BEETALOO EXPLORATION PROJECT GREENHOUSE GAS ABATEMENT PLAN

Review record

Rev	Date	Reason for issue	Reviewer	Approver
0	08/12/2021	Issued for use	RU	MK
1	08/07/2022	Update to include Amungee Delineation Scope	LP	MK
1.1	13/09/2022	Minor update to emission estimates	LP	MK
1.2	25/10/2022	Minor edits to Table 1	LP	MK
2.0	21/09/2023	Revision	LP	MK
3.0	16/11/2023	Revision to include Shenandoah South E&A program	LP	MK

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1. INTRODUCTION

Tamboran B2 Pty Ltd (Tamboran) is a registered holder and the operator of Exploration Permit (EP) 98, EP 76 and EP 117 located in the Beetaloo Sub-basin. Tamboran as a part of its ongoing exploration and appraisal (E&A) program, is proposing to undertake a series of activities over the 2024 – 2027. A Greenhouse Gas Abatement Plan (GGAP) was submitted in December 2021, in accordance with the Northern Territory Greenhouse Gas Emissions Management for New and Expanding Large Emitters (referred to herein as the Large Emitters policy) as the project is anticipated to generate greenhouse gas emissions that will exceed the 100,000 tCO_2e- threshold in a financial year.

This GGAP is an evolving document and will be updated based on revisions to the project's exploration strategy and in emission profiles. This GGAP version provides an update to the predicted Greenhouse gas emissions associated with Tamboran's forward exploration and appraisal program, specifically the inclusion of the Shenandoah South Exploration and Appraisal program.

2. PROJECT OVERVIEW

Tamboran is planning to undertake petroleum exploration and appraisal works within the Beetaloo Sub-basin, to fulfil its commitments under its tenure work program. Over the 2024 to 2027 period, Tamboran proposes to drill, stimulation and well test up to 17 new E&A wells to confirm the technical and commercial feasibility of the Velkerri shale. These exploration wells are anticipated to be drilled within the Shenandoah South Pilot Area and/or the Amungee Delineation Area (Figure 1).

This GGAP covers the proposed regulated activities required to enable Tamboran to continue to drill, stimulate, test, maintain and decommission the proposed E&A wells as outlined in the various approved EMPs or anticipated future scope.[1]

[1] Approved EMPs can be found on the DEPWS website at: https://depws.nt.gov.au/onshore-gas/environment-management-plan/emp-decisions.

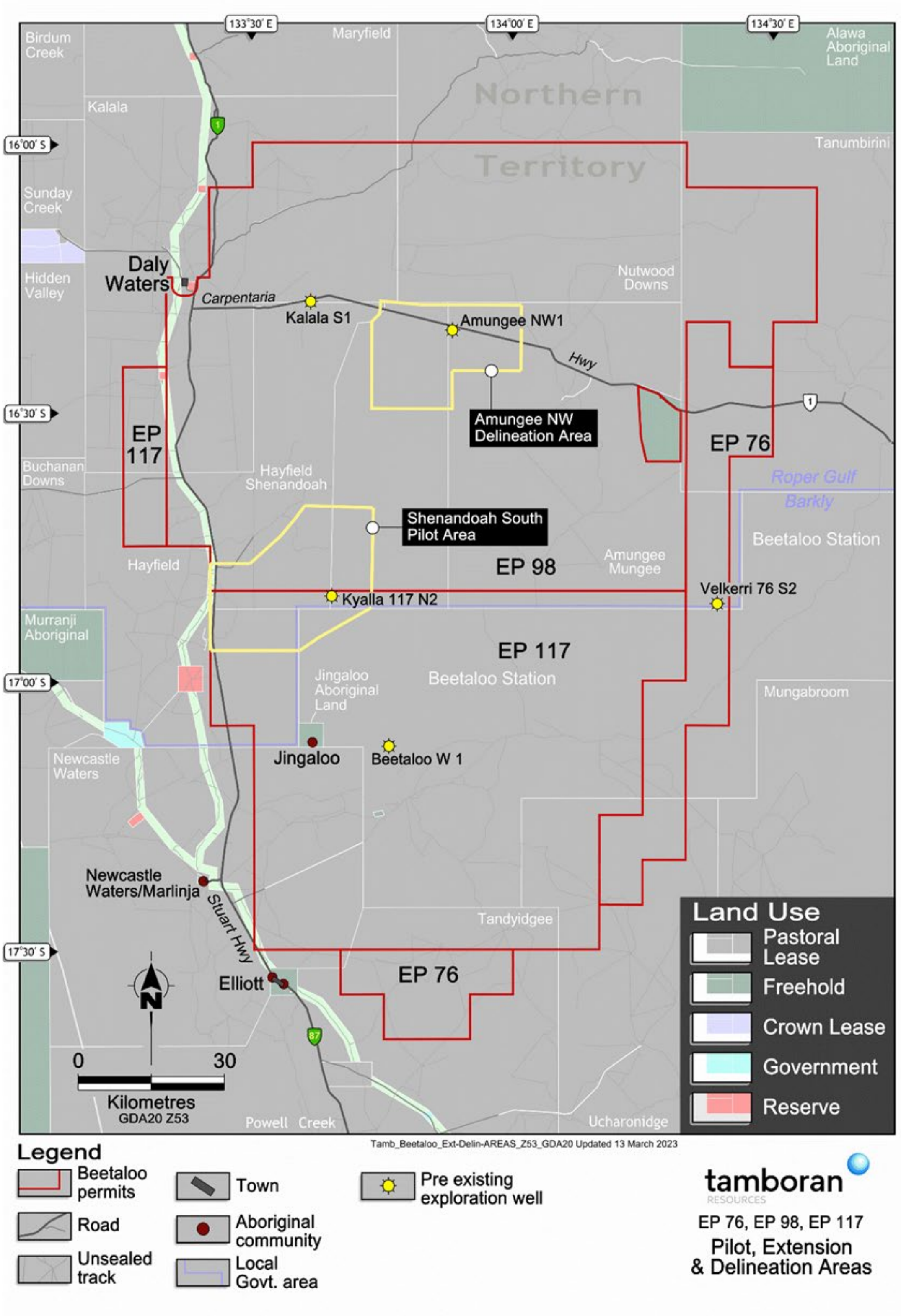

Figure 1: Location of the proposed Amungee Delineation Area and Shenandoah South Pilot Area

3. GREENHOUSE GAS ABATEMENT PLAN

The requirements of the GGAP are described extensively in Tamboran's approved or proposed EMPs. These include:

- Beetaloo Basin Shenandoah South Exploration and Appraisal EMP (TAM1)
- Beetaloo Sub-basin Amungee Multi-well Drilling, Stimulation and Well Testing Program NT EMP EP 98 (ORI11-3)
- Beetaloo Sub-basin Amungee NW Delineation Drilling, Stimulation and Well Testing Program EP 98 & EP 76 EMP (ORI10-3)
- Beetaloo Basin Kalala S1 EMP EP 98 (ORI9-2)
- Beetaloo Basin Beetaloo W1 EMP EP117 (ORI 8-2)
- Beetaloo Basin Amungee NW-1H Stimulation EMP EP 98 (ORI7-2)
- Beetaloo Basin Kyalla Multi-well EMP EP 117 (ORI6-3)
- Beetaloo Basin Velkerri 76 Drilling, Stimulation and Well Testing EMP EP 76 (ORI5-4)
- Beetaloo Basin Velkerri 76 S2 Civil Construction EMP EP 76 (ORI4-1)
- Beetaloo Basin Kyalla 117 Drilling, Stimulation and Well Testing Program EMP EP 117 (ORI3-2)
- Beetaloo Basin Velkerri 76 S2 Groundwater monitoring bore drilling EMP EP 76 (ORI2-1)
- Beetaloo Basin Kyalla 117 N2 civil construction EMP EP 117 (ORI1-1)
- Beetaloo Basin EP 98 Groundwater Monitoring Bore EMP
- Beetaloo Basin Kyalla 117 Water bore drilling EMP EP 117 (Variation)
- Beetaloo Basin Kyalla 117 N2 Water bore EP 117 EMP

How Tamboran addresses the GGAP requirements is summarised in Table 1.

Table 1: GGAP summary

#	Requirement	Tamboran response
1	Brief description of the project.	The scope of Tamboran's Financial year (FY) 2024-26 campaign includes: • Drilling, hydraulic fracture stimulation and well testing of 17 exploration and appraisal wells within Tamboran's Beetaloo tenure (exploration permit 76, 98 and 117). • Civil construction activities required to construct lease pads, camp pads, laydown areas, helipads, firebreaks, seismic lines and access tracks to support the drilling the proposed E&A wells. • Setup and operation of a temporary camps (~75-person) and drilling mini-camp (8-person) at each of the sites. • Flaring of gas and condensate and/or beneficial use of hydrocarbons where possible. • Groundwater bore installation with groundwater extraction under WEL GRF 10285.

#	Requirement	Tamboran response
		• All other activities required to achieve the exploration program activities.
2	An estimate of the project's net scope 1 emissions and how these emissions will contribute to the Territory's overall emissions profile.	The scope 1 emissions break down per year are provided in Appendix A, including offset requirements and residual emission levels. The total scope 1 emission breakdown per activity is provided in Appendix B. Emissions are estimated to peak at 190,839 tCO_2-e in FY 2025. This includes emission from other proposed Tamboran activities in the Beetaloo Sub-basin. Over 88% of the anticipated emissions are associated with flaring. Flaring of produced hydrocarbons is typically required to understand whether commercial volumes of gas have been encountered. The potential emissions of Tamboran's activities represent 1.35% total NT GHG emissions compared to 2021 levels. Based upon the life cycle assessment analysis of a similar (but different) unconventional gas development in Australia completed by the Gas Industry Social and Environmental Research Alliance (GISERA) (Heinz 2019), the current net climate benefits of using natural gas in replacing coal for electricity generation is up to 50% less emissions (Heinz 2019). It is anticipated that a future shale gas development will be net zero scope 1 and 2 emissions, through the utilisation of world's best practice emission reduction technology, such as drilling of longer laterals (reduce vertical components of wells), field electrification, flare minimisation strategies, use of renewable energy sources and procurement of emission offsets. Scope 3 emissions will also be reduced through investigation in low emission technologies, such as carbon capture and sequestration (CCS) enable blue ammonia/ hydrogen and electricity export. This would further reduce the emission intensity of a future gas developments and highlights the role of natural gas as a transition or 'firming' fuel to support the roll out of large-scale renewables in the future.
3	An estimate of the project's net scope 2 emissions and how these emissions will contribute to the Territory's overall emissions profile.	There are no scope 2 emissions associated with Tamboran's Beetaloo exploration program.
4	An estimate of the project's scope 3 emissions.	Scope 3 emissions are restricted to the emission associated with the material and supply chains associated with Tamboran's activities. The project's estimated Scope 3 emissions are 162,286 tCO_2-e. These emissions are extremely conservative as it is assumed all wells drilled are 3000 m horizontals. Most emissions are associated with the steel casing and cement for the proposed 17 E&A wells. Emissions from wastewater and material transport area included in scope 1 emissions.
5	An overarching long-term emissions target for the project that represents a meaningful contribution to the Territory's net zero emissions target.	Tamboran's Beetaloo development will be a scope 1 and scope 2 neutral development. This aligns with the NT Government's Net Zero by 2050 Policy and NGERS Safeguard mechanism. How Tamboran intends to use offsets to deal with residual emissions is discussed in item 9 of this plan.

#	Requirement	Tamboran response
6	Regular interim targets that establish a trajectory to achieving the overarching target and the methods that will be applied to achieve the interim targets.	N/A- interim targets are not appropriate for exploration and appraisal projects. Offset targets are discussed in item 9 of this plan.
7	An explanation of, and justification for, the proposed long-term and interim targets and how these will make a meaningful contribution to the Territory's emissions target.	Tamboran's Beetaloo development will be a scope 1 and scope 2 neutral development. This aligns with the NT Government's Net Zero by 2050 Policy and NGERS Safeguard mechanism.
8	A demonstration that all reasonable and practical measures have been applied to avoid and mitigate emissions through best practice design, process, technology and management.	Greenhouse gas emissions during well testing are required to be generated to prove the commerciality of a potential resource. Well testing data is used to generate a well's Estimated Ultimate Recovery (EUR), which determines how many wells are required to be drilled and how often replacement wells are required to be brought online to maintain production levels (i.e. as wells decline over time). The minimum required well testing (or piloting) duration for unconventional gas development generally exceeds 2 years (730 days) per geographic region. The more data on production, the lower the commercial risk of a development. This duration is based upon Tamboran's (and previously Origin's) current experience in appraising and developing unconventional gas assets The mitigation of emissions has been undertaken through: • **Minimising well test durations:** Well testing duration using flaring will be restricted in CY 26 and beyond to below the 100,000t CO_2e- threshold for a defined facility. The beneficial use of appraisal gas will be prioritised for long term appraisal to reduce scope 1 emissions. This is currently not approved, and approval is anticipated to be sought in FY24/25, once stakeholder engagement has been completed. Given the financial outlay and uncertainty around production rates (i.e. production rates may not be sufficient to warrant long term testing), appraisal gas sale could be introduced in FY 26 and beyond. • **Minimising production rates:** Wells may be "choked" in the FY 26,27 period to reduce production volumes to ensure emissions stay below the 100,000 tCO_2e- threshold. Choking a well can still provide valuable pressure data. • **Utilisation of the best practice emission management controls** outlined in the *Code of Practice: Onshore petroleum activities in the Northern Territory* (the Code) including reduced emissions completions, minimisation of venting and utilisation of leak detection and repair programs. • **Appraisal gas sale:** Where volumes of gas are sufficient, appraisal gas will be sold in FY 26/27 during appraisal to reduce reliance on flaring. This will directly decrease scope 1 emissions. Appraisal gas sale is currently not approved and will require additional approvals.

#	Requirement	Tamboran response
9	A description of all strategies proposed to avoid, mitigate and offset the project's scope 1 and scope 2 emissions.	1. GHG emissions will be mitigated through the adoption of the mandatory requirements in the Code, which requires: - The development and implementation of a methane emission management plan (D5.1). - Restrictions on venting (D.5.9). - Use of a Reduced Emissions Completion (REC) (D.5.9). - Implementation on a routine Leak Detection and Repair (LDAR) program (D.5.3.). - Pressure and gas testing all in service equipment to ensure any leaks are identified and fixed prior to commission (D.5.9). - Flanges, valves and fittings are all API compliant and gas tight (D.5.9). - Equipment is appropriately sized and regularly maintained to minimise diesel wastage (D.5.9). - Routine site inspections and assurance undertaken to ensure equipment is maintained and operated as per manufacturers' requirements. 2. Well test duration and volume will be restricted in CY 26 and 27 to ensure emissions are below the 100,000 tCO_2e- threshold. 3. During extended appraisal program in CY 26/27, appraisal gas will be sold (subject to approvals) to reduce the need for flaring to collect longer term resource evaluation data required for commercial evaluation of the shale resources. 4. Where emissions from a defined facility exceed the 100,000 tCO_2e- threshold NGERS safeguard emissions trigger, all scope 1 emissions for that reporting period will be offset in accordance with the Commonwealth NGERS Safeguard requirements. 5. Where emissions are below the NGERS safeguard trigger, a % of residual emissions shall be voluntarily offset using credible carbon credit units approved by the Commonwealth Clean Energy Regulator or the Commonwealth's Climate Active Carbon Neutral Standard. This ensures the project is in alignment with the NT Net Zero by 2050 Policy. 6. Where emissions are below the NGERS safeguard, minimum offset levels shall increase year-on-year by 3.7% (based on a baseline financial year of 2023) to result in a linear decrease in residual emission levels to net zero by 2050 as per the following schedule: - Financial year 2023: 3.7% of total emissions offset. - Financial year 2024: 7.4% of total emissions offset. - Financial year 2025: 11.1% of total emission offset. - Financial year 2026 14.8% of total emissions offset. - Financial year 2027 18.5% of total emissions offset.

#	Requirement	Tamboran response
		7. Actual emission levels produced during a financial year will be estimated in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS) reporting methodology. 8. Offsets volumes shall be calculated retrospectively, by multiplying the actual emission volumes generated during a financial year with the corresponding financial year offset % requirement level. 9. Estimates of offset volumes and residual emission levels are provided in Appendix A. 10. Offsets shall be secured and retired within 6 months of the end of a financial year.
10	Flexibility to review mitigation actions and abatement plans so they can be improved and updated to enable further emissions reductions going forward.	Tamboran will continue to look for opportunities to mitigate carbon emissions during the project. Tamboran will prioritise the sale of appraisal gas in FY 26 and 27 to minimise scope 1 emissions. This is subject to ongoing stakeholder engagement and additional approvals.
11	A schedule for periodic public reporting on implementation and progress against the interim and overarching targets and any changes that have had to be made to the strategies proposed in the GGAP to deliver on the targets.	1. Tamboran is required under condition D.6.2 of the Code of Practice to report its GHG emissions to the Department of Environment, Parks and Water Security on an annual basis. During this report, Tamboran assesses the level of GHG emissions against its EMP estimated levels to demonstrate it has met it has met its performance standards. 2. A report from an appropriately qualified independent person shall be provided to DEPWS by October 31 each year, verifying the actual emission levels estimated and confirming the required offset for the previous financial year have been acquired and retired.
12	Information about the project's obligations under the Australian Government's National Greenhouse and Energy Reporting Act 2007 and any expected baseline determinations.	Where Tamboran exceeds 100 ktCO_2 in a reporting period (financial year), Tamboran will trigger the NGERS reporting threshold and safeguard mechanism. A baseline emission intensity will be generated for Tamboran's activities which is anticipated to be zero.
13	A timetable for review that is considerate of the project's lifespan and the identified interim and overarching targets.	The emissions associated with the project will be reviewed annually.

4. REFERENCES

Heinz Schandl, Tim Baynes, Nawshad Haque, Damian Barrett and Arne Geschke (2019). *Final Report for GISERA Project G2 - Whole of Life Greenhouse Gas Emissions Assessment of a Coal Seam Gas to Liquefied Natural Gas Project in the Surat Basin, Queensland, Australia*. CSIRO, Australia.

Appendix A Scope 1 emissions breakdown, offsets and residual emissions per year

Emission period	Cumulative tCO_2-e	Estimated voluntary emission offset requirements (tCO_2)	Total cumulative residual emissions tCO_2 (total emissions minus offsets)
FY 2024	45,400	3,397	42,040
FY 2025	190,692	190,976*	0*
FY 2026	98,253	14,541	83,711
FY 2027	86,533	15,922	70,611
Total	**421,663**	**224,836***	**196,826***
*Assumes the NGERS safeguard 100 ktCO_2e trigger has been reached and offset requirements triggered.			

Appendix B Tamboran's project scope 1 emissions estimate

Summary of Tamboran's Total scope 1 emissions estimates from FY 2024 to 2027.

Activity	Anticipated volume	Estimated emissions	Estimate methodology and assumptions
Diesel combustion – transport to cover seismic program	25 kL	68 t	Diesel estimates multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kg) 38.6 CO_2 Factor 69.9 kgCO_2-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 kgCO_2-e/ GJ of diesel
Diesel combustion civil construction	650 kL	1,772 t	Diesel estimates multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kg) 38.6 CO_2 Factor 69.9 kgCO_2-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 kgCO_2-e/ GJ of diesel
Diesel combustion – transport to cover drilling/stimulation mobilisation and transport activities (including offsite wastewater transport)	1,472 kL	4,000 t	Diesel estimates multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kill) 38.6 CO_2 Factor 69.9 kgCO_2-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 kgCO_2-e/ GJ of diesel

Activity	Anticipated volume	Estimated emissions	Estimate methodology and assumptions
Diesel combustion – drilling	3,806 kL	9,647 t	Diesel estimates multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kill) 38.6 CO_2 Factor 69.9 kgCO_2-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 kgCO_2-e/ GJ of diesel
Diesel combustion – camp	904 kL	2,448 t	Diesel consumption estimates multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kill) 38.6 CO_2 Factor 69.9 kgCO_2-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 kgCO_2-e/ GJ of diesel
Fugitive methane emissions – drill cuttings	19.74 t	553 t	Estimate by engineer based on gas saturation and core volume multiplied by NGERS Global Warming Potential (GWP) of 28 tCO_2e/tCH_4.
Fugitive emissions – completion (venting)	881 t methane	24,657 t	2 completion days anticipated per well. Table 5-23 Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry; American Petroleum Institute (API), 2009 NGERS completion factor of 25.9 tonnes of methane per day multiple by NGERS Global Warming Potential (GWP) of 28 tCO_2-e/tCH_4

Activity	Anticipated volume	Estimated emissions	Estimate methodology and assumptions
Fugitive emission – wastewater storage	60 t methane	1,6888 t	Emissions multiplied by Table 5-10 produced saltwater tank methane flashing emission factors - Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry; American Petroleum Institute (API), 2009 emission factor of 0.11 tCH_4/ML (assuming 2% salinity, 250 psi separator pressure) multiplied by NGERS Global Warming Potential (GWP) of 28 tCO_2-e/tCH_4.
Well testing – flared natural gas emissions	4,320 TJ of natural gas total	362,715 t	Flared estimate using forecasted P50 success case of 9 TJ/day per well. Estimated production rates multiplied by NGER Determination: Subdivision 3.3.2.2—Oil or gas exploration and development (emissions that are flared) section 3.44 Method 1—oil or gas exploration and development item 1: CO_2 Factor 2.8 tCO_2-e/ t unprocessed gas CH_4 Factor 0.933 tCO_2-e/ t unprocessed gas N_2O Factor 0.026 tCO_2-e/ t unprocessed gas
Well stimulation – stationary sources (diesel combustion)	1,695 kL	4,593 t	Diesel consumption estimated from historical data and multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kg) 38.6 CO_2 Factor 69.9 $kgCO_2$-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 $kgCO_2$-e/ GJ of diesel
Well testing – (wastewater transport including in transport emissions)	665 kL	1,802t	Diesel consumption estimated from historical data and multiplied by NGERS emission factor from NGER Determination: Division 2.4.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide from liquid fuels other than petroleum-based oils or greases, section 2.41 Method 1—emissions of carbon dioxide, methane and nitrous oxide and Part 3—Fuel combustion—liquid fuels and certain petroleum-based products for stationary energy purposes item 40: Energy Content Factor (GJ/kg) 38.6

Activity	Anticipated volume	Estimated emissions	Estimate methodology and assumptions
			CO_2 Factor 69.9 $kgCO_2$-e/ GJ of diesel CH_4 Factor 0.1 kgO_2-e/ GJ of diesel N_2O Factor 0.2 $kgCO_2$-e/ GJ of diesel
Land clearing for site preparation and seismic surveys	119 ha land clearing (77 tCO_2e/ ha)	7,561 t	TAGG 2013 Appendix I vegetation clearing methodology, Table 6, assumed maximum potential biomass class = 1.
Total over 4 years		**421,663 t**	