WOODLARK GOLD PROJECT:

ADDENDUM TO ENVIRONMENTAL IMPACT STATEMENT

2018

EXECUTIVE SUMMARY

Geopacific Resources Limited (Geopacific) through its subsidiary Woodlark Mining Limited (WML) is proposing to develop the Woodlark Gold Project (hereafter termed 'the project'). The project is located on Woodlark Island, situated approximately 600 km east of Port Moresby and 300 km northeast of Alotau in Milne Bay Province, Papua New Guinea (PNG).

Approval in principle for the Woodlark Gold Project was granted on the 27th November 2013, with **Permit No. WD-L3(388)** granted on the 17th of February 2014 by the Department of Environment and Conservation (now the Conservation and Environment Protection Agency - CEPA), with the Environment Permit coming into force on the 15th March 2014 with a validity of 20 years (expires 15th March 2034). An Environmental Impact Statement (EIS) was completed in 2013 to meet the requirements of PNG regulations under the *Environment Act 2000*.

In parallel with the preparation of an updated feasibility study for the project, Geopacific submitted a request on the 18th May 2018 to make some amendments to the Environment Permit following some modifications and improvements to the project.

The project modifications will not result in a significant change to the essential nature of the activity being carried out, or change the assessment level of the project (the project has already been determined as Level 3 and the required EIS completed). Project modifications include:

- Change in location of the processing plant to a more central location to reduce haul distances and minimise the overall project footprint;
- Increased plant and DSTP throughput from 1.8 Mtpa to 2.4 Mtpa, with revised near and far field modelling completed;
- Location and geometry of waste dump locations to reduce land clearing requirements, reduce impacts to natural surface water drainage and to minimise haulage distances;
- Realignment of the wharf road to shorten the overall route and provide more direct access between the wharf and mine services facilities;
- Realignment of DSTP pipeline to reduce overall pipeline length from 14 km to 11 km;
- Change in the location of the camp to enable better access from outside the mining lease;
- Revised water management strategy based on a philosophy of maintaining natural drainage wherever possible to minimise impacts to surface water environments and to ensure integration between water supply, pit dewatering and site drainage management, as well as to simplify sediment control infrastructure;
- Change from heavy fuel oil to diesel fired power station, and overall reduced power requirements;
- Increased mine life from 9 years to 13 years, providing improved employment and training opportunities and income to traditional land owners from royalties payments.

Where necessary impacts have been reassessed. In general, there is minimal change to the impact duration and severity presented in the EIS, with improvements in some aspects (e.g. a halving of land clearing requirements). In many cases the approved EIS presents a conservative assessment compared to the present project. The proposed increase in tailings volumes has been fully modelled as was done for the original EIS with only a minor increase in the overall deposition footprint identified. The proposed project modifications do not alter the conceptual closure plan presented in the EIS.

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1. INTRODUCTION

Geopacific Resources Limited (Geopacific) through its subsidiary Woodlark Mining Limited (WML) is proposing to develop the Woodlark Gold Project (hereafter termed 'the project'). The project is located on Woodlark Island, situated approximately 600 km east of Port Moresby and 300 km northeast of Alotau in Milne Bay Province, Papua New Guinea (PNG). WML holds a 100% interest in Mining Lease 508. WML is owned 49% by Kula Gold Limited (Kula), a Public Company incorporated in New South Wales, Australia, and 51% by Geopacific, a Public Company incorporated in Western Australia, Australia. Geopacific is the largest shareholder of Kula with an 85% holding. Geopacific's total interest in WML is 93%, which includes both the direct interest and the indirect interest through Kula. Geopacific became the Project Manager in October 2016 and has been responsible for all activities on the project since that time.

Approval in principle for the Woodlark Gold Project was granted on the 27th November 2013, with **Permit No. WD-L3(388)** granted on the 17th of February 2014 by the Department of Environment and Conservation (now the Conservation and Environment Protection Agency - CEPA), with the Environment Permit coming into force on the 15th March 2014 with a validity of 20 years (expires 15th March 2034). An Environmental Impact Statement (EIS) was completed in 2013 to meet the requirements of PNG regulations under the *Environment Act 2000*.

Geopacific has continued to progress engineering work since the approval of the project. As foreshadowed in the EIS (p1-4):

> *The development proposal will continue to evolve as engineering work progresses through the detailed design phase. WML does not expect these changes to materially affect the findings of this EIS but will assess these variations as a matter of course and report potentially significant changes to the relevant government agencies and other stakeholders.*

In parallel with the preparation of an updated feasibility study for the project, Geopacific submitted a request on the 18th May 2018 to make some amendments to the Environment Permit following some modifications and improvements to the project. A site visit is planned for the 7th and 8th of December to further discuss the proposed amendments and to present the project Definitive Feasibility Study (DFS) and EIS addendum.

Geopacific propose that the requested amendments are minor as per Section 71(1) of the *Environment (Permits) Regulation 2002* in so far as the project modifications will not result in a significant change to the essential nature of the activity being carried out, or change the assessment level of the project (the project has already been determined as Level 3 and the required EIS completed). The project remains an open cut mining development with waste rock dumps, carbon in leach processing and deep sea tailings placement as described in the EIS, however this EIS addendum has been prepared to ensure that any project updates are communicated to CEPA and, where necessary, impact assessments have been re-evaluated.

2. PROJECT OVERVIEW

Woodlark Island is part of the Woodlark Oceanic Rise, one of a succession of composite east-west trending island arcs in the eastern region of PNG and part of the broad regional New Guinea Mobile Belt geological province which hosts several multi-million ounce gold and copper-gold deposits. The project area is located in the central part of Woodlark Island, with project activity focussed around the Busai, Kulumadau and Woodlark King areas. Each of these areas has been the focus of gold mining in the past.

The project will involve open-cut mining of gold resources at the Kulumadau, Busai and Woodlark King deposits using multi-staged pit designs, with a pre-stripping ratio of 3.2:1 over the first five years of mining and 3.9:1 over the 13 year project life. Waste rock will be deposited in engineered waste rock dumps located adjacent to each pit.

Ore will be treated by conventional cyanidation and gold recovery in a carbon-in-leach (CIL) processing plant. Ore processing will consist of crushing and grinding, gravity separation, leaching and adsorption, elution and electrowinning and gold dorè production. The processing facility will have a capacity of 2.4 Mtpa over a 13 year project life.

The project will incorporate a Deep Sea Tailings Placement (DSTP) system including an approximately 11 km pipeline from the process plant to the north-east coast of the island, a mixing tank to pre-dilute the tailings slurry with seawater and to remove entrained air, and a discharge pipeline.

Additional infrastructure will include:

- A new wharf to be constructed at Kwaiapan Bay including fuel storage and laydown areas;
- The development of a road network suitable for the transport of personnel, equipment and ore haulage;
- Development of a permanent mine camp;
- Administration offices and support facilities including stores and warehouse areas, training rooms, security and emergency response;
- Workshops for maintenance of open pit heavy vehicles (HV Workshop) and light vehicles (LV);
- Offices and facilities located within the HV workshop;
- Fuel storage and refuelling facilities at the HV workshop and the processing plant area;
- Improved communications infrastructure;
- A centralised power station and power distribution network to provide power for operating and support areas of the operation and the mine camp;
- In integrated mine dewatering and water supply system, including a central water storage dam located adjacent to the process plant;
- Water management infrastructure including culverts, drainage and sediment control.

The island is relatively sparsely populated with small villages scattered around the coastal areas and inland locations, with residents typically living a subsistence lifestyle. The main administration centre is Guasopa in the south-eastern part of the island. Kulumadau is the second largest village on the island and is located within the proposed area of development. An agreement is in place with the Kulumadau residents to relocate the village to several locations outside of the mining lease.

A Project Location Map is provided in Figure 1 and a General Site Layout in Figure 2.

Figure 1: Woodlark Gold Project Location

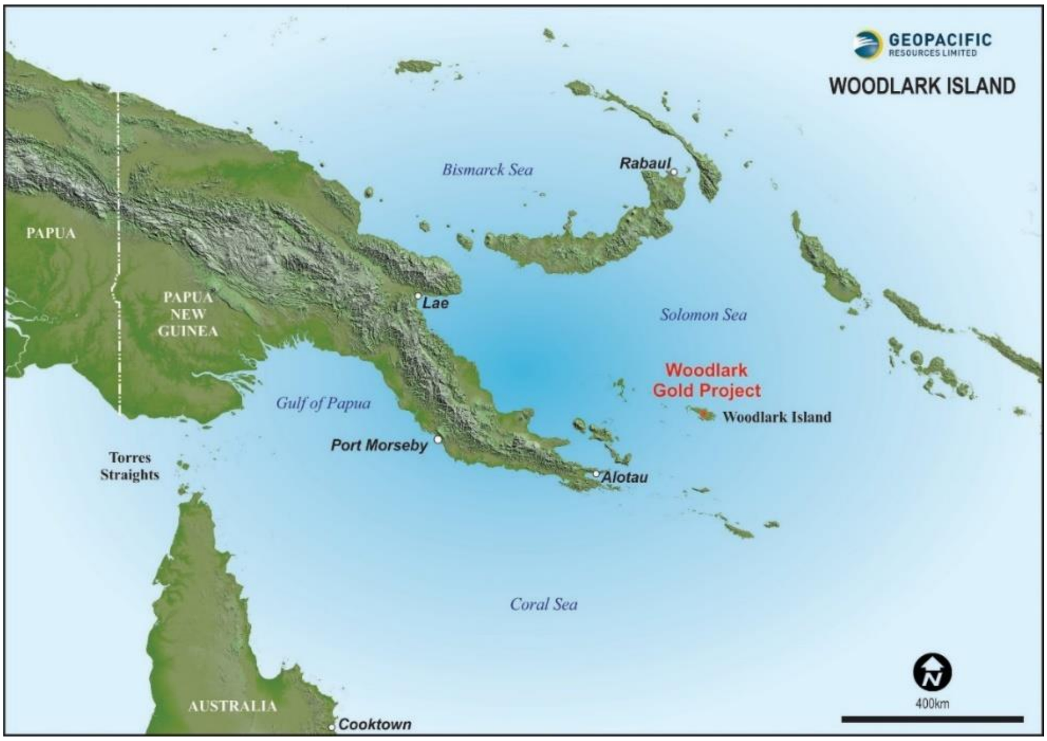
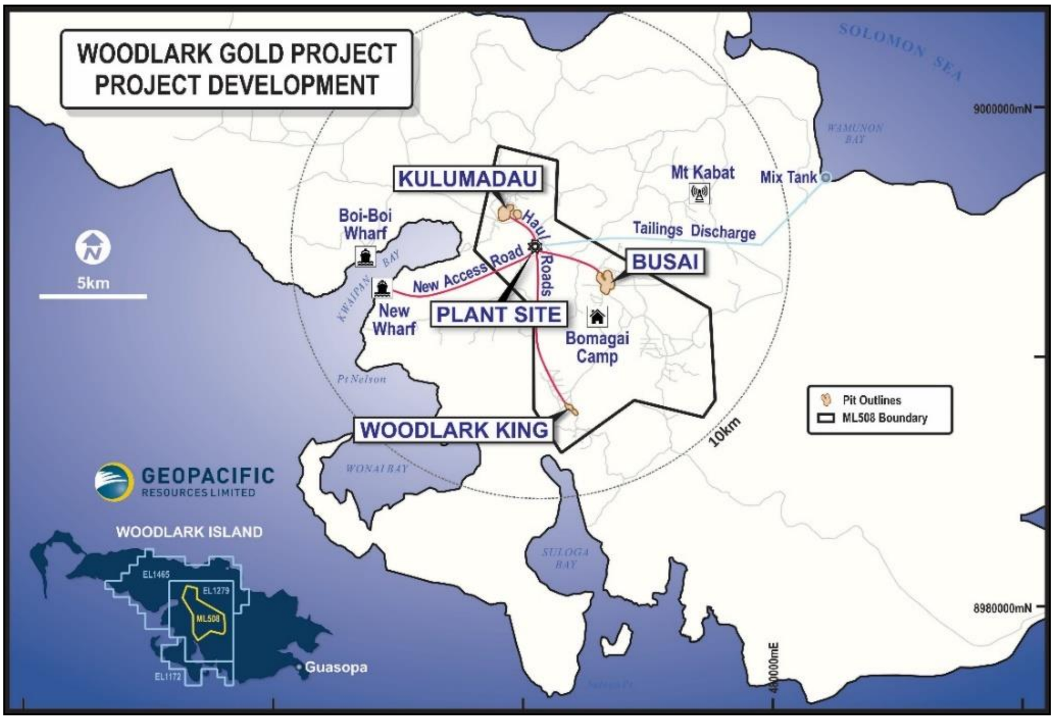


Figure 2: Woodlark Gold Project General Layout



3. SITE SETTING

Woodlark Island is characterised as a humid lowland climate with annual average maximum temperature around 33°C and annual average minimum temperature of approximately 21°C. Humidity ranges between approximately 47% and 98%.

Annual rainfall ranges from highs of over 6,000 mm per annum to lows of below 2000 mm per annum, with an annual average of approximately 4,000 mm, with little seasonal variation. Rainfall is consistently greater than evaporation rates, with evaporation rarely exceeding 100 mm per month.

Seasonal wind trends show that strong prevailing winds occur from the south-southeast from the months of June through to September, reversing to the north-northwest from October to April (albeit at lower velocities).

The landscape of Woodlark comprises predominately flat-lying limestone plains, with a central spine of andesitic and basaltic volcanics dividing its eastern and western halves. The central part of Woodlark Island rises to 325 m above sea level, however the project area is relatively flat with small undulating hills. Woodlark Island is much less seismically active than areas to the north, however intra-slab earthquakes below Woodlark Island have been recorded.

The project is predominantly located within lowland rainforest, which is the most widespread vegetation type on the island, however the area has been variably disturbed over time through historical logging and mining activities.

4. PROJECT HISTORY

Woodlark Island has a rich history of gold mining dating back to the late 19th century. Alluvial gold was first discovered on Woodlark Island in 1895 with mining commencing shortly after. The initial alluvial mining shifted to underground mining of lode deposits in 1899 and continued to 1918 and then recommenced in 1930 before closing in 1939. Between these two main periods and from after World War Two until 1963, mining operations were intermittent although some exploration was initiated during 1962 and 1963 with the Bureau of Mineral Resources (BMR) undertaking surface geochemistry, limited geophysics and diamond drilling at Kulumadau

During the 1980s logging became the major economic activity on Woodlark Island with the Woodlark Island Development Company exporting approximately 50,000 m^3 of timber per year. An extensive network of roads and logging tracks was developed during this period that provides vehicle access to most of the population centres on the island.

In 1988, BHP-Utah Minerals International, in a joint venture with Nord Resources (Pacific) Pty Ltd, undertook an exploration investigation on Woodlark Island after encouraging initial sampling results. The exploration investigation aimed to assess the viability of a potential gold mining operation and included preparing an Environmental Plan Inception Report. Highlands Gold Limited took over the exploration activity from the BHP-Nord Resources joint venture in 1989 and undertook regional exploration, a drilling program, a prefeasibility assessment and prepared an Environmental Inception Report. Highlands Gold Limited's activities focussed on the two main identified deposits, Busai and Kulumadau. Auridiam (PNG) Pty Ltd acquired the project from Highlands Gold, and in 1996, commenced an infill drilling program and subsequently prepared a feasibility study and Environmental Inception Report. Since that time, an Auridiam (PNG) Pty Ltd and Battlefield joint venture from 1998 to 2004, and then BDI Mining Limited (which wholly-owned WML) from 2005 to 2007, continued exploration effort until the purchase of WML by Kula Gold Limited in 2007.

5. WOODLARK GOLD PROJECT TENURE

Mining lease ML508 was granted in 2014 by the Minister of Mines with a validity of 20 years (expires in 2034) and encompasses an area of 60 km^2 including the three reserve areas (Kulumadau, Busai and Woodlark King), additional areas of high exploration potential and areas for key project infrastructure. In 2016, Geopacific successfully applied to maintain the currency of the mining lease by gaining approval for the extension of the condition to complete construction and commissioning by December 2019. ML508 was granted by the PNG Government through the Mineral Resources Authority (MRA) following completion of a detailed Environmental Impact Statement (EIS), finalisation of Compensation and Relocation Agreements and a Memorandum of Agreement with the local land owners and Provincial and Central Governments.

In addition, the following Leases for Mining Purposes (LMP) and Mining Easements (ME) have also been granted as part of the project development:

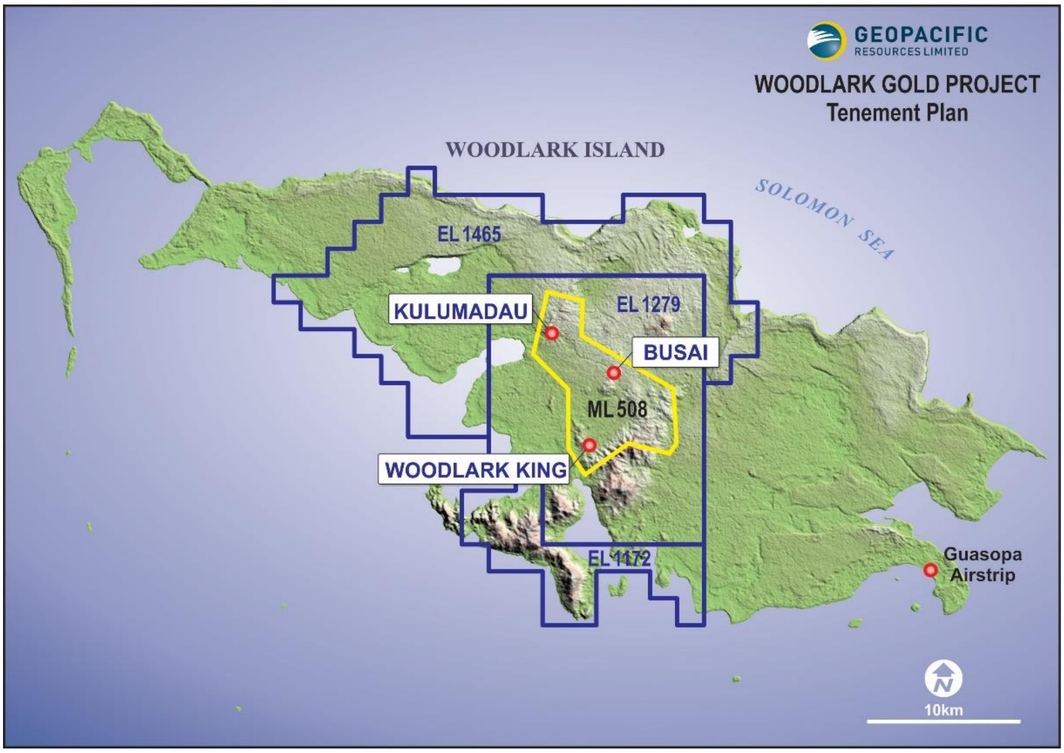
- LMP 89 – provides tenure over the area in which the wharf will be constructed;
- LMP90 – provides tenure over the areas in which the onshore wharf depot will be constructed;
- ME86 – provides an easement for construction of a road from the edge of the mining lease to the wharf depot and wharf;
- LMP91 – provides tenure of the key area in which the Kulumadau village will be relocated to ensure security of land for the new village;
- LMP92 – provides some additional tenure for mine operations (additional areas for waste dumps etc.);
- LMP93 – provides tenure for the DSTP mixing tank and discharge outlet;
- ME85 – provides an easement for the construction DSTP pipeline between the mining lease boundary and LMP93.

WML also holds the following three Exploration Licences (ELs) covering the most prospective central and western portions of Woodlark Island:

- Exploration Licence 1172 is located in the south-central part of the island and comprises 22 sub-blocks covering about 72 km^2. EL-1172 was first granted on the 28th of November 1997, and covered 33 sub-blocks. In November 2005, 11 sub-blocks were released. This EL covers the copper-gold skarns of the Suloga Peninsula as well as quartz sulphide-gold veins at Wonai;
- Exploration Licence 1279 comprises 74 sub-blocks covering a total of 246 km^2. This tenement covers the bulk of currently known resources on Woodlark Island and most of the prospective targets delineated to date;
- Exploration Licence 1465 comprises 75 sub-blocks covering about 250 km^2, and is located in the northern and west-central part of Woodlark Island.

Tenement Boundaries for the Woodlark Gold Project are presented in Figure 3.

Figure 3: Woodlark Gold Project Tenements Map



6. ENVIRONMENTAL IMPACT ASSESSMENT

An Environmental Impact Statement (EIS) was completed to meet the requirements of PNG regulations under the *Environment Act 2000*. This included completion of an Environmental Inception Report (equivalent to a Scoping Study) and an Environmental Impact Statement (equivalent of a full Environmental and Social Impact Assessment - ESIA).

6.1. ENVIRONMENTAL INCEPTION REPORT (EIR)

The EIR is a regulatory requirement and is the first step in the environmental and social impact assessment process. The objectives of the EIR are to:

- Provide high level identification of potential environmental and social issues which may be relevant to the project for review and approval by the regulator;
- Outline the scope and approach for developing an Environmental Impact Statement;
- Formally initiate the consultation process with the relevant government agencies.

The EIR for Woodlark was prepared by Coffey Environments in late 2010/early 2011 based on an agreed scope, and details:

- The purpose of the development;
- Viability of the project;
- Description of the development;
- Development timetable;
- Biophysical environmental setting and issues;
- Socio-economic settings and issues.

6.2. ENVIRONMENTAL IMPACT STATEMENT (EIS)

The project is considered a Level 3 activity under the PNG *Environment Act 2000*, requiring completion of an Environmental Impact Statement.

The EIS, completed by Coffey Environments in January 2013 and submitted to the Department of Environment and Conservation (DEC, now known as CEPA), covers:

- The viability and purpose of the development;
- Policy, legal and administrative framework;
- Stakeholder engagement;
- Description of the proposed development;
- Assessment of alternatives;
- Description of the existing environment;
- Biophysical impact assessment;
- Socio-economic impact assessment;
- Natural hazards and accident events;
- Environmental management, monitoring and reporting.

Extensive specialist studies were completed by a range of subject matter expert consultancies as part of the EIS process. These studies cover all environmental and social aspects of the project and are listed below:

1. *Assessment of the Geochemical Characteristics of Drill Core and Tailings, and the Implications for Pit Water Quality and the Management of Mine Waste Materials*. Environmental Geochemistry International (EGI), March 2012.
2. *Waste Management Feasibility Study*. Knight Piesold, April 2012.
3. *Tailings Management Feasibility Study*. Knight Piesold, April 2012.
4. *Toxicity Assessment of Deep Sea Tailing Placement of Tailing Slurry from the Woodlark Gold Project*. CSIRO, April 2012.
5. a) *DSTP Detailed Design – Part 1 of 2: Engineering Design and Cost Estimate*. EBA, January 2013.
   b) *DSTP Detailed Design – Part 2 of 2: Density and Plume Dispersion Modelling.* EBA, January 2013.
6. *Oceanographic Analysis*. Coffey Environments, October 2012.
7. *Woodlark Hydrogeology DFS Report*. Klohn Crippen Berger, February 2012.
8. *Conceptual Closure Plan*. Richard T. Jackson Consultancy Services, Enzo Guarino and Coffey Environments, January 2013.
9. a) *Social Characterisation for the Proposed Woodlark Gold Mine*. Richard T. Jackson Consultancy Services, December 2011.
   b) *Social Impact Assessment*. Richard T. Jackson Consultancy Services.
10. *Hydromet Summary Report 2009 – 2011*. Sentinel, 2012.
11. *Detailed Seismicity Assessment*. Knight Piesold, July 2011.
12. *Soil and Landform Units Report*. James Douglass (Kula Gold), January 2012.
13. *Flora Characterisation Study*. Osia G. Gideon (University of PNG), August 2010.
14. *Terrestrial Biodiversity Assessment Report*. Francis Crome, Stephen Richards and Ken Aplin, December 2012.
15. *Land, Freshwater and Marine Resource Use Report.* Coffey Environments, December 2012.
16. *Freshwater and Sediment Quality Monitoring – September 2008 to December 2010.* Hydrobiology, August 2011.
17. *Surface Water Management Feasibility Study*. Knight Piesold, May 2012.
18. *Baseline Freshwater Ecology Survey.* Hydrobiology, December 2010.
19. *Nearshore Marine Study Report*. Hydrobiology, December 2010.
20. *Slope Fishes of Wamunon Bay, Woodlark Island – Species Diversity and Biological Assessment.* Coffey Environments, June 2012.
21. *Nearshore Sedimentation Monitoring Report.* Coffey Environments.
22. *Deep Sea Sediment Sampling Survey Report.* Coffey Environments, June 2012.
23. *Baseline Health Survey.* Centre for Environmental Health, November 2011,
24. *Archaeology and Cultural Heritage Report.* PNG Natural History Museum, April 2011.
25. *Additional Cultural Heritage Study – Wharf and Accommodation Facilities and DSTP Pipeline.* Andrew Long and Associates, December 2012.
26. *Air Quality Impact Assessment.* Author and date unknown.
27. *Noise, Vibration and Blast Overpressure Impact Assessment.* Sonos, December 2012.
28. *Settling and Re-suspension Tests on Tailings Samples, Woodlark Gold Project – Summary Report.* CSIRO, 2012.

29. *DSTP Tailing Physical Testwork Program, Woodlark Gold Project – Summary Report.* IHA Consult, 2012.
30. *Potential for Re-suspension of Deposited Tailings Solids.* IHA Consult, 2012.
31. *The Possibility for Coastal Upwelling to Occur Along Northern Woodlark Island.* George Cresswell, January 2013.
32. *Deep Sea Tailing Placement – Tailing Fate Modelling.* January 2013.

7. PROJECT MODIFICATIONS

7.1. OVERVIEW

A number of modifications have been made to the project as a result of the DFS completed in November 2018. These modifications generally represent improvements to the project footprint for a number of reasons, including a reduction of the overall physical extent of the project (and the combined footprint of infrastructure) by about half, improvement of project economics through reductions in haul distances etc. and to avoid disruption to major creeks flowing through the project area.

The project modifications will not result in a significant change to the essential nature of the activity being carried out, or change the assessment level of the project (the project has already been determined as Level 3 and the required EIS completed).

According to the *Environment (Permits) Regulation 2002*, a permit amendment is considered major where:

There is a significant change in the nature of the activity being carried out;

- A Level 2 activity becomes a Level 3 activity;
- A substantial change quantity or quality of contaminant permitted to be released into the environment;
- A substantial change in the results of the release of a quantity or quality of contaminant permitted to be released into the environment.

As no activity has yet occurred there are no monitoring results to compare against permitted quantities or qualities of contaminant release. There is an increase in the proposed quantity of tailings to be discharged via the DSTP system from 1.8 Mtpa to 2.4 Mtpa, however there is an increase in the pre-discharge dilution to be applied. The increase in the tailings discharge throughput is outlined in Section 7.3, with an updated Impact Assessment detailed in Section 8.1.4 (including results of near and far field modelling) and 8.1.5. None of the project modifications are considered to constitute a major amendment as defined in the Regulations. An overview of the key characteristics of the project where modifications have occurred in comparison to those presented in the EIS is provided in Table 1, with areas where there is a modification highlighted.

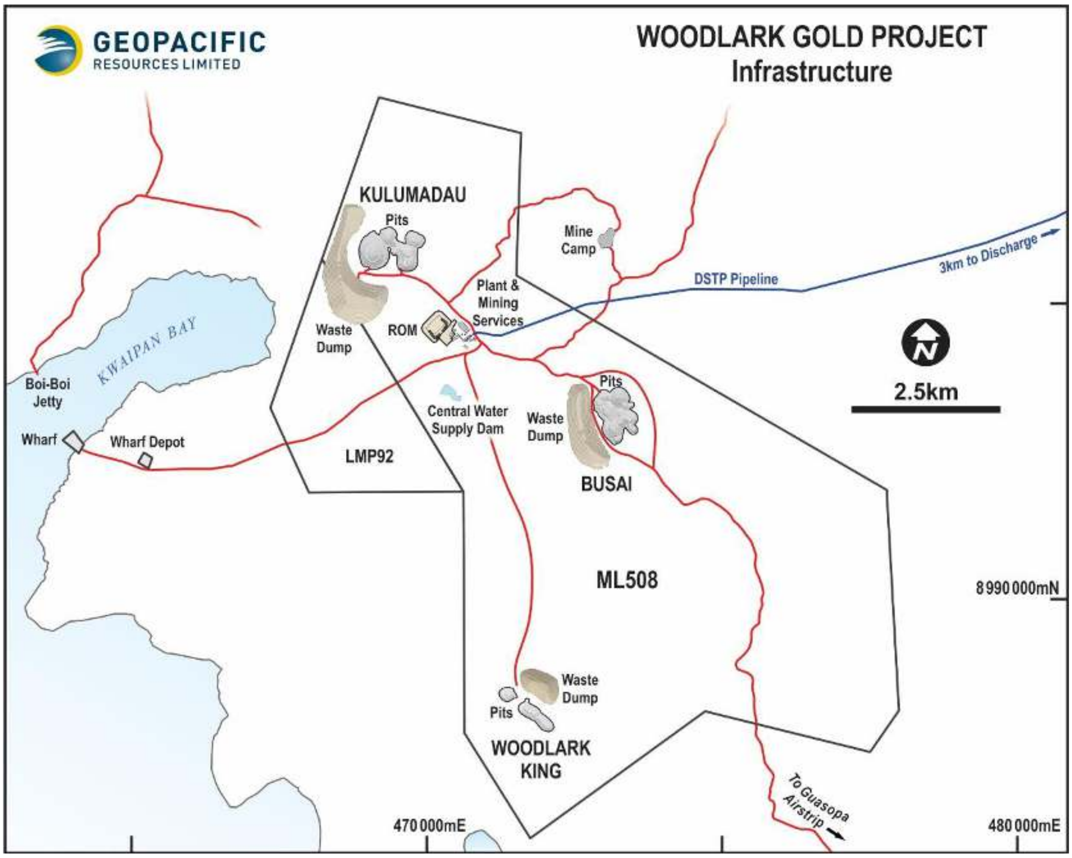
Table 1: Key Project Characteristics

Item	Description (EIS)	Description (current)
Project footprint	Approximately 759 ha.	Approximately 400 ha.
Open pit dimensions (final pit shell)	Busai – 967 m long x 853 m wide x 145 m deep. Kulumadau – 802 m long x 577 m wide x 250 m deep. Kulumadau East – 377 m long x 311 m wide x 100 m deep. Woodlark King – 675 m long x 266 m x 80 m deep.	Busai – 967 m long x 853 m wide x 145 m deep. Kulumadau (including Kulumadau East and Boscalo) – 1,001 m long x 778 m wide x 230 m deep. Woodlark King (including Woodlark King North) – 938 m long x 209 m x 80 m deep.
Mill throughput	1.8 Mt/a of ore.	2.4 Mt/a of ore.
Life of Mine	9 years	13 years
Gold production	Up to 120,000 oz/year. Total of 813,000 oz.	Up to 110,000 oz/year. Total of 1,011,000 oz.
Tailing management	Deep sea tailing placement (DSTP) in Wamunon Bay.	Deep sea tailing placement (DSTP) in Wamunon Bay as approved.
Power supply	Stand-alone heavy fuel oil-fired power station; separate diesel generators at the wharf and airstrip.	Stand-alone diesel fired power station; separate diesel generator at the wharf.
Power requirement	10.9 MW (average operational load) and 13.6 MW (peak load).	8.8 MW (average operational load) and 10.9 MW (peak load).
Raw water supply	Surface water from rainfall and pit dewatering, supplemented by groundwater abstraction.	Surface water and pit dewatering.
Raw water requirement	4,448 ML/year.	2,365 ML/year.

7.2. PROCESS PLANT

The conventional carbon in leach process plant design and footprint remain fundamentally the same as that described in the EIS. The only material change is that the location of the plant has been moved to a location approximately half way between the Kulumadau and Busai pit areas (see Figure 4). The reason for the move was to improve project economics by reducing overall haul distances. From an environmental perspective, this will result in a reduction in overall vehicle emissions during the life of the project and will reduce overall clearing requirements. Further metallurgical studies have resulted in significant reductions in process water (~45% reduction) and power (~20%) requirements of the plant.

Figure 4: Detailed Site Layout



7.3. DSTP THROUGHPUT

Due to changes in the mine scheduling, the overall annual throughput through the plant and DSTP system is planned to increase from 1.8 Mtpa to 2.4 Mtpa. The placement of the DTSP mixing and de-aeration tank will not change.

The depth of discharge has been increased marginally from 200 m below surface to 230 m to comply with the requirements of the *Draft General Guidelines and Criteria for Mining Operations in PNG Involving DSTP* (SAMS, 2010), which state that the discharge point should be:

1. *"At a minimum depth of 120 m where the maximum depth of the euphotic zone is 80 m or less,*
2. *Where the euphotic zone is deeper than 80m the discharge should be below the maximum observed depths of the surface mixed layer or the euphotic zone, whichever is deepest, + 50% of that length,*

3. *Formation of plumes of tailings in the water column must be minimised. In the event of density changes in the water column occurring the length of the pipe should enable the discharge of tailings to occur below low-density weakly stratified surface waters as detailed in the site specific hydrographic measurements."*

Based on the available CTD data, the maximum measured euphotic zone depth is in excess of 80 m and the maximum measured surface mixed layer depth (153 m) exceeds the maximum measured euphotic zone depth (106 m). Therefore, the DSTP outfall terminus must be located at a minimum depth of 230 m (50% greater than 153 m). Detailed CTD analysis from monitoring undertaken between February 2012 and February 2018 is presented in Appendix 5 (section 2.2.3).

Revised near field and far field tailings discharge modelling has been completed and is detailed in Section 8.1.4.

7.4. WASTE DUMPS LOCATION AND GEOMETRY

There are proposed changes to the placement and geometry of the three waste dumps (see Figure 5).

The Kulumadau Waste Dump has been moved approximately 1 km to the northwest, to a location immediately to the south and west of the Kulumadau Pit, in order to reduce the impact to natural drainage in the project area and to reduce the overall waste haulage distance.

The Busai Waste Dump has been moved from its original location of approximately 1 km to the north-east of the Busai pit to a location immediately to the east of the Busai pit. The movement of the Busai waste dump from east of the Busai pit to immediately west of the Busai pit will remove any project infrastructure, other than the DSTP pipeline, from the Bwalei Creek/Lufuai River catchment, significantly reducing the risk of impacts to that catchment.

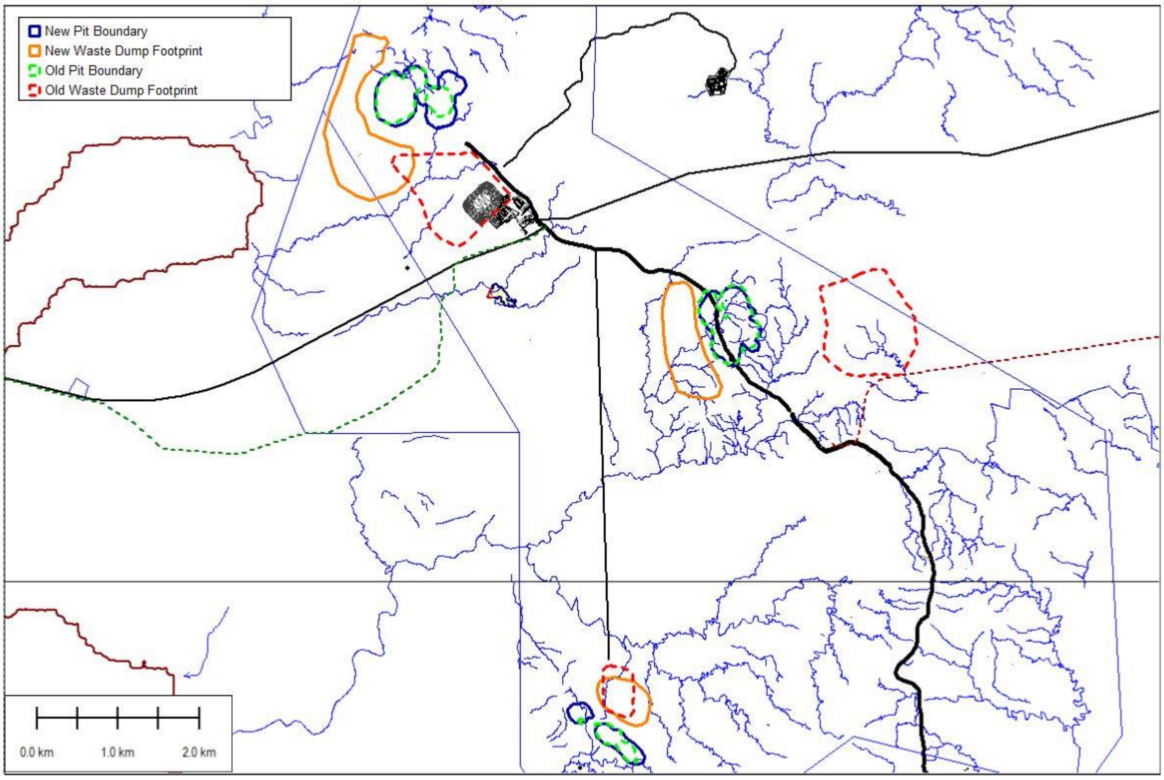
The location of the Woodlark King Waste Dump remains the same, however it has been realigned slightly for operational purposes.

Total waste material quantities have also changed. There have been some significant improvements in overall strip ratios over the life of the Project and some reconfiguration of pits. This has no effect on the overall proposed footprints of the waste dumps. Life of mine waste quantities are presented in Table 2. Waste volumes for Kulumadau and Woodlark King have increased primarily due to increased pit depth, whilst there has been a reduction in waste at Busai due to improved strip ratios.

Table 2: Life of Mine Waste Quantities

Pit	2018 DFS (Mt)	2012 DFS (Mt)
Kulumadau	69.3	45.8
Busai	37.9	53.2
Woodlark King	12.3	4.8

Figure 5: Old and New Waste Dump and Pit Footprints with Key Drainage Lines



7.5. CHANGES TO PIT DIMENSIONS

The dimensions of the Busai and Woodlark King pits have only been marginally altered, primarily due to mine planning and geotechnical reasons (see Figure 5).

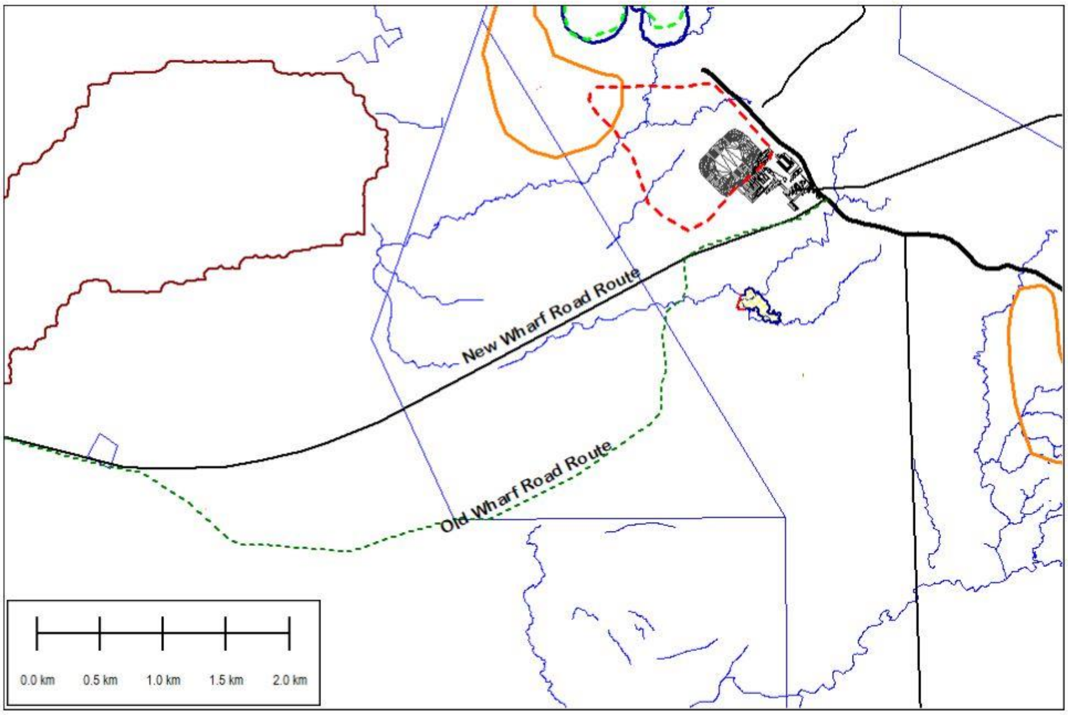
Kulumadau was previously planned as two separate pits. Recent drilling has identified additional resource in this area and as such the pit areas will eventually be merged to one area, with the overall boundary being marginally larger than previously expected. There is no additional impact predicted as a result of this change, however further geochemical analysis will be undertaken shortly as per the conditions of the Permit, with kinetic geochemical testing to be undertaken prior to commencement of operations.

7.6. REALIGNMENT OF WHARF ROAD

Previously the Wharf Road had been planned to follow an existing logging track. However, for safety reasons and to minimise transport distances the planned route has been realigned to create a shorter, straighter road (see Figure 6). An application for an amendment to the Lease for Mining Purposes is currently being prepared and will be submitted accordingly.

The total road length is approximately 5.8 km and will have a width of 5 m and total cleared width of 12 m to allow for transport of wider items. Construction will comprise two 150 mm layers of coronus material roadbase with culverts emplaced on drainage channels.

Figure 6: Old and New Wharf Road Alignments



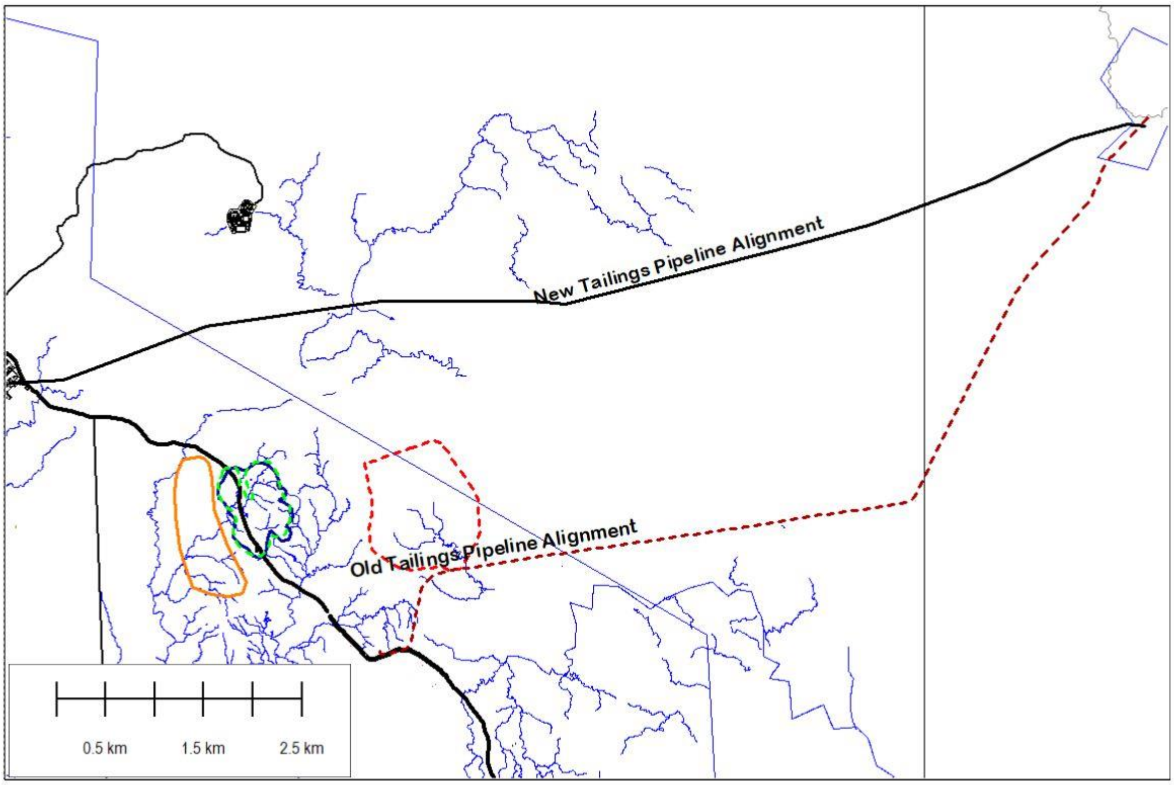
7.7. REALIGNMENT OF DSTP PIPELINE

Due to the new proposed location for the process plant the DSTP pipeline has been realigned (see Figure 7). The realignment will reduce the overall pipeline length from approximately 14 km to 11 km and also avoid crossing a significant creek which would previously have been impacted. An application for an amendment to the Lease for Mining Purposes is currently being prepared. The new proposed route for the DSTP pipeline is now positioned at the upper reaches of the Bwalei Creek/Lufuai River catchment where drainage lines are significantly smaller, significantly reducing the risk of the pipeline being affected by flooding events.

It was previously proposed to construct the overland pipe as a "pipe in pipe" construction. Further investigation however has concluded that the benefits of pipe in pipe are negligible if the purpose of the outer shell is for fluid containment purposes only (typically pipe in pipe construction is done primarily to provide insulation to the inner pipe). Pipe in pipe also has significant limitations when it comes to condition monitoring and failure detection (i.e. if the inner pipe fails it would not likely be identified until the outer pipe also fails). For this reason, it is preferred to construct the pipeline as a single line, utilising bunding for pipeline protection. The proposed pipeline has been designed to ensure a high safety factor should it become over pressurised for any reason. The maximum predicted operating pressure along the pipeline is 5.1 bar with the pipeline rated to 8.9 bar at 50˚C.

Additionally, a system of real time leak detection and automatic shutdown will be installed. Flow meters and pressure sensors will be installed at each end of the pipeline. If pressure in the pipe reaches a designated trigger level the pipeline will be inspected immediately. Should a secondary trigger be identified (indicating a significant failure) the line will be shutdown to minimise discharge to the environment. Management of a leak or failure will be addressed in the Operations EMMP.

Figure 7: Old and New DSTP Alignments



7.8. MOVEMENT OF CAMP

It was originally proposed to construct the permanent mine camp at the location of the existing exploration camp to the south of the Busai Pit. This camp location however sits within the blast exclusion zone for the Busai Pit and as such was considered an unacceptable safety risk. As such, the camp is now proposed to be constructed at a location approximately 2.7 km to the north-east of the process plant location (as shown in Figure 4). This location also provides access to the camp without the need to pass through any of the operational areas of the mine.

The camp will accommodate up to 300 workers and also provide meals for an additional 175 workers who reside in nearby villages outside of the Mining Lease area.

The majority of the buildings will be constructed with steel frames and Colourbond roofing, with walls to be built using cement blocks manufactured on-site by local landowners and workers (block making has already commenced). Camp facilities will include:

- Six senior management accommodation buildings, each with eight ensuite rooms;
- Six supervisor accommodation buildings, with twelve rooms per block and bathrooms shared by two rooms;
- Nineteen workers accommodation buildings, with twelve twin (bunked) rooms per building and shared ablutions;
- A dry mess with 220 seat capacity;
- A wet mess with beer garden;
- Admin building;
- Locker building;

- Gymnasium;
- Ablution blocks;
- Laundry buildings;
- Clinic with ambulance bay;
- Gate house/induction building;
- TV / recreation room;
- BBQ facilities with covered areas;
- Bus pick up / drop off area;
- LV car park;
- Potable water storage tank with UV filtration, and rainwater collection tanks;
- Sewerage water treatment plant;
- Power, water, internet and TV entertainment services.

Potable water will be pumped to storage tanks from a water treatment plant located at the central mine services area. Power will be supplied via an overhead transmission line from the primary power station also located at the central mine services area. Water and power services will follow the planned DSTP road before merging off along the camp access road (existing road which will be upgraded).

The existing camp at Bomagai will be used during the construction phase until the Permanent camp has been constructed.

7.9. WATER MANAGEMENT STRATEGY

A revised overall water management strategy has been developed with a philosophy of maintaining natural flows wherever possible, minimising impacts to major drainage lines and taking a risk based approach through better understanding potential receptors, particularly other water users.

This overarching philosophy has driven several of the minor changes above, particularly the placement of the waste dumps. Previously, sediment control dams were planned to be placed to capture runoff from both disturbed and undisturbed areas, with undisturbed areas forming the majority of catchment areas intersected. Geopacific now proposes an approach which aims to avoid intersection of clean water wherever possible to maintain natural flows with placement of sediment control infrastructure as close to the sediment source as possible. Sediment control will be dynamic and will be implemented on a progressive basis as the mine develops using a range of methodologies including sediment ponds/sumps and other sediment trapping mechanisms, with systems modified as appropriate based on the results of ongoing monitoring. Detailed design of initial sediment control infrastructure including resizing of near source sediment ponds will be completed prior to commencement of construction as per the conditions of the Permit. Designs and design processes will be in line with the International Erosion Control Association Best Practice Erosion and Sediment Control document.

It is no longer proposed to develop a water supply borefield, with adequate water supplies to be provided through pit dewatering and through the construction of a surface water storage dam to the south of the process plant area (in the same location as one of the previously proposed sediment control dams).

Details of the water management plan are provided in Sections 7.9.1 to 7.9.3.

7.9.1. PIT WATER MANAGEMENT

Groundwater

Klohn Crippen Berger (KCB) undertook a definitive feasibility level hydrogeological study in 2011/12 for each of the three mining areas and for the development of a separate groundwater supply for the project. Works included data collection, an intrusive field program (bore drilling, installation and testing), analysis and the development of numeric groundwater models. The KCB report provides:

- An outline of the field program and data analysis undertaken;
- A description of the conceptual hydrogeology;
- Numerical modelling approach, including model parameters and predicted dewatering volumes;
- Recommended dewatering strategies for each pit; and
- Recommended dewatering and groundwater supply infrastructure.

As noted, pit dimensions have been modified since this work was completed, however hydrogeological parameters obtained during the KCB field program have been used to reconfirm the potential groundwater contribution to overall pit inflows.

The hydrogeological conditions suggest that dewatering via ex-pit bores may not be possible due to low hydraulic conductivities. On this basis and given the likely requirement for significant dewatering of incident rainfall, it has been assumed that all pit dewatering will be completed via in-pit sumps. Ex-pit or in-pit dewatering bores may be determined to be beneficial as further data becomes available during operations. Further depressurisation will also be required using horizontal and sub-horizontal drains within the pit walls.

Analytical modelling has been completed by Ashley Price from Geopacific Resources (Ashley is an experienced mine hydrogeologist) to estimate flows over time within each pit using the hydraulic parameters calculated by KCB. The modelling is based on the Dupuit-Forcheimer and Thiem equations for flow to a large diameter well (pit) from an aquifer of uniform permeability and with drawdown in the water table occurring over time in response to abstraction. The method can, as a result of averaging permeability, under-predict inflows where discrete, high permeability zones (e.g. faults or solution features) are intersected. To account for this, three scenarios have been modelled using a range of hydraulic conductivity (k) values within the range determined during the KCB field testing, with the results compared to the KCB numerical modelling for further validation. In any case, groundwater dewatering requirements are likely to be small in comparison to surface water dewatering requirements. Total groundwater inflows for the three mining areas are provided in Tables 3 to 5, with a full pit by pit breakdown provided in Appendix 1.

Table 3: Kulumadau Mining Area Groundwater Inflow Analysis (L/s)

Year	Low k (0.05m/day)	Medium k (0.1m/day)	High k (0.2m/day)
0	14	24	42
1	21	38	68
2	26	47	85
3	31	56	101
4	38	67	123
5	41	74	135
6	42	76	139
7	28	51	93
8	27	49	90

Table 4: Busai Mining Area Groundwater Inflow Analysis (L/s)

Year	Low k (0.05m/day)	Medium k (0.1m/day)	High k (0.2m/day)
0	-	-	-
1	5	9	17
2	10	18	33
3	13	23	42
4	14	25	45
5	5	9	16
6	5	9	16
7	9	16	28
8	13	23	42
9	16	28	49
10	7	12	22

Table 5: Woodlark King Mining Area Groundwater Inflow Analysis (L/s)

Year	Low k (0.05m/day)	Medium k (0.2m/day)	High k (0.4m/day)
0	-	-	-
1	-	-	-
2	-	-	-
3	-	-	-
4	-	-	-
5	-	-	-
6	3	10	18
7	8	24	44
8	9	28	52
9	6	18	34

Surface Water

Average monthly surface water inflows (for an average rainfall year, a low rainfall year and a high rainfall year based on site rainfall data) to each pit, as well as potential inflows during a 1 in 2 year and a 1 in 10 year rainfall event calculated using the methods detailed in the PNG Flood Estimation Manual (SMEC, 1990) have been estimated based on predicted pit surface area over the life of the mine. Given the location of the pits at the top of watersheds, it has been assumed all runoff from outside the pits will be directed through bunding and other methods implemented as part of the mine development and will not require dewatering. Note that once mining has been completed in a pit, it is assumed that dewatering of that pit will no longer be required. However, monitoring of groundwater levels and pit wall pressures may indicate a requirement to reduce the levels of water within disused pits. Total surface water dewatering requirements for each of the mining areas are provided in Tables 6 to 8, with a full pit by pit breakdown provided in Appendix 2. Note that pit areas listed in Tables 6 to 8 indicate the area of those pits which will require dewatering. They assume that where mining has ceased in a pit area it will no longer require dewatering.

Table 6: Kulumadau Mining Area Total Surface Water Inflows

Year	Pit Area (m^2)	Average Inflow (average year) (m^3/day)	L/s	Average Inflow (low year) (m^3/day)	L/s	Average Inflow (High year year) (m^3/day)	L/s	1 in 2 year event (m^3/day)	L/s	1 in 10 year event (m^3/day)	L/s
0	150,000	1,800	21	660	8	2,700	31	21,300	247	30,615	354
1	177,000	2,124	25	779	9	3,186	37	25,134	291	36,126	418
2	177,000	2,124	25	779	9	3,186	37	25,134	291	36,126	418
3	363,000	4,356	50	1,597	18	6,534	76	51,546	597	74,088	858
4	483,000	5,796	67	2,125	25	8,694	101	68,586	794	98,580	1,141
5	483,000	5,796	67	2,125	25	8,694	101	68,586	794	98,580	1,141
6	483,000	5,796	67	2,125	25	8,694	101	68,586	794	98,580	1,141
7	240,000	2,880	33	1,056	12	4,320	50	34,080	394	48,984	567
8	240,000	2,880	33	1,056	12	4,320	50	34,080	394	48,984	567

Table 7: Busai Mining Area Total Surface Water Inflows

Year	Pit Area (m^2)	Average Inflow (average year) (m^3/day)	L/s	Average Inflow (low year) (m^3/day)	L/s	Average Inflow (High year year) (m^3/day)	L/s	1 in 2 year event (m^3/day)	L/s	1 in 10 year event (m^3/day)	L/s
0	-	-	-	-	-	-	-	-	-	-	-
1	10,000	120	1	44	1	180	2	1,420	16	2,041	24
2	165,000	1,980	23	726	8	2,970	34	23,430	271	33,677	390
3	170,000	2,040	24	748	9	3,060	35	24,140	279	34,697	402
4	265,000	3,180	37	1,166	13	4,770	55	37,630	436	54,087	626
5	120,000	1,440	17	528	6	2,160	25	17,040	197	24,492	283
6	125,000	1,500	17	550	6	2,250	26	17,750	205	25,513	295
7	91,000	1,092	13	400	5	1,638	19	12,922	150	18,573	215
8	210,000	2,520	29	924	11	3,780	44	29,820	345	42,861	496
9	210,000	2,520	29	924	11	3,780	44	29,820	345	42,861	496
10	115,000	1,380	16	506	6	2,070	24	16,330	189	23,472	272

Table 8: Woodlark King Mining Area Total Surface Water Inflows

Year	Pit Area (m^2)	Average Inflow (average year) (m^3/day)	L/s	Average Inflow (low year) (m^3/day)	L/s	Average Inflow (High year year) (m^3/day)	L/s	1 in 2 year event (m^3/day)	L/s	1 in 10 year event (m^3/day)	L/s
0	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	-	-
6	135,000	1,620	19	594	7	2,430	28	19,170	222	27,554	319
7	190,000	2,280	26	836	10	3,420	40	26,980	312	38,779	449
8	190,000	2,280	26	836	10	3,420	40	26,980	312	38,779	449
9	135,000	1,620	19	594	7	2,430	28	19,170	222	27,554	319

Dewatering methodology

Removal of both groundwater and surface water from the pits will be via sump pumping methods. Suitable sized sumps will be constructed within the pits to contain runoff before it is removed. Water may be pumped to a number of locations including:

- Directly to the processing plant fresh water storage tank/pond;
- To a water storage dam;
- To a disused pit; or
- Directly to the environment (via the water storage dam for sediment control) should yields exceed storage capacity and is of acceptable quality to ensure Permit conditions are met.

Dewatering systems will be fully integrated with water storage and supply systems, with flexibility provided through the use of easily relocatable pipes and pumps which can be configured to cater for a wide range of flow rates.

Where discharge to the environment is required, it will be directed a point which allows flow to the nearest primary drainage line as follows (see Figures 8 - 10 in Section 7.9.2):

- Kulumadau – Kabagai Creek (#2 Creek);
- Busai – Piak Creek or Yibwaboum Creek;
- Woodlark King – Thompsons Creek or Sinakeb Creek.

As part of the Environment Permit amendment application is it requested that the location of discharge points be changed to better reflect the updated project layout. The new points (locations listed in Section 9.2) factor in these overflow points.

If required, flow will pass though some form of sediment control structure (i.e. sediment trap, settling pond) prior to being discharged to the environment. The type of sediment control structure will be dependent on the level of sediment contained in the discharge and the overall flow rate.

Monitoring

Monitoring of groundwater levels will be critical for ongoing dewatering optimisation, pit wall stability and for environmental management. This will require the installation of several piezometers/monitoring bores in and around the mining area, and further afield. Piezometers may be in the form of either open PVC in which groundwater levels can be measured, or vibrating wire instruments encased in grouted boreholes. Vibrating wire piezometers are an efficient way of measuring pore pressure through the various levels of the formation.

Dewatering rates and water quality will also require careful monitoring during operations. A formal monitoring program will be implemented as per the EMMP.

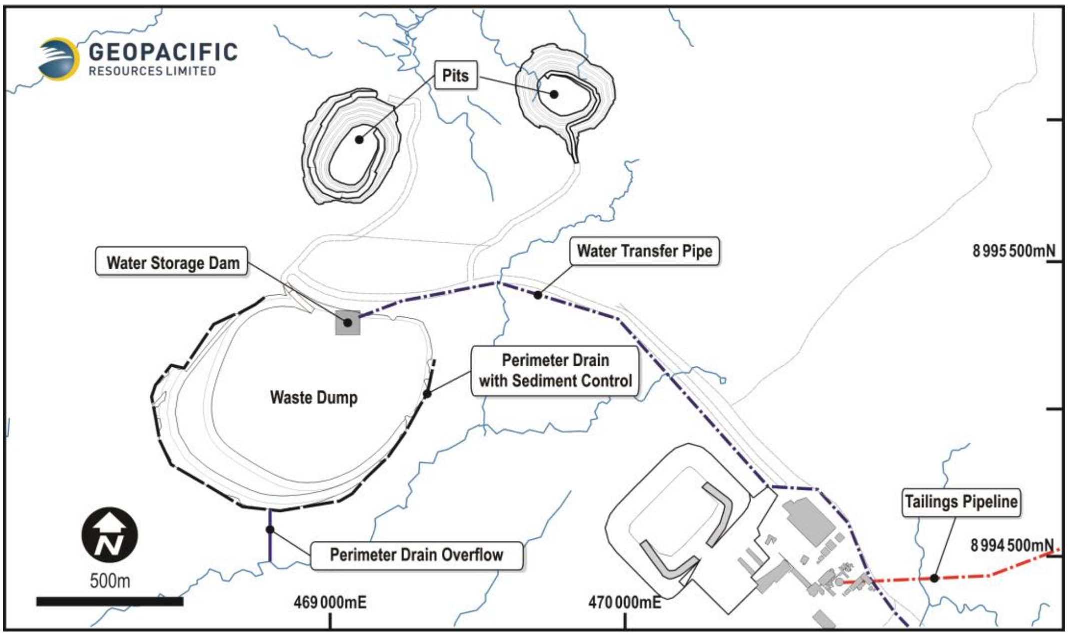
7.9.2. MANAGEMENT OF RUNOFF

Kulumadau

Runoff from the waste dump will flow into a perimeter drain and be directed to sediment control structures before being discharged to the natural drainages. Sediment control infrastructure may include small sediment ponds/channels or sediment traps utilising rip rap or cleared vegetation material. Detailed design of initial sediment control infrastructure including resizing of near source sediment ponds will be completed prior to commencement of construction as per the conditions of the Permit. Designs and design processes will be in line with the International Erosion Control Association Best Practice Erosion and Sediment Control document. During the first few years of mining (up until the end of year 2) a water storage pond will be constructed within the Kulumadau waste dump to provide supplementary water for the process plant. Dewatering yield will be discharged to the pond with additional yield coming from runoff from the area between the Kulumadau pits and the waste dump, as well as runoff which can be directed from the waste dump itself (Figure 8).

As the waste dump footprint increases over time a channel will be maintained running north-east to south west approximately in the middle of the footprint to allow runoff from the area between the Kulumadau pits and the waste dump to be discharged. Once the channel area is lost to the waste dump water flow (which is expected to be minimal at that point due to the small catchment footprint) will be directed under the dump via a drainage system (likely comprised of placement of high permeability coarse rock) or will be directed into a disused pit for water supply storage.

Figure 8: Kulumadau Surface Water Management (Year 1 of Mining)

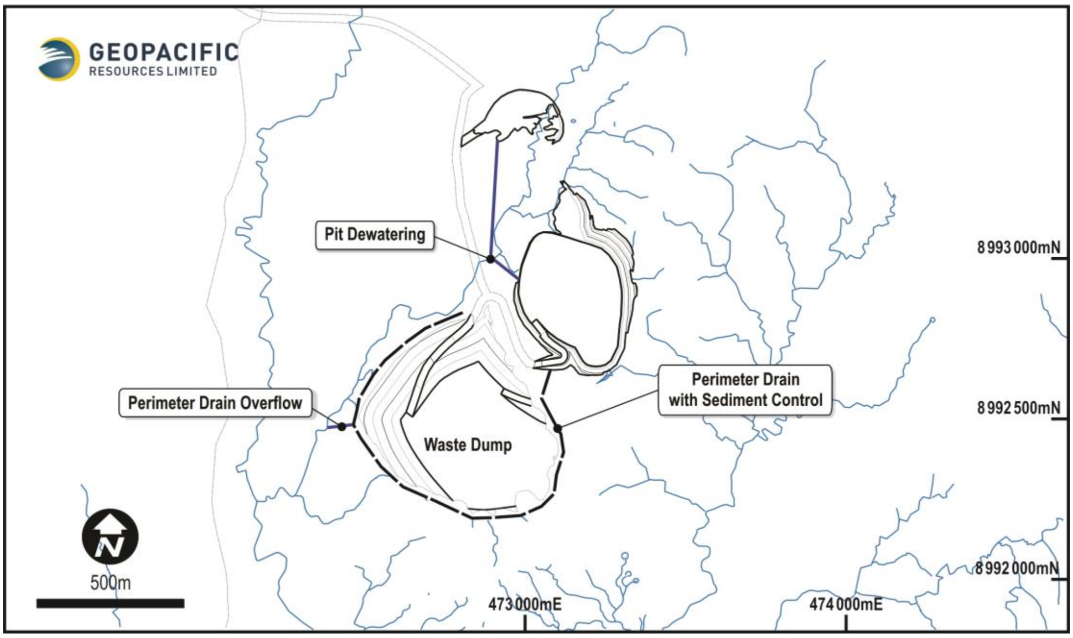


Busai

Runoff from the Busai waste dump will be captured in a perimeter drain and directed to sediment control structures before being discharged to the natural drainages. Sediment control infrastructure may include small sediment ponds/channels or sediment traps utilising rip rap or cleared vegetation material. Detailed design of initial sediment control infrastructure including resizing of near source sediment ponds will be completed prior to commencement of construction as per the conditions of the Permit. Designs and design processes will be in line with the International Erosion Control Association Best Practice Erosion and Sediment Control document. If required, runoff could be contained within a small sump and transferred to any disused pits for water supply storage (Figure 9).

As with the Kulumadau waste dump, the Busai dump will cut off a small catchment area between the pits and the dump itself, which may need to be channelled through or under the dump. Alternatively, if required, the water can be transferred to a disused pit for water supply storage.

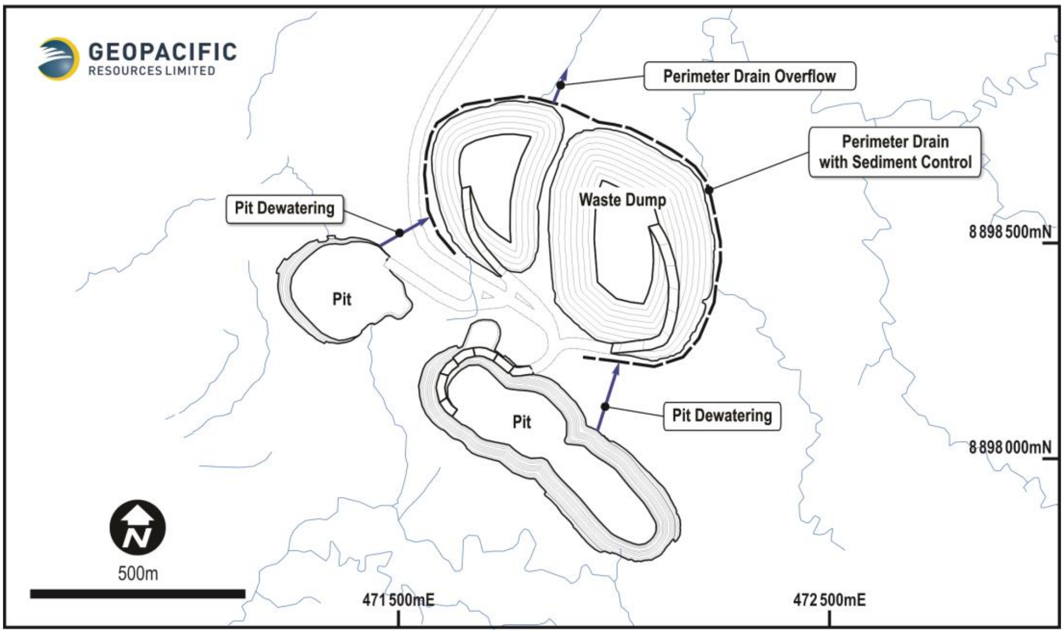
Figure 9: Busai Surface Water Management (Year 2 of Mining)



Woodlark King

Drainage at the Woodlark King waste dump is towards the north. Surface flows from the southern side of the dump will be captured in a perimeter drain and directed around the dump. Flows from the northern side will also be captured in a perimeter drain and directed to sediment control structures before being discharged to the natural drainages (Figure 10). Detailed design of initial sediment control infrastructure including resizing of near source sediment ponds will be completed prior to commencement of construction as per the conditions of the Permit. Designs and design processes will be in line with the International Erosion Control Association Best Practice Erosion and Sediment Control document.

Figure 10: Woodlark King Surface Water Management (Year 7 of Mining)



Haul Road

Runoff from the haul road will be directed to a drainage channel running along the downstream edge of the road. Water will be directed towards natural drainages with installed culverts draining any flow under the road. Rip rap material can be emplaced within the drain to assist with sediment capture, and small sediment traps (sumps) may also be constructed to provide additional sediment management if required. Given the small catchment length and generally rapid drainage following rainfall events, haul road culverts have been designed for a 1 in 2 year rainfall event based on the rainfall intensity estimates calculated using the methods detailed in the PNG Flood Estimation Manual (SMEC, 1990). Culverts are assumed to be corrugated steel pipe with dimensions ranging between 900 mm and 1950 mm and a length of 25 m. Details are provided in Table 9.

Table 9: Haul Road Culvert Details

Culvert No.	Easting	Northing	Culvert Length (m)	Culvert Diameter (mm)	No. of Culverts
1	469587	8995458	25	1800	2
2	470056	8995292	25	1500	1
3	470281	8995090	25	1200	2
4	471011	8994270	25	1950	3
5	471620	8994053	25	900	1
6	471830	8994037	25	900	1
7	472525	8993767	25	1500	2

Where there is no further infrastructure downstream of the haul road water will be allowed to continue to flow along natural drainage lines. Where there is infrastructure, water will be further redirected towards natural drainage channels.

DSTP Pipeline and Access Track

The DSTP pipeline and access track will intersect multiple catchments. Given the criticality of the pipeline both from an operational and environmental perspective, drainage will be designed to cope with a 1 in 100 year rainfall event based on the rainfall analysis calculated using the methods detailed in the PNG Flood Estimation Manual (SMEC, 1990).

A total of 25 drainage points have been identified along the pipeline route based on detailed LiDAR data. Peak flows for each drainage point have been calculated using the Rational Method as described in the PNG Flood Estimation Manual. Culverts are assumed to be corrugated steel pipe with dimensions ranging between 900 mm and 1950 mm and a length of 7 m. Locations of culverts are detailed in Table 10. Final culvert locations will be refined during construction to ensure optimal placement.

Table 10: DSTP Pipeline and Access Track Culvert Details

Culvert No.	Easting	Northing	Culvert Length (m)	Culvert Diameter (mm)	No. of Culverts
1	481373	8996820	7	900	1
2	480363	8996322	7	1800	3
3	479650	8995970	7	1950	9
4	478523	8995813	7	1950	5
5	477838	8995588	7	1800	1
6	477590	8995526	7	1500	2
7	477387	8995478	7	1200	1
8	477193	8995422	7	900	1
9	476982	8995369	7	1200	1
10	476588	8995260	7	1500	1
11	476448	8995231	7	900	1
12	476211	8995219	7	1200	1
13	476080	8995231	7	1500	2
14	475671	8995242	7	1200	1
15	475522	8995238	7	1800	1
16	475223	8995240	7	900	1
17	474729	8995243	7	1200	1
18	474571	8995238	7	900	1
19	474261	8995210	7	900	1
20	474148	8995191	7	1950	13
21	474006	8995168	7	1950	3
22	472227	8994780	7	1800	1
23	472007	8994713	7	1950	3
24	471069	8994459	7	1950	3
25	470887	8994404	7	1500	2

Wharf Road

Runoff from the wharf road will be directed to a drainage channel running along the downstream edge of the road. Water will be directed towards natural drainages with installed culverts draining any flow under the road. Rip rap material can be emplaced within the drain to assist with sediment capture, and small sediment traps (sumps) may also be constructed to provide additional sediment management as required. Given the small catchment length and generally rapid drainage following rainfall events wharf road culverts have been designed for a 1 in 2 year rainfall event based on the rainfall intensity estimates calculated using the methods detailed in the PNG Flood Estimation Manual (SMEC, 1990). Culverts are assumed to be corrugated steel pipe with dimensions ranging between 1200 mm and 1950 mm and a length of 7 m. Locations of culverts are detailed in Table 11. Final culvert locations will be refined during construction to ensure optimal placement.

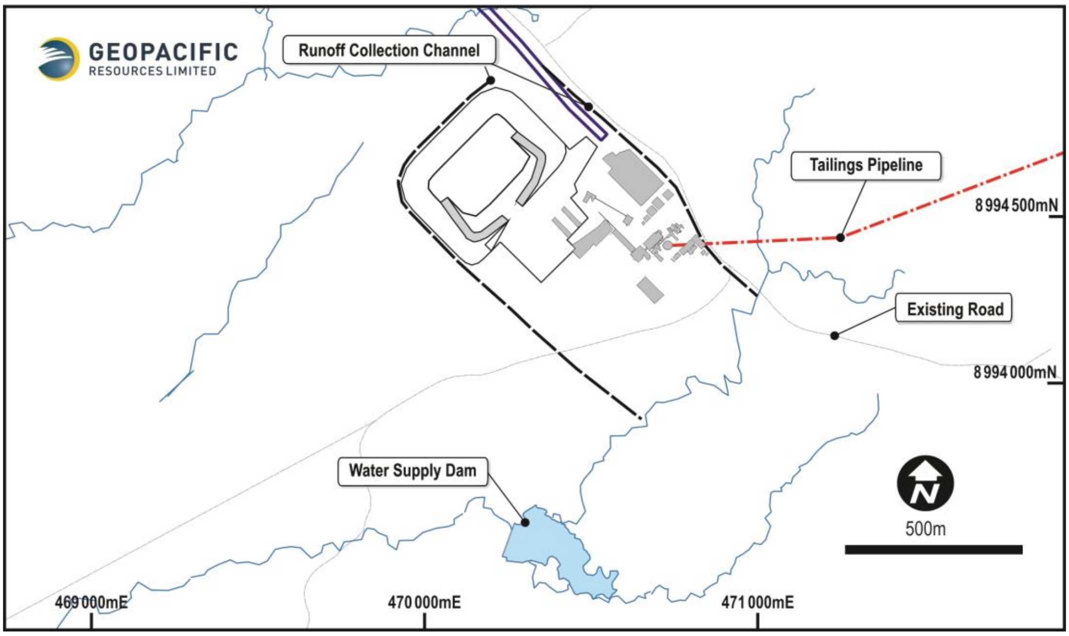
Table 11: Wharf Road Culvert Details

Culvert No.	Easting	Northing	Culvert Length (m)	Culvert Diameter (mm)	No. of Culverts
1	468431	8993230	7	1950	7
2	468228	8993036	7	1200	1
3	467509	8992649	7	1800	3

Process Plant, ROM and Stockpiles

Runoff from the process plant, stockpile and ROM areas will be directed through drains and bunds wherever possible to the primary water supply dam (see Section 7.9.3). Flow direction in this area is from the north, all flows approaching the cleared area will be redirected through bunding to the natural creek lines which flow to along the north-west and south east bounds (Figure 11).

Figure 11: Process Plant, ROM and Stockpiles Surface Water Management



Camp

Both the temporary construction camp and the permanent camp will be located on elevated ridges and will not be affected by any major drainage lines. Runoff from within the camp areas will be directed through small drains before being discharged towards natural drainage lines. There is not expected to be any significant runoff of sediment or other contaminants from the camp areas, however creeks downstream will be monitored.

7.9.3. WATER SUPPLY

Demand

Processing Plant

Water demand for the processing plant is dependent on the moisture content of the ore; a conservative value of 10% has been applied. Of the total plant water demand, a proportion of fresh only water is required for mixing of reagents and gland water. The remainder can be either fresh water or sea water. Sea water does result in an increase in lime use within the plant, so the preference is to utilise fresh water wherever possible, using sea water as a back-up only when necessary.

Potable Supply

Potable supply requirements have been based on the following assumptions:

- 170 L/person/day for accommodation (AusIMM handbook):
  - 300 residents in camp at any one time (other staff will reside at their homes nearby villages);
- 80 L/person/day for daily usage in an office/industrial area (AusIMM handbook):
  - 60 staff at main office (incl. gate house, warehouse, emergency response centre);
  - 10 laboratory staff;
  - 120 mine services staff (including truck drivers and other equipment operators);
  - 2 staff located at the wharf depot;
  - 70 staff at the process plant.
- 10 m^3/day for the gold room.

This equates to a total potable demand of 82m^3/day.

Mine Services

A nominal 240m^3/day has been allocated to mine services for primarily washdown and dust suppression (if required) purposes.

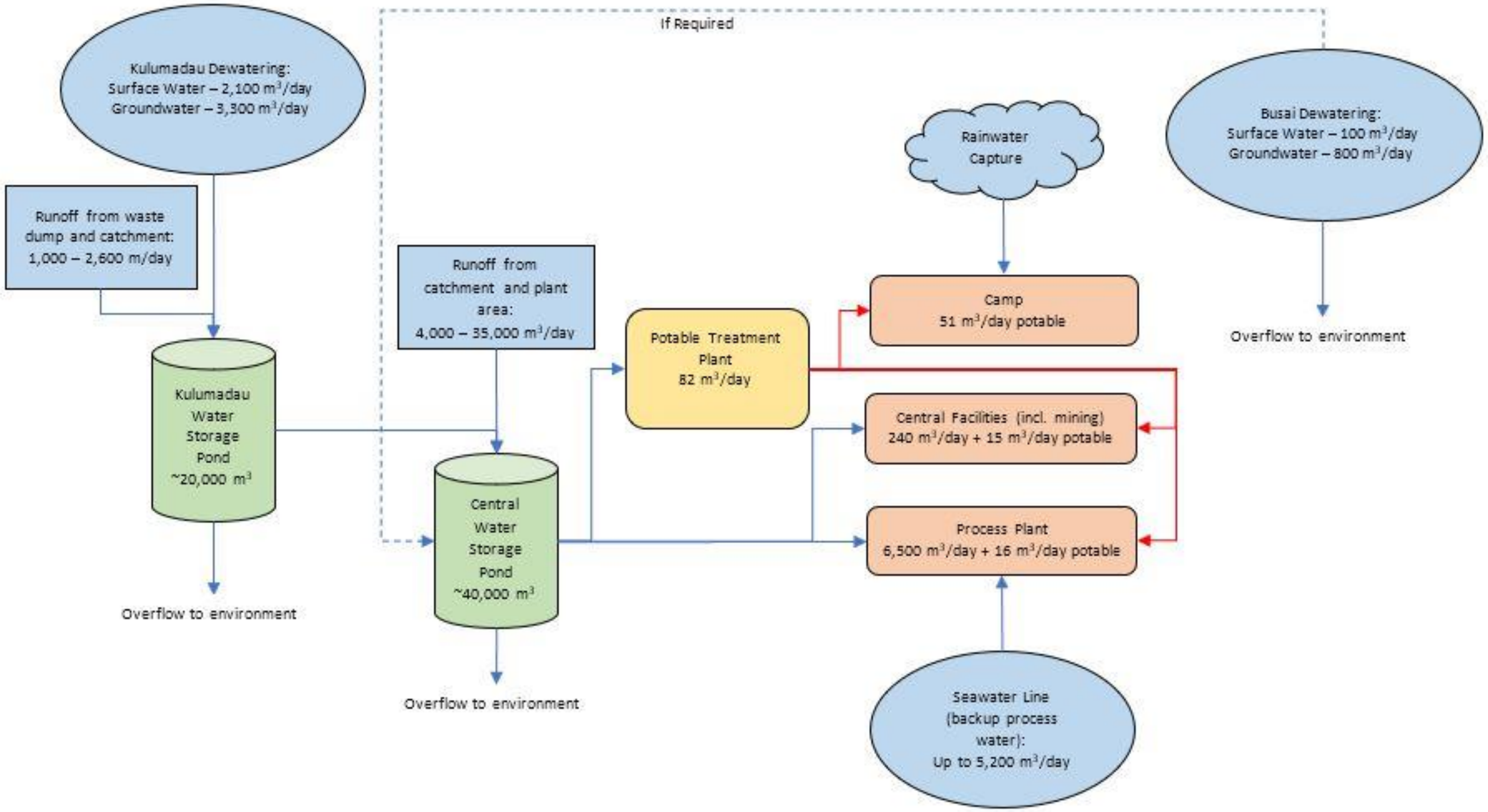
Water Use Summary

A total site water use summary based on a 10% ore moisture content is provided in Table 12, with a summary water balance diagram provided in Figure 12. The water requirements for the project are approximately half of that stated in the EIS.

Table 12: Site Water Use Summary

	m^3/day	m^3/hr	L/s
Water in Mill Feed	816	34	
Water in Plant Tailings	6,936	289	
Difference (water required into slurry)	6,120	255	
Raw water (reagents, gland) into plant (fresh water requirement)	1,344	56	16
Difference (raw water makeup) can be fresh or seawater	4,776	199	55
Cooling water losses (fresh water only)	24	1	0
Plant dust suppression	0	0	0
Mine services and mine dust suppression (fresh water only)	240	10	3
Raw water for camp/potable water (fresh water only)	96	4	1
Total other (fresh or seawater) water requirement	**4,776**	**199**	**55**
Total fresh water requirement	**1,704**	**71**	**20**

Figure 12: Water Balance Diagram



Supply Sources and Storage

Processing Plant and Mine Services

A primary water supply dam will be constructed on the Uwenu Creek to the south west of the process plant location at the same location and of the same approximate size of one of the previously planned sediment control dams. Recorded flow rates from the Uwenu Creek range between 70 and 450 L/s (6,000 to 39,000 m^3/day) (monitoring is ongoing), so will likely be capable of meeting all of the site water requirements for most of the time whilst still maintaining some downstream flow. The dam is estimated to hold approximately 40,000 m^3, equivalent to six days of storage. Runoff from some parts of the process plant area will be redirected towards the water supply dam to supplement recharge from Uwenu Creek and to also enable the dam to provide some sediment control.

The walls of the primary water supply dam will be of earthen construction to a maximum height of ~2.5 m comprising general fill keyed in under the upstream batter slope to provide water tightness and avoid slip failure, and overlain on the downstream side by low permeability clay. Rip rap batter will be emplaced on the upstream face of the dam walls to prevent erosion with a geotextile layer placed between the general fill and the low permeability clay to improve structural integrity.

The dam has been designed to create a natural spillway to ensure controlled discharge and avoid overtopping of the dam wall. Discharge from the dam will only occur during extreme events to avoid water flowing over and damaging the dam wall. The discharge point is at the north western point of the dam to ensure maximum sediment is removed prior to the discharge of water. A preliminary dam design drawing is provided in Figure 13.

It is anticipated that there will also be some water availability through pit dewatering activities (surface water and groundwater). During the first three years of operation (year 0 to year 2) a water storage pond will be constructed within the Kulumadau waste dump footprint to capture some runoff from the waste dump and the upstream area between the waste dump and the pits, and to receive dewatering yield. It is anticipated that 800 - 2,500 m^3/day (10 – 30 L/s) can be collected in the Kulumadau waste dump water storage pond. Water from the Kulumadau waste dump water storage pond will be pumped as required to a point in Uwenu creek adjacent to the haul road and allowed to flow down into the primary water supply pond.

A seawater supply line, capable of supplying up to 60 L/s for the plant, will be established from Kwaiapan Bay to provide back-up supply when required. A layout of the integrated water supply system is provided in Figure 14.

Figure 13: Preliminary Water Supply Dam Drawing

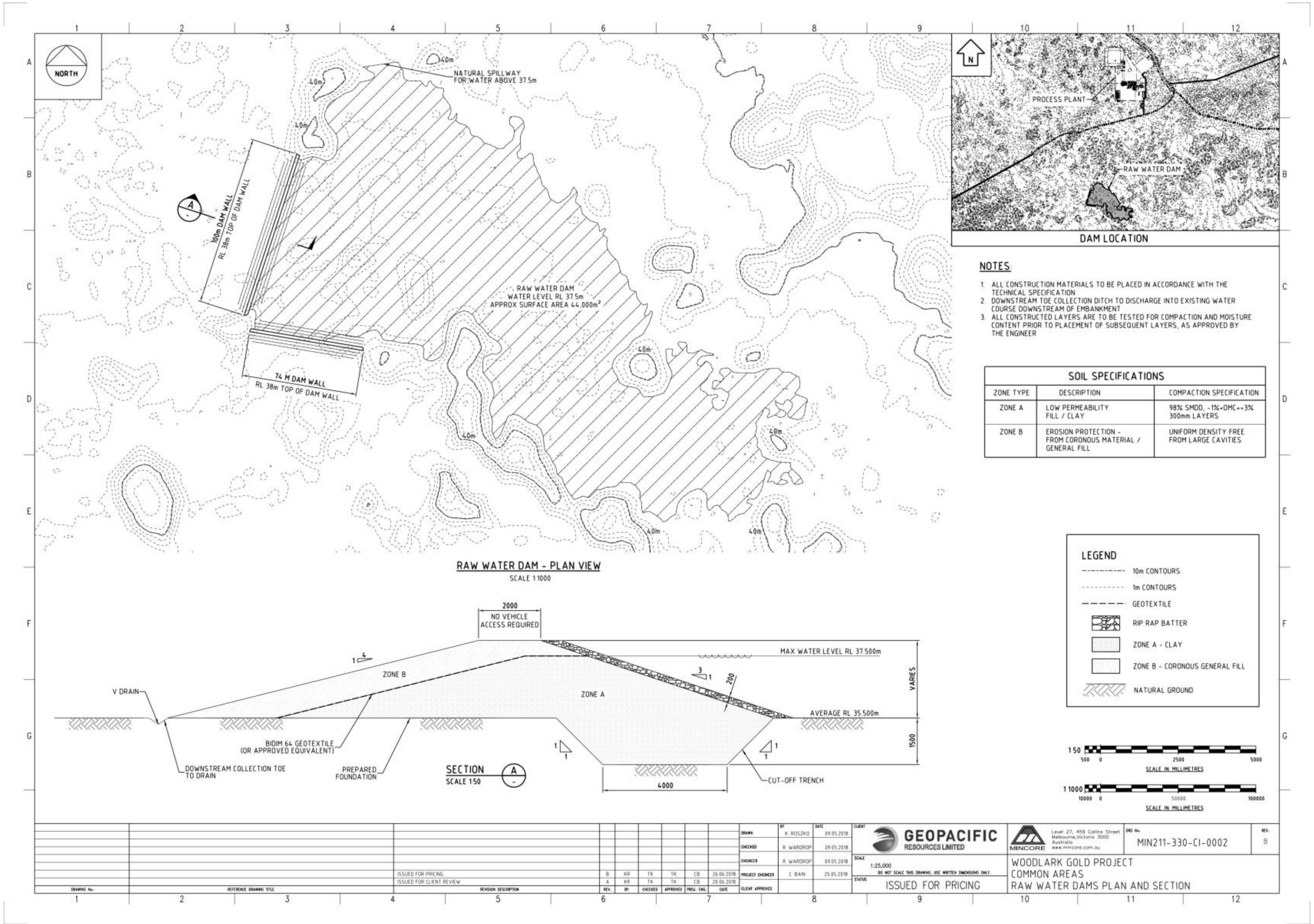
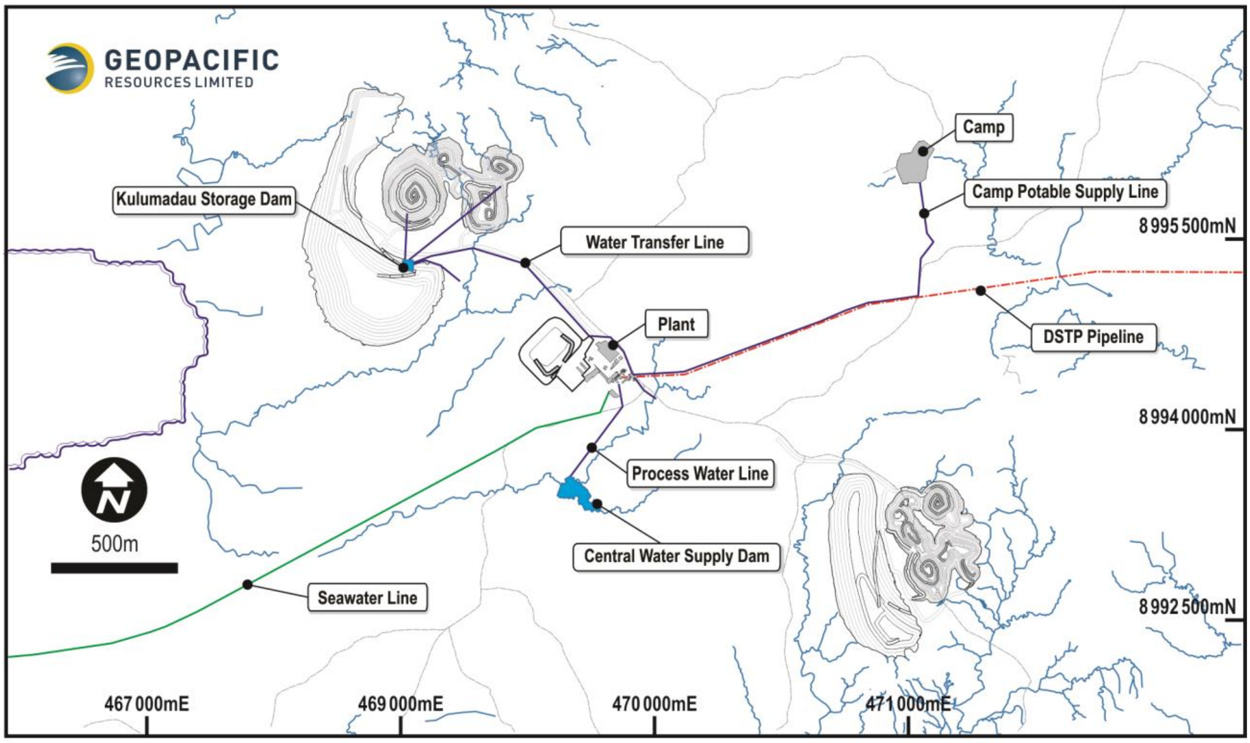


Figure 14: Integrated Water Supply System



Potable Supply

Potable supply will come from either the integrated water supply system described in Section 9.4.2, or from rainwater collected and stored in tanks at the camp.

A centralised potable water treatment system comprising filtration and chlorination will be located at the mine services area near to the process plant with potable water then distributed to the site offices, process plant and the camp potable storage tanks. Additional ultra-violet treatment will also be applied at the camp between the tanks and consumption.

Potable water storage will be provided as follows:

- Three 60 m^3 potable water storage tanks will be located at the camp, providing approximately three days of storage;
- A small rainwater collection tank (likely 1 m^3 located at the wharf depot);
- A 50 m^3 potable storage tank located at the process plant.

7.9.4. SEWAGE MANAGEMENT

The previous EIS specified using simple septic systems for sewerage management. There are a number of disadvantages associated with using simple septic systems, including:

- Sewage backup, which is commonly due to a clogged tank or drain;
- Risk of soil contamination;
- Odour issues caused by poor maintenance or clogged septic systems;
- A poorly maintained septic system can be a breeding ground for flies and insects;
- Risk of overflow, particularly in high rainfall areas.

Geopacific are proposing to use a more sophisticated system to provide further treatment and minimise the risk of contamination of soils and waterways. The system will comprise physical and biological filtration, anaerobic and aerobic treatment, clarification and sterilisation (chlorination) fully enclosed within a single sealed tank. Water will be treated to a standard suitable for either reuse as irrigation water (except for root vegetables) or drip discharge to nearby vegetation with no risk of spreading harmful pathogens.

Sewerage management systems will include:

- One 60 m^3/day self-contained treatment unit (comprising filtration, anaerobic and aerobic treatment, clarification and sterilisation (chlorination)) for the camp (will be relocated from the construction camp to the permanent camp once the permanent camp is constructed);
- One 30 m^3/day self-contained treatment unit (comprising filtration, anaerobic and aerobic treatment, clarification and sterilisation (chlorination)) for the central mine services area and plant;
- One 2.2 m^3 septic tank to be located at the wharf depot (there will only be a small one or two person office located at the wharf depot).

An environmental report prepared by the manufacturer of the proposed system is provided in Appendix 3.

7.10. POWER GENERATION

Total power requirements for the project been reduced by approximately 20% from a previously reported average demand of 10.9 MW to 8.8 MW (see Table 13). The Project is now also proposing to use cleaner diesel fuelled generators rather than the previously proposed high sulphur, heavy fuel oil (HFO) engines. This will act to significantly reduce greenhouse gas emissions over the life of the project (see Section 8.6.1). A further environmental benefit is that diesel does not produce the waste sludge which is characteristic of HFO.

Table 13: Plant Power Demand

Area	Plant Installed Load	Plant Maximum Demand	Plant Average Continuous Load
Process Plant	13,6451 kW	8,920 kW	8,101 kW
Infrastructure	3,518 kW	2,022 kW	691 kW
Totals	**17,163 kW**	**10,942 kW**	**8,792 kW**

The site power station will be located to the south-west (downwind) of the process plant and will include a day tank providing 24 hours of operational supply with necessary fuel treatment and ancillary fluid systems to support standalone operation of the facility. This will be supplied fuel from the bulk fuel storage facility at the wharf depot via a tanker delivery.

The small power requirements for the wharf will be provided by a small stand-alone generator and local distribution system. A common spare to this generator will be utilised at the accommodation camp to provide emergency power to essential facilities.

8. REVISED IMPACT ASSESSMENT

8.1. BIOPHYSICAL IMPACTS

8.1.1. LANDFORM, SOILS AND LAND RESOURCE USE

The types of impacts described in the EIS remain the same, that is:

- Primary disturbance to landforms will be the waste dumps and the pits;
- Impacts to soil quality could occur due to land clearing or contamination.

The proposed mitigation measures will remain the same. It should be noted that overall the project changes have significantly reduced the land clearing required to develop the project from approximately 760 ha to approximately 400 ha. This will significantly reduce the predicted sediment load from the project area as well as maintain a significantly greater portion of land within the mining lease in its current state retaining existing habitat and undisturbed land for subsistence resource use. Additionally, the areas planned for both the Busai and Kulumadau waste dumps are already heavily disturbed through historical logging and mining activities so there will be minimal need to clear undisturbed land.

Previous analysis indicates a relatively low volume of potentially acid forming (PAF) material (see EIS Appendix 1 – Assessment of the Geochemical Characteristics of Drill Core and Tailings). Mine waste characterisation indicates an abundance of Kiriwina Limestone at both Kulumadau and Busai to enable encapsulation of PAF material should it occur, as outlined in Chapter 8.2.1.2 of the EIS. Continuous in-pit identification of PAF material will be undertaken during mining so that it can be appropriately handled. Additionally, the waste dumps themselves will be located on Kiriwina limestone to provide further buffering capacity should any acidic runoff occur. Further geochemical analysis will be undertaken shortly as per the conditions of the Permit, with kinetic geochemical testing to be undertaken prior to commencement of operations.

The design of the waste dumps, and waste dump drainage will be consistent with the Waste Management Feasibility study completed by Knight Piesold in 2012, included as Appendix 2 in the EIS.

Impact Summary

The overall extent of impacts to landform, soils and land resource use has been reduced due to a significant reduction in the overall area to be cleared during the life of the project. Mitigation actions and monitoring as outlined in the EIS remain valid and will be applied accordingly. Residual Impacts remain as localised, short term (in the case of cleared areas which can easily be rehabilitated when no longer required) to prolonged (in the case of pits and waste dumps) and of low to moderate severity. Therefore, the approved EIS presents a conservative assessment compared to the present project.

8.1.2. TERRESTRIAL ECOLOGY

Extensive terrestrial ecology surveys were completed both prior to and during the EIS, inside and outside of the mining lease and is applicable to the proposed locations for the waste dumps, process plant and camp. The EIS identified a number of potential impacts relating to terrestrial ecology, including:

- Barriers to fauna movement;
- Disturbance to fauna;
- Reduced conditions favourable for plant growth;
- Destruction and deterioration of habitat;
- Introduction of weed species;
- Introduction or increased abundance of fauna species;
- Reduced fauna abundance;
- Loss or significant decline of population of endemic species.

The impact assessment and mitigation measures detailed in the EIS remain valid and will be implemented accordingly. As noted, the project modifications have significantly reduced the land clearing required to develop the project from approximately 760 ha to approximately 400 ha. Also as noted, the areas planned for both the Busai and Kulumadau waste dumps are already heavily disturbed through historical logging and mining activities so there will be minimal need to clear undisturbed land. This reduction in required clearing, and the overall reduction in the spatial extents of the project provide a positive improvement to most of the potential impacts to terrestrial ecology as listed above, including simplifying the management of impacts associated with introduced weeds.

Water courses provide important habitat areas for both terrestrial and aquatic fauna. As outlined in Section 7.8, a revised water management strategy has been designed to ensure wherever possible that natural surface water flows are maintained and that significant creeks remain in their current state.

Impact Summary

The EIS identified linear infrastructure, such as the wharf road or DSTP line, as potential barriers to fauna movement. Mitigation actions which remain valid include minimising the width of the clearing column. Therefore, the residual impact of barriers to fauna remains as localised, short duration and low severity; the approved EIS presents a conservative assessment compared to the present project.

The reduction in the amount of required clearing will reduce the overall risk to terrestrial ecology, however the predicted level of potential impact remains the same in relation to:

- Disturbance of fauna (localised, short duration and low to moderate severity);
- Reduced conditions favourable for plant growth (localised, short duration and negligible severity);
- Destruction or deterioration of habitat (localised, potentially prolonged and of moderate severity);
- Introduction or spread of weed species (prolonged and of moderate severity depending on the nature of the weeds);
- Introduction or increased abundance of introduced fauna species (prolonged and island wide depending on ability to control outbreaks;
- Reduction of species abundance (prolonged and of moderate severity, however mitigation measures have been designed to prevent species loss).

Therefore, the approved EIS presents a conservative assessment compared to the present project.

8.1.3. HYDROGEOLOGY

Impacts to groundwater are in the form of either reductions in aquifer water levels due to abstraction (for pit dewatering purposes in this case) or changes in water quality. As the changes in pit dimensions are relatively minor, the predicted impacts to the groundwater system due to pit dewatering have not changed. It is likely that dewatering will primarily occur through the use of in-pit sumps rather than with dewatering bores but this does not change the findings of the EIS.

Generally, potential impacts to groundwater quality outlined in the EIS remain the same, however the reduced footprint has reduced the overall number of catchments which will be affected by the project so there is a reduced potential for groundwater contamination in those catchments for which there is now no project activity.

In late 2017/18 a survey of village water supplies was undertaken to identify potential receptors. There is currently no identified groundwater users which are likely to be impacted on by the project. The closest groundwater supply being utilised is a spring located approximately 2.5 km to the west of the Kulumadau mining area. This spring sits outside of the predicted water level declines which will result from dewatering activities, however it has been included in the ongoing monitoring program. Additional monitoring bores will be installed prior to commencement of dewatering to monitor the overall groundwater system around each pit.

All other mitigation actions and monitoring as described in the EIS remain valid and will be applied accordingly.

Impact Summary

The reduced footprint of the project will result in a reduction in the potential of extent of any potential impacts to groundwater quality; potential residual impacts remain as localised, short-term to prolonged and of low to moderate severity.

8.1.4. NEARSHORE MARINE ENVIRONMENT AND RESOURCE USE

Impacts to the near shore environment may occur through a number of activities. The key aspects addressed in this EIS addendum as a result of the project modifications are:

- An increase in sediment or other contaminants in runoff from disturbed areas across the project site;
- Contamination from tailings discharge, or accidental release of tailings through failure of the offshore tailings discharge pipeline.

There is no change to the EIS in terms of:

- Underwater noise during construction of the wharf;
- Vessel collisions with marine fauna;
- Light pollution;
- Hydrodynamic changes from wharf construction;
- Introduction of invasive marine species;
- Direct removal of habitat due to wharf construction.

Impacts with regards to reduction of marine species abundance and marine resource use are directly related to the impacts which may arise from an increase in sediment or other contaminants in runoff or contamination from tailings discharge.

Geopacific have engaged suitably qualified consultant to undertake additional sediment modelling (DHI). The results and updated impact assessment are presented below.

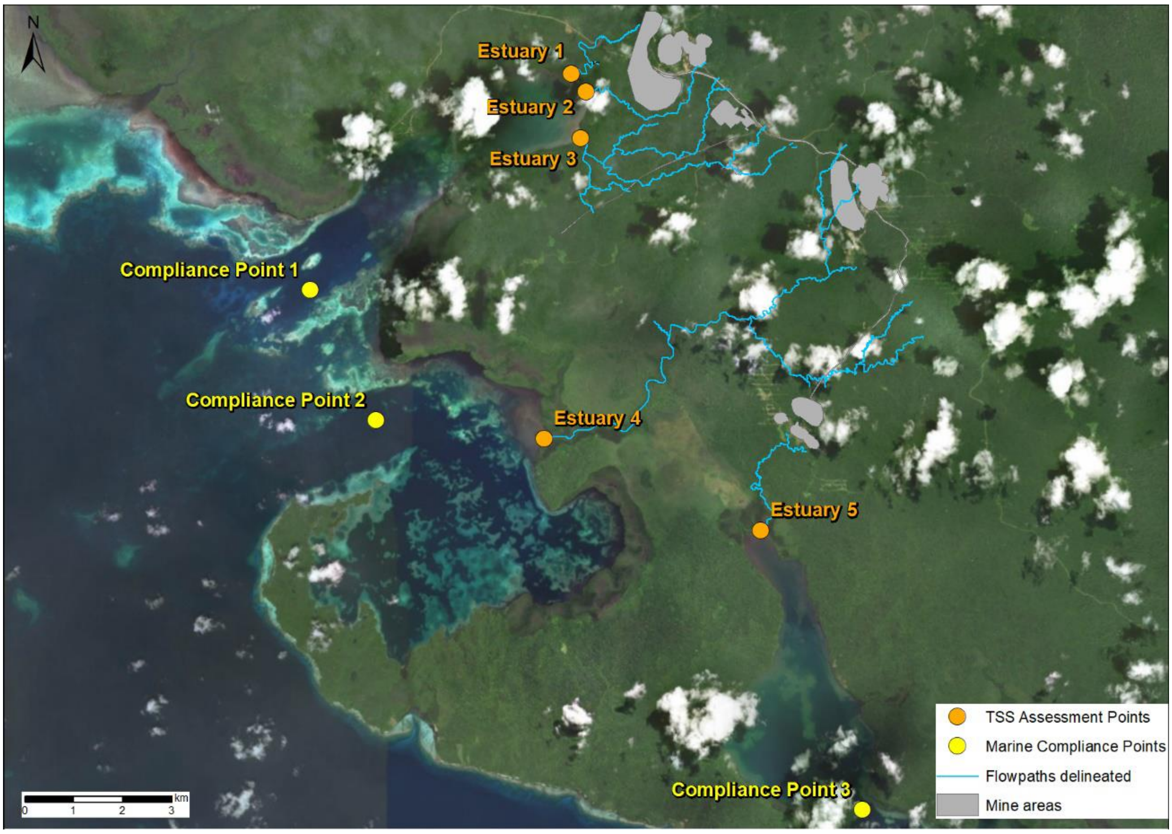
Sediment Transport Modelling

Sediment modelling was undertaken by consulting firm DHI to provide predictions of sediment discharge from areas to be disturbed as part of the project and to assess water quality in the drainage lines and downstream environments. Modelling was based on the internationally recognised Revised Universal Soil Loss Equation (RUSLE). The data utilised in the catchment sediment load assessment include:

- Rainfall Erosivity Factor (R):
    - This factor is calculated as a function of average annual rainfall and varies with climate and location/region;
    - R was calculated based on the available rainfall data.
- Soil Erodibility Factor (K):
    - Soil erodibility depends on the soil texture and composition;
    - Based soil profile data from the EIS it was assumed that on average, soil in the study area consists of 75% clay, 13% silt, and 12% sand;
    - A triangular nomograph (Goldman et al., 1986) was used to derive a K value of 0.16.
- Slope Length and Gradient Factor (LS):
    - This factor was calculated based on topographic information from the digital elevation model;
- Cropping Management Factor (C):
    - The C factor is related to land use and land cover characteristics;
    - Based on literature values a C factor of 0.03 for natural areas and 1.0 for mining areas was applied;
- Erosion Control Practice Factor (P): - The P factor takes into account practices that reduce erosion such as different sediment control structures and methods:
    - A P factor of 1.0 for natural areas and 0.5 for mining areas (all mining areas in apart from Wharf Road) was applied;
    - The P factor assigned to the mining areas assumes a sediment pond as sediment control practice achieving 50% sediment reduction.

A conservative modelling approach (i.e. worst case scenario) was taken as there is a lack of long term total suspended solids (TSS) and flow data for the site. The model looked to predict sediment concentrations at five points where the streams enter the Kwaiapan, Wonai and Suloga bays (see Figure 15).

Figure 15: Model Concentration Extraction Points



As expected, the results indicate an increase in TSS concentrations downstream from disturbed areas, with the highest concentrations corresponding with the larger disturbed areas (i.e. Estuary 2 downstream from Kulumadau). Analysis was made against the requirement of maintaining TSS concentrations below 100 mg/L for 90% of the time for Compliance Points 1 and 2, and below 25 mg/L for 90% of the time for Compliance Point 3. Note that the sediment concentrations predicted for the model extraction points would be significantly higher than that expected at the Compliance Points specified in the Environment Permit once dilution through interaction with seawater and ocean movements. Results indicate that TSS concentrations over 100 mg/L would occur more than 10% of the time at Estuary 2 (28%) and Estuary 4 (14%) (see Table 14), however these concentrations would be significantly reduced by the time flow reaches the Compliance Points (well below the required limits). Importantly, changes in sediment discharging into Suloga Bay are expected to be small (<10%). It should be noted that the predicted natural TSS concentration (i.e. without mining) at Estuary 4 would exceed 100 mg/L 8% of the time, so only a moderate increase is noted as a result of mining.

Table 14: Percentage of Time Where TSS Concentrations >100 mg/L

Assessment Point	Natural Conditions	Mining Conditions
Estuary 1	1%	4%
Estuary 2	1%	28%
Estuary 3	2%	5%
Estuary 4	8%	14%
Estuary 5*	30%	30%

*Refers to TSS concentrations >25 mg/L as it relates to Compliance Point 3.

As noted, the model assumes a worst case scenario which assumes the maximum cleared area across the project, in reality, cleared areas at any one time are expected to be significantly smaller due to project ramp up and rehabilitation over time. As a result, the model predictions are considered an over estimation and compliance limits at the specified Compliance Points are likely to be easily maintained. Regardless, the results highlight those areas which will require greater sediment control effort as the project progresses. Ongoing monitoring during construction and operation will be critical and will allow comparison with the model predictions (and, if necessary, the model can be revised to improve accuracy). A clearing strategy will be developed prior to the commencement of construction to ensure sediment control occurs from the outset.

The full DHI report is provided in Appendix 4.

Impact Summary

The results of the sediment modelling do not indicate any change in the level of impact determined in the EIS, that is, that if near-shore sedimentation occurs it will be of moderate severity and may cause short term and prolonged changes to the nearshore environment. The reduced level of clearing, and the avoidance of disturbance to key drainage lines where possible will assist in the management of sediment runoff. Sediment control infrastructure will evolve during the life of the project as infrastructure is constructed and as waste dumps expand.

8.1.5. DEEP OCEAN ENVIRONMENT

DSTP Modelling – Near Field

Near field modelling of the tailings discharge was completed by EBA Tetratech (formerly EBA Engineering) who also completed the near field modelling for the EIS. The full report, including tailings system design and near field modelling is provided in Appendix 5.

Predicted dilutions and density current thickness at various distances from the outfall pipe are provided in Table 15. Flux-averaged dilutions of 22:1 are achieved about 10 m downstream from the outfall terminus. At 100 m downstream from the terminus, flux-averaged dilutions of 473:1 are achieved. Finally, at 120 m downstream from the outfall terminus, at the downstream boundary of the fine-grid model, flux-averaged dilutions of 639:1 are observed.

Table 15: Predicted near field dilutions

Distance from Outfall	10 m	20 m	50 m	100 m	120 m
Flux-Averaged Dilution	22:1	42:1	149:1	473:1	639:1
Plume Centre-Line Dilution	19:1	36:1	122:1	355:1	473:1

DSTP Modelling - Far Field

Far field modelling was completed by Coffey who also completed the far field modelling for the EIS using the Ocean Sciences Institute Marine Tailing Fate Model developed jointly by Coffey and the University of Sydney with inputs from the near field modelling completed by EBA Tetratech. The full modelling report is presented in Appendix 6.

The following critical dilutions were set for the modelling:

1) Critical dilution #1 - Achieve PNG water quality criteria for free cyanide. There are two ways of calculating critical dilution #1:
   a) Based on the tailing characterisation results (from Appendix 4 of the EIS). The highest free cyanide concentration obtained in the tailing characterisation testwork is 88 mg/L. The concentration after pre-discharge dilution in the mix/deaeration tank would be 88 mg/L divided by (8.173+1) i.e., 88/9.173 = 9.593 mg/L. PNG water marine quality criterion for free cyanide is 0.01 mg/L (10 µg/L). So, 9.593/0.01 = 959 post-discharge dilutions would be required;
   b) Based on the elutriate test results, free cyanide required 2,500 dilutions in both the one- and 24-hour mixing tests to meet its PNG water quality criterion (from Appendix 4 of the EIS). After allowance for pre-discharge dilution in the mix/deaeration tank, the 2,500 dilutions would be reduced by (8.173+1) i.e., 2,500/9.173 = 273 post-discharge dilutions.
2) Critical dilution #2: Achieve 'safe' concentration to protect 95% of species with 50% confidence. Based on CSIRO's toxicity testwork results (in Appendix 4 of the EIS), some 100,000 dilutions are required to protect 95% of species with 50% confidence. Some 9.173 dilutions will be obtained in the mix tank, leaving 100,000/9.173 = 10,902 post-discharge dilutions to be found in the receiving ocean water column.

The modelling results are summarised in Table 16, along with the results of the previous (2013) modelling for comparison. The first two columns show that 12% of the simulated subsurface tailing plume form in the first 120 m vertically below the outfall (i.e. between the 230 and 350 m depth contours) and the remaining 88% of the simulated subsurface tailing plumes form deeper in the ocean water column.

Table 16: Summary of model results – simulated dilution of subsurface plumes

	Subsurface Plumes		**Critical Dilution #1(a) (959 dilutions)**		**Critical Dilution #2 (10,902 dilutions)**	
	Depth (m)	% of Total No. of Plumes	Average Distance* (m)	Maximum Distance** (m)	Average Distance* (m)	Maximum Distance** (m)
2018 Modelling	<350	12	832	1,530	1,062	3,305
	>350	88	-	-	-	-
2013 Modelling	<350	11	962	2,185	1,250	4,327
	>350	89	-	-	-	-

* Average distance plumes travel to reach critical dilution (post-discharge)
** Maximum distance a plume travels to reach critical dilution (post-discharge)

Of the simulated subsurface tailing plumes, the average horizontal distance travelled before the critical dilution #1(a) (based on the tailing characterisation results of 959 post-discharge dilutions) is reached will be 832 m from the proposed DSTP outfall. The model predicts that the maximum distance travelled by a simulated subsurface plume to reach critical dilution #1(a) (based on the tailing characterisation results of 959 post-discharge dilutions) is 1,530 m for a simulated plume at 275 m depth.

As for critical dilution #2 (10,902 post-discharge dilutions), the horizontal distance travelled by simulated subsurface tailing plumes before critical dilution #2 is reached is expected to be, on average, 1,018 m and that a maximum distance of 3,305 m from the proposed DSTP outfall is required before critical dilution #2 is reached.

From the point of view of simulated water quality, the revised study shows that the number of dilutions required to achieve both critical dilution #1(a) and #2 is less that in the EIS, meaning that the 1000 m mixing zone in the Permit remains valid (i.e. no change required to the Permit).

The far field modelling completed by Coffey Environments also looked at the behaviour of discharged tailings material within the deep sea environment. The results, despite the increase in overall tailings material, are almost identical to the results of the previous modelling, that is that the pattern within the predicted main zone of tailing solids deposition shows the following features:

- No significant deposition immediately below the outfall and then about 0.4 m thickness increasing to about 0.7 m thickness at around 500 m water depth;
- Very low and patchy deposition from below 500 m to about 3,300 m water depth;
- Most deposition is predicted to occur in water depths of over 3,300 m. Predicted deposits up to about 1.3 m in thickness are predicted between 3,300 and 3,500 m water depth, but the thickest (up to about 3 m) and most extensive deposition is predicted to occur in patches within the basin-like structure below 3,500 m water depth;
- Tailing solids deposition, less than 0.1 m in thickness, will also occur outside the main zone of tailing solids deposition, but the locations of these thinner deposits cannot be predicted with certainty by the far field density current model;
- The predicted main zone of tailing deposition is expected to extend some 40 km from the outfall and cover an area of some 67 km^2.

The results mean that the other studies completed as part of the EIS and used to undertake the impact assessment remain valid, including:

1) *Toxicity Assessment of Deep Sea Tailing Placement of Tailing Slurry from the Woodlark Gold Project*. CSIRO, April 2012.
2) *Land, Freshwater and Marine Resource Use Report*. Coffey Environments, December 2012.
3) *Slope Fishes of Wamunon Bay, Woodlark Island – Species Diversity and Biological Assessment*. Coffey Environments, June 2012.
4) *Deep Sea Sediment Sampling Survey Report*. Coffey Environments, June 2012.
5) *Settling and Re-suspension Tests on Tailings Samples, Woodlark Gold Project – Summary Report*. CSIRO, 2012.
6) *DSTP Tailing Physical Testwork Program, Woodlark Gold Project – Summary Report*. IHA Consult, 2012.
7) *Potential for Re-suspension of Deposited Tailings Solids.* IHA Consult, 2012.
8) *The Possibility for Coastal Upwelling to Occur Along Northern Woodlark Island*. George Cresswell, January 2013.

Impact Summary

Impacts relating to the following aspects detailed in the EIS have not changed:

- Physiography and oceanography;
- Water and sediment quality;

- Water column ecology.

As described in the EIS, the key impact relating to DSTP is the smothering of benthic environments. As indicated by the modelling undertaken by Coffey Environments, despite the increased throughput and extended mine life there will be only a ~10% increase in the overall deposition footprint. This is not likely to have a material impact on the level of impact, remaining as regional scale and high severity during the life of the project, but will gradually reduce with time as the tailing is recolonised by benthic communities and over the longer term, covered by deposition of natural sediment.

8.1.6. AIR QUALITY AND GREENHOUSE GAS EMISSIONS

The air quality modelling presented in the EIS is likely to be improved due to a reduction in annual fuel use, however revised modelling will be completed prior to construction for completeness. Greenhouse gas emissions have been recalculated using the same methodology used in the EIS and are lower on an annual basis than was reported in the EIS due to reduced overall power requirements resulting in substantial reductions in fuel use. Results of the GHG emissions recalculations is presented in Table 17.

Table 17: Project Greenhouse Gas Emissions

Year	Annual Diesel Use (L)	Total Emissions (t CO_2-e)	2013 Emissions Calculations for Comparison (t CO_2-e)
Construction	6,974,000	24,037	51,790
1	24,949,000	85,992	100,810
2	24,949,000	85,992	91,260
3	24,949,000	85,992	91,260
4	24,949,000	85,992	91,260
5	24,949,000	85,992	91,260
6	24,949,000	85,992	91,260
7	24,949,000	85,992	91,260
8	24,949,000	85,992	91,260
9	24,949,000	85,992	91,260
10	16,984,000	58,539	-
11	16,984,000	58,539	-
12	16,984,000	58,539	-
13	16,984,000	58,539	-

Reduced clearing requirements have also resulted in a reduction of emissions due to deforestation from 486,900 t CO_2-e (as reported in the EIS) to 256,200 t CO_2-e.

Therefore, the approved EIS presents a conservative assessment compared to the present project and further impact assessment is required at this stage.

8.1.7. NOISE AND VIBRATION

The noise and vibration modelling presented in the EIS remain valid, no further impact assessment is required.

8.1.8. FRESHWATER ENVIRONMENT

Extensive freshwater ecology surveys were completed as part of the EIS by Hydrobiology Pty Ltd. These baseline studies remain valid in relation to the project layout changes. The EIS identifies three main catchments likely to be affected by the project:

- Gidalog River catchment;
- Muniai River catchment;
- Bwalei Creek/Lufuai River catchment.

The movement of the Busai waste dump from east of the Busai pit to immediately west of the Busai pit will remove any project infrastructure, other than the DSTP pipeline, from the Bwalei Creek/Lufuai River catchment, significantly reducing the risk of impacts to that catchment. The new proposed route for the DSTP pipeline is now positioned at the upper reaches of the Bwalei Creek/Lufuai River catchment where drainage lines are significantly smaller, significantly reducing the risk of the pipeline being affected by flooding events. The risk of contamination due to a failure of the DSTP pipeline remains the same.

The proposed new locations for the Kulumadau and Busai waste dumps place them at the top end of the catchments, minimising the requirement to direct upstream flow around the dumps. This is particularly pertinent to the Kulumadau waste dump which was previously positioned close to the mid-point of a relatively large catchment area. Additionally, all three dumps have been positioned and shaped to avoid larger creek lines to ensure natural flow is maintained wherever possible.

Impacts to surface water environments can occur due to:

- Changes in water quality, including:
    - Increased sediment loads;
    - Increases in other contaminants including metals, hydrocarbons etc.
- Changes in hydrological regimes.

Generally, the potential risk of contamination other than sediment has not changed as part of the project modifications, other than the reduced risk to the Bwalei Creek/Lufuai River catchment as previously noted. There is a reduced risk of contamination from sewerage disposal with the now proposed use of a more advanced and comprehensive treatment system in place of the previously proposed simple septic treatment systems, and also a reduced risk of mobilisation of metals due to soil erosion with the overall reductions in required clearing for the project.

The revised water management strategy outlined in Section 7.8 seeks to minimise disruption to natural hydrological regimes wherever possible. Previously it was proposed to construct several very large sediment dams which were positioned to intersect water from both disturbed and undisturbed areas (in most cases runoff from the undisturbed areas dwarfs that from disturbed areas). Sediment control infrastructure, in the form of small sediment ponds/channels and sediment traps will be installed on an as needs basis as infrastructure is developed, and positioned to intersect only runoff from disturbed areas, maintaining natural flows from undisturbed areas wherever possible and minimising disturbance to major drainage lines. Detailed design of initial sediment control infrastructure including resizing of near source sediment ponds will be completed prior to commencement of construction as per the conditions of the Permit. Designs and design processes will be in line with the International Erosion Control Association Best Practice Erosion and Sediment Control document.

The potential for acid mine drainage (AMD) is limited, however it will be actively managed through the identification and appropriate handling of PAF waste rock, should AMD occur, it will be captured in seepage drains at the toes of the waste rock dumps and returned to the processing plant for use there. The closure of the waste rock dumps will be designed to minimise the potential for ongoing AMD.

These water management strategies will reduce the spatial extent of potential impacts to aquatic habitats and biological communities and freshwater systems used by residents of Woodlark Island and enable better targeted monitoring. A comprehensive monitoring program has already been implemented for the project area and surrounds, including village water supplies and creeks not likely to be impacted by the project, this will be further expanded as the project is developed.

As noted in Section 8.1.4, additional sediment modelling has been completed by consulting firm DHI. The results of the DHI modelling have been used to delineate areas of high, moderate and low severity impacts to the downstream environments. Areas are shown in Figures 16, with the results presented in the 2013 EIS provided in Figure 17 for comparison.

Figure 16: Predicted Impacts to Freshwater Streams (2018 Modelling)

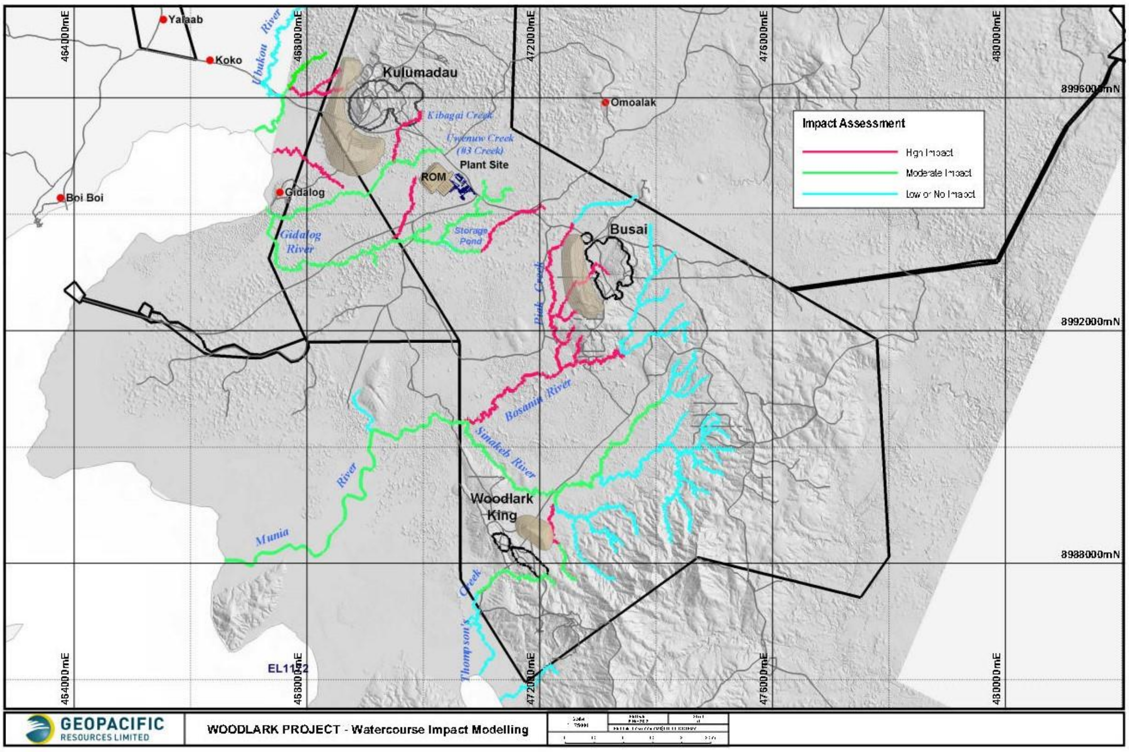
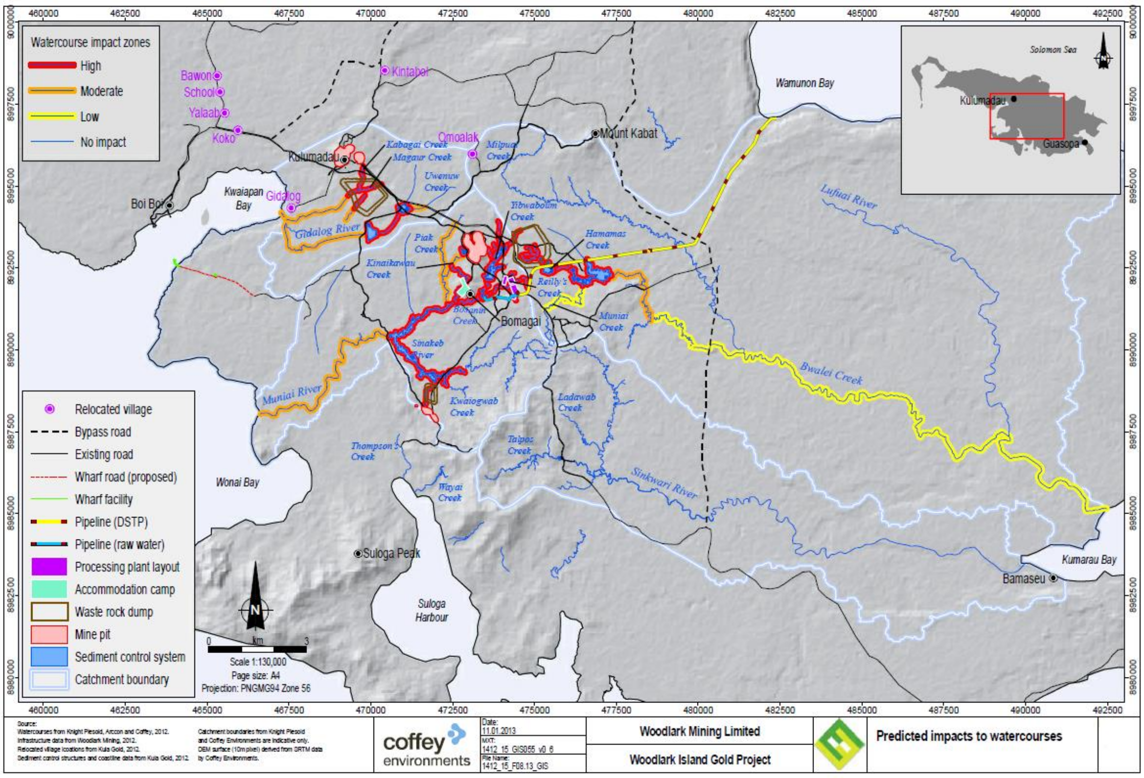


Figure 17: Predicted Impacts to Freshwater Streams (2013 EIS) for Comparison



Impact Summary

As noted in the EIS, the impacts to freshwater environments will range from high severity to no impact depending on proximity to areas of disturbance. The shifting of the Busai waste dump will significantly reduce the impact to the Bwalei Creek/Lufuai River catchment, removing all of the high and moderate severity impact areas from this catchment. The broader strategy of avoiding larger creek lines where possible to allow natural flow has reduced the level of impact in some creeks adjacent to all three mining areas, however the downstream areas of Gidalog and Muniai Creeks will remain classified as moderate severity impact.

Therefore, the approved EIS presents a conservative assessment compared to the present so there is no major change to the impact assessment.

8.2. SOCIO-ECONOMIC

8.2.1. EMPLOYMENT AND TRAINING

The impact assessment and mitigation actions presented in the EIS remain valid however the increased life of mine will provide improved opportunities for long term training and employment programs, no further impact assessment is required.

8.2.2. INCOME FLOWS

The impact assessment and mitigation actions presented in the EIS remain valid however the increased life of mine and overall increase (~25%) in gold production will provide additional income to the community that that presented in the EIS, no further impact assessment is required.

8.2.3. LOCAL BUSINESS DEVELOPMENT – SMALL COMPANY LOANS

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required. During the past year Geopacific, through WML, have established a program of small company loans to local residents. To date several businesses have been established with the support of Geopacific including a small baking business and a number of ventures developing livestock (chickens, pigs etc.).

8.2.4. TRANSPORT ACCESS AND INFRASTRUCTURE

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.5. IMPACT ON KULA EXCHANGE

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.6. MIGRATION ONTO THE MINING LEASE

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.7. RELOCATION

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required. Geopacific recognises that time has passed since the relocation agreement was finalised, and as such have completed an additional detailed census of the Kulumadau Village. Any homes and trade stores which were constructed since the previous census have now been added to the overall relocation package.

8.2.8. LABOUR AVAILABILITY AND LIVELIHOODS

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.9. WOMEN

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.10. SOCIAL COHESION AND CONFLICT

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.11. HEALTH

The impact assessment and mitigation actions presented in the EIS remain valid, no further impact assessment is required.

8.2.12. ARCHAEOLOGY AND CULTURAL HERITAGE

A detailed survey of the mining lease and surrounds to identify archaeological and cultural heritage sites of significance was completed as part of the EIS. Sites were categorised as either:

- Sites which can be disturbed (in consultation with the community);
- Sites which can be salvaged (i.e. relocation of relics etc.);
- Sites which must be avoided.

A review of the changes to the project layout has been undertaken against all identified sites. None of the sites categorised as those which must be avoided will be impacted on by the project changes. Therefore, the impact assessment and mitigation actions will remain the same.

Impact Summary

The residual impacts to archaeology and cultural heritage remain as localised, short duration and low severity.

9. MINE CLOSURE

The Company is committed to managing all phases of the proposed Woodlark Gold Project in accordance with best practice environmental management such that the medium and long term social and environmental impacts are minimised. A conceptual closure plan (incorporating decommissioning) was been prepared and presented in the EIS, the overarching objectives and closure activities have not changed as a result of the project modifications. Where appropriate, progressive rehabilitation will be undertaken during the life of the project and will close / decommission the project with the objectives of removing public safety hazards, and providing a post mining land use compatible with the prevailing beneficial land-uses of the area. The rehabilitation plan will encompass potential end-land use, rehabilitation principles, land rehabilitation methods, post monitoring and management techniques. The closure / decommissioning plan includes the environmental objectives and a provisional plan for rehabilitation and site closure.

9.1. OBJECTIVES AND FRAMEWORK

The primary aim of project closure will be to rehabilitate disturbed areas in such a manner that they will be able to support self-sustaining vegetation that is consistent with that of surrounding natural areas, where possible, and to leave a lasting legacy for impacted communities in the form of transferred skills and self-sustaining community development programs. The intention is to rehabilitate, remediate and re-vegetate progressively throughout the life of the project, where possible.

The objectives of the closure activities for the project are described in **Error! Reference source not found.**.

Table 18: Objectives of Closure Activities

Criterion	Objective
Future Land Use	Developed in a manner that will not harm human health or safety. Establish a safe and stable post-mining land surface, which resembles the previous topography, supports vegetation growth, attracts fauna and is resilient to both erosion and sedimentation. Revegetate and rehabilitate the site with local native vegetation, to meet where practicable, defined reference conditions. Minimise impacts on surrounding land uses, and facilitate sustainable use of land by local land owners. Restore soil profile and landform as close as practicable to pre mining conditions so that facilitates a self-generating ecosystem, incorporating vegetation and subsequent habitat restoration.
Landform	Ensure that final landforms are compatible with the surrounding landscape. Develop final landforms in a manner, which is safe and where negative impacts or risk to people, fauna and the environment is reduced to an acceptable level. Contour landforms such that they resemble as far as practicable the landforms encountered. Design disturbed land such that drainages are functional and resemble as close as practicable the pre mining environment.
Vegetation	Rehabilitate and re-vegetate the site with native vegetation with known provenance.

Criterion	Objective
	Re-vegetate and rehabilitate impacted and disturbed land so that a self-generating ecosystem is established resembling the surrounding environment.
Groundwater	Groundwater level and quality to be restored as far as practicable to the pre-mine condition.
Surface water	Minimise downstream impacts on the freshwater streams, estuaries, riparian zones and near-shore environments. Achieve water quality conditions which meet reference conditions.
Pollution	Achieve a condition where pollution or contaminants are in compliance with agreed ranges and or as close to reference condition. Ensure the site is not a perpetual source for contamination or pollution, and that plant or infrastructure not required post operation is removed.
Monitor	Monitor environmental performance during decommissioning, rehabilitation and post closure stages of the project and continue with corrective action until approved completion criteria are achieved.

9.2. DECOMMISSIONING AND CLOSURE

9.2.1. OPEN PITS

Pit closure will involve the following:

- Allowing the pits to fill naturally with groundwater and surface runoff after closure;
- Ensuring that the geotechnical stability of the pit walls and the pit verge is maximised;
- Encouraging vegetation to become established on the exposed walls and benches to the maximum extent practicable;
- Restricting community access to the pit by ripping and revegetating access roads and constructing earthen bunds around the more accessible sections of the pit perimeters.

Hydrological and geochemical modelling of changes in post-closure pit water quality over time will be required to:

- Further evaluate the preferred receiving waters for the pit discharges;
- Predict the rate at which pit water will discharge, by seepage and/or overflow from the pits;
- Assess the downstream water quality implications of pit water and ground water discharge (seepage or springs) external to the pits;
- assess the need for mitigation measures.

This modelling will be undertaken as relevant information becomes available during operations.

9.2.2. WASTE DUMPS

Closure of the waste dumps will be undertaken primarily to maximise long-term geotechnical and geochemical stability. Revegetation of the waste dumps will be an important but subordinate priority. Closure of the dumps will involve the following:

- Progressive rehabilitation of waste dump surfaces during operations, where possible. Soil waste, mulch or other suitable revegetation media will be placed on the benches, faces and top surfaces to allow vegetation to establish, where practical;

- Ensuring the integrity and stability of all dump drainage controls (e.g. ensuring that drains are sized appropriately and lined with rip-rap as necessary);
- Construction of appropriate final closure covers for the PAF cells of the dumps, including erosion control material;
- Minor earthworks to direct surface drainage off the dump and into the sediment control system; this may include grading of the NAF oxide waste cover, construction of drop chutes and bunds, and the use of sediment settling and polishing ponds.

9.2.3. TAILINGS DISPOSAL SYSTEM AND FACILITIES

At closure, the DSTP pipeline will be flushed to remove residual tailing. Land-based infrastructure will then be removed, while the outfall pipeline will remain in situ.

To comply with draft DSTP technical guidelines, post closure environmental monitoring must commence at the time of mine closure. The initial monitoring must ascertain the environmental conditions that prevail at the time of mine closure, including:

- A detailed bathymetric and seismic survey of the area impacted by tailing;
- Geochemical characterisation of the area including mineralogy, particle size distribution, biogeochemical cycling of trace elements and flux of trace elements across the benthic water interface is required;
- Characterisation of the benthic community including, mega, macro and meio fauna using internationally recognised and accepted methods of sampling and analysis.

This must be done using internationally recognised and accepted methods for sampling and analysis and must be to an internationally accepted level of quality assurance.

9.2.4. OTHER FACILITIES, EQUIPMENT, INFRASTRUCTURE AND SERVICES

Once mining operations have ceased, decommissioning will commence and involve the removal of infrastructure, facilities, equipment and services, unless otherwise agreed with stakeholders. After the cessation of operations, the following will be undertaken:

- Remove mobile equipment;
- Dismantle or economically demolish any remaining equipment, infrastructure and services;
- Remove salvageable materials from site and sell as scrap for recycling. Such materials will probably include items such as steel pipework, framework, beams and sheeting;
- Remove and dispose of non-salvageable, non-contaminated materials in designated landfills or voids. Such materials will probably include concrete foundations, miscellaneous building materials and tyres;
- Fracture concrete structures and foundations to promote infiltration and cover with NAF material;
- Incinerate hazardous materials such as hydrocarbons;
- Leave in situ cabling and non-hydrocarbon pipework located at depths greater than 600 mm below the final ground surface;
- Complete final profiling of Waste Rock Dumps and other landforms;

- Leave in situ subsurface pipelines if they cannot be economically salvaged or where their recovery is likely to result in adverse environmental impacts. Plug and cap all subsurface pipelines;
- Revegetate landforms to meet the agreed final land use after consultation with stakeholders.

At the time of mine closure, Geopacific may come to an agreement to transfer infrastructure to a third party, if this is mutually beneficial. This will be determined with relevant stakeholders to ensure that prerequisite approvals have been obtained.

9.2.5. END LAND USES

End land uses will be in line with the current local land uses, which include:

- Food gardens, which produce a variety of vegetable staples: yams, taro, cassava, sweet potato and plantain bananas. Green vegetables, fruit and sugar cane are also produced;
- Forested areas for building houses, pig fences, firewood and fishing canoes;
- Game hunting for wild pig;
- Village and hamlet sites;
- Land, sea and reef resources for harvesting fish, shellfish and turtles.

Management measures to minimise issues and risks associated with end land use include the following:

- Establish a safe and stable post mining land surface, which resembles the previous topography, supports vegetation growth, attracts fauna and is resilient to both erosion and sedimentation;
- Re-vegetate and rehabilitate the site with local native vegetation, to meet defined reference conditions, where possible;
- Minimise impacts on surrounding land uses, and facilitate sustainable use of land by local land owners;
- Restore soil profile and landform as close as practicable to pre mining conditions so that facilitates a self-generating ecosystem, incorporating vegetation and subsequent habitat restoration.

Minimise contamination and the containment of potential contaminating areas (hydrocarbon, waste rock and tailings).

10. REQUESTED PERMIT AMENDMENTS

10.1. INTRODUCTION

The following Section provides a summary of the requested amendments to the Permit. As noted, none of the requested amendments constitute a change in essential nature of the activity being carried out. There is an increase in the proposed quantity of tailings to be discharged via the DSTP system (from 1.8 Mtpa to 2.4 Mtpa); revised near and far field modelling completed by Tetra Tech (near field) and Coffey Environments (far field) suggests that this increase does not result in a material change to the impacts previously predicted as detailed in Section 8.1.4 and 8.1.5.

In many cases, multiple conditions require amending to reflect the project modifications, for example:

- The request to replace the term “septic tank” to “domestic waste water treatment and disposal system” relates to items in the Interpretations section, and conditions 45, 51, 52, 77 and 79;
- The request to replace the term “sediment pond” to “sediment control infrastructure” relates to items in the Interpretations section, and conditions 27, 41, 48, 49, 50, 80 and 81.

Several other requested amendments are simple wording changes that do not in any way alter the requirements of the permit or its conditions (i.e. removing reference to the DEC and including reference to CEPA).

10.2. INTERPRETATIONS

1. **Associated Facilities**: Spelling correction (the word *“facilities”* (in relation to *tailings disposal facilities*) is incorrectly spelt).

2. Addition of CEPA into the list of Interpretations.

3. Remove DEC from the list of Interpretations.

4. **Director/Director of Environment**: Replace “*Department of Environment and Conservation*” with “*Conservation and Environment Protection Authority*”.

5. **Discharge Point 1**: Replace “*septic tank*” with “*domestic waste water treatment and disposal system*”. The reason for this change is that we are exploring other waste water treatment options which may allow water to be recycled (as irrigation water for gardens for example). Also, remove “*through an absorption trench*” as we may not actually discharge contaminated water as such if other treatment methods are used. Also, as the camp location has changed, we are not yet sure of the actual waste water discharge location (or if we will actually be disposing contaminated waste water as such) so the coordinates listed here are no longer correct. Request that a statement be included that the proposed point of discharge, be provided to CEPA three months prior to discharge occurring.

6. **Discharge Point (3), (4), (5) and (6)**: The sediment ponds proposed in the previous mining plan are not considered to be a suitable strategy in that they were designed to unnecessarily intersect clean, natural flow as well as runoff from disturbed areas, and also present a safety

risk by having large bodies of water across the project whilst not necessarily adequately capturing sediment. As discussed, we are proposing an improved method of having sediment control structures located as close to sediment sources as possible (i.e. to minimise the size of the catchment which they intercept and to maintain natural drainage wherever possible). As such these discharge points are no longer valid so we would request revising these locations to the following:

- Discharge Point 3: 468589E, 8994443N;
- Discharge Point 4: 470259E, 8993573N;
- Discharge Point 5: 472170E, 8992183N;
- Discharge Point 6: 470560E, 8990500N.

7. **Extraction Point (1) and (2)**: Water extracted from Busai and Kulumadau pits will be predominantly from in-pit sumps, with only minor (if any) extraction via bores. We would request that the term "*borefield*" is removed.

8. **Fugitive sediment**: Replace the term "*sedimentation ponds*" with "*sediment control infrastructure*". We are proposing to utilise a range of different sediment control methods, including traps and ponds.

9. **Surface Water**: Replace "*Septic Tank*" with "*Domestic Waste Water Treatment and Disposal System*". As noted above, we may look to newer more suitable technologies to treat and manage domestic waste water.

10.3. TERMS AND CONDITIONS OF ENVIRONMENT PERMIT

1. **Further Environmental Studies, condition 15**: Include the term "*unless otherwise advised in writing by CEPA*".

2. **Design, condition 24**: Condition refers to a requirement to have the overland tailings pipeline to be double walled construction (pipe in pipe). We feel that suitable bunding of the pipeline with containment sumps at strategic locations would be a more practical and effective mechanism for containment should there be a pipe failure. The pipe (and entire DSTP system) would be fitted with pressure sensors and automatic cut-offs in case of a failure to minimise any risk of uncontrolled discharge. Request that "*will be of double walled construction ("pipe in pipe")*" be replaced with "*is appropriately contained within bunding of earthen or other construction material*".

3. **Design, condition 27**: As previously noted, we are looking at a range of sediment control structures and not just ponds. Request that the term "*of the sedimentation ponds*" is removed.

4. **Works, condition 41**: Request the addition of several creek names. There are multiple creek naming systems used on Woodlark and in the project area. To be safe I have included some additional creeks which may have been missed during the original drafting of the condition.

5. **Works, condition 42**: Request replacing "*sediment control ponds*" with "*sediment control infrastructure*".

6. **Works, condition 45**: Request replacement of "*Septic Tank*" with "*Domestic Waste Water Treatment Disposal System*", replacement of "*construct septic tanks with soak away trenches*" with "*implement a domestic waste water treatment and disposal system*" and replace "*septic tanks*" with "*domestic waste water treatment and disposal systems*".

7. **Works, conditions 48, 49 and 50**: Request replacement of "*sediment ponds*" with "*sediment control infrastructure*".

8. **Operations, condition 51**: Replace "*septic tanks*" with "*domestic waste water treatment and disposal systems*" and replace "*sediment ponds*" with "*sediment control infrastructure*".

9. **Operations, condition 52**: Replace "*that leachates from domestic waste water effluent should not flow out onto the land surface from the soak away trench after being discharged from the septic tank referred to in condition 45.*" to "*that untreated domestic waste water should not flow out onto the land surface.*" As noted, we are looking at alternative domestic waste water treatment technologies.

10. **Waste Management, condition 66**: Request minor sentence restructure from "*During any submarine activities (e.g. wharf construction) which may involve percussive sources (e.g. pile driving)……..*" to "*During any submarine activities which may involve percussive sources (e.g. pile driving during wharf construction)…….*".

11. **Waste Management, condition 75 (c)**: Remove the word "*tank*" after "*outfall pipeline*", I think this is a typo.

12. **Waste Discharge, condition 77**: Replace "*septic tanks*" with "*domestic waste water treatment and disposal system*". Remove "*through an absorption trench*".

13. **Waste Discharge, condition 79**: Replace "*septic tanks*" with "*domestic waste water treatment and disposal system*".

14. **Waste Discharge, condition 80**: Replace "*sediment ponds*" with "*sediment control infrastructure*".

15. **Waste Discharge, condition 83**: Amendment of tailings discharge volumes requested following updated mine planning and scheduling to the following:

Description	Source	Discharge Rate*			
Discharge Point (2)	Ore Processing Plant	**Tonnes per hour**	**Hours per day**	**Days per year**	**Annual discharge (dry weight solids, tonnes)***
		273	24	365	2,400,000
		Volume per hour (m^3/hr)	**Hours per day**	**Days per year**	**Annual discharge volume (m^3/yr)***
		353	24	365	3,100,000

16. **Waste Discharge, condition 84**: Amend some values in the criteria to at least those specified in the Marine Water Quality Criteria listed in Table 6. Currently some of the values of the tailings quality criteria are significantly lower than the marine water quality criteria (and sometimes even drinking water standards).

17. **Water Extraction, condition 88**: Request rewording of condition from "*The Permit Holder shall ensure that the quality of the water extracted from the bores at Extraction Point 1 and Extraction Point 2 complies with the Public Health (Drinking) Water Quality Standards in Table 6 below, if the water is to be used for domestic consumption.*" to "*The Permit Holder shall ensure that the quality of the water to be used for domestic consumption complies with the Public Health (Drinking) Water Quality Standards in Table 6 below.*" Potable water supplies will likely come from a range of sources and will be treated prior to use, including rainwater collection at the camp and other locations, so consider it more appropriate that the condition refers to the need to provide water which meets the standards.