

Wednesday, August 25, 2021

Michelle Carey  
Tetris Environmental Pty Ltd  
PO Box 3103, Myaree WA 6154

Dear Michelle,

### **GHG Assessment for Beharra Silica Sands Project**

Greenbase Pty Ltd (Greenbase) was engaged by Tetris Environmental Pty Ltd, on behalf of Perpetual Resources Limited (Perpetual), to prepare a greenhouse gas (GHG) estimate for the Beharra Silica Sands Project (the Project) located in Western Australia's mid-west region.

The Pre-feasibility Study released by Perpetual in March 2021 and associated energy supply strategy documents have been used to define the scope of the Project.

The key inputs for estimating the GHG emissions from the Beharra Project are diesel combustion from the power station, mining fleet and haulage, and land clearing activities. Emissions from minor sources such as oils and greases have been excluded from the assessment.

Estimates have been calculated over the expected 32 year Life of Mine (LOM) and include construction and commissioning activities in year 1.

#### **Estimates**

GHG estimates have been prepared using methods and emissions factors from the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (NGER Determination), current as of July 2021.

The key inputs provided by Perpetual for estimating GHG emissions over the LOM are displayed in Table 1 attached to this letter.

Two scenarios have been considered in the GHG estimate. Scenario 1 is based upon Perpetual using a combined solar-diesel approach for on-site electricity generation, while scenario 2 is based on a diesel only fuelled power station. All other inputs, namely haulage and fleet diesel consumption and land clearing, are unaffected by changes in the power generation approach.

Diesel consumption has been assigned to key activities and defined as being used for stationary or transport energy purposes. Based on the definitions outlined in NGER Determination, light vehicles and road trains were considered transport vehicles. All other activities including diesel consumed for electricity generation are considered stationary.

Haulage is likely to be undertaken by a third-party contractor, however emission estimates arising from this activity have been included to provide a comprehensive estimation of the Project's total GHG emission footprint.

Emissions associated with clearing 600 hectares of land for the Project have been calculated using the Full Carbon Accounting Model (FullCAM) guidelines produced by the Department of Industry, Science, Energy and Resources and methodology outlined in *Carbon Credits (Carbon Farming Initiative—Avoided Clearing of Native Regrowth) Methodology Determination 2015*.

A summary of the GHG emission estimates is presented in Table 2 attached to this letter. Further details of these estimations can be viewed in the document 'Beharra Environmental Accounting Ledger August 2021.pdf'.

## Results

All emissions expected from diesel combustion and land clearing during the Project's LOM are categorised as Scope 1 emissions as defined by NGER\*. No Scope 2 emissions (from electricity purchased) were identified in either scenario.

The results show that over the LOM (32 years), the estimated total GHG emissions from the Project under scenario 1 (solar-diesel power generation), including emissions from land clearing, are 524,812 tCO<sub>2</sub>-e with an average of 16,400 tCO<sub>2</sub>-e/year (Table 2). In comparison under scenario 2, which assumes the use of a diesel only power station, the Project is estimated to produce total emissions of 568,373 tCO<sub>2</sub>-e over LOM, with an average of 17,762 tCO<sub>2</sub>-e/year.

A breakdown of the emissions into key activities indicates haulage is likely to produce the highest emissions of 9,062 tCO<sub>2</sub>-e/year regardless of the power station scenario. Emissions generated from the power station are the second largest contributor to emissions in both scenarios followed by the mining fleet and land clearance (Table 3).

The average emissions intensity of the Project over LOM has been estimated at 0.011 tCO<sub>2</sub>-e/tonne of silica sand produced in scenario 1 and 0.012 tCO<sub>2</sub>-e/tonne in scenario 2 (Table 2).

Yours sincerely,



Karyn Courtney

Environmental Accountant

Greenbase Pty Ltd

---

\*Scope 1 emission: Emission of greenhouse gas, in relation to a facility, means the release of greenhouse gas into the atmosphere as a direct result of an activity or series of activities (including ancillary activities) that constitute the facility.

**Table 1:** Key Inputs for the Beharra Project

ITEM	TOTAL (LOM)	UNITS	NOTE	Yr 1	Yr 2	Yr 3	Yr 4*
<b>PROJECT OVERVIEW</b>							
Year				2022 - Full Year	2023	2024	2025
Project Timeline				Construction & Commissioning & Ramp up (single shift)	Ramp up (double shift)	Full production	
Production %				33%	64%	100%	100%
<b>PRODUCTION</b>							
<u>Total Product Produced</u>							
- Silica Sand Production	46.8	Mt	1	0.491	0.967	1.51	1.51
<b>FUEL CONSUMPTION</b>							
<b>Power - Scenario 1 (Solar-Diesel)</b>							
<u>Diesel Consumption - Power Station (3.6MW Capacity)</u>							
- Total Fuel Consumption by Diesel Power Station	65,925,000	L	2	692,000	1,363,000	2,129,000	2,129,000
<b>Power - Scenario 2 (Diesel)</b>							
<u>Diesel Consumption - Power Station (3.6MW Capacity)</u>							
- Total Fuel Consumption by Diesel Power Station	82,001,000	L	3	989,000	1,692,000	2,644,000	2,644,000
<b>Mining Fleet</b>							
<u>Diesel Consumption - Mining Fleet</u>							
- Excavator	1,769,442	L		18,573	36,583	57,143	57,143
- Haul Truck	3,538,885	L		37,147	73,166	114,286	114,286
- Front End Loader	2,831,108	L		29,718	58,533	91,429	91,429
- Grader	707,777	L		7,429	14,633	22,857	22,857
- Vibrating Roller Compactor	707,777	L		7,429	14,633	22,857	22,857
- Dozer	1,415,554	L		14,859	29,267	45,714	45,714
- Water Truck	1,061,665	L		11,144	21,950	34,286	34,286
- Lighting towers	1,769,442	L		18,573	36,583	57,143	57,143
- Generator	10,440	L	4	10,440	-	-	-
- Service Truck	353,888	L		3,715	7,317	11,429	11,429
- Light vehicles	707,777	L		7,429	14,633	22,857	22,857
- Total Fuel Consumption by Mining Fleet	14,873,756	L		156,017	307,299	480,000	480,000
<b>Haulage</b>							
<u>Diesel Consumption - Haulage</u>							
- Total Fuel Consumption by Road Trains	106,694,696	L	5	1,068,333	2,150,000	3,449,212	3,449,212
<b>Land Clearing</b>							
- Area of the project	600	ha					
<b>NOTES:</b>							
1. Year 1 and 2 Silica Sand Production has been estimated based on the production percentage. Production percentage has been calculated from the power station diesel consumption outlined in the <i>Beharra Sands Project Energy Supply Strategy</i> (Appendix 2) by Project Consultancy Services Pty Limited.							
2. Assumes one power generation scenario will be applied for LOM. Scenario 1 employs 1MW solar plus 3.6MW diesel power station for electricity generation. No emissions are generated from the solar plant. Full details of the power supply options and assumptions are outlined in the <i>Beharra Sands Project Energy Supply Strategy</i> by Project Consultancy Services Pty Limited.							
3. Assumes one power generation scenario will be applied for LOM. Scenario 2 employs only a 3.6MW diesel power station for electricity generation. Full details of the power supply options and assumptions are outlined in the <i>Beharra Sands Project Energy Supply Strategy</i> by Project Consultancy Services Pty Limited.							
4. Electricity will be generated during construction phase via a 20 kVa (16kW) genset. Fuel has been estimated using Greenbase diesel usage rates for Gensets under normal load.							
5. Transport of the final product from the mine site to the Geraldton port will be provided by a third party but has been included in the assessment to provide an overview of the project's emission footprint							
* Yr 4- Yr32 have consistent inputs and outputs							

**Table 2: Emissions Summary for the Beharra Project**
**Scenario 1: Solar-Diesel Power Station**

<b>1 - Total Emissions Predicted over LOM</b>				<b>Life of Mine = 32 years</b>	
1a	Scope 1:	524,812	tCO <sub>2</sub> e	<i>Includes emissions arising from land clearing and diesel consumed by the power station, mining fleet and haulage contractor</i>	
1b	Scope 2:	-	tCO <sub>2</sub> e		<i>No electricity expected to be purchased for the project</i>
1c	Total of Scope 1 & Scope 2:		524,812		tCO <sub>2</sub> e
				<i>= 1a + 1b</i>	
<b>2 - Average Yearly Emissions Predicted over LOM</b>					
2a	Scope 1:	16,400	tCO <sub>2</sub> e/yr	<i>No electricity expected to be purchased for the project</i>	
2b	Scope 2:	-	tCO <sub>2</sub> e/yr		
2c	Total of Scope 1 & Scope 2:		16,400		tCO <sub>2</sub> e/yr
				<i>= 2a + 2b</i>	
<b>3 - Emission Intensity</b>					
3a	Emissions Intensity - Silica Sand Produced:		0.011	tCO <sub>2</sub> -e/tonne silica sand produced	

**Scenario 2: Diesel Power Station**

<b>4 - Total Emissions Predicted over LOM</b>				<b>Life of Mine = 32 years</b>	
4a	Scope 1:	568,373	tCO <sub>2</sub> e	<i>Includes emissions arising from land clearing and diesel consumed by the power station, mining fleet and haulage contractor</i>	
4b	Scope 2:	-	tCO <sub>2</sub> e		<i>No electricity expected to be purchased for the project</i>
4c	Total of Scope 1 & Scope 2:		568,373		tCO <sub>2</sub> e
				<i>= 4a + 4b</i>	
<b>5 - Average Yearly Emissions Predicted over LOM</b>					
5a	Scope 1:	17,762	tCO <sub>2</sub> e/yr	<i>No electricity expected to be purchased for the project</i>	
5b	Scope 2:	-	tCO <sub>2</sub> e/yr		
5c	Total of Scope 1 & Scope 2:		17,762		tCO <sub>2</sub> e/yr
				<i>= 5a + 5b</i>	
<b>6 - Emission Intensity</b>					
6a	Emissions Intensity - Silica Sand Produced:		0.012	tCO <sub>2</sub> -e/tonne silica sand produced	

**Table 3:** Emissions Breakdown by Activity for the Beharra Project

**Scenario 1: Solar-Diesel Power Station**

*Total Emissions Predicted Over LOM - Breakdown*

Power Station Emissions	178,638	tCO <sub>2</sub> -e
Mining Fleet Emissions	40,309	tCO <sub>2</sub> -e
Haulage Emissions	289,978	tCO <sub>2</sub> -e
Land Clearance Emissions	15,886	tCO <sub>2</sub> -e
<b>Total Scope 1 Emissions over LOM</b>	<b>524,812</b>	<b>tCO<sub>2</sub>-e</b>

*Average Emissions Predicted Over LOM - Breakdown*

Average Power Station Emissions	5,582	tCO <sub>2</sub> -e/yr
Average Mining Fleet Emissions	1,260	tCO <sub>2</sub> -e/yr
Average Haulage Emissions	9,062	tCO <sub>2</sub> -e/yr
Average Land Clearance Emissions	496	tCO <sub>2</sub> -e/yr
<b>Total Average Scope 1 Emissions over LOM</b>	<b>16,400</b>	<b>tCO<sub>2</sub>-e/yr</b>

**Scenario 2: Diesel Power Station**

*Total Emissions Predicted Over LOM - Breakdown*

Power Station Emissions	222,200	tCO <sub>2</sub> -e
Mining Fleet Emissions	40,309	tCO <sub>2</sub> -e
Haulage Emissions	289,978	tCO <sub>2</sub> -e
Land Clearance Emissions	15,886	tCO <sub>2</sub> -e
<b>Total Scope 1 Emissions over LOM</b>	<b>568,373</b>	<b>tCO<sub>2</sub>-e</b>

*Average Emissions Predicted Over LOM - Breakdown*

Average Power Station Emissions	6,944	tCO <sub>2</sub> -e/yr
Average Mining Fleet Emissions	1,260	tCO <sub>2</sub> -e/yr
Average Haulage Emissions	9,062	tCO <sub>2</sub> -e/yr
Average Land Clearance Emissions	496	tCO <sub>2</sub> -e/yr
<b>Total Average Scope 1 Emissions over LOM</b>	<b>17,762</b>	<b>tCO<sub>2</sub>-e/yr</b>