

## Expert report - Environmental management and monitoring plans

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*Independent Environmental Management*

This report examines the environmental management and monitoring plans which are parts of the Environmental Impact Statement (EIS) for the proposed Sepik Development Project (the Project) in Papua New Guinea. I was asked to prepare this report by the Center for Environmental Law and Community Rights Inc (**CELCOR**), who are working with community members in the Sepik area. The report is based on my reading of the Project's Environmental Impact Statement, and in particular these documents:

- Executive Summary - <https://friedariver.com/wp-content/uploads/2019/09/Executive-Summary-English.pdf>.
- [Attachment 1 - Environmental Management Commitments](#)
- [Attachment 2a - Frieda River Copper-Gold Project Environmental Management and Monitoring Plan](#)
- [Attachment 2b - Frieda River Hydroelectric Project Environmental Management and Monitoring Plan](#)
- [Attachment 2c - Sepik Infrastructure Project: Public road from Vanimo to Hotmin Environmental Management and Monitoring Plan](#)
- [Attachment 2d - Sepik Infrastructure Project: Vanimo Ocean Port Environmental Management and Monitoring Plan](#)
- [Attachment 2e - Sepik Infrastructure Project: Green River Airport Environmental Management and Monitoring Plan](#)
- [Attachment 2f - Sepik Power Grid Project Environmental Management and Monitoring Plan](#)

I have read the Division 23.12 of Part 23 of the Australian Federal Court Rules and the Expert Evidence Practice Note including the associated Annexures, and agree to be bound by their terms. In particular, in accordance with clause 2 of the Expert Witness Code of Conduct, this report has been provided on the basis that I have a paramount duty to provide advice impartially on matters relevant to my area of expertise.

# 1. Summary of the key issues raised by the Project EIS

## Project description

I understand the Project consists of four components, namely:

- Frieda River Copper-Gold Project (FRCGP), hereafter referred to as Copper-Gold Project.
- the Frieda River Hydroelectric Project (FRHEP), hereafter referred to as Hydroelectric Project.
- the Sepik Infrastructure Project (SIP).
- the Sepik Power Grid Project (SPGP).

I understand that the largest Project component is the Copper-Gold Project integrated storage facility (or tailings dams which would be 75% of the total construction footprint), followed by open-pit void and haul roads, spoil dumps and the infrastructure corridor.

A plain English **summary** of the **key issues** raised by the Project EIS, relevant to my area of expertise is provided below. The summary of key issues has been based on descriptions provided in the EIS executive summary and EIS chapters. Analysis, critique and/or judgement of issues presented in the EIS does not form part of section 1 of the expert report.

## Key issues raised by the Project EIS

The Project would cover an area of 16,257 ha in north-west Papua New Guinea. This area would be cleared of vegetation and fauna, and land and water impacted by the Project. The EIS states that 91% of the 16,257 ha area is likely to be unavailable for rehabilitation. This equates to a minimum of 14,794 ha of the Project area that would not be rehabilitated.

## TERRESTRIAL BIODIVERSITY

The Sepik River basin is a globally significant area of biodiversity and will be impacted by the Project. At the landscape-level, the residual direct impacts to extensive intact habitats is predicted to be **major**, as forest loss is likely to have a **considerable** local impact. Predicted residual impacts to habitats and biodiversity of cultural significance are **moderate**. Residual indirect impacts from increased hunting or land use due to in-migration is predicted to be **moderate** for the high biodiversity level at the landscape scale, species new to science and congregatory flying foxes.

At the ecosystem-level, indirect impacts to montane forests from in-migration (e.g. increased effects relating to wildfires and the introduction of exotic invasive species) are predicted to have a **major** residual impact.

At the habitat level, the Project is predicted to have **moderate** direct residual impacts on riparian forests as a result of inundation, and impacts on upland streams from erosion and sedimentation. The Project is predicted to have **moderate** indirect impacts on caves due to the potential for in-migration and resettlement to increase hunting pressure on cave fauna and to introduce wildlife diseases.

At the species level, residual impacts (i.e. losses of individuals and populations within the Project Area) have been assessed for 85 species. For direct Project impacts there are **moderate** impacts predicted for **five species**. Residual indirect impacts are likely to be higher due to the expected difficulty in controlling in-migration related effects. As a consequence, **major** impacts on **eight species**, and **moderate** impacts on **eight species** are predicted from indirect causes. **Major** indirect impacts to **eight threatened species** of conservation concern resulting from indirect causes for species targeted by hunters are predicted for:

- **Critically Endangered** black-spotted cuscus (*Spiloguscus rufoniger*), Telefomin cuscus (*Phalanger matanim*), Sir David's long-beaked echidna (*Zaglossus attenboroughi*), and Bulmer's fruit bat (*Aproteles bulmerae*).
- **Endangered** Western Montane tree kangaroo (*Dendrolagus notatus*) and Goodfellow's tree kangaroo (*Dendrolagus goodfellowi*).
- **Culturally significant** northern cassowary (*Casuarius unappendiculatus*) and dwarf cassowary (*Casuarius bennetti*).

## **WATER FLOW AND SEDIMENTS**

**Moderate residual impacts** are predicted for the soils and landforms in the mountainous terrain due to the reduced physical integrity and stability of landforms and soils, and reduced soil capacity (i.e. physical loss of soil through erosion and changes to the physical and chemical properties of the soil).

The Integrated Storage Facility (ISF) on the Frieda River will cause:

- Flows in the Frieda River will be **highly modified** from the baseline flow conditions arising from the regulation of flows within the reservoir.

- Downstream flow will be **reduced** during filling of the ISF reservoir. Construction of the embankment will modify downstream flows in the Frieda River, which will have an environmental flow of 50 m<sup>3</sup>/s during the initial 10-month impoundment filling period.

Regulation of Frieda River flows resulting from operation of the hydroelectric power facility will cause:

- Under dry conditions, daily flows at most assessment points will **increase by 65%** in the Frieda River.
- During wet conditions, predicted flows are expected to **decrease by 30 to 40%** in the Frieda River.

During ISF operations, suspended sediment concentrations are predicted to **increase** in the Frieda River over the first 14 years of operations, after which concentrations are predicted to decrease.

Due to the lower sediment delivery from upstream watercourses and sediment capture in the ISF, the EIS predicts reductions in bed levels in the Frieda River up to 3 m in the vicinity of AP6 (i.e. downstream of the hydroelectric facility outlet) and AP7 (i.e. 0.4 km upstream of the existing Paupe village) over 60 years, compared to a reduction of less than 1 m under existing conditions. Longer-term (100 years) predictions of bed levels in the Frieda River indicate that bed levels at AP6 will stabilise around Year 30 of FRCGP operations with a final minimum channel elevation 3 m below the existing bed level, and at AP7 the bed levels will stabilise around 37 years FRCGP post closure with a final minimum channel elevation of around 1 m below the existing bed level.

In near-mine watercourses such as Ubai Creek and Uba Creek, annual median suspended sediment concentrations are expected to **increase substantially** during construction. There will also be increases in stream bed levels (Ubai Creek up to 5m) downstream of mining and infrastructure areas.

Some spoil dumps are designed to gradually erode, with high sediment losses from dumps entering the Ok Binai River, and then enter the ISF throughout the life of the Copper-Gold Project. **Stream bed levels** in the Ok Binai River are predicted to **increase by 2 to 3 m** and are expected to continue increasing until the spoil and **waste dumps** are **fully eroded after 20 years**.

Groundwater extraction over the life of Copper-Gold Project will depressurise and dewater the open-pits. This will result in the **lowering** of surrounding **groundwater levels** and an altered

hydrogeological regime, with the open pits acting as a groundwater sink (i.e. a point of groundwater discharge).

## **WATER QUALITY**

The most significant changes to non-sediment related water quality are likely be associated with:

- Open-pit water discharge.
- Placement of a total of 1,450 Mt of waste rock [including 1,340 Mt of potentially acid-forming (PAF) sulphide] and a total of 1,500 Mt tailings within the ISF.

The following impacts are predicted:

- In the Frieda River, Australian aquatic ecosystem trigger values for **aluminium, chromium and copper** are predicted to be **exceeded** during average and low flows.
- In the Sepik River, Australian aquatic ecosystem trigger values for **aluminium and copper** are predicted to be **exceeded**.
- In Frieda and Sepik rivers, **cadmium and zinc** are predicted to **marginally exceed** Australian aquatic ecosystem trigger values.
- International Finance Corporation discharge criteria for metals in the ISF discharge are predicted to be met, with the **exception** of **iron** which is naturally elevated in the receiving Frieda River at the ISF discharge location.

Following closure of the ISF, the open-pit lake will become a flow-through surface water feature, receiving groundwater from up-slope and discharging down-slope via a spill point where contaminated water will be collected for treatment until closure water quality criteria are met.

**Active water treatment** is expected to be required throughout the life of the mine and continue for **50 years after mine closure** until downstream water quality criteria are met.

## **FRESHWATER ECOLOGY**

The Ekwai, Ubai and Uba creeks, aquatic habitats, aquatic flora and fauna will be **entirely impacted/removed** in the Project area, and habitats within the **recreated diverted creeks** are likely to be **poor quality** with low structural diversity compared to the original pre-construction streams.

Construction impacts on freshwater ecology in the Frieda River would be **moderate**. Increases in suspended sediment during construction, prior to filling of the reservoir will result in a **reduction** in the quality of river-bottom habitat available to microflora, and some **reduction** in photosynthetic

activity caused by **increased** water turbidity. Direct impacts on river-bottom macroinvertebrate habitats are expected through burial or suffocation, and indirect impacts through **reduction** of macroinvertebrate food resources (e.g. river-bottom algae, diatoms, periphyton, and particulate organic matter). A reduction in macroinvertebrate distribution and abundance is likely to cause **severe reductions** in **fish abundance** and **diversity** within impacted areas adjacent to, and downstream of mine construction areas and Hydroelectric Project area. Increased sediment concentrations in the Frieda River during construction may favour macroinvertebrates, and to a lesser extent fish, that are tolerant of high suspended sediment concentrations. These changes may be of sufficient duration, intensity or extent to result in a **shift** in the overall **ecosystem structure** within reaches of the Frieda River.

After Copper-Gold Project operations commence, the main impacts on aquatic ecology will result from the discharge of treated open pit water to Ubai Creek, and the deposition of tailings and waste rock into the reservoir, which are expected to result in **increased dissolved metals** and **metalloid** concentrations within and downstream of the reservoir. Impacts on aquatic habitats in the upper Frieda River during Copper-Gold Project operations are predicted, due to the **transformation of the habitats** below the ISF embankment caused by a reduced sediment load.

Construction impacts on aquatic ecology of the Sepik River are predicted to have negligible impact due to the significant separation distance from construction activities, and the Sepik River being a turbid river with naturally high suspended sediment concentrations.

During post closure, treated open-pit water outflows are predicted to **not meet** the Australian **guideline** value for total dissolved **copper** (i.e. marginally exceeds guideline) for Frieda River 0.4 km upstream of the existing Paupe village (at AP7), and in the Sepik River.

## **MARINE**

Construction of the Vanimo Ocean Port will require reclamation of coastline adjacent to the settlement of Wesdeco. This will result in direct loss of adjacent reef and seagrass along a 500 m stretch of coastline. Land reclamation for the Vanimo Ocean Port will result in **permanent loss** of about **3.4 ha of fringing reef and seagrass** adjacent to the existing port. Construction of the new shipping berths will disturb the seabed and cause direct **loss of small areas of seabed** where pylons are installed. Excess filtrate water from the Vanimo Ocean Port concentrate thickener will be discharged into nearshore waters of Dakriro Bay for the duration of the Copper-Gold Project. The EIS

predicts that the PNG ambient marine water quality standards will be achieved at 10 m from the discharge point.

### **LANDSCAPE AND VISUAL AMENITY**

The mine and Hydroelectric Project infrastructure will **permanently change** the landscape. Excavation and reshaping of the distinctive floodplain hills for the infrastructure corridor and river port facilities will cause a **permanent change** to substantial elements of the landscape. This will **impact** on the **long-term scenic amenity** of residents living in villages in close proximity to the road corridor and those with direct views of the river port facilities.

Residents of Wesdeco, Lido and parts of Vanimo will experience views of the Vanimo Ocean Port including the concentrate export facility. The facility will be a **visually prominent** element when viewed from the Vanimo shoreline. Construction and operation of the Vanimo Ocean Port has the potential to impact the amenity of adjacent settlements of Wesdeco and Cis Point through the imposition of noise, light and vehicular traffic at nuisance levels, and alter the character of the existing surrounding environment by **changing the visual outlook** from a peri-urban village to an industrial precinct.

The Northern Transmission Line will be a **prominent** feature in the **landscape** for public road users and residents of villages located in close proximity to it, such as Sumumini, Kilifas, Dioru and Uramesin 2. This infrastructure is also likely to be visible from the upper Sepik River.

### **GREENHOUSE GASES**

Greenhouse gas (GHGs) emissions from construction and operation of the Project are estimated to average 639 kt CO<sub>2</sub>-e per annum, or a **total of 24,930 kt CO<sub>2</sub>-e** (or 24,930,000 tonnes CO<sub>2</sub>-e) over the life of the Project (a 1.1% increase in national emissions).

### **AIR QUALITY**

There is the potential for **inhalable particles** (i.e. 24-hour average PM<sub>10</sub> concentrations) to **exceed** Project **air quality criteria** during road and concentrate pipeline construction where humans (i.e. sensitive receptors) are present within 500 m of the construction activities. In addition, **inhalable particles** (i.e. maximum 24-hour average PM<sub>10</sub> concentration) are predicted to **exceed** guidelines up to 800 m downwind of the works.

## **SOCIAL**

Four villages (Ok Isai, Wabia, Paupe, and Wameimin 2) in the Project area will have to **leave their home/village and resettle** in a new home/village. This will affect 194 households, and **1,316 people** who would need to leave their home/village and establish a new home/village.

As villagers will use the road as a pedestrian walkway, safety risks resulting from the interaction of residents and traffic are almost certain with the potential for loss of human life. Even with effective implementation of traffic management and safety plans, the **risk remains high** for potential **loss of human life**.

Payment of wages and distribution of Project benefits can result in **strains on social relations** within and between communities, changes to traditional lifestyles and systems of governance, and the consumption of **alcohol** and **drugs** that can lead to increased public and domestic **violence**.

The Paiyamo social sub-catchment is predicted to encounter substantial **in-migratory pressure** due to Paupe's location close to Project infrastructure and physical accessibility. Impacts predicted to particularly occur at Telefol and Paiyamo due to **village relocation** will place **significant pressures** on **social values**, and will require external support and partnerships to ensure effective management.

When closure of the Copper-Gold Project commences, **income streams** for local villagers will **sharply decrease** as levels of **employment will reduce significantly**. This will particularly be the case for villages in Miyan, Telefol and Paiyamo (Catchment 1A), and villages between Hotmin and Green River (Catchment 1B), which are located closest to the mine area. This labour decrease is a **significant social risk** during the closure process.

### Fishing for food

Some villages may experience **short term disruption** to **fishing** from barge movements during construction. In advance of the public road being constructed, fishing activity in the Frieda and May rivers has the **potential to be disrupted** by construction barge movements. Fish nets may not be able to be set when barges are passing through, or they could be damaged or destroyed by passing barges if not removed before barge movements.

Construction impacts are predicted to not impair the habitat integrity for crocodiles and turtles in the lower Frieda River and the Sepik River. The magnitude of **impact** on aquatic flora,

macroinvertebrates, fish communities and other conservation significant aquatic species (turtles and crocodiles) of the Frieda River is assessed as **medium**. The EIS also states, that the proximity of the lower Frieda River to the Sepik River would offer alternative suitable habitat for these species.

#### Flooding

There is a risk that the wave-wash from barges travelling along the Sepik River could lead to **minor flooding in houses** built in proximity to the banks. This being the case, as during periods of flooding, the water level along the river rises close to the underside of the flooring of houses.

## **2. Environmental Management and Monitoring Plans (EMMP)**

### **appropriate and sufficient?**

Relevant to my area of expertise, environmental management and monitoring plans (i.e. measures and targets) that are in-sufficient have been identified below.

Factoring in high rainfall (mine zone average annual rainfall 7,700 and 8,600 mm & lowland zone average annual rainfall 3,700 and 6,000 mm) (**Frieda River Limited, 2018**) and potential seismic activity in Project locations (**Frieda River Limited, 2018**), it is uncertain that environmental management and monitoring measures and targets (particularly for Acid and Metalliferous Drainage, Waste Rock and Tailings, soils, waterways and aquatic/marine biodiversity) could be confidently implemented and achieved. Resolution of these uncertainties needs to be a pre-requisite for any decision regarding approval of the Project.

With reference to "EIS Attachment 1 – Environmental Management Commitments", this attachment does not include a commitment to prepare an Earthquake management plan and/or a Flood management plan. To address high rainfall and potential seismic activity in Project locations, both an **Earthquake management plan** and a **Flood management plan** should be prepared prior to an environmental permit being issued.

#### **All Environmental Management and Monitoring Sub-plans**

The majority of EMMP measures and targets are qualitative and lack the necessary definition and commitment to enable targets to be effectively monitored, and to determine if environmental and/or social target outcomes will be met (or not). For example, across all sub-plans there are several uses of non-committal terms such as where possible, where practicable, and where appropriate.

#### **Erosion, Sediment and Soils Management Sub-plans**

The majority of EMMP measures and targets are qualitative and lack the necessary definition and commitment to enable targets to be effectively monitored, and to determine if erosion, sediment and soils targets will be met (or not). The Sub-plans make no requirement to utilize or adopt Erosion and Sediment Control documents, such as:

- Best Practice Erosion and Sediment Control (BPESC) document (**IECA, 2019**) produced by the International Erosion Control Association of Australasia. The document is intended to reduce the degradation of land and water from uncontrolled erosion and sedimentation.
- The NSW Government MANAGING URBAN STORMWATER, Soils and Construction, Volume 2E Mines and quarries “Blue Book Vol 2E” (**Department of Environment and Climate Change, 2008**), which specifies management of soils for construction of mines and quarries.

## Frieda River Copper-Gold Project Environmental Management and Monitoring Plan – Construction

| EIS Section                                    | EIS Statement  | Reviewer comment / recommendation   |
|--|--|---|
| 3.1.2 Regional tectonic setting and seismicity | PNG is bounded by several major tectonic plates and is one of the most <b>seismically active</b> regions in the world  | Section 4.2.1 Concentrate pipeline does not address “seismically active”. The EMMP needs to provide measures to address potential impacts of seismic activity on the integrity of the 325km pipeline. |
| 5.4.2 Audits                                   | Audits will be undertaken by the Environment Superintendent (or their delegate) on a <b>regular basis</b> against relevant standards and criteria to ensure compliance with the environmental management procedures and environment permit conditions and continual improvement of the management systems and processes for the Project. | The frequency of audits need to be specified  |
| 6.3 Quality control                            | The instrumentation, sampling methods, analytical procedures and data analyses used in the monitoring program will be consistent   | “Accepted good practice” needs to be defined. i.e. accepted good practice by what organisation/s?   |

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|  | with <b>accepted good practice.</b> |  |
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**EMMP Acid and Metalliferous Drainage, Waste Rock and Tailings Management Sub-plan - Construction and operations**

**Comment on Table 1-2 AMD management measures**

| <b>No.</b> | <b>EIS Management measure</b>   | <b>EIS Target</b>  | <b>Reviewer comment / recommendation</b>   |
|------------|---|--|--|
| MP006      | Visually monitor runoff from construction sites. Uncontained stormwater contamination from AMD, hydrocarbons or sediment must be recorded. Where practicable and where required, appropriate steps will be taken to remediate the area.   | Avoidance of uncontained stormwater being contaminated with AMD, hydrocarbons or sediment. | Specify in what circumstance remediation would be required   |
| MM23       | Design and operate the ISF to limit the potential for AMD including: <ul style="list-style-type: none"> <li>• Store PAF materials subaqueously.</li> <li>• Manage potentially contaminated water from the open-pits. From Year 1 and during operations, treat open-pit contact water (using a high-density sludge lime treatment system) with treated water discharged to Ubai Creek which</li> </ul> | Downstream water quality meets environment permit criteria at compliance point.            | Recommend that the ISF freeboard/ overflow requirements be based on the NSW Dam Safety Committee requirements (NSW Dam Safety Committee, 2012) |

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|       | <p>flows into the ISF.</p> <ul style="list-style-type: none"> <li>• Deposit the water treatment solids (sludge) within tailings in the ISF.</li> </ul>   |   |  |
| MM042 | <p>Treat open-pit water runoff using an engineered water treatment plant to mitigate poor water quality downstream. Discharge treated open-pit water to Ubai Creek where it will flow into the ISF for further dilution prior to entering the downstream environment. Discharge treatment residues to the bottom of the ISF.</p> | <p>No direct discharge of untreated poor quality water to Ubai Creek.</p> | <p>Management measure needs to define what is “untreated poor water quality”</p> <p>Recommend discharges from the water treatment plant into Ubai Creek, and from the IFS to waters be assessed against the Australian government (2018) guidelines.</p> |
| MM056 | <p>Minimise time of exposure for PAF waste rock prior to subaqueous deposition within the ISF impoundment.</p>   | <p>No waste rock stockpiles exposed for more than 12 weeks.</p>           | <p>Management measure needs to explain why 12 weeks is appropriate</p>   |

Comment on **Table 1-4 AMD monitoring**

| EIS Monitoring measure            | EIS Performance indicator                                     | EIS Target  | Reviewer comment / recommendation  |
|-----------------------------------|---|---|--|
| Monitor downstream water quality. | Water quality in watercourses downstream of FRCGP activities. | Monitoring results comply with environment permit conditions. | <p>Acid forming material under water will reduce dissolved metal generation, but the actual dissolved metal levels that may result in the continuous discharges from the ISF may still be at significant levels for aquatic ecosystems downstream.</p> <p>To ensure protection of downstream aquatic ecosystems, any non-compliant result/s with environment permit conditions will require prompt action to rectify the non-compliance.</p> |

**EMMP Biodiversity Management Sub-Plan - Construction**

Comment on **Table 3-3 Construction measures**

| No.   | EIS Management measure                                       | Reviewer comment / recommendation                         |
|-------|--|---|
| MM067 | Install fauna 'underpasses' and/or 'overpasses' at strategic | Identify how many fauna 'underpasses' and/or 'overpasses' |

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|  | locations along the infrastructure corridor to reduce vehicular fauna strike. | and at what locations? Mark them on maps and on ground |
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Comment on **Table 3-4 Biodiversity monitoring**

| <b>EIS Monitoring measure</b>   | <b>EIS Performance indicator</b>   | <b>EIS Target</b>   | <b>Reviewer comment / recommendation</b>   |
|---|--|---|--|
| Ground disturbance and vegetation clearance   | Cleared vegetation recovered, reused, recycled or stockpiled appropriately | Zero non-compliances recorded.                            | Reused, recycled or stockpiled for what purpose/use? Monitoring needs to specify for what purpose/use          |
| Analysis of imagery to monitor habitat cover and condition.   | Broad-scale vegetation community changes.                                  | No large-scale vegetation community changes are recorded. | Monitoring needs to quantitatively define large-scale. Target can then be measured                             |
| Monitoring of abundance and diversity of aquatic biota including the presence/abundance of introduced species in watercourses downstream of the FRCGP, as well as at reference sites. | Diversity and abundance of macroinvertebrate and fish taxa.                | No departure from predicted changes in aquatic biota.     | Monitoring needs to quantitatively define the predicted changes in aquatic biota, target can then be measured. |

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| Catches per unit effort of key fish species important from a resource use perspective. | Departure of biomass of key fish in comparison to baseline.   | No significant change from baseline.   | Monitoring needs to quantitatively define what is significant change, target can then be measured.   |
| Downstream riverine and floodplain ecosystem condition.                                | Broad-scale vegetation or community changes.  | No significant change from baseline.   | Define significant change, target can then be measured.  |
| Monitoring of amphibious fauna in streams and adjoining forests.                       | Integrated measure of ecological health of streams and riparian vegetation.   | No reduction of ecological health at landscape scale.                        | Monitoring needs to quantitatively &/or qualitatively define what constitutes ecological health at landscape scale, target can then be measured.   |
| Fauna injury and mortality.  | Records kept of animal deaths, injuries or entrapments as a result of FRCGP activities.<br><br>Routine marine fauna observation near Vanimo Ocean Port. | No increase in rate of fauna injury and mortality during FRCGP construction. | This target is potentially flawed and could encourage the FRCGP construction to record high rates of fauna injury and mortality at the commencement of works. Works could then comfortably comply with a “no increase in rate of fauna injury and mortality during FRCGP construction”. Monitoring needs to quantitatively set a low limit for fauna injury and/or mortality for entire FRCGP construction”. |

**General comments:**

| EIS   | Reviewer comment / recommendation  |
|---|--|
| <p>Section 8.6.5 Offsets states:</p> <ul style="list-style-type: none"> <li>• FRL is committed to developing and implementing a biodiversity offsets package and program consistent with the goals of CEPA, and</li> <li>• “Offsets for any project would then be a formal contribution to a planned conservation system by the particular project. This will be further discussed with CEPA during the EIS assessment and approval process (<b>Frieda River Limited, 2018a</b>)</li> </ul> | <p>A Project commitment to develop and implement a biodiversity offsets package and program consistent with the goals of CEPA is not stated in EMMPs. This is a key matter that needs to be captured in EMMPs.</p> |

**EMMP Rehabilitation Management Sub-plan - Construction**

Comment on **Table 8-2 Rehabilitation measures**

| No.   | EIS Management measure   | EIS Target  | Reviewer comment / recommendation  |
|-------|--|---|--|
| MP100 | Rehabilitate disturbed lands progressively, where practicable. | Vegetative cover is increasing, and on a trajectory to achieve in excess of 70% of foliage cover. | Monitoring needs to quantitatively define timeframe to achieve 70% foliage cover |
| MP102 | Establish a nursery for selected                               | Functioning nursery   | Recommend only local native  |

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|  | species to be used in revegetation including local native pioneer species and nitrogen-fixing plants. | established. | species be used in revegetation |
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### EMMP Water Management Sub-plan - Construction and Operations

Comment on **Table 11-2 Hydrology management measures**

| No.   | EIS Management measure  | EIS Target   | Reviewer comment / recommendation  |
|-------|---|--|--|
| MM033 | Maintain environmental flows downstream of the ISF embankment in the Frieda River at 50 m <sup>3</sup> /s except for a short period during initial impoundment. | No flows recorded less than 50 m <sup>3</sup> /s at AP7.                           | To minimize impacts on environmental flows downstream of the ISF embankment in the Frieda River, "A short period" needs to be defined by a specific timeframe. |
| MM096 | Conduct washing, servicing and refuelling of equipment, vehicles or machinery at designated, appropriately designed facilities, away from watercourses.         | Equipment and machinery cleaned, serviced or refuelled in designated bunded areas. | Management measure needs to define storage capacity and proposed treatment   |

Comment on **Table 11-3 Contamination management measures**

| No.   | EIS Management measure  | EIS Target   | Reviewer comment / recommendation  |
|-------|---|--|--|
| MP006 | Visually monitor runoff from construction sites. Uncontained surface water contamination from AMD, hydrocarbons or sediment must be recorded. Where practicable and where required, appropriate steps will be taken to remediate the problem. | Large runoff events monitored  | Is it possible to “visually monitor” acid and metalliferous drainage (AMD)? If no, a management measure is required which can detect AMD   |
| MP143 | Line landfill facilities to limit the potential for seepage to groundwater.   | No non-compliances downstream of landfill facilities.  | Specify what impermeable lining material to use, e.g. permeability of $1 \times 10^{-9}$ m/s over 1 metre thickness (NSW Dam Safety Committee, 2012), to prevent seepage to groundwater. |
| MP163 | Place excavated material, cleared vegetation or fill away from gullies, creeks or other natural drainage lines.   | No excavated material is stockpiled in gullies, creeks or other natural drainage lines, with the exception of engineered waste rock and spoil dumps. | Specify how many metres, excavated material, cleared vegetation or fill be placed away from gullies, creeks or other natural drainage lines.   |

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| MP164 | Pass any water used in workshops through an oil-water separator trap prior to discharge.   | Workshop water captured and directed through trap before discharge.                | Specify what to do with oil collected e.g. reuse in Project   |
| MM013 | Carry out pre-construction survey of work sites for weeds, exotic fauna and dieback using a risk-based approach to identify areas susceptible to invasion of exotic species. | Understanding of weed, exotic fauna and dieback, type, distribution and abundance. | For exotic fauna detected, specify what action will be taken.   |
| MM072 | Control infestations of high priority weeds prior to commencement of construction.   | All high priority weeds outbreaks controlled.                                      | Specify what will be done with weeds removed, ensuring that weeds removed do not create a weed problem at their disposal site |

## Frieda River Hydroelectric Project Environmental Management and Monitoring Plan

### EMMP Biodiversity Management Sub-plan – Construction

Comment on **Table 2-4 Biodiversity monitoring**

| EIS Monitoring measure  | EIS Performance indicator                                   | EIS Target  | Reviewer comment / recommendation  |
|---|---|---|--|
| Analysis of imagery to monitor habitat cover and condition.   | Broad-scale vegetation community changes.                   | No large-scale vegetation community changes are recorded. | Monitoring needs to quantitatively define large-scale. Target can then be measured                             |
| Monitoring of abundance and diversity of aquatic biota including the presence/abundance of introduced species in watercourses downstream of the project, as well as at reference sites. | Diversity and abundance of macroinvertebrate and fish taxa. | No departure from predicted changes in aquatic biota.     | Monitoring needs to quantitatively define the predicted changes in aquatic biota, target can then be measured. |
| Catches per unit effort of key fish species important from a resource use perspective.  | Departure of biomass of key fish in comparison to baseline. | No significant change from baseline.                      | Monitoring needs to quantitatively define what is significant change, target can then be measured.             |

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| Downstream riverine and floodplain ecosystem condition.          | Broad-scale vegetation or community changes.  | No significant change from baseline.                                   | Define significant change, target can then be measured.  |
| Monitoring of amphibious fauna in streams and adjoining forests. | Integrated measure of ecological health of streams and riparian vegetation.               | No reduction of ecological health at landscape scale.                  | Monitoring needs to quantitatively &/or qualitatively define what constitutes ecological health at landscape scale, target can then be measured.   |
| Fauna injury and mortality.                                      | Records kept of animal deaths, injuries or entrapments as a result of project activities. | No increase in rate of fauna injury and mortality during construction. | This target is potentially flawed and could encourage the construction to record high rates of fauna injury and mortality at the commencement of works. Works could then comfortably comply with a "no increase in rate of fauna injury and mortality during construction". Monitoring needs to quantitatively set a low limit for fauna injury and/or mortality for entire construction". |

**EMMP Rehabilitation Management Sub-plan - Construction**

Comment on **Table 7-3 Rehabilitation monitoring**

| <b>EIS Monitoring measure</b>     | <b>EIS Performance indicator</b>  | <b>EIS Target</b>  | <b>Reviewer comment / recommendation</b>  |
|-----------------------------------|---|--|---|
| Progressive rehabilitation works. | Assess the range of species established through documented monitoring, including visual inspection and photography. | Area under rehabilitation undertaken progressively as construction completed and within the required timeframes. | Photography to be taken from set photo-points and marked on-ground and on drawings. |

**EMMP Water Management Sub-plan - Construction and Operations**

Comment on **Table 10-3 Contamination management measures**

| <b>No.</b> | <b>EIS Management measure</b>   | <b>EIS Target</b>                       | <b>Reviewer comment / recommendation</b>   |
|------------|---|---|--|
| MP169B     | Check the quality of ponded water prior to discharge near a waterbody, treating to remove sediment, hydrocarbons and chemicals if necessary. Discharge ponded water away from cleared areas to stable | No discharge of unchecked ponded water. | Define what constitutes "ponded water quality" that requires treatment to remove sediment, hydrocarbons and chemicals, prior to discharging ponded water away from cleared areas to stable |

|  |                    |  |                    |
|--|--------------------|--|--------------------|
|  | (vegetated) areas. |  | (vegetated) areas. |
|--|--------------------|--|--------------------|

## Sepik Infrastructure Project: Public road from Vanimo to Hotmin Environmental Management and Monitoring Plan

### EMMP Biodiversity Management Sub-plan – Construction

Comment on **Table 2-4 Biodiversity monitoring**

| EIS Monitoring measure                                      | EIS Performance indicator   | EIS Target   | Reviewer comment / recommendation   |
|---|---|--|---|
| Ground disturbance and vegetation clearance                 | Cleared vegetation recovered, reused, recycled or stockpiled appropriately                | Zero non-compliances recorded.   | Reused, recycled or stockpiled for what purpose/use? Monitoring needs to specify for what purpose/use   |
| Analysis of imagery to monitor habitat cover and condition. | Broad-scale vegetation community changes.   | No large-scale vegetation community changes are recorded.                      | Monitoring needs to quantitatively define large-scale. Target can then be measured  |
| Fauna injury and mortality.                                 | Records kept of animal deaths, injuries or entrapments as a result of project activities. | No increase in rate of fauna injury and mortality during project construction. | This target is potentially flawed and could encourage the construction to record high rates of fauna injury and mortality at the commencement of works. Works could then comfortably comply with a “no increase in rate of fauna injury and mortality during construction”. Monitoring needs to quantitatively set a low limit for fauna injury |

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|  |  |  | and/or mortality for entire construction”. |
|--|--|--|--|

**EMMP Rehabilitation Management Sub-plan - Construction**

Comment on **Table 7-3 Rehabilitation monitoring**

| <b>EIS Monitoring measure</b>     | <b>EIS Performance indicator</b>                                      | <b>EIS Target</b>  | <b>Reviewer comment / recommendation</b>  |
|-----------------------------------|---|--|---|
| Progressive rehabilitation works. | Documented monitoring will include visual inspection and photography. | Area under rehabilitation Undertaken progressively as construction completed and within the required timeframes. | Photography to be taken from set photo-points and marked on-ground and on drawings. |

**EMMP Water Management Sub-plan - Construction**

Comment on **Table 10-2 Contamination management measures**

| <b>No.</b> | <b>EIS Management measure</b>  | <b>EIS Target</b>   | <b>Reviewer comment / recommendation</b>  |
|------------|--|---|---|
| MP167      | Divert water of poor quality to sedimentation ponds and/or use this water as makeup water during construction (e.g., vehicle washdown).  | Poor quality water reports to a sedimentation pond or is reused prior to discharge. | Management measure needs to define what is "water of poor quality"  |
| MP169      | Check the quality of ponded water prior to discharge near a waterbody, treating to remove sediment, hydrocarbons and chemicals if necessary. Discharge ponded water away from cleared areas to stable (vegetated) areas. | No discharge of unchecked ponded water.   | Define what constitutes "ponded water quality" that requires treatment to remove sediment, hydrocarbons and chemicals, prior to discharging ponded water away from cleared areas to stable (vegetated) areas. |

## Sepik Infrastructure Project: Vanimo Ocean Port Environmental Management and Monitoring Plan

### EMMP Biodiversity Management Sub-plan – Construction

Comment on **Table 2-1 Planning and preparation**

| No.   | EIS Management measure   | EIS Target  | Reviewer comment / recommendation                                  |
|-------|--|---|--|
| MM135 | Limit, where practicable, disturbance of fringing reefs and seagrass during construction of the Vanimo Ocean Port. | Minimal disturbance to fringing reefs and seagrass.   | Define what constitutes disturbance of fringing reefs and seagrass |
| MP016 | Ensure that sensitive features that are to be avoided are identified on maps and work plans.                       | Inclusion of all recorded sensitive features on maps. | Define what constitutes sensitive features                         |

#### General comments:

| EIS  | Reviewer comment / recommendation   |
|--|---|
| Section 8.10.4 Residual Impact Assessment states “Land reclamation for the Vanimo Ocean Port will result in permanent loss of about 3.4 ha of fringing reef and seagrass adjacent to the existing port.”<br><b>(Frieda River Limited, 2018a)</b> | The Project does not propose a biodiversity offset for the loss of 3.4 ha of fringing reef and seagrass. The Project needs to commit to develop and implement a biodiversity offset package and program consistent with the goals of CEPA. This is a key matter that needs to be captured in EMMPs. |

**EMMP Water Management Sub-plan - Construction**

Comment on **Table 9-1 Planning and preparation**

| No.   | EIS Management measure   | EIS Target   | Reviewer comment / recommendation                      |
|-------|--|--|--|
| MM053 | Design and construct project facilities involving the storage, handling, or use of hazardous materials to intercept potentially contaminated water for treatment if required prior to discharge. | Potentially contaminated water is intercepted where practicable. | Define what constitutes potentially contaminated water |

**Sepik Infrastructure Project: Green River Airport Environmental Management and Monitoring Plan**

No comment

**Sepik Power Grid Project Environmental Management and Monitoring Plan**

**EMMP Biodiversity Management Sub-plan – Construction**

Comment on **Table 2-3 Construction measures**

| No.   | EIS Management measure   | EIS Target                               | Reviewer comment / recommendation                          |
|-------|--|--|--|
| MM101 | Implement good industry-practice management of in-stream activities to | Implementation of good industry-practice | Management measure needs to define what is "good industry- |

|  |   |            |   |
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|  | limit the downstream extent of turbid water created by fords, trenching or bridge building as far as practicable. | management | practice management of in-stream activities'' |
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Comment on **Table 2-4 Biodiversity monitoring**

| <b>EIS Monitoring measure</b>                               | <b>EIS Performance indicator</b>  | <b>EIS Target</b>  | <b>Reviewer comment / recommendation</b>   |
|---|---|--|--|
| Ground disturbance and vegetation clearance                 | Cleared vegetation recovered, reused, recycled or stockpiled appropriately                | Zero non-compliances recorded.   | Reused, recycled or stockpiled for what purpose/use? Monitoring needs to specify for what purpose/use  |
| Analysis of imagery to monitor habitat cover and condition. | Broad-scale vegetation community changes.   | No large-scale vegetation community changes are recorded.                      | Monitoring needs to quantitatively define large-scale. Target can then be measured   |
| Fauna injury and mortality.                                 | Records kept of animal deaths, injuries or entrapments as a result of project activities. | No increase in rate of fauna injury and mortality during project construction. | This target is potentially flawed and could encourage the construction to record high rates of fauna injury and mortality at the commencement of works. Works could then comfortably comply with a "no increase in rate of fauna injury and mortality during construction''. Monitoring needs to quantitatively set a low limit for fauna injury and/or mortality for entire construction''. |

**EMMP Rehabilitation Management Sub-plan - Construction**

**Comment on Table 7-3 Rehabilitation monitoring**

| <b>EIS Monitoring measure</b>     | <b>EIS Performance indicator</b>   | <b>EIS Target</b>  | <b>Reviewer comment / recommendation</b>  |
|-----------------------------------|--|--|---|
| Progressive rehabilitation works. | Documented monitoring will include visual inspection and photography for coverage and species established. | Area under rehabilitation undertaken progressively as construction completed and within the required timeframes. | Photography to be taken from set photo-points and marked on-ground and on drawings. |

**Comment on Table 10-2 Contamination management measures**

| <b>No.</b> | <b>EIS Management measure</b>  | <b>EIS Target</b>  | <b>Reviewer comment / recommendation</b>   |
|------------|--|--|--|
| MP101      | Implement good industry-practice management of in-stream activities to limit the downstream extent of turbid water created by fords, trenching or bridge building as far as practicable. | Implementation of good industry-practice management of in-stream activities. | Management measure needs to define what is "good industry-practice management of in-stream activities" |

### 3. Any further observations or opinions

Relevant to my area of expertise, further observations and/or opinions on the Proposal are provided.

It is **recommended** that the following important matters be considered concurrently with this Proposal:

- The EIS should address the World Heritage tentative listing of the Upper Sepik River Basin. The Upper Sepik River Basin is tentatively listed on the World Heritage List (Date of Submission: 06/06/2006) due to its globally significant biodiversity (**UNESCO, 2019**), and the EIS (i.e. chapter 8) does not address the World Heritage tentative listing.
- The Proposal should be considered against the 17 United Nations Sustainable Development Goals (SDGs) (**United Nations, 2019**). There is no mention of the SDGs in chapters 2, 3, 6, 9 or 12 of the EIS. The report "Mapping Mining to the SDGs: An Atlas" could be used to assess the Proposal against achieving SDGs (**UNDP, 2016**).
- The Proposal should be aligned with "Climate-Smart Mining" (**The World Bank, 2019**) which aims to minimize environmental and climate footprints.
- The Proposal should not compromise the Sepik Wetlands Management Initiative (SWMI) established in 1998, which aims to conserve/restore local wetlands and crocodile nesting areas, and achieve sustainable harvest of crocodile eggs (**UNDP, 2019**).

**If the Project was to NOT proceed**, and the Project site 16,257 ha not impacted (i.e. rainforest areas retained), the following economic benefits could be activated:

- As a signatory to the **Paris Agreement (United Nations, n.d.)**, retention of rainforest would retain carbon and contribute to meeting the Paris agreement which aims to respond to the global climate change threat by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels, and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius by 2030.
- Earning income from organisations who offset their carbon emissions (opportunities through the mitigation of climate change effects through programs such as United Nations - Reduced Emissions from Deforestation and Degradation (**REDD (de Lamo et.al., 2018)** and (**Landscape Finance Lab, 2019**)).

- Earning income from sustainable timber harvesting (see Papua New Guinea attains global forest accreditation (**WWF, 2019**)).
- Earning income from medicines sourced from rainforest areas (Prescott T. et.al., 2017) and (Cámara–Leret, R. & Dennehy Z, 2019).
- Earning income through potential ecotourism ventures (**Divine Word University and WWF, 2005**); (**PNG Value Tours, 2020**); (**Sepik Eco Adventures, 2020**); (**Sepik Tours, 2020**); and (**True North, 2020**).

Peter Ryan OAM

10 February 2020

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