Medcalf Project GHG Estimation

1 PROJECT BACKGROUND

Audalia Ltd is developing the Medcalf Project which contains iron, titanium and vanadium resource located near Lake Johnston in Western Australia. Audalia has completed the environmental studies and currently is progressing on the environmental approvals. JDE is engaged to estimate the Greenhouse Gas (GHG) emissions of the entire project life cycle.

1.1 MINING

The medcalf Project contains vanadium, titanium and iron with JORC appliance mineral resource of 32 Million tonnes Indicated and Inferred Resource. According to the preliminary mine pit designs, the pit inventory includes:

- Ore: 19.1 Mt at 53.36% average Fe_2O_3 grade, 0.51% average V_2O_5 grade and 9.34% average TiO_2 grade.
- Waste: 2.8 Mt resulting in a strip ratio of 0.15 (waste:ore).
- Life of mine: 13 years is scheduled at 1.5 Mtpa Run of Mine (ROM) throughput.
- Three surface open mine pits namely Vesuvius, Fuji and Egmont are designed.

A bucket excavator and 5 haul trucks fleet will be used to excavate and haul the ROM out of mine pit.

1.1 PROCESSING

The ROM ore will be hauled to ROM pad then fed to processing plant. The processing plant includes a comminution circuit and a magnetic separation circuit, beneficiating the ROM ore to a primary concentrate. The comminution circuit includes both crushing and milling processes. The following magnetic separation circuit consists of two different types of magnetic separation units, namely Low Intensity Magnetic Separator (LIMS) and High Gradient Magnetic Separator (HGMS). The product concentrate is dewatered by thickening and filtration. The tailings generated from the magnetic separation circuit will be thickened and stored in an unlined tailings storage facility (TSF). The filtered product concentrate will be hauled to the load out area adjacent to the Coolgardie-Esperance Highway via a 74 km private haul road. The product concentrate then will be loaded to the road trains and transported to Esperance Port for export.

2 SCOPE OF WORK

The scope of work is to provide GHG emission analysis for the proposed Medcalf project by applying international and Australian standards and guidelines.

2.1 REFERENCE

- Medcalf project process design documents
- Australian National Greenhouse Accounts Factors 2017
- National Greenhouse and Energy Reporting Scheme Measurement, Technical Guidelines for the estimation of emissions by facilities in Australia, applies to the estimation of emissions in the 2017-18 reporting year

2.2 SCOPE

The GHG assessment for the proposed Medcalf Project includes all identified Scope 1 emissions and no Scope 2 emissions (given that no purchase of off-site electricity would occur). Scope 3 emissions were limited to those activities within Australian that were a consequence of the proposed developments activities, specifically personal travel from to site. A discussion regarding the project life cycle emissions associated with the mining, processing and transportation is presented in this report.

3 GREEN HOUSE GAS EMISSIONS

3.1 EMISSION FACTORS

The emission factors used in this study were sourced from the Australia National Greenhouse Accounts (NGA) Factors. The NGA factors were also used to determine Scope 3 (indirect) emissions where necessary.

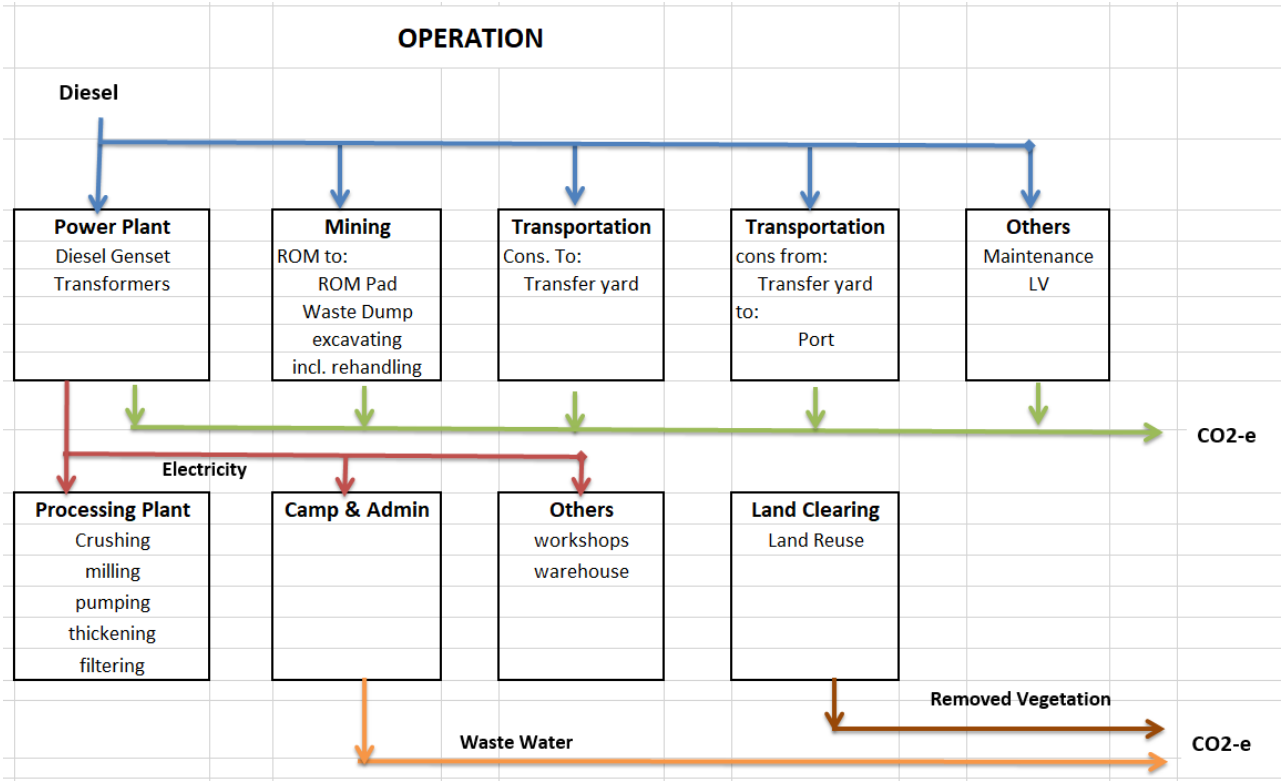
The emissions for the proposed development were calculated by multiplying the volume of diesel by an emission factor, to generate a value for the likely amount of tCO2-e emitted.

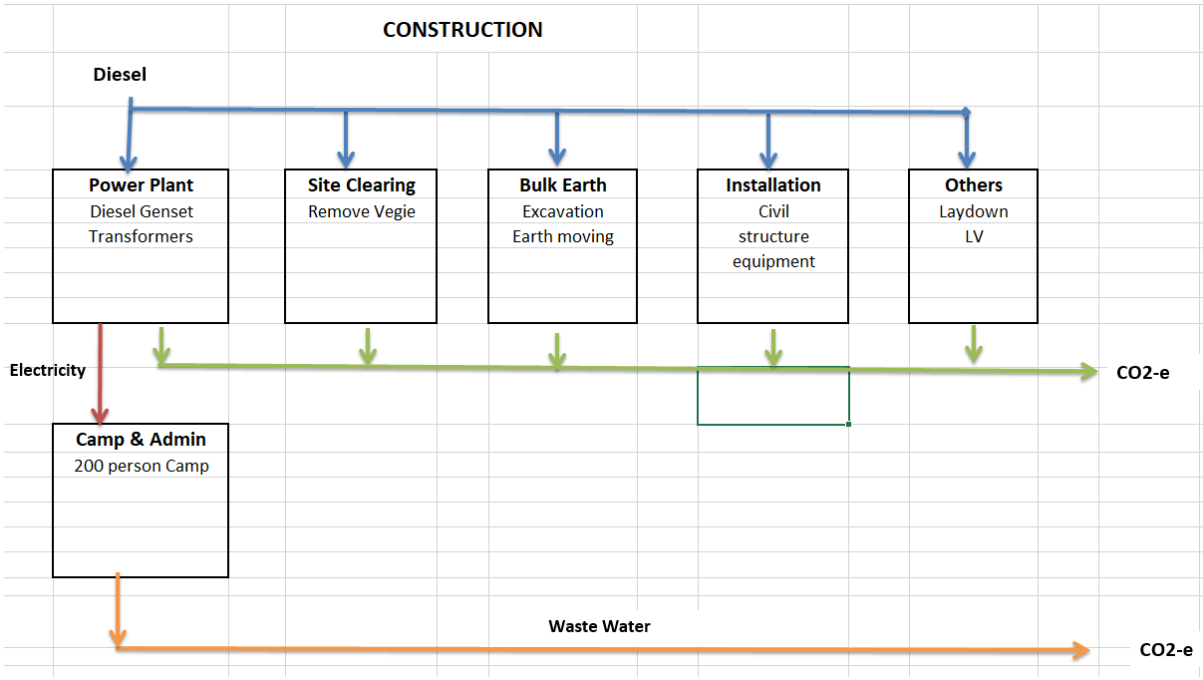
3.2 EMISSION SOURCES

The principal sources of greenhouse gas emissions are diesel used for mining power plant and beneficiation process. Emission sources and activity data description in following table according to the mine site development plan.

Emission Activity	Description
Diesel consumption for mining	Diesel for mining operation, i.e. excavation, movement of ore and waste rock
Diesel consumption for power generation	Electricity power for ore processing and infrastructures on site
Diesel consumption for concentrate transportation	Concentrate haulage from site to Esperance Port
Wastewater from accommodation	Methane gas emitted from wastewater treatment plant (WWTP)
Diesel consumption for construction	Diesel consumption during construction phase
Land use change	400 Ha land disturbance

GHG source emission diagram:





4 GHG EMISSIONS ESTIMATE

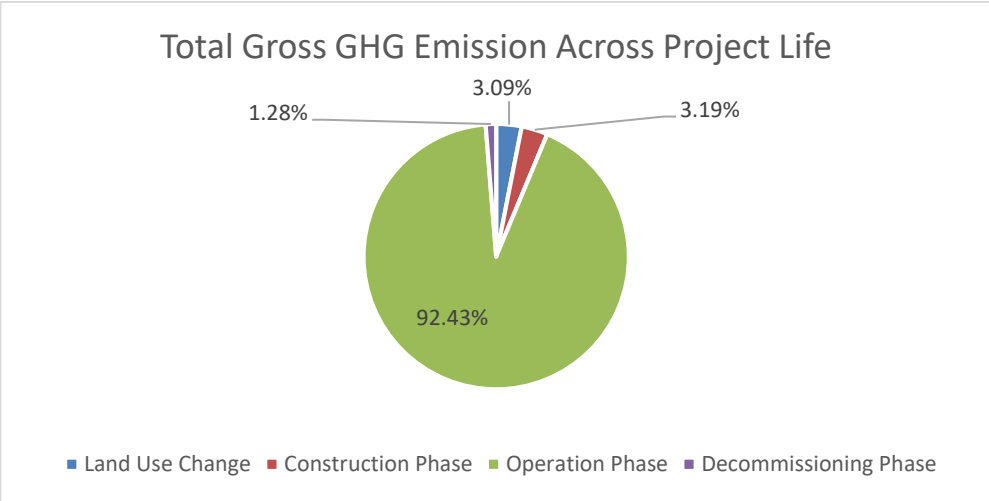
4.1 ASSUMPTION

The following assumptions were made in estimating the annual and life of project GHG emissions:

- Indicative figures for the consumption of and generation of energy, waste, transportation, etc. taken from Project CAPEX processing design;
- Metallurgical plant throughput is up to 1.5 Mtpa;
- Life of the mine is 13 years, whilst, the life of the plant is 13 years;
- Total land disturbance is assumed to be 400 ha according to the mining general arrangements;
- Diesel fuel consumption as per the project throughput and current processing design;
- Processing plant construction phase has been assumed to last for 1.2 years, only 0.7 years is considered for erection;
- 200 people and 90 people accommodation has been assumed during construction and operation stage;

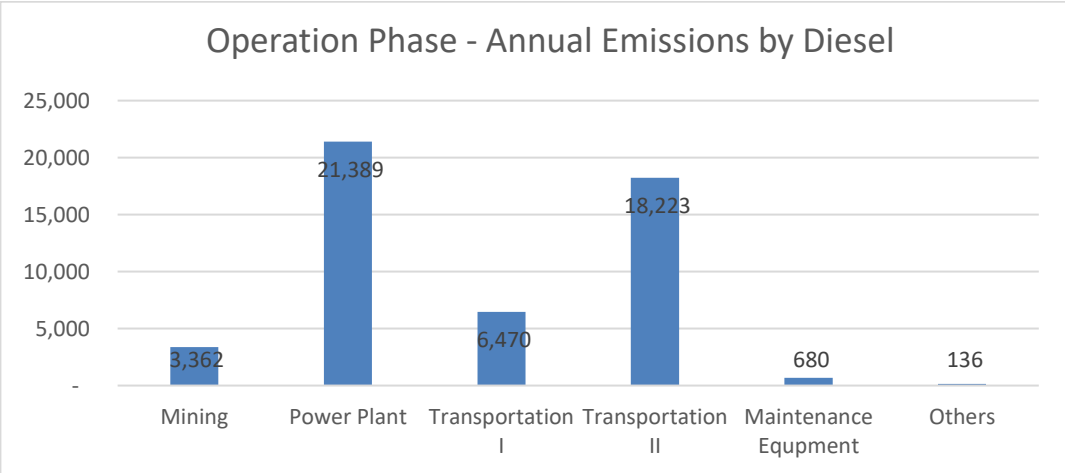
4.2 GROSS PROJECT GHG EMISSIONS FOR THE ENTIRE PROJECT LIFE

The following figure shows the total indicative GHG emissions across the project life cycle. Total gross project GHG emissions are approximately 707.2 kt CO2-e, of which approximately 92.43% is accounted for in the operations phase. A once off release of GHG emissions (3.09%) associated with land use and 3.19% emission associated with construction activities.



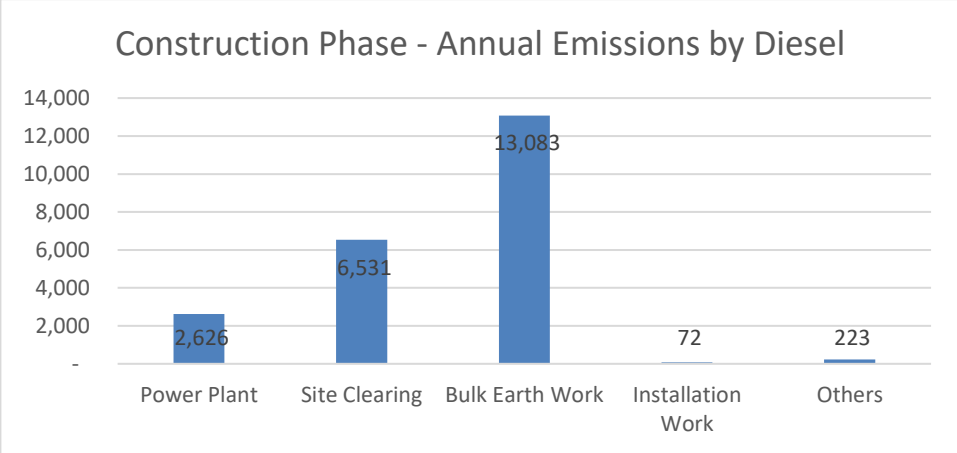
4.3 GHG EMISSIONS DURING OPERATIONS PHASE

The annual GHG emissions during the operations phase is 50,261 tCO2-e per annual. At approximately 49.2% diesel fuel consumption for transportation of the product to port is the largest source of total GHG emissions during the operations phase, followed by diesel consumption for power generation at 42.78%. Refer to the calculation the calculation for detail.



4.4 ONCE OFF GHG EMISSIONS DURING CONSTRUCTION PHASE

Once off GHG emissions during the operations phase is 22,591 tCO2-e. Single largest source of GHG emission is Bulk Earth Work which accounts for approximately 58.06%, followed by diesel fuel consumption for site clearing at 28.98%. Refer to the calculation in Section 7 for detail. Approximate 11.65% GHG emission is for power generation purpose.



5 GREENHOUSE GAS REDUCTION MEASURE

In order to reduce the GHG emission, it is proposed to adopt GHG management programs to monitor and minimize greenhouse gas emissions during operation of Medcalf project. The program will improve the efficiency of electricity generation and diesel consumption.

5.1 ELECTRICAL EFFICIENCY

It is normal operating procedure to maximize electrical efficiency due to the business requirements to minimize costs. The following activities will be proposed to maximize electrical efficiency:

- Regular monitoring of electrical load on the processing equipment and investigation whenever the load falls outside optimal parameters.
- Regular maintenance and inspection of processing equipment to keep them in high efficiency.
- Regular electrical calibration checks on the processing equipment.
- Use of high efficiency electrical motors throughout the mine site.
- Use of variable speed drive pumps, compressors and other processing equipment.

5.2 DIESEL EFFICIEENCY

Diesel consumption by haul trucks and other on-site vehicles is a major business cost and source of greenhouse gas emissions and it is normal business practice to minimize its use. The following activities will be proposed to minimize the use of diesel:

- Haul truck scheduling, routing and idling times will be optimized through the sophisticated design to minimize the amount of diesel consumed.
- Pit access ramps will be designed to limit the amount of effort required for fully-laden trucks to climb.
- Haul roads will be compacted to reduce rolling resistance.
- Optimized the ramp and haul road design to minimize the amount of distance haul trucks need to travel.
- Truck maintenance schedule, including tyre condition monitoring.
- Consideration of fuel efficiency of haul trucks during procurement.

6 SUMMARY

This greenhouse gas (GHG) emission forecast is prepared for the proposed Medcalf project development. The predictive estimate calculated a total gross emission of approximately 707.258 kt CO2-e across the project life. The project life includes land clearing, construction, operations and decommissioning, for a period of up to 13 years. The project's mining is proposed at a rate of up to 1.5 Mtpa, which is estimated to produce up to 1.2 Mtpa of concentrate. The biggest contribution of the emissions is expected to occur during the operation phase, which is 92.43% of total GHG emission. The Emissions intensity of the project life is 0.0363 tCO2-e/tROM.

7 CACULATIONS

Project Life GHG Emission

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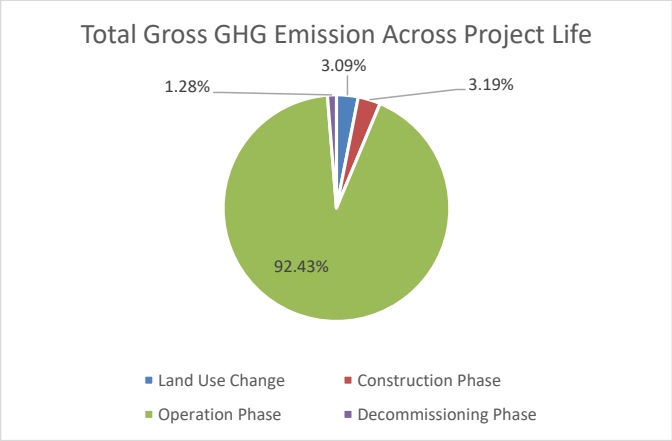
Project Number: JD1902 Project： Medcalf Project JD1902CAL001-01

Item	Project Stage	Specification	TCO2-e annual	Stage Life	Total of project life TCO2-e	Total Gross GHG	Remark
a	Land Use Chang	Scope 1	21,880	1	21,880	3.09%	
a1	Construction Phase	Scope 1 Method 1	22,591	1	22,591	3.19%	
a2	Operation Phase	Scope 1 Method 1	50,288	13	653,750.20	92.43%	
a3	Decommissioni ng Phase	Scope 1 Method 1	9,036	1	9,036	1.28%	
a6				**Total:**	707,258		
			Emissions intensity:		0.0363	TCO2-e/t ROM	



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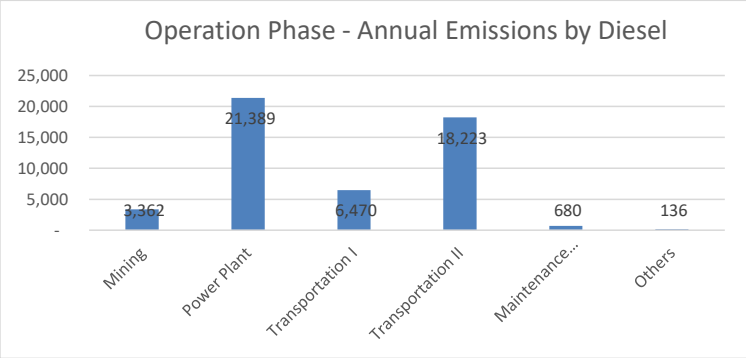
Operation GHG Emission

Project Number: JD190 Project： Medcalf Project JD1902CAL001-02

Item	Project Stage	Specification	Diesel kL annual	Energy Factor GJ/kL	CO2 kg CO2-e/GJ	CH4 kg CO2-e/GJ	N2O kg CO2-e/GJ	TCO2-e annual	%	Remark
a	**Operation**									
a1	Mining	Scope 1 Method 1 Transport energy purposes	1,235	38.6	69.9	0.1	0.5	3,362	6.69%	ROM 1.5Mtpa Strip ratio: 0.15
a2	Power Plant	Scope 1 Method 1 stationary energy purposes	7,894	38.6	69.9	0.1	0.2	21,389	42.78%	processing plant and site facility
a3	Transportation I	Scope 1 Method 1 Transport energy purposes	2,378	38.6	69.9	0.1	0.5	6,470	12.88%	74kM, private haul road to transfer yard ref. trasporation proposal
a4	Transportation II	Scope 1 Method 1 Transport energy purposes	6,697	38.6	69.9	0.1	0.5	18,223	36.29%	220kM puplic road to port ref. trasporation proposal
a5	Maintenance Equpment	Scope 1 Method 1 Transport energy purposes	250	38.6	69.9	0.1	0.5	680	1.35%	Mobile equipment for maintenance purpose
a6	Others	Scope 1 & Scope 3 Method 1 LV Transport energy purposes	50	38.6	69.9	0.1	0.5	136	0.27%	LV and other usages
							Total:	50,261		



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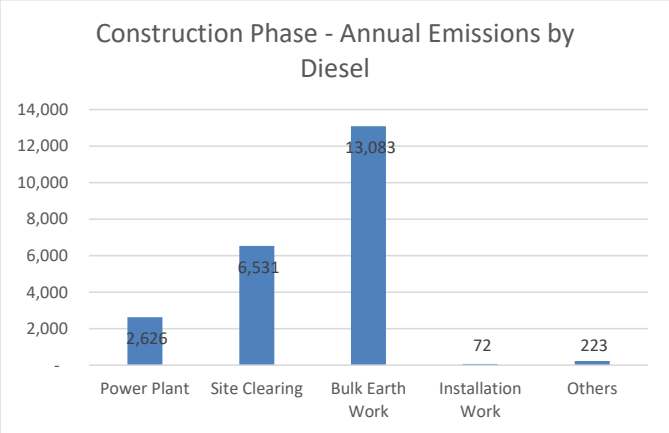
Construction GHG Emission

Project Number: JD190 Project： Medcalf Project

JD1902CAL001-03

Item	Project Stage	Specification	Diesel kL annual	Energy Factor GJ/kL	CO2 kg CO2-e/GJ	CH4 kg CO2-e/GJ	N2O kg CO2-e/GJ	TCO2-e annual	%	Remark
b	**Construction**	1.2 years Construction								
b1	Power Plant	Scope 1 Method 1 stationary energy purposes	969	38.6	69.9	0.1	0.2	2,626	11.65%	construction Camp&Admin 200 persons@2400l/year/person
b2	Site Clearing	Scope 1 Method 1 Transport energy purposes	2,400	38.6	69.9	0.1	0.5	6,531	28.98%	0.4 L Diesel/m2
b3	Bulk Earth Work	Scope 1 Method 1 Transport energy purposes	4,808	38.6	69.9	0.1	0.5	13,083	58.06%	ref. bulk earth work estimation
b4	Installation Work	Scope 1 Method 1 Transport energy purposes	26.5	38.6	69.9	0.1	0.5	72	0.32%	ref. installation work estimation
b5	Others	Scope 1 & Scope 3 Method 1 LV Transport energy purposes	82	38.6	69.9	0.1	0.5	223	0.99%	People traveling from to site or within site
							Total	22,536		



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Land Use GHG Emission

Project Number: JD190 Project： Medcalf Project JD1902CAL001-04

Item	Project Stage	Phase	Specification	Area Ha	Emission Factor t CO2-e/Ha/year	TCO2-e annual	Remark
a	One off Emission						
a1		Land Use Change	Scope 1 Method 1	400	54.7	21,880	54.7 tCO2-e/Ha/year
a2							
a3							
a4							
a5							
a6							
a7							

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Waste Water GHG Emission

Project Number: JD190 Project： Medcalf Project

JD1902CAL001-05

Item	Project Stage	Phase	Specification	Waste Water kL annual	CODw	Fsl	CODeff	MCFww or MCFsl	EFw or EFsl	TCO2-e annual	Remark
a	Construction		first 2 years Construction								
a1		Camp	Scope 1 waste Water	21,600,000	11.6	0.3	0.58	0.8	6.3	38	200 persons @ 300l/persons/day
a2			Scope 1 Sludge		11.6	0.3	0.58	0.8	6.3	18	
a3									Total	55.5	
b	Operation										
b1		Camp	Scope 1 waste Water	9,720,000	5.8	0.3	0.29	0.8	6.3	19	90 persons @ 300l/persons/day
b2			Scope 1 Sludge		5.8	0.3	0.29	0.8	6.3	9	
b3									Total	27.8	

Reference: Australian National Greenhouse Accounts Factors - 2018