions | Low | Medium | Minor |
| WG002 | Babul Archaeological Site | Archaeological | IC | Y | Major | Collection of surface artefacts and (if necessary) salvage excavation | Low | High | Moderate |
| WG003 | Fere Sacred Site | Story | IC | Y | Major | Recording of oral traditions and confirmation of site boundary; avoidance through minor adjustments to infrastructure corridor alignment and / or erecting barriers if practicable | Low | High | Moderate |
| WG005 | Babul Sacred Swamp Site | Story | MBQ | Ind. | Moderate | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Low | Low | Minimal |
| WG008 | Wames Archaeological Site | Archaeological | MBQ | Y | Major | Salvage collection of surface artefacts and salvage excavation | Low | High | Moderate |
| WG026 | Sibal Sacred Site | Story | MBQ | Y | Extreme | Recording of oral traditions | Low | High | Moderate |
| WG031 | Fere C Archaeological Site | Archaeological | MARF | Y | Extreme | Identification of site boundary; salvage collection surface artefacts and salvage excavation | Low | High | Moderate |
| WG040 | Gwavengo/Ngendakghoma II Rockshelter Site | Rockshelter | MSZ | Y | Extreme | Salvage excavation; recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |
| WG043 | Mea Gova Biangova Sacred Spring Site | Story | MSZ | Y | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG044 | Mea Gova Tongova Sacred Spring Site | Story | GWD | N | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG045 | Beavemo Burial Site | Burial | MSZ | Y | Extreme | Appropriate legal and cultural exhumation and relocation; recording of oral traditions | Low | High | Moderate |
| WG059 | Ngendakghoma I Rockshelter | Camp | MSZ | Y | Major | Assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG060 | Mia Yo Sacred Spring Site | Story | GWD | N | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG121 | Magense | Burial | NARBP | Y | Extreme | Confirm location of site; appropriate legal and cultural exhumation and relocation; recording of oral traditions | Low | High | Moderate |
| WG202 | Buasus 1 | Archaeological | IC | N | Major | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG207 | Nomonum 1 | Story | IC | Y | Major | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |

| Site No. | Site Name | Site Type | EIS Study Area | Inside Worksite or ROW? (Y/N) | Impact Significance | Proposed Avoidance and Impact Management Measures | Residual Impact Magnitude | Cultural Heritage Significance | Residual Impact Significance |
|----------|--------------------------|----------------|----------------|-------------------------------|---------------------|--|---------------------------|--------------------------------|------------------------------|
| WG208 | Babul Village 1 | Archaeological | IC | Y | Major | Salvage collection of surface artefacts and salvage excavation | Low | High | Moderate |
| WG209 | Mugus Badzim 1 | Story | IC | Y | Moderate | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | Medium | Nil |
| WG214 | Fere H | Archaeological | IC | N | Major | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG215 | Fere I | Archaeological | IC | N | Major | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG216 | Fere J | Archaeological | IC | Y | Major | Salvage collection of surface artefact | Low | High | Moderate |
| WG229 | Ngandoyeng | Story | MSZ | N | Major | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |
| WG231 | Nea | Story | MBP | N | Major | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | Medium | Nil |
| WG234 | Mia Yo A | Story | GWD | N | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG235 | Mi a Yo B | Story | GWD | N | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG236 | Mia Yo C | Story | GWD | N | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG238 | Mia Yo D | Story | MSZ | Y | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Medium | High | Major |
| WG241 | Zenapu 2 | Camp | NPHR | Y | Minor | Recording of oral traditions | Low | Low | Minimal |
| WG261 | Sangia | Story | WRGEA | Y | Extreme | Recording of oral traditions | Low | High | Moderate |
| WG264 | Zindaga River Story Site | Story | WRGEA | Ind | Major | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG276 | Anga Masalai Tree | Story | WMF/IC | Y | Extreme | Recording of oral traditions; assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |
| WG277 | Ontang Garden Site | Story | PPT | Y | Major | Assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG300 | WSC1-1 | Archaeological | FAF | Y | Extreme | Salvage collection of surface artefacts | Low | High | Moderate |
| WG301 | WSC1-2 | Archaeological | FAF | Y | Extreme | Salvage collection of surface artefacts | Low | High | Moderate |

| Site No. | Site Name | Site Type | EIS Study Area | Inside Worksite or ROW? (Y/N) | Impact Significance | Proposed Avoidance and Impact Management Measures | Residual Impact Magnitude | Cultural Heritage Significance | Residual Impact Significance |
|----------|----------------------------|-------------------|--------------------------|-------------------------------|---------------------|--|---------------------------|--------------------------------|------------------------------|
| WG302 | WSC1-3 | Archaeological | FAF | N | Extreme | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG303 | WSC1-4 | Archaeological | FAF | Y | Extreme | Salvage collection of surface artefacts | Low | High | Moderate |
| WG304 | WSC1-5 | Archaeological | FAF | Y | Extreme | Salvage collection of surface artefacts | Low | High | Moderate |
| WG305 | WCS2-1 | Archaeological | FAF | Y | Extreme | Salvage collection of surface artefacts | Low | High | Moderate |
| WG306 | WCS2-2 | Archaeological | FAF | N | Extreme | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG307 | WCS2-3 | Archaeological | FAF | N | Extreme | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG308 | Fere Clay Source Site | Subsistence/Trade | IC | Ind | Extreme | Identification of site boundary; management of erosion and sediment run-off during construction within the Infrastructure Corridor; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings. | Nil | High | Nil |
| WG309 | WCSAR-1 | Former Village | IC | N | Moderate | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | Low | Nil |
| WG314 | Kakarak Story Site | Story | IC | Y | Minor | Assist communities with culturally appropriate ceremonies as required | Low | Low | Minimal |
| WG315 | Kobabarong Settlement Site | Former Village | IC | Y | Moderate | Assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG316 | Kokok Settlement Site | Former Village | IC | Y | Moderate | Assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG319 | Wames Story Site | Story | HBP/NAR BP/MBQ/ IC | Y | Major | Assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |
| WG320 | Nufgarak Story Site | Story | IC | Y | Major | Assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |
| WG321 | Ngalulase Story Site | Story | IC | Y | Major | Assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |
| WG322 | Fobias Story Site | Story | IC | Y | Major | Assist communities with culturally appropriate ceremonies as required | Low | High | Moderate |

| Site No. | Site Name | Site Type | EIS Study Area | Inside Worksite or ROW? (Y/N) | Impact Significance | Proposed Avoidance and Impact Management Measures | Residual Impact Magnitude | Cultural Heritage Significance | Residual Impact Significance |
|----------|------------------------------------|----------------|----------------|-------------------------------|---------------------|--|---------------------------|--------------------------------|------------------------------|
| WG323 | Taganek Story Site | Story | IC | Y | Moderate | Assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG327 | Litia Burial Site | Burial | IC | Y | Extreme | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Low | High | Moderate |
| WG334 | Mutufom Story Site | Story | IC | N | Moderate | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | Medium | Nil |
| WG335 | Fiafan Story Site | Story | IC | N | Moderate | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | Medium | Nil |
| WG336 | Umironon Story Site | Story | IC | N | Major | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG337 | Orogwanginpup Settlement Site | Former Village | IC | N | Major | Identification of site boundary; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | High | Nil |
| WG338 | Ngaroperem Story Site | Story | IC | Y | Moderate | Assist communities with culturally appropriate ceremonies as required | Low | Medium | Minor |
| WG339 | WWII Clinic Archaeological Site | Archaeological | IC | N | Major | Assessment by an historical archaeologist, salvage excavation if deemed appropriate | Low | Medium | Minor |
| WG341 | Kafag Airstrip Archaeological Site | Archaeological | IC | Y | Moderate | Assessment by an historical archaeologist, salvage excavation if deemed appropriate | Low | Medium | Minor |
| WG346 | Tanam Airfield Archaeological Site | Archaeological | IC | Y | Moderate | Assessment by an historical archaeologist, salvage excavation if deemed appropriate | Low | Medium | Minor |
| WG351 | Spirit Tree Site | Story | BRGEA | N | Moderate | Confirmation of site location; erection of protective barrier or other measures such as cultural awareness training; reference to site protection strategy in daily toolbox meetings | Nil | Low | Nil |

MSZ – Mine Subsidence Zone

VS – Ventilation Shafts

PTA – Portal Terrace Area

PPT – Process Plant Terrace

MBP – Migiki Borrow Pit

HBP – Humphries Borrow Pit

NARBP – Northern Access Road Borrow Pit

MBQ – Mt Beamena Quarry

WMF – Waste Management Facility

WDRWP – Wastewater Discharge/Raw Water Make-up Pipeline

FAF – Fere Accommodation Facility

FCAF – Finchif Construction Accommodation Facility

PGF – Power Generation Facility

W Worksite

ROW Construction Right of Way

BRGEA – Bavaga River Gravel Extraction Area

WRGEA – Waime River Gravel Extraction Area

MARF – Mine Access Road at Fere

IC – Infrastructure Corridor

PFA – Port facilities Area

GWD Ground Water drawdown

NPHR Nambonga Haul Road and Portal Haul Road

Table 23: Residual impact assessment summary data

| Impact Significance | Number of Sites Before Implementation of Avoidance or Management Measures | | Number of Sites After Implementation of Avoidance or Management Measures | |
|---------------------|---|-----|--|-----|
| | N | % | N | % |
| Nil | 0 | 0 | 15 | 25 |
| Minimal | 0 | 0 | 3 | 5 |
| Minor | 2 | 3 | 11 | 18 |
| Moderate | 13 | 22 | 24 | 40 |
| Major | 21 | 35 | 7 | 12 |
| Extreme | 22 | 40 | 0 | 0 |
| Total | 60 | 100 | 60 | 100 |

Prior to the implementation of any management measures outlined in Section 6.3.2 above, only 26% of the cultural heritage sites included in the impact assessment would have experienced impacts with significance ratings of moderate or less. Subject to the appropriate implementation of the potential management measures, this figure should improve markedly, and greater than 88% of cultural heritage sites would either experience significantly diminished impacts, or none at all.

Table 23 indicates that despite the implementation of the potential management measures, seven cultural heritage sites would still experience impacts rated as being of major significance. Five of these are story sites situated on Mount Golpu that relate to water, which may be impacted by groundwater drawdown required to allow safe underground mining operation. In addition to potential groundwater drawdown, two of these sites, Mea Gova Biagova Sacred Spring Site (WG043) and Mia Yo D (WG238), may also be affected by the subsidence of Mount Golpu. The unmanaged impact magnitude ratings were assessed as high for these seven sites on this basis. The residual impact magnitude assessed for each of the sites was deemed to be medium, acknowledging the mitigating influences of formal oral tradition recording by qualified specialists in concert with support for local communities to hold appropriate ceremonies in order to make the local areas safe for future works. When combined with a high cultural heritage significance rating for each site, this has resulted in major residual impact significance ratings for all seven sites.

It should be noted that ongoing monitoring will be undertaken during Project construction and operation to verify whether ground surface subsidence and groundwater drawdown occur in the manner predicted by the Wafi-Golpu Environmental Impact Statement (WGJV, 2018).

6.3.4 Cumulative Impact Assessment

Cumulative impacts are those impacts resulting from the successive, incremental and/or combined effects of a project when added to existing, planned or reasonably anticipated future projects, i.e., impacts over and above those expected from a stand-alone project (adapted from IFC, 2013).

Cumulative impacts have the potential to occur where impact pathways overlap or intersect.

Other developments that are being implemented or planned that may also give rise to cultural heritage impacts in the vicinity of the Project include:

- Lae Port expansion and development of the Lae Tidal Basin (PNG Ports Corporation) – in progress.
- PNG Biomass Energy Project (Oil Search and Aligned Energy Limited) in the Markham River Valley – in progress.

- Malahang Fisheries Wharf Project (National Fisheries Authority) – proposed.

Substantial ground-disturbing works have already been undertaken in relation to the construction of the Lae Tidal Basin. As such, it is unlikely that any unrecorded cultural heritage sites have been retained intact. Given the low potential for cultural heritage sites to be impacted by construction and operation of the Project's proposed Port Facilities Area (Section 5.3.1), cumulative impacts are therefore expected to be minimal to nil.

The Biomass Energy Project proposed for the Markham River Valley may have the potential to impact oral tradition and archaeological sites of the Wampar community. The proposed Infrastructure Corridor, which crosses through Wampar land, has the potential to give rise to limited cumulative impacts on the heritage of this community. However, due to their linear infrastructure nature, management measures (e.g. refining the concentrate pipeline alignment) may be undertaken to avoid or limit these impacts, should pre-construction surveys identify any further cultural heritage sites along route. Again, cumulative impacts are expected to be minimal to nil.

The Malahang Fisheries Wharf Project is a proposed fisheries wharf to provide for the berthing of purse seine tuna fishing vessels (typically 50m long with a beam of 12m) to supply freshly caught tuna to three new tuna fish processing plants and canneries at the Malahang Industrial Centre in Lae. Given the inclusion of areas immediately east Wagang Village in the present cultural heritage assessment, cumulative impacts are therefore expected to be minimal to nil.

7 REFERENCES

- Adams, K. and L. Lauck. 1985. Dialect survey of Mumeng dialect chain. *Pacific Linguistics A-63*: 1-27.
- Allen, J. and J.F. O’Connell. 2003. The long and the short of it: Archaeological approaches to determining when humans first colonised Australia and New Guinea. *Australian Archaeology* 57: 5-19.
- Alo, Y. 2016. Bavaga Borehole Sites and Access Roads Cultural Heritage Survey, Wafi-Golpu Project, Morobe Province. Unpublished report to Andrew Long and Associate and Coffey Environments, December 2016.
- Armitage, L. 2002. Land Tenure in Papua New Guinea: Custom and Commerce at the Interface. A Case Study of the Ahi People’s Land, Morobe Province, PNG. Accessed at: http://www.prrs.net/Papers/Armitage_indigenous_property_rights_custom_&_commerce_PNG.pdf (accessed 7 December 2017).
- Australia ICOMOS. 2013. The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance, 2013. Australia ICOMOS Incorporated.
- Ballard, C. 1992. The Hahiv: Further social mapping studies at Golpu (Wafi) Prospect. Report to CRA Minerals (PNG) Pty Ltd. November 1992. Port Moresby: Unisearch PNG Pty Ltd.
- Ballard, C. and B. Kanasa. 1993. Golpu (Wafi) Prospect Social Mapping Study. Report to CRA Minerals (PNG) Pty Ltd. May 1993. Port Moresby: Unisearch PNG Pty Ltd.
- Beer, B. 2002. Wampar. In C. Ember, M. Ember and I. Skoggard (eds), *International Encyclopedia of World Cultures Supplement*, pp: 372-374. New York: Macmillan Reference.
- Bellamy, J.A. and J.R. McAlpine. 1995. *Papua New Guinea Inventory of Natural Resources, Population Distribution and Land Use Handbook, 2nd edition. PNGRIS Publication No. 6.* Canberra: Australian Agency for International Development.
- Bennet, T. 2009. Yalu Village and Surrounds, Morobe Province (PDF 557kb, 8pp) [Online, Document], RMIT University, Melbourne, Vic, Available from: /browse:ID=ik8r9re2omki1.pdf. Accessed 27 November 2017.
- Bullard, S. (translator). 2007. Japanese Army Operations in the South Pacific Area New Britain and Papua Campaigns 1942-43. Canberra: Australian War Memorial.
- Bulmer, S. 1964. Prehistoric stone implements from the New Guinea Highlands. *Oceania* 34(4): 246-268.
- Coffey Environments Australia. 2013. Socio-economic Baseline Report Wafi-Golpu Advanced Exploration Project. Unpublished report to Morobe Mining Joint Venture and Wafi-Golpu Joint Venture.
- Coffey Environments. 2016. Wafi-Golpu Project Socioeconomic Impact Assessment. Appendix J to the Wafi-Golpu Project Environmental Impact Statement. Report to Wafi-Golpu Joint Venture.
- Coutts, P.J.F. 1967. Pottery of Eastern New Guinea and Papua. *Mankind* 6(10): 482-488.
- CRA. 1996. *Compensation Agreement Made Between CRA Exploration (PNG) Pty Limited and The Land Holders of the Hengambu and Yanta Clans, EL 440 Wafi Prospect.* Contract dated 20 December 1996.
- Department of Lands. 2008. Valuer-General’s Compensation Schedule for Trees, Plants, All Regions. January 2008. Boroko: Office of the Valuer-General, Department of Lands.
- Denham, T., C. Bronk Ramsey and J. Specht. 2012. Dating the appearance of Lapita pottery in the Bismarck Archipelago and its dispersal to remote Oceania. *Archaeology in Oceania* 47: 39-46.
- Dunn, R.L. 2014. The search for General Walker: new insights. *Air Power History* 61 (3): 6-19.

- Eckermann, W. (2007). *A descriptive grammar of the Bukawa language of the Morobe Province of Papua New Guinea*. Canberra: Pacific Linguistics.
- Fischer, H. 1962. Oberflaechenfunde und rezente Toepferei am unteren Watut-River (Ost-Neuguinea. *Abhandlungen und Berichte des Staatlichen Museums fur Voelkerkunde, Dresden* 21: 23-33.
- Fischer, H. 1963. *Watut. Notizen zur Kultur eines Melanesier-Stammes in Nordost Neuguinea*. Kulturgeschichtliche Froschungen Bd. 10. Braunschweig: Albert Limbag Verlag.
- Fischer, H. 1968. *Negwa. Eine Papua-Gruppe im Wandel*. Muenchen: Klaus Renner Verlag.
- Fischer, H. 1969. Archaeologische Funde und Beobachtungen vom Tauri-Oberlauf Neuguineas. *Abhandlungen und Berichte des Staatlichen Museums fur Voelkerkunde, Dresden* 28: 73-81.
- Fischer, H. 1976. Forms of oral traditions among the Wampar people. *Journal of the Morobe District Historical Society*, 3: 5-20.
- Gamble, B. 2013. *Target: Rabaul: The Allied Siege of Japan's Most Infamous Stronghold, March 1943 - August 1945*. Minneapolis, MN: Zenith Press. pp. 95–113.
- G-tek, 2015. Unexploded Ordnance (UXO) Assessment WGP 1012 – Project, Morobe Province, PNG. Report prepared by G-tek Australia Pty Limited for Wafi-Golpu Joint Venture.
- Green, M. and J. Muke. 2013a. Wafi Golpu Advanced Exploration EIS: Cultural Heritage Impact Assessment. Unpublished draft report to Coffey Environments and Wafi-Golpu Joint Venture, May 2013.
- Green, M and J. Muke. 2013b. Wafi Project Cultural Heritage Assessment: Additional Works (Phase 1) – Worksite Inspections. Unpublished draft report to Wafi Golpu Services Limited, September 2013.
- Green, M., J. Muke and R. Skelly. 2017a. Wafi-Golpu Project Worksite Inspection Cultural Heritage Field Program 2012-2013. Unpublished report to the PNG National Museum and Art Gallery, June 2017.
- Green, M., J. Muke and R. Skelly. 2017b. Wafi-Golpu Project Additional Works Program – Phase 1. Unpublished report to the PNG National Museum and Art Gallery, May 2017.
- Green, M. and J. Sepe. 2013. Wafi Project Cultural Heritage Assessment: Additional Works (Phase 2) – Study Areas 2A and 2B. Unpublished draft report to Wafi Golpu Services Limited, December 2013.
- Green, M. and J. Sepe. 2014. Wafi Project Cultural Heritage Assessment: Additional Works (Phase 3) – Wafi Access Road (Bavaga-Demakwa), Wafi Link Road/PFS Plant, Vengiki Ridge, Buvu TSF. Unpublished draft report to Wafi Golpu Services Limited, June 2014.
- Green, M. and J. Sepe. 2017. Wafi-Golpu Project 2015 Cultural Heritage Field Program. Unpublished report to the PNG National Museum and Art Gallery, July 2017.
- Green, M., J. Sepe and R. Skelly. 2017a. Wafi-Golpu Additional Works Program (Phase 2) – Study Areas 2A and 2B. Unpublished report to the PNG National Museum and Art Gallery, June 2017.
- Green, M., J. Sepe and R. Skelly. 2017b. Wafi-Golpu Additional Works Program (Phase 3) – Wafi Access Road (Bavaga-Demakwa), Wafi Link Road/PFS Plant, Vengiki Ridge, Buvu TSF. Unpublished report to the PNG National Museum and Art Gallery, July 2017.
- Groube, L.M., J. Chapelle, J. Muke and D. Price. 1986. A 40,000 year old human occupation site at Huon Peninsula, Papua New Guinea. *Nature* 324: 453-455.
- Hall, C.M. and S. McArthur 1993. Heritage management: An introductory framework. In C.M. Hall and S. McArthur (eds), *Heritage Management in New Zealand and Australia*, pp. 1-17. Oxford University Press, Auckland.
- Hayter, C. 2012. A short history of mission on Siassi. *Journal of Friends of Lutheran Archives* 22: 5-21.

- Hitchcock, G. 2012. Cultural Heritage Report on the Project Tailing Storage Facility (Markham Gap Basin), Morobe Province, Papua New Guinea. Report to Morobe Mining Joint Venture and Coffey Environments. Melbourne: Arafura Consulting. March 2012.
- Hogbin, H.I., 1951. *Transformation Scene. The Changing Culture of a New Guinea Village*, Routledge, London.
- Holzkecht, H. 1974. *Anthropological Research and Associated Findings in the Markham Valley of Papua New Guinea*. Department of Agriculture, Stock and Fisheries Research Bulletin 15. Port Moresby.
- Holzkecht, S. 1989. *The Markham Languages of Papua New Guinea*. Pacific Linguistics, Series C, No. 115. Canberra: Department of Linguistics, Research School of Pacific Studies, Australian National University.
- IFC, 2012. *IFC Performance Standards on Environmental and Social Sustainability*. January 2012.
- IFC, 2013. *Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets*, Washington D.C.: International Finance Corporation, World Bank Group.
- Johnston, M. That Magnificent 9th: An Illustrated History of the 9th Australian Division 1940–46. Crows Nest, New South Wales: Allen & Unwin.
- Kenney, G. 1949. General Kenney Reports: A Personal History of the Pacific War. New York City: Duell, Sloan and Pearce.
- Kerr, J.S. 1990. *The Conservation Plan: A Guide to the Preparation of Conservation Plans for Places of European Cultural Significance*. National Trust, Sydney
- Landweer, L. and S. Reitmaier. 1990. Sociolinguistic survey report of Middle Watut. Transcript held by the Summer Institute of Linguistics, Ukarumpa, PNG.
- Leahy, P. n.d. Documented Land Disputes in the Wafi Area, Wafi (Mt Golpu). Unpublished draft report to CRA Minerals (PNG) Pty Ltd.
- Lilley, I. 1987. *Prehistoric Exchange in the Vitiaz Strait, Papua New Guinea*, PhD thesis, Australian National University, Canberra. University Microfilms International, Ann Arbor.
- Lilley, I. 2004. 'Trade and culture history across the Vitiaz Strait, Papua New Guinea: The emerging post-Lapita coastal sequence', in Attenbrow, V. and Fullagar R. (eds.), *A Pacific Odyssey: Archaeology and Anthropology in the Western Pacific. Papers in Honour of Jim Specht*, Records of the Australian Museum, supplement 29: 89-96.
- Löffler, E. 1977. *Geomorphology of Papua New Guinea*, CSIRO, Australian National University Press, Canberra.
- Malinowski, B. 1922. *Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagos of Melanesian New Guinea*, Routledge and Kegan Paul, London.
- Marquis-Kyle, P & M Walker. 2004. *The Illustrated Burra Charter: Good Practice for Heritage Places*, Australia ICOMOS, Sydney.
- May, P. and M. Tuckson. 1982. *The Traditional Pottery of Papua New Guinea*. Sydney: Bay Books.
- Miller, J., 1959. Cartwheel: The Reduction of Rabaul (Vol. 2). Office of the Chief of Military History, Department of the Army.
- Muke, J., A. Kuaso and J. Mangi. 2007. Archaeological and Cultural Heritage Survey, Wafi Gold Project, Morobe Province, Papua New Guinea. Report prepared for Harmony Gold Ltd. May 2007. Port Moresby: Social Research Institute Report Series No. 2.

- Muke, J., S. Ipang and K. Mond. Cultural heritage assessment, Northern Access Road, Morobe Mining Joint Ventures, Morobe Province, Papua New Guinea. Unpublished report to Wafi-Golpu Joint Venture, September 2016.
- Muke, J., K. Mond, J. Sepe and L. Muke. 2015. Cultural heritage assessment, Northern Access Road, Morobe Mining Joint Ventures, Morobe Province, Papua New Guinea. Unpublished report to Andrew Long and Associates, December 2015.
- Muke, J. and R. Skelly. 2017. Wafi-Golpu Project Cultural Heritage Field Survey 2017: Cultural Heritage Mapping – Phase 1. Unpublished Interim Report to the PNG National Museum and Art Gallery, June 2017.
- Murphy, J. 1938 Stone Workers of New Guinea, Past and Present. *Oceania* 9(1): 37-40.
- Oram, N. 1977 'Environment, migration and site selection in the Port Moresby coastal area', in Winslow, J. (ed.), *The Melanesian Environment*, pp. 74-99, Australian National University, Canberra.
- Oram, N. 1982 'Pots for sago: The *hiri* trading network', in Dutton T. (ed.), *The hiri in history: Further aspects of long distance Motu trade in central Papua*. Pacific Research Monograph 8, Research School of Pacific Studies, pp. 1-33, Australian National University, Canberra.
- Piteau Associates South Africa (Pty) Ltd. 2017. Wafi-Golpu Mine, Groundwater Management, Modelling of Inflows to Golpu Underground Mining Using FEFLOW. Unpublished report prepared for Wafi Golpu Services Ltd, November 2017.
- PNG Chamber of Mines and Petroleum. 2008. Compensation Schedule for Land Use and Land Damage, and Man Made Structures in the Mining and Petroleum Sectors. January 2008. Port Moresby.
- Rye, O.S. 1976. Keeping your temper under control: materials and the manufacture of Papuan pottery. *Archaeology and Physical Anthropology in Oceania* 11(2): 106-137.
- Sack. P.G. 1976. The Bloodthirsty Laewomba? Myth and History in Papua New Guinea. Canberra: Department of Law, Research School of Social Sciences, Australian National University and The Morobe District Historical Society.
- Sand, C. 2010. Ceramic chronologies of the Western Pacific during the Lapita Period. In Lilley (ed.) *Early Human Expansion and Innovation in the Pacific*. ICOMOS Thematic Study, December 2010, pp.73-93.
- Schapper, J. 1993. The importance of aesthetic value in the assessment of landscape heritage. In J. Ramsay (ed.), *More Than Meets the Eye: Identifying and Assessing Aesthetic Value*. Technical Workshop Series 7, Australian Heritage Commission, Canberra.
- Skelly, R., J. Muke, J. Sepe and M. Green. 2017. Wafi-Golpu Project Cultural Heritage Field Survey 2017: Archaeological Surveys – Phase 2. Unpublished Report to the PNG National Museum and Art Gallery,
- Specht, J. and H. Holzkecht. 1971 Some archaeological sites in the Upper Markham Valley, Morobe District. *Records of the Papua and New Guinea Public Museum and Art Gallery* 1(2): 52–73.
- Summerhayes, G.R, M. Leavesley, A. Fairbairn, H. Mandui, J. Field, A. Ford and R. Fullagar. 2010. Human adaptation and plant use in highland New Guinea 49,000-44,000 years ago. *Science* 330: 78-81.
- Tcschopik, H. 1950 'An Andean ceramic tradition in historical perspective', *Society for American Antiquity*, vol. 15 (3), pp. 196-218.
- The National. 2010. Ahi festival to bring together local Lae villages. Newspaper article published by The National on Thursday 17 September 2015. Accessed at: <http://www.thenational.com.pg/ahi-festival-to-bring-together-local-lae-villages/> (accessed on 7 December 2017)

-
- The National. 2015. Landowner firms join to form company. Newspaper article published by The National on Thursday 17 September 2015. Accessed at: <http://www.thenational.com.pg/landowner-firms-join-to-form-company/> (accessed on 7 December 2017)
- Tovue, J.C. 1989. Wafi Prospect PA440 – Problems. Report to Elders Mining PNG.
- WGJV. 2018. Wafi-Golpu Project Environmental Impact Statement. Report prepared for the Papua New Guinea Conservation and Environment Protection Authority. Wafi-Golpu Joint Venture. Brisbane.
- Watson, V. 1993 Adzera and Agarabi: Contrastive ceramics in Papua New Guinea. *The Journal of the Polynesian Society* 102 3): 305-318.
- WorleyParsons. 2016. Wafi-Golpu Project Numerical Groundwater Flow Model Development. Appendix H to the Wafi-Golpu Project Environmental Impact Statement. Report to Wafi-Golpu Joint Venture.

Appendix 1: Mine Area Cultural Heritage Site Predictive Model

A1.1 Methodology

The predictive model considered various existing spatial datasets, including location data for previously recorded cultural heritage sites, geological and landform data, vegetation/ecological data, and relevant topographical data such as slope and elevation. Attributes to be included in the model were selected on the basis that the environmental parameters they represent would have had a modifying influence on human occupation within and use of the study area, and that this influence may be detectable in variations in the distribution and density of cultural heritage sites across the study area.

The cultural heritage site data collected by SRI during their 2007 field season and presented in Muke et al. (2007) comprised the most reliable data set available prior to the 2012-2015 cultural heritage field program. Based on their results, five different site types were expected to be differentially distributed across the study area in relation to a number of environmental variables. These included:

- Archaeological sites (including ceramic and stone artefacts)
- Burials/Cemeteries
- Former Villages
- Camps
- Story sites

Two spatial datasets, PNGRIS.shp and ContoursLidar5m.shp (both derived from GIS data supplied by Coffey Environments on 23 May 2012), were used to generate data for a number of environmental variables, including lithology, landform, inundation, vegetation, elevation and slope. Lithology, landform, inundation and vegetation were generated directly from the PNGRIS dataset. Slope and elevation were derived from the 5m contour Lidar dataset.

The locations of the 67 cultural heritage sites recorded by Muke et al. (2007) were cross-referenced against the model's six environmental variables using Excel pivot tables. These tables were then reviewed to determine if any patterns emerge that might characterise the locations of any given site type. Given the geographical and cultural factors differentiating Babuaf communities from Hengambu and Yanta communities, a Babuaf dataset was analysed separately from a combined Yanta/Hengambu dataset. A secondary reason for combining the latter two groups into a single dataset was to maximise the sample size for each of the five site types.

A1.2 Spatial Data

The Papua New Guinea Resource Information System (PNGRIS) was developed by the PNG and Australian governments to determine both the current use and the development potential of PNG's natural resources for food and cash crop production (Bellamy and McAlpine 1995). It summarises a range of environmental data within basic mapping units referred to as Resource Mapping Units (RMU). An RMU is an area of land that has the same pattern of landform, geology, climate, hydrology and soils throughout its extent. As such, point locations within the same RMU will share essentially the same environmental characteristics.

Many of the variables included within PNGRIS list two, and sometimes three, elements (e.g. VEG1, VEG2 and VEG3) which characterise the variable overall within an RMU. The element numbered ###1 is the most common form of the variable within an RMU, and is used here in developing the predictive model.

Lithology

Geological data was incorporated into the predictive modelling process as a factor highlighting resource variability within the landscape, both in terms of the effects of geology on the distribution of plant and animal resources, as well as the availability of stone raw materials for the manufacture of tools.

Landform

Landform data was used as a summary statement regarding the dominant geomorphic processes relevant to the location of any cultural heritage site. It provides a useful indicator of the site's general landform formation processes.

Inundation

It is widely accepted that the availability of water and the resources associated with water have acted as a powerful modifier to human behaviour and use of the broader landscape. Within cultural resource management studies, the acceptance of this relationship has resulted in the almost uniform treatment of all areas of land located in close proximity to water, that is within 200m, as areas of high archaeological potential or sensitivity. This has resulted in a level of bias within such studies which has significantly affected sampling strategies.

The type, frequency and duration of inundation/flooding were used as a proxy to develop insights into the availability of water in the vicinity of each site.

Vegetation

The PNGRIS Vegetation variable was used as a means of integrating vegetation structure into the predictive model. It is assumed that vegetation structure can be used a reflection of resource availability at the time, both in terms of edible resources, materials for tool construction and such basic needs as the availability of firewood.

Elevation

Elevation data was considered in the predictive model as an environmental factor that has the potential to influence the presence or absence of cultural heritage across the landscape. Rather than use the Altitude variable included in the PNGRIS dataset which only provides elevations in 600m intervals (and is therefore too coarse for the present study), the elevation data was extracted from Lidar 5m contour data and then grouped into 50m intervals to enable a more effective comparison.

Slope

Slope acts as a modifying factor in terms of the location of human habitation site – villages and campsites are less likely to be located on steeply sloping land than on more level ground. This is not to discount the potential for other site types such as stone artefact scatters, quarries and rock art sites to be present on sloping ground surfaces, but merely to draw attention to the likelihood that the distribution of one of the most common site types present within the study area is likely to be modified by relative slope. Slope data was extracted from Lidar 5m contour data and then grouped into intervals to enable a more effective comparison.

A1.3 Constraints

The outcomes of the predictive modelling exercise were constrained by a number of limiting factors.

- The PNGRIS dataset is based on the construction of RMUs, each of which is characterised by similarities across a range of environmental variables, most of which were not included in the present model. On this basis, the characterisation of the environment for each of the six environmental variables relating to any one of the 67 cultural heritage sites included in the model is the result of a 'smoothing' process that is forced as a result of the need to generate units of similarity, i.e. RMUs with the 'same' environmental parameters. The generation of any one RMU and the boundaries that separate it from its neighbours becomes an expression of the degree of 'sameness' across the RMU for over 30 variables, and this has the potential to mask local variation across the RMU in any one of the six variables selected for inclusion in the model.

- Although the model predicts the occurrence of specific cultural activities in the landscape and the resulting formation of particular types of cultural heritage places (particularly archaeological sites), it cannot be inclusive of all cultural activities. It can only predict the presence or absence of the specific site types used to create it.
- The assumption inherent in the use of the environmental data sets is that they adequately reflect the class of phenomena they purport to reflect for the entire period during which humans were present in the area (assumed to be at least 40,000 years), i.e. that the area has been environmentally and climatically stable for this entire period, which is highly unlikely.
- The model assumes that the cultural heritage database used to generate it accurately describes the full range and nature of cultural activities practiced in the study area over the total period that humans have occupied the area, which is also highly unlikely.
- Conditions of preservation will differ between site types – absence of evidence is not evidence of absence.
- Missing data for Elevation and Slope against some cultural sites owing to incomplete coverage of the Lidar 5m contour data.

A1.4 Results

Summary data describing the results of separate pivot table analyses for the Babuaf and combined Yanta/Hengambu datasets are provided in Table A1.1 and Table A1.2 (Babuaf), and Table A1.3 and Table A1.4 (Yanta/Hengambu). Note that the total number of sites in the Yanta/Hengambu dataset is reduced from 36 to 34 due to the absence of coordinate data for two cultural heritage sites.

A1.4.1 Babuaf

Babuaf cultural heritage sites are located within four defined RMUs (Table A1.1) which can be summarised as follows:

RMU 163 and RMU 169 (Floodplains and swamps – Zone 1)

Relatively low elevation landscapes generally 100-200m above sea level associated with alluvial swamps and meander floodplains of the Watut River valley. The dominant vegetation is either seasonally inundated large to medium crowned forests on plains or fans, or permanently inundated swampy woodland. This zone includes 15 (47%) of the recorded Babuaf cultural heritage sites, most of which are found in association with back swamps on gently to moderately inclined slopes (2-20°). All site types are present within Zone 1, including all three recorded Babuaf campsites.

RMU 168 (Low mountains and foothills – Zone 2)

Well-drained low elevation mountains and foothills of the Watut Range with an underlying coarse-grained sedimentary geology generally associated with large to medium crowned forests. Cultural heritage sites within Zone 2 occur at elevations between 100 and 500m AMSL on gently to steeply inclined slopes (2->30°). This zone includes 14 (44%) recorded Babuaf cultural heritage sites. Site types within Zone 2 are limited to archaeological sites, former villages and story sites.

RMU 174 (Grassland escarpments – Zone 3)

Well-drained low elevation landscapes generally 100-300m above sea level associated with *kunai* grasslands in the foothills of the Watut Range. Zone 3 is limited to homoclinal ridges (also called *cuestas*), a stratigraphic landform characterised by steep escarpments with gentle rear slopes. Cultural heritage sites within this zone occur on gently to moderately inclined slopes (2-20°) probably located to the rear of the escarpments. Zone 3 includes only three (9%) recorded Babuaf sites, including two former villages (n=2) and one story site.

| PNGRIS Resource Mapping Unit | Archaeological n=10 | Burial/ Cemetery n=2 | Former Village n=10 | Camp n=3 | Story n=7 | Total n=32 |
|---|------------------------|----------------------------|---------------------------|-------------|--------------|---------------|
| RMU 163 | | | | | | |
| <ul style="list-style-type: none"> Alluvial deposits Meander floodplains: unstable alluvial floodplain Areas with shallow inundation for 4-6 months Large to medium crowned forests on plains and fans Sites ranging between 100 and 200m AMSL elevation Sites ranging between <2 and 20 degree slopes | | 1 | 1 | | 1 | 3 |
| RMU 168 | | | | | | |
| <ul style="list-style-type: none"> Coarse-grained sedimentary Mountains and hills – weak or no structural control No flooding or inundation Large to medium crowned forests on plains and fans Sites ranging between 100 and 500m AMSL elevation Sites ranging between 2 and >30 degree slopes | 6 | | 5 | | 3 | 14 |
| RMU 169 | | | | | | |
| <ul style="list-style-type: none"> Alluvial deposits Back Swamps Areas permanently inundated, usually to a considerable depth Swamp woodland Sites ranging between <100 and 150m AMSL elevation Sites ranging between <2 and 20 degree slope | 4 | 1 | 2 | 3 | 2 | 12 |
| RMU 174 | | | | | | |
| <ul style="list-style-type: none"> Coarse-grained sedimentary Homoclinal ridges and cuestas – inclined asymmetrical structurally controlled ridges No flooding or inundation Grassland Sites ranging between 100 and 300m AMSL elevation Sites ranging between <2 and 20 degree slopes | | | 2 | | 1 | 3 |

Table A1.1: Distribution of recorded Babuaf cultural heritage sites by RMU

| Environmental Variable | | Archaeological n=10 | Burial/ Cemetery n=2 | Former Village n=10 | Camp n=3 | Story n=7 | Total n=32 |
|------------------------|--|------------------------|----------------------------|---------------------------|-------------|--------------|---------------|
| Lithology | Coarse-grained sedimentary | 6 | | 7 | | 4 | 17 |
| | Alluvial | 4 | 2 | 3 | 3 | 3 | 15 |
| Landform | Meander floodplains: unstable alluvial floodplain | | 1 | 1 | | 1 | 3 |
| | Back Swamps | 4 | 1 | 2 | 3 | 2 | 12 |
| | Mountains and hills – weak or no structural control | 6 | | 5 | | 3 | 14 |
| | Homoclinal ridges and cuestas – inclined asymmetrical structurally controlled ridges | | | 2 | | 1 | 3 |
| Inundation | No flooding or inundation | 6 | | 7 | | 4 | 17 |
| | Areas with shallow inundation for 4-6 months | | 1 | 1 | | 1 | 3 |
| | Areas permanently inundated, usually to a considerable depth | 4 | 1 | 2 | 3 | 2 | 12 |
| Vegetation | Large to medium crowned forests on plains and fans | 6 | 1 | 6 | | 4 | 17 |
| | Swamp woodland | 4 | 1 | 2 | 3 | 2 | 12 |
| | Grassland | | | 2 | | 1 | 3 |
| Elevation | <100 m | | | | 2 | 1 | 3 |
| | 100-150m AMSL | 4 | 1 | 2 | | 1 | 8 |
| | 150-200m AMSL | 2 | | 1 | | 1 | 4 |
| | 200-250m AMSL | 1 | | | | | 1 |
| | 250-300m AMSL | | | | | 1 | 1 |
| | 300-350m AMSL | | | 1 | | 1 | 2 |
| | 400-450m AMSL | 1 | | | | | 1 |
| | 450-500m AMSL | | | 1 | | | 1 |
| | 500-550m AMSL | | | 1 | | | 1 |
| | missing | 2 | 1 | 4 | 1 | 2 | 10 |
| Slope | <2 degrees | 1 | 1 | 2 | 2 | 1 | 7 |
| | 2-5 degrees | 1 | | | | | 1 |
| | 5-10 degrees | 3 | | | | | 3 |
| | 10-20 degrees | 1 | | 3 | | 2 | 6 |
| | 20-30 degrees | 2 | | 1 | | 1 | 4 |
| | >30 degrees | | | | | 1 | 1 |
| | missing | 2 | 1 | 4 | 1 | 2 | 10 |

Table A1.2: Distribution of recorded Babuaf cultural heritage sites against environment

| PNGRIS Resource Mapping Unit | Archaeological n=7 | Burial/ Cemetery n=8 | Former Village n=6 | Camp n=2 | Story n=11 | Total n=34 |
|---|-----------------------|----------------------------|--------------------------|-------------|---------------|---------------|
| RMU 168 | | | | | | |
| <ul style="list-style-type: none"> Coarse-grained sedimentary Mountains and hills – weak or no structural control No flooding or inundation Large to medium crowned forests on plains and fans Sites ranging between 150 and 500m AMSL elevation Sites ranging between 2 and >30 degree slopes | 2 | 2 | 4 | 1 | 2 | 11 |
| RMU 226 | | | | | | |
| <ul style="list-style-type: none"> Low grade metamorphic Mountains and hills – weak or no structural control No flooding or inundation Large to medium crowned forests on plains and fans Sites ranging between 500 and 800m AMSL elevation Sites >30 degree slopes | | 1 | 2 | 1 | | 4 |
| RMU 227 | | | | | | |
| <ul style="list-style-type: none"> Low grade metamorphic Mountains and hills – weak or no structural control No flooding or inundation Large to medium crowned forests on plains and fans Sites ranging between 200 and 700m AMSL elevation Sites ranging between 5 and >30 degree slopes | 5 | 5 | | | 9 | 19 |

Table A1.3: Distribution of recorded Yanta and Hengambu cultural heritage sites by RMU

| Environmental Variable | | Archaeological n=7 | Burial/ Cemetery n=8 | Former Village n=6 | Camp n=2 | Story n=11 | Total n=34 |
|------------------------|---|-----------------------|----------------------------|--------------------------|-------------|---------------|---------------|
| Lithology | Coarse-grained sedimentary | 2 | 2 | 4 | 1 | 2 | 11 |
| | Low grade metamorphic | 5 | 6 | 2 | 1 | 9 | 23 |
| Landform | Mountains and hills – weak or no structural control | 7 | 8 | 6 | 2 | 11 | 32 |
| Inundation | No flooding or inundation | 7 | 8 | 6 | 2 | 11 | 32 |
| Vegetation | Large to medium crowned forests on plains and fans | 7 | 8 | 6 | 2 | 11 | 32 |
| Elevation | 150-200m AMSL | | 1 | 1 | | | 2 |
| | 200-250m AMSL | | 2 | 1 | | 2 | 5 |
| | 250-300m AMSL | 1 | | 1 | 1 | | 3 |
| | 300-350m AMSL | 2 | | | | 1 | 3 |
| | 350-400m AMSL | 1 | | | | 2 | 3 |
| | 400-450m AMSL | | 3 | | | 2 | 5 |
| | 450-500m AMSL | 1 | | 1 | | 4 | 6 |
| | 500-550m AMSL | 1 | | | 1 | | 2 |
| | 550-600m AMSL | 1 | | | | | 1 |
| | 650-700m AMSL | | 1 | | | | 1 |
| | 750-800m AMSL | | 1 | 1 | | | 2 |
| | missing | | | | 1 | | 1 |
| Slope | 2-5 degrees | | 1 | | | | 1 |
| | 5-10 degrees | 1 | 2 | | | 1 | 4 |
| | 10-20 degrees | 1 | 2 | 3 | 1 | 5 | 12 |
| | 20-30 degrees | 4 | 2 | | | 3 | 9 |
| | >30 degrees | 1 | 1 | 2 | 1 | 2 | 7 |
| | missing | | | | 1 | | 1 |

Table A1.4: Distribution of recorded Yanta and Hengambu cultural heritage sites against environment

The distribution of Babuaf cultural heritage site types across these three environmental zones can be summarised as follows (Table A1.1 and Table A1.2):

- **Archaeological sites** (n=10) are found only on forested mountains and foothills within Zone 2 (60%) and in the vicinity of back swamps within Zone 1 (40%). Six of eight archaeological sites (75%) are located at elevations between 100 and 200m AMSL, and five of eight archaeological sites (63%) are located on gently inclined slopes less than 10°.
- **Burials/Cemeteries** (n=2) are restricted to Zone 1. The single Babuaf burial with elevation and slope data is located at an elevation of 100-150m AMSL on flat land (<2°). All of the burials described by Muke et al. (2007) are inhumations.
- **Former Villages** (n=10) are spread across all three environmental zones, but occur mostly (50%) within Zone 2 (Zone 1 – 30%; Zone 3 – 20%). Former settlements occur at elevations between 100 and 550m AMSL. Four of six former settlements (67%) are located on moderate to steep slopes between 10° and 30°.
- **Camp sites** (n=3) are all located in Zone 1, in the vicinity of back swamps situated at elevations less than 100m above sea level on level ground.
- **Story sites** (n=7) are present in all three environmental zones (Zone 1 – 43%; Zone 2 – 43%; Zone 3 – 14%), at all elevations and on slopes ranging between <2° and >30°.

With regard to an earlier proposition that former villages and camp sites are less likely to be located on steeply sloping land (Section 2.4.1 – Slope), five of 22 (or 23%) Babuaf cultural heritage sites with available slope data are located on steep slopes (>20°). These include two archaeological sites (B013 and B032), one former village site (B028) and two story sites (B012 and B021). The two archaeological sites and the former village site are all located on narrow, steeply sloping ridgelines only a few metres wide within the Watut Range (Muke et al. 2007). It is possible that the error margin associated with non-differential GPS recordings have located these sites within the Project GIS on adjacent slopes rather than the ridgelines on which they are actually located. Muke et al. (2007) describe both story sites as being located on steeply sloping ground.

The model has identified only three Babuaf cultural heritage sites (two former villages and one story site) as being located on anthropogenic *kunai* grasslands in Zone 3. However, Muke et al. (2007) recorded a further five archaeological sites (B014, B015, B029, B030 and B031) on ridgelines within *kunai* grasslands on the western foothills of the Watut Range. This highlights the limitations inherent in the use of the PNGRIS database, in that the overarching descriptions of the RMUs within which these six sites are located (RMU 168 and RMU 169) do not account for the localised presence of *kunai* grasslands within them.

A1.4.2 Yanta/Hengambu

Yanta and Hengambu cultural heritage sites are located within three defined RMUs (Table A1.3), which can be summarised as follows:

RMU 168 (Low mountains and foothills – Zone 2)

Well drained low elevation mountains and foothills of the Watut and Wanion Ranges with an underlying coarse-grained sedimentary geology generally associated with large to medium crowned forests. Yanta and Hengambu cultural heritage sites within Zone 2 occur at elevations between 150 and 500m AMSL on gently to steeply inclined slopes (2->30°). This zone includes 11 (32%) recorded Yanta/Hengambu sites. All Yanta/Hengambu site types are present within Zone 2.

RMU 226 and RMU 227 (Dissected mountains – Zone 4)

Well drained, heavily dissected mountains within the Watut and Wanion Ranges around 1,000m AMSL with an underlying metamorphic geology associated with large to medium crowned forests. Yanta/Hengambu cultural heritage sites within Zone 4 occur at a range of elevations between 150 and 800m AMSL, generally on moderately to steeply inclined slopes (10->30°). This zone includes 23 (68%) recorded Yanta/Hengambu sites. All Yanta/Hengambu site types are present within Zone 4.

The environmental descriptions based on the four variables extracted from the PNGRIS dataset are identical for RMUs 226 and 227 (Table A1.3). Their differentiation within the PNGRIS database is presumably based on other environmental variables not included in the model.

The distribution of Yanta/Hengambu cultural site types across Zones 2 and 4 can be summarised as follows (Table A1.3 and Table A1.4):

- **Archaeological sites** (n=7) are predominantly found within Zone 4 (n=5, 71%), at all elevations between 250 and 600m AMSL and mostly on steep slopes greater than 20° (n=5, 71%).
- **Burials and Cemeteries** (n=8) are predominantly found within Zone 4 (n=6, 75%), at all elevations between 150 and 800m AMSL, and mostly on gentle to moderate slopes less than 20° (n=5, 62%).
- **Former Villages** (n=6) are predominantly found within Zone 2 (n=4, 67%), mostly at elevations below 300m AMSL (three of five sites, 60%), and mostly on moderate slopes between 10° and 20° (three of five sites, 60%).
- **Camp sites** (n=2) are located in Zones 2 and 4, at elevations of 250-300 and 500-500m AMSL, on moderate (10-20°) and steep (>30°) slopes.
- **Story sites** (n=11) are predominantly found within Zone 4 (n=9, 82%), mostly at elevations between 300 and 500m above sea level (n=9, 82%), and mostly on moderate to steep slopes between 10° and 30° (n=8, 73%).

Given the mountainous terrain of the area occupied by the Yanta and the Hengambu, it is not surprising that 16 of 34 sites (47%) are modelled as being located on steeply inclined slopes greater than 20°. However, a review of the site descriptions provided by Muke et al. (2007) for these 16 sites indicates that only nine are located on true slopes, whereas three are located on undulating ridgeline crests and three are located on relatively level creek or river banks (one could not be allocated to a landform based on the available site description). Of the nine truly steep sites, five are archaeological sites (including four rockshelters), two are isolated burials and two are described as small sacred springs. Again, it is possible that the error margins associated with handheld GPS recordings have located the remaining six sites within the Project GIS on steep slopes rather than on the ridgelines or creek and river banks on which they are actually located.

The 11 Yanta/Hengambu story sites reported by Muke et al. (2007) include nine sites associated with water (including rivers, creeks, springs and standing pools), with some also associated with sacred boulders. A further two sites are defined as story sites based on the presence of sacred boulders on hill slopes.

A review of the site descriptions in Muke et al. (2007) for the six Yanta/Hengambu former villages and two camps indicates that three former villages are located on ridge tops, one in foothills and two on riverbanks. Both camps are located on riverbanks.

A1.5 Predictive Statement

The following predictive statements about the likely locations of Babuaf, Yanta and Hengambu cultural heritage sites are based on the outcomes of the digital modelling exercise, moderated by a review of the published site descriptions.

Given the constraints of both limited previous cultural heritage survey and the coarseness of the environmental data used in the digital modelling exercise, these predictive statements should not be taken as exclusive indicators of all site types likely to be present within the Project EIS study area, or of their likely locations within the study area.

- In general terms, Babuaf cultural sites can occur anywhere within their present occupied range. They can also occur in elevated areas within the Watut Range in locations immediately adjacent to recorded Yanta and Hengambu cultural heritage sites.
- Similarly, in general terms Yanta and Hengambu cultural heritage sites can occur anywhere within their present occupied range. They are not limited to any specific environmental zone and can occur at a range of elevations and on a range of slopes.

- Babuaf archaeological sites are likely to be located on gently inclined slopes and ridgelines within forested mountains and foothills between 100 and 200m AMSL. They are also likely to be found within or immediately adjacent to localised areas of *kunai* grassland on the lower foothills of the Watut Range.
- Yanta and Hengambu archaeological sites are likely to occur on gently to moderately sloping ridgelines, or within rockshelters on steeply sloping valley sides.
- Babuaf burial sites and campsites are likely to be restricted to either the margins of swamps on gentle slopes or the meander floodplains of the Watut River Valley. Burials will most likely be inhumations.
- Yanta and Hengambu burials are likely to be inhumations located within the dissected mountainous terrain of the Watut and Wanion Ranges at a range of elevations between 150 and 800m AMSL but limited to gentle to moderate slopes less than 20°.
- Babuaf former villages are likely to be found across all environmental zones up to 500m AMSL but are likely to concentrate within the western portion of the Watut Range and foothills on gentle to moderate slopes and ridgelines.
- Yanta and Hengambu former villages and camps are likely to be located either on ridgelines at higher elevations, or on areas of level ground adjacent to larger watercourses.
- Babuaf story sites are likely to be found in all environmental zones across their cultural range, at all elevations and on a variety of slopes.
- Yanta and Hengambu sacred sites are likely to be smaller pools and springs, or large boulders often located adjacent to or within watercourses.

Appendix 2: NMAG Permits



NATIONAL MUSEUM AND ART GALLERY

P.O. BOX 5560, BOROKO, PAPUA NEW GUINEA TELEPHONE: 25 2422

PERMIT FOR ARCHAEOLOGICAL RESEARCH IN PNG

PERMIT 193

Permission is granted to DR MICHAEL GREEN / DR JOHN MUKE

(as required by the National Cultural Property Schedule for 18 May, 1967) to collect and examine material from archaeological sites in WAFI/GOLPU PROJECT AREA, LOWER WATUT, HUON GULF DISTRICT, MIKROBE PROVINCE FROM 18 MAY - 31 JULY 2015

Province(s), providing you agree to the following conditions:

- 1. A brief report (diary) of your field activities should be submitted to the Curator of Prehistory before you leave PNG. It should mention any problems that you faced.
2. We also request that subsequent publications, reports and a representative selection of any B/W photographs and slides taken should be sent as they become available. If possible at least one colour and B/W shot of each major site. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
3. During your fieldwork we expect you to record any sites and significant artifacts that you come across for inclusion within the National Antiquities File held at the National Museum.

Permission is granted ALOIS KWASSO ACTING CHIEF CURATOR - PREHISTORY

Date 18/05/2015

I accept the above conditions Andrew Long + Associates

Address: Social Research Institute Ltd P.O. Box 172 UNIVERSITY NCD PNG

NATIONAL MUSEUM AND ART GALLERY P.O. Box 5560 BOROKO, N.C.D. PH: 325 2422 / Fax: 325 1779

Date: 18/5/2015



PNG NATIONAL MUSEUM & ART GALLERY

P.O. BOX 5560, BOROKO, PAPUA NEW GUINEA
Telephone: 3252405 Fax: 3251779 Email: nationalmuseum@museumpng.gov.pg Webpage: www.museumpng.gov.pg

PERMIT FOR CULTURAL HERITAGE MAPPING IN PAPUA NEW GUINEA

PERMIT 002

Permission is granted to DR JOHN MUKE

(as required by the National Cultural Property Schedule for 18 May 1957) for consultation and physical cultural heritage mapping of tangible and intangible cultural heritage inclusive of archaeological, traditional, social, historical, natural sites at both marine and terrestrial environments in

Lower Wabut River Northern route survey from
Bavaga Village to Highlands Highway, Huan Gulf District
Morobe Province

Providing you agree to the following conditions:

1. The cultural heritage mapping permit should not be used to conduct archaeological surveys and/or excavations, neither should be used to collect, move, relocate and modify, deface any cultural properties and/or content of a site.
2. Provide to NMAG a proposal specifying plans for documentation of intangible and tangible components of indigenous cultural heritage and living components.
3. Conduct (a) oral documentation of spatial arrangements of cultural properties, and (b) physical cultural heritage landscape mapping.
4. Applicable only for field site (s) covered in application and only for period specified in this permit document.
5. Permit will only be issued under an individual's name and to persons with cultural heritage management background.
6. Provide resumes of archaeologists and anthropologist and/or competent cultural heritage specialists.
7. Provide material evidence of valid visa and work permit if you are participating in consultancy work.
8. Submit report of your field activities and findings to Curator of Prehistory within one month of completion of your fieldwork.
9. Ensure impartial and independent reporting to NMAG upon discovery of cultural properties including reporting on deliberate and/or accidental damages to known (existing) or undocumented cultural heritage properties.
10. Unrestricted accessibility for inspection and monitoring by officers and/or authorised agents of the NMAG
11. We also request that subsequent publications, thesis, reports and a representative selection of black/white photographs and slides taken should be sent as and when they become available. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
12. Person (s) who breach conditions of a permit and/or who have been blacklisted will not be issued permit.
13. NMAG reserves the right to refuse, cancel or withdraw the permit at any time if the terms and conditions of the permit are abused, or change at any time.

Validity period of Permit: 12 May 2016 to 30 November 2016

Permission is granted by

Azolis Kwaso

Date: 12/05/16



I accept the above conditions

[Signature]

Address:

SOCIAL RESEARCH INSTITUTE
P.O. Box 172
VNI, P.O. NCD
PAPUA NEW GUINEA

Date: 12th May 2016



PNG NATIONAL MUSEUM & ART GALLERY

P.O. BOX 5560, BOROKO, PAPUA NEW GUINEA
Telephone: 3252405 Fax: 3251779 Email: nationalmuseum@museumpng.gov.pg Webpage: www.museumpng.gov.pg

PERMIT FOR CULTURAL HERITAGE MAPPING IN PAPUA NEW GUINEA

PERMIT 003

Permission is granted to DR JOHN MUKE

(as required by the National Cultural Property Schedule for 18 May 1967) for consultation and physical cultural heritage mapping of tangible and intangible cultural heritage inclusive of archaeological, traditional, social, historical, natural sites at both marine and terrestrial environments in

LOWER WATUT RIVER AREA, TSE DRILLING SITES LOCATED BETWEEN FERE, MUGOSO, MARI, WOANS AND MADZIM, HUON GULF DISTRICT, MORDEBE PROVINCE

Providing you agree to the following conditions:

- 1. The cultural heritage mapping permit should not be used to conduct archaeological surveys and/or excavations, neither should be used to collect, move, relocate and modify, deface any cultural properties and/or content of a site.
2. Provide to NMAG a proposal specifying plans for documentation of intangible and tangible components of indigenous cultural heritage and living components.
3. Conduct (a) oral documentation of spatial arrangements of cultural properties, and (b) physical cultural heritage landscape mapping.
4. Applicable only for field site (s) covered in application and only for period specified in this permit document.
5. Permit will only be issued under an individual's name and to persons with cultural heritage management background.
6. Provide resumes of archaeologists and anthropologist and/or competent cultural heritage specialists.
7. Provide material evidence of valid visa and work permit if you are participating in consultancy work.
8. Submit report of your field activities and findings to Curator of Prehistory within one month of completion of your fieldwork.
9. Ensure impartial and independent reporting to NMAG upon discovery of cultural properties including reporting on deliberate and/or accidental damages to known (existing) or undocumented cultural heritage properties.
10. Unrestricted accessibility for inspection and monitoring by officers and/or authorised agents of the NMAG
11. We also request that subsequent publications, thesis, reports and a representative selection of black/white photographs and slides taken should be sent as and when they become available. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
12. Person (s) who breach conditions of a permit and/or who have been blacklisted will not be issued permit.
13. NMAG reserves the right to refuse, cancel or withdraw the permit at any time if the terms and conditions of the permit are abused, or change at any time.

Validity period of Permit: 12 MAY 2016 - 30 NOVEMBER 2016

Permission is granted by

Acob Kuaso (Signature)

Date: 12/05/16

I accept the above conditions

(Signature)

Address: SOCIAL RESEARCH INSTITUTE LTD P.O. BOX 172 VUNI P.O. NCD



12/5/2016



PNG NATIONAL MUSEUM & ART GALLERY

P.O. BOX 5560, BOROKO, PAPUA NEW GUINEA
Telephone: 3252405 Fax: 3251779 Email: nationalmuseum@museumpng.gov.pg Webpage: www.museumpng.gov.pg

PERMIT FOR CULTURAL HERITAGE MAPPING IN PAPUA NEW GUINEA

PERMIT 007

Permission is granted to DR JOHN MUKE & DR ROBERT SKELLY

(as required by the National Cultural Property Schedule for 18 May 1967) for consultation and physical cultural heritage mapping of tangible and intangible cultural heritage inclusive of archaeological, traditional, social, historical, natural sites at both marine and terrestrial environments in

BAVAEA TAILINGS STORAGE FACILITY AREA ON THE BAVAGA RIVER VALLEY AND IMMEDIATE FLOOD PLAINS, LOWER WATUT RIVER, WAMPAR LLB, MOROBE PROVINCE

Providing you agree to the following conditions:

1. Conduct (a) oral documentation of spatial arrangements of cultural properties, and (b) physical cultural heritage landscape mapping
2. Provide to NMAG a proposal specifying plans for documentation of intangible and tangible components of indigenous cultural heritage and living components.
3. Applicable only for field site (s) covered in application and only for period specified in this permit document.
4. Permit will only be issued under an individual's name and to persons with cultural heritage management background.
5. Provide resumes of archaeologists and anthropologist and/or competent cultural heritage specialists.
6. Provide material evidence of valid visa and work permit if you are participating in consultancy work.
7. Submit report of your field activities and findings to Curator of Prehistory within one month of completion of your fieldwork.
8. Ensure impartial and independent reporting to NMAG upon discovery of cultural properties including reporting on deliberate and/or accidental damages to known (existing) or undocumented cultural heritage properties.
9. Unrestricted accessibility for inspection and monitoring by officers and/or authorised agents of the NMAG
10. We also request that subsequent publications, thesis, reports and a representative selection of black/white photographs and slides taken should be sent as and when they become available. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
11. The cultural heritage mapping permit should not be used to conduct archaeological surveys and/or excavations, neither should be used to collect, move, relocate and modify, deface any cultural properties and/or content of a site.
12. Person (s) who breach conditions of a permit and/or who have been blacklisted will not be issued permit.
13. NMAG reserves the right to refuse, cancel or withdraw the permit at any time if the terms and conditions of the permit are abused, or changed at any time.

Validity period of Permit: 18th NOVEMBER 2016 TO 28 FEBRUARY 2017

Permission is granted by

Arcus Kwaso
Deputy SRC Division

[Signature]
Date: 18/11/16



I accept the above conditions

[Signature]
Address: Social Research Institute
P.O. Box 172
VNI P.O. NCD

Date: 18/11/16



PNG NATIONAL MUSEUM & ART GALLERY

P.O. BOX 5560, BOROKO, PAPUA NEW GUINEA
Telephone: 3252406 Fax: 3251779 Email: nationalmuseum@museumpng.gov.pg Webpage: www.museumpng.gov.pg

PERMIT FOR CULTURAL HERITAGE MAPPING IN PAPUA NEW GUINEA

PERMIT 008

Permission is granted to DR JOHN MUKE & DR ROBERT SKELLY (SRI) (MONASH UNI)

(as required by the National Cultural Property Schedule for 18 May 1967) for consultation and physical cultural heritage mapping of tangible and intangible cultural heritage inclusive of archaeological, traditional, social, historical, natural sites at both marine and terrestrial environments in

ROUTES OF DSTP AND CONCENTRATE SHIPMENT FROM SIFAZING TO YALU - AND DSTP FROM YALU TO WANRANG & CONCENTRATE SHIPMENT FROM YALU TO PORT OF LAE & FASUN IN HUON GULF & NAWAE DISTRICTS, MOROBE PROVINCE

Providing you agree to the following conditions:

- 1. Conduct (a) oral documentation of spatial arrangements of cultural properties, and (b) physical cultural heritage landscape mapping.
2. Provide to NMAG a proposal specifying plans for documentation of intangible and tangible components of indigenous cultural heritage and living components.
3. Applicable only for field site (s) covered in application and only for period specified in this permit document.
4. Permit will only be issued under an individual's name and to persons with cultural heritage management background.
5. Provide resumes of archaeologists and anthropologist and/or competent cultural heritage specialists.
6. Provide material evidence of valid visa and work permit if you are participating in consultancy work.
7. Submit report of your field activities and findings to Curator of Prehistory within one month of completion of your fieldwork.
8. Ensure impartial and independent reporting to NMAG upon discovery of cultural properties including reporting on deliberate and/or accidental damages to known (existing) or undocumented cultural heritage properties.
9. Unrestricted accessibility for inspection and monitoring by officers and/or authorised agents of the NMAG
10. We also request that subsequent publications, thesis, reports and a representative selection of black/white photographs and slides taken should be sent as and when they become available. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
11. The cultural heritage mapping permit should not be used to conduct archaeological surveys and/or excavations, neither should be used to collect, move, relocate and modify, deface any cultural properties and/or content of a site.
12. Person (s) who breach conditions of a permit and/or who have been blacklisted will not be issued permit.
13. NMAG reserves the right to refuse, cancel or withdraw the permit at any time if the terms and conditions of the permit are abused, or changed at any time.

Validity period of Permit: 18th APRIL 2017 TO 18th JULY 2017

Permission is granted by PNG NATIONAL MUSEUM & ART GALLERY BOROKO N.G.P. PERMIT DIRECTOR - SRC

Date: 18/04/17

I accept the above conditions Dr John Muke Address: Social Research Institute LTD V O BOX 172 UNIVERSITY

Date: 24/4/2017



PNG NATIONAL MUSEUM AND ART GALLERY

P.O. BOX 5560, BOROKO, PAPUA NEW GUINEA
Telephone: 3252405 Fax: 3251779 Email: nationalmuseum@museumpng.gov.pg Webpage: www.museumpng.gov.pg

PERMIT FOR ARCHAEOLOGICAL SURVEY IN PAPUA NEW GUINEA

PERMIT 216

Permission is granted to DR JOHN MUKE & DR ROBERT SKELLY (SRI) (MONASH UNI)

(as required by the National Cultural Property Schedule for 18 May 1967) for survey only to document cultural heritage inclusive of archaeological, traditional, historical, natural sites both marine and terrestrial environments in/on: ROUTES OF DSTP AND CONCENTRATE SHIPMENT FROM SIFAZING TO YALU AND DSTP FROM YALU TO WANGANG AND CONCENTRATE SHIPMENT FROM YALU TO PORT OF LAE AND FUNSUN HUON GULF & NAWAE DISTRICTS, MOROBE PROVINCE

Providing you agree to the following conditions:

- 1. Permit applicable only for archaeological survey for field site (s) covered in application and only for period specified in this permit document.
2. Undertake not to excavate a site and/or collect, move, relocate and modify, deface any cultural properties and/or content of a site.
3. Provide to NMAG a proposal specifying plans (including names of participating researchers) for documentation of archaeological surveys of intangible and tangible cultural heritage.
4. Permit will only be issued under an individual's name and restricted to persons with background in archaeology and/or cultural heritage management. No open permit to be issued to persons (including company persons) with no background in archaeology or cultural heritage management.
5. Provide to the Curator of Prehistory resume of principle and lead investigators/researchers.
6. Provide material evidence of valid visa and work permit if you are participating in consultancy work.
7. Return to the Curator of Prehistory all completed cultural heritage site recording forms which may include map, sketches, photos and reports.
8. A report of your field activities and findings should be submitted to Curator of Prehistory within one month of completion of your fieldwork.
9. We also request that subsequent publications, thesis, reports and a representative selection of black/white photographs and slides taken should be sent as and when they become available. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
10. Ensure impartial and independent reporting to NMAG upon discovery of cultural properties including the reporting of deliberate and/or accidental damages to known (existing) or undocumented cultural heritage properties.
11. Unrestricted accessibility for inspection and monitoring by officers and/or agents of the NMAG.
12. Person (s) who breach conditions of a permit and/or who have been blacklisted will not be issued permit.
13. NMAG reserves the right to refuse, cancel or withdraw the permit at any time if the terms and conditions of the permit are abused or changed at anytime.

Validity period of Permit: 18th APRIL 2017 TO 18th JULY 2017

Permission is granted by



Date: 18/04/17

I accept the above conditions

Dr John Muke
Address: Social Research Institute
P.O. Box 172
UNIVERSITY

Date: 24/4/2017



PNG NATIONAL MUSEUM AND ART GALLERY

P.O. BOX 5560, BOROKEO, PAPUA NEW GUINEA
Telephone: 3252405 Fax: 3251779 Email: nationalmuseum@museumpng.gov.pg Webpage: www.museumpng.gov.pg

PERMIT FOR ARCHAEOLOGICAL SURVEY IN PAPUA NEW GUINEA

PERMIT 000
 Extension

Permission is granted to DR JOHN MIKE

(as required by the National Cultural Property Schedule for 18 May 1967) for survey only to document cultural heritage inclusive of archaeological, traditional, historical, natural sites both marine and terrestrial environments in/over WADIT RIVER TO SIFARINE (40 MILE)

TO YALU VILLAGE - YALU TO WANGANG (BUSA) AND TO MAUS MARKHAM, HONI GULF DISTRICT, MOKOBE PROVINCE

Providing you agree to the following conditions: WAFI-GOLPU - CONCENTRATE SHIPMENT & DSTP ROUTES SURVEY

1. Permit applicable only for archaeological survey for field site (s) covered in application and only for period specified in this permit document.
2. Undertake not to excavate a site and/or collect, move, relocate and modify, before any cultural properties and/or content of a site.
3. Provide to NMAG a proposal specifying plans (including names of participating researchers) for documentation of archaeological surveys of intangible and tangible cultural heritage.
4. Permit is issued under an individual's name and restricted to persons with background in archaeology and/or cultural heritage management. No open permit to be issued to persons (including corporate persons) with no background in archaeology or cultural heritage management.
5. Provide to the Curator of Prehistory resume of principle and lead investigators/researchers.
6. Provide material evidence of valid visa and work permit if you are participating in consultancy work.
7. Return to the Curator of Prehistory all completed cultural heritage site recording forms which may include map, sketches, photos and reports.
8. A report of your field activities and findings should be submitted to Curator of Prehistory within one month of completion of your fieldwork.
9. Subsequent publications, thesis, reports and a representative selection of black/white photographs and slides taken should be sent as and when they become available. A copy of any unpublished formal lectures and seminars on your fieldwork and field findings should also be sent.
10. Ensure impartial and independent reporting to NMAG upon discovery of cultural properties including the reporting of deliberate and/or accidental damages to known (existing) or undocumented cultural heritage properties.
11. Unrestricted accessibility for inspection and monitoring by officers and/or agents of the NMAG.
12. Person (s) who breach conditions of a permit and/or who have been blacklisted will not be issued permit.
13. NMAG reserves the right to refuse, cancel or withdraw the permit at any time if the terms and conditions are abused or changed at anytime.

Validity period of Permit: 18th JULY TO 31st DECEMBER 2017

Permission is granted by ALOU KETSO
DEPUTY SAC DIVISION

[Signature]
Date: 14th July 2017



I accept the above conditions

[Signature]
Address: Social Research
100 4th 6th
P.O. Box 172
VNI PO MCT

Date: 14/7/2017