Sturt Plateau Compression Facility - Appraisal Gas

Environment Management Plan (TAM2-3)

EP 98 & EP 117

REV	DATE	REASON FOR ISSUE	COMPILER	APPROVER
0	17 July 2024	Issued for Assessment	L Pugh	M Kernke
1	2 Oct 2024	Addresses feedback from NLC and DLPE regulation 10 letters	L Pugh	M Kernke
1.1	23 Oct 2024	Addresses comments from OGC		M Kernke
1.2	14 Nov 2024	Minor amendments to TAM2-3		L Pugh

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Executive Summary

Tamboran B2 Pty Ltd (Tamboran) is the registered holder and operator of exploration permits (EP) 98 and 117 located in the Beetaloo Sub-basin. This Environment Management Plan (EMP) represents Tamboran's application to the Northern Territory (NT) Minister for Environment for the collection, use and sale of appraisal gas through the construction and operation of the temporary Sturt Plateau Compression facility (SPCF) – hereafter referred to as 'the Project'.

The *Sturt Plateau Compression Facility – Appraisal Gas EMP* is designed to collect, use and sell appraisal gas recovered during E&A well exploration activities, to support and determine the future technical and commercial viability of the underlying shales within Exploration Permits (EPs) 98 and 117. The environmental benefit of the SPCF is a significant reduction in scope 1 greenhouse gas emissions generated from exploration and appraisal (E&A) activities, as well as the beneficial use of gas resources which would otherwise not be utilised.

This EMP is restricted to exploration and appraisal activities and does not cover production as defined in the NT *Petroleum Act 1984*. In summary, the regulated activity proposed in this EMP pertains to the recovery and beneficial use of appraisal gas obtained during extended well testing, in accordance with Section 57AAA of the *Petroleum Act 1984*.

The Project involves the civil, mechanical and electrical construction, commissioning, operation, maintenance and rehabilitation of the temporary appraisal gas SPCF. The SPCF is located at the Shenandoah South 2 (Shenandoah S2) site, which was approved by the Minister on 23 May 2024, as part of the *Beetaloo Basin Shenandoah South E&A Program EMP (TAM1-3),* (hereafter referred to as 'the TAM1-3 EMP'). The EMP for this Project (TAM2-3) covers the facilities and activities from the downstream flange of the production wing valve on the wellheads to the flange that connects the SPCF to the export pipeline.

Compressed gas processed at the site will be metered and fed into a new proposed pipeline – the 38 km Sturt Plateau Pipeline that will be connected into the Amadeus Gas Pipeline (AGP). The approval and operation of the Sturt Plateau Pipeline is outside of the scope of this EMP, with the boundary of the EMP ending with the discharge of gas from the SPCF into the pipeline.

The EMP has been prepared in compliance with the NT Petroleum (Environment) Regulations 2016 (the "Regulations"), *Code of Practice: Onshore Petroleum Activities in the Northern Territory* (the "Code") and the Exploration Agreements between Tamboran, native title holders and the Northern Land Council (NLC). The EMP is designed to ensure that the proposed activities are carried out in such a manner that the environmental impacts and risks will be reduced to as low as reasonably practicable (ALARP) and acceptable.

Location of the regulated activities

The SPCF will be located on the Shenandoah S2 site on EP 98, within the Shenandoah pastoral station (NT portion 7026). Access to the site is via existing approved access tracks connecting the Stuart Highway to the Shenandoah S2 location. The location of the Project in relation to existing infrastructure and sites in the vicinity is provided in Figure 1.

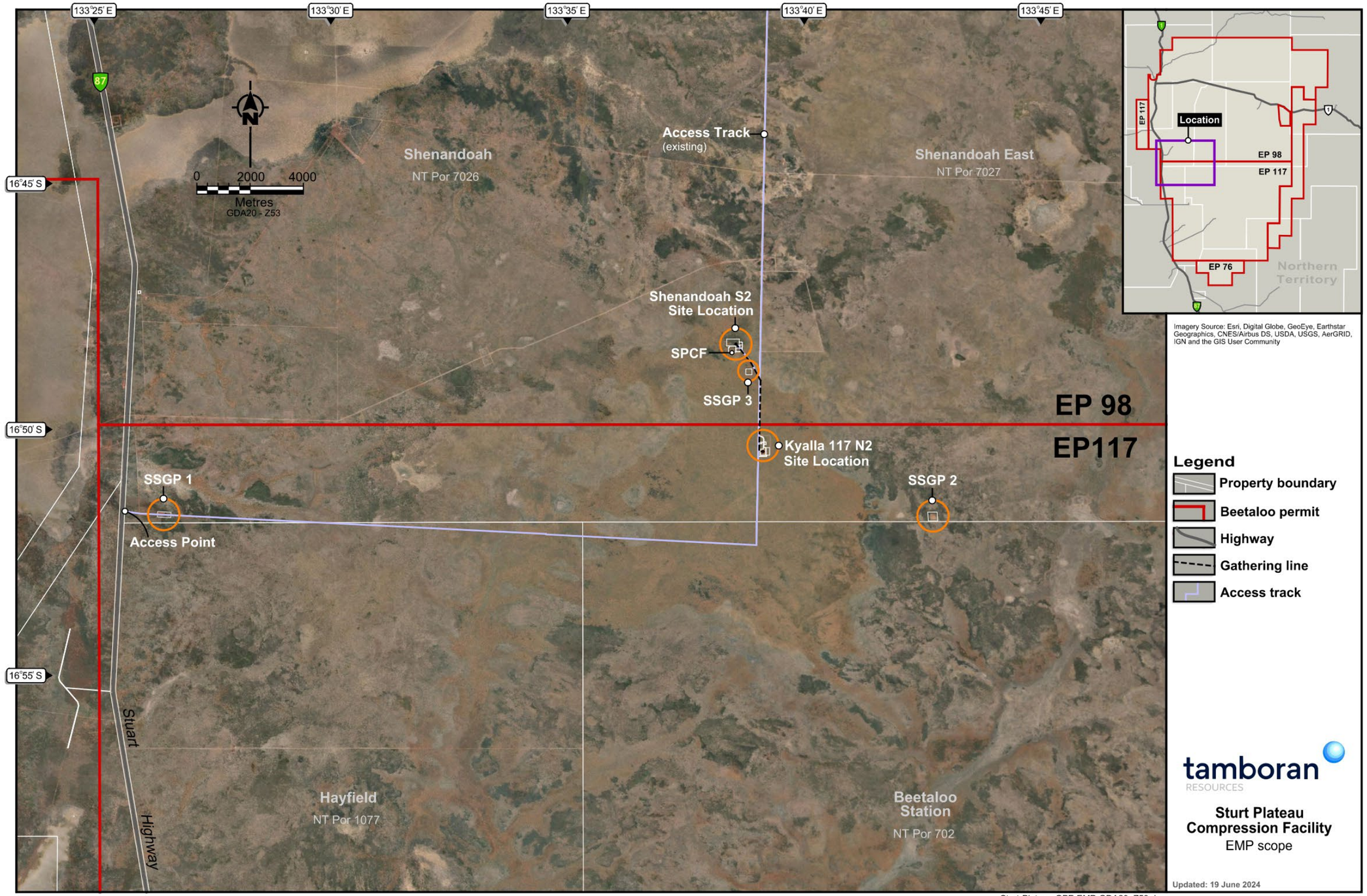

Figure 1: Location of the Project

Description of the activity

The regulated activities covered in this EMP include:

- **Extended appraisal of petroleum wells:** Extended (36 month) appraisal of the 15 E&A wells drilled under the TAM1-3 EMP.
- **Civil construction:** Including minor detailing earth works to contour and grade the SPCF hard stand area in preparation for foundations, the majority of which will be steel pilings to minimise the use of concrete.
- **Construction, commissioning, operation and maintenance of the temporary appraisal gas SPCF:** the SPCF will process the raw gas so that it meets the required gas specifications and is at a pressure such that it can be transmitted via the proposed Sturt Plateau Pipeline into the AGP. Compressors, generators and infrastructure will predominantly be skid mounted to enable easy removal upon completion of the project. The SPCF includes:
    - Concrete and steel pile foundations
    - Skid mounted compression packages
    - Gas and water pipe work and pipe racks
    - Flare and flare exclusion zone
    - Slug catcher, inlet cooler and inlet scrubber to remove entrained water within the gas stream
    - Triethylene glycol (TEG) dehydration package
    - Gas metering station
    - Office and ablutions
    - Power generation, including usage of produced appraisal gas
    - Small workshops and laydown
    - Electrical switch boards and control room
    - Water systems – service water, potable water and safety showers
    - Flowback separation and wastewater management:
    - Facility oily water treatment and waste oil storage system
    - Stormwater management
    - Chemical and oil storage areas
    - Gas, water and utility air pipework
    - Diesel back-up power generation
    - Chemical and fuel handling, storage and use
    - Mercury and H_2S removal units (if required)
    - De-energising and decommissioning of the SPCF
- **Gathering networks operation:** Operation of the wastewater and gas gathering networks between Kyalla 117 N2 and Shenandoah S2 constructed under the TAM1-3 EMP.

- **Gathering line tie-in to the SPCF:** construction and operation of gathering pipelines connecting the SPCF to the existing gathering network approved under the TAM1-3 EMP. This includes the construction of a pipeline connecting the SPCF to wastewater storage tanks on Shenandoah S2.
- **SPCF wastewater pipeline** connecting the compression facility inlet separator to the Shenandoah S2 wastewater storage area
- **Sale of appraisal gas:** Discharge of appraisal gas form the SPCF into the Sturt Plateau Pipeline for sale.
- **Camps**: Construction and operation of a 2.0 ha (~150 person) camp to support the SPCF construction and operations. Camps are also currently approved at the Shenandoah S2 and Kyalla 117 N2 sites.
- **Ancillary activities comprising:**
  - Wellhead facilities and flowlines to connect the wellheads to the gathering lines.
  - Construction and maintenance of fence lines and firebreaks (1.0 ha)
  - Material transport and storage
  - Use of existing access tracks
  - Gravel extraction
  - Helicopter operations
  - Flaring during plant upsets and maintenance
  - Groundwater extraction and use
  - Environmental monitoring for weeds, flora, fauna, soil, air quality and other environmental aspects
  - Inspection and maintenance of facilities and infrastructure
  - Operation of construction office, workshop and laydown areas
  - Decommissioning of the SPCF and rehabilitation of the disturbance area (8.0 ha)

The proposed regulated activities do not include drilling of new wells, hydraulic fracturing or any activities associated with the future Sturt Plateau Pipeline.

A summary of the regulated activities is provided in Table 1.

Table 1: Project description

Activity	Parameter	Description
Civil construction activities to support the temporary SPCF	Civil construction activities	• Civil construction activities to support the temporary SPCF located on the repurposed 5.0 ha laydown hardstand area on the Shenandoah S2 site. • Civil construction includes including construction of temporary footings (pilings) / foundations to support the structures that make up the temporary SPCF, of stormwater drains, sediment basins and erosion and sediment controls on the site.

Activity	Parameter	Description
		• Construction of a 2.0 ha camp (see below). • Construction of 1.0 ha fencing and firebreaks around SPCF (see below).
	Access tracks	• Use of existing access tracks approved under the TAM1-3 EMP with no additional surface disturbance.
	Gravel pits	• Gravel will be sourced from Tamboran's existing approved gravel pits on EP 117 and EP 98 (SSGP1, SSGP2 and SSGP3), as approved under the TAM1-3 EMP.

Structural, mechanical and electrical construction, commissioning, operations and maintenance of the temporary SPCF	SPCF facility	• Construction, commissioning, operation and maintenance of the temporary SPCF on the existing 5 ha Shenandoah S2 laydown area. The SPCF includes:
		  • Concrete and steel pile foundations
		  • Skid mounted compression packages
		  • Gas and water pipe work and pipe racks
		  • Flare and flare exclusion zone
		  • Slug catcher, inlet cooler and inlet scrubber to remove entrained water within the gas stream
		  • Triethylene glycol (TEG) dehydration package
		  • Gas metering station
		  • Office and ablutions facilities
		  • Power generation, including usage of produced appraisal gas
		  • Small workshops and laydown
		  • Electrical switch boards and control room
		  • Water systems – service water, potable water and safety showers
		  • Flowback separation and wastewater management
		  • Facility oily water treatment and waste oil storage system
		  • Stormwater management
		  • Chemical and oil storage areas
		  • Gas, water and utility air pipework
		  • Diesel back-up power generation
		  • Chemical and fuel handling, storage and use
		  • Mercury and H_2S removal units (if required)

Appraisal gas sale	50 TJ/day	• Sale of up to 50 TJ/day of appraisal gas into the proposed Sturt Plateau Pipeline that will connect the SPCF to the AGP.
Camp operations	~150-person camp (2.0 ha)	• Construction and operation of a 2.0 ha camp on the Shenandoah S2 location to support the SPCF. • Camp will accommodate up to 150 people during construction, reducing to <30 people during SPCF

Activity	Parameter	Description
		operations. Additional camp capacity may be brought online for plant maintenance or to accommodate other works in the area associated with scope under the approved EMP TAM 1-3. • Additional / overflow accommodation will be available on Shenandoah S2 and Kyalla 117 N2.
Water extraction	~60 ML (~12 ML per annum)	• Use of existing water extraction bores located on the adjacent Shenandoah S2 well pad. • Groundwater extraction under existing groundwater extraction licence (WEL GRF1028). • ~32 ML of water for civil construction activities such as dust suppression surface conditioning and camps. • Operational water usage is estimated to be approximately 28 ML, predominantly used for evaporative cooling.
E&A well tie into the SPCF	Pipeline tie-in and gathering lines	• Construction of underground pipeline connecting the Shenandoah S2 well test package to the SPCF. • Connection of the Kyalla 117 N2 - Shenandoah S2 gathering lines to the SPCF.
SPCF tie into the Shenandoah S2 wastewater storage tanks	200 m underground pipeline	• Connection of the SPCF to the Shenandoah S2 wastewater tanks to manage wastewater collected in the slug catcher / inlet separators.
Operation of gathering lines	4.5 km gathering line	• The SPCF will tie into the proposed Kyalla 117 N2-Shenandoah S2 gathering lines described in the TAM1-3 EMP.
Traffic	23 traffic movement per day	Up to 23 traffic movements per day, per month during construction and 3 movements per day during operations.
Low impact monitoring activities		Monitoring activities (including groundwater, stormwater, soils, leak detection, and all other low impact ancillary programs).
Site decommissioning	SPCF	• De-energising and blowdown of all equipment and pipework. • Decommissioning and removal of all surface infrastructure and wastes from site including the removal of all ancillary infrastructure.
Total Project disturbance and rehabilitation (approx.)	8.0 ha total Project footprint including: • 5.0 ha (existing disturbance) for the SPCF • 2.0 ha (new disturbance) for the SPCF camp	A revised Rehabilitation Management Plan is provided as Appendix L. Rehabilitation of the site will be integrated into the overall Shenandoah S2 site rehabilitation.

Activity	Parameter	Description
	• 1.0 ha (new disturbance) fencing and firebreak	

Description of the existing environment

The SPCF and associated activities are located on EP 98 and EP 117 within the Shenandoah and Shenandoah East pastoral stations. Access to the site is via existing approved access tracks, which connects the existing approved Shenandoah S2 and Kyalla 117 N2 sites with the Stuart Highway. The SPCF will be located on the existing approved Shenandoah S2 laydown area, which forms part of the TAM1-3 EMP, which was approved on 23 May 2024.

A land condition assessment (LCA) and cultural heritage assessment of the existing environment of the Shenandoah S2 site was completed in March – April 2023. An abridged version of the LCA and cultural heritage covering the Shenandoah S2 site is provided as Appendix H and Appendix I, respectively. A description of the existing environment for the Shenandoah S2 site is provided in section 4. Figure 2 provides an overview of vegetation communities that occur within the disturbance areas of Shenandoah S2. A summary of the existing environment in which the Project will be located is provided in Table 2.

The Project falls within the Sturt Plateau Bioregion. The bioregion is characterised by undulating plains on sandstone with predominantly neutral sandy red and yellow earth soils. Dominant vegetation is eucalypt woodland, which include extensive areas of Lancewood (*Acacia shirleyi*), Bullwaddy (*Macropteranthes kekwickii*) vegetation and associated fauna, including the Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*). Land condition in the bioregion is moderate to good but is threatened by impacts from weeds, feral animals, pastoralism and changed fire regimes.

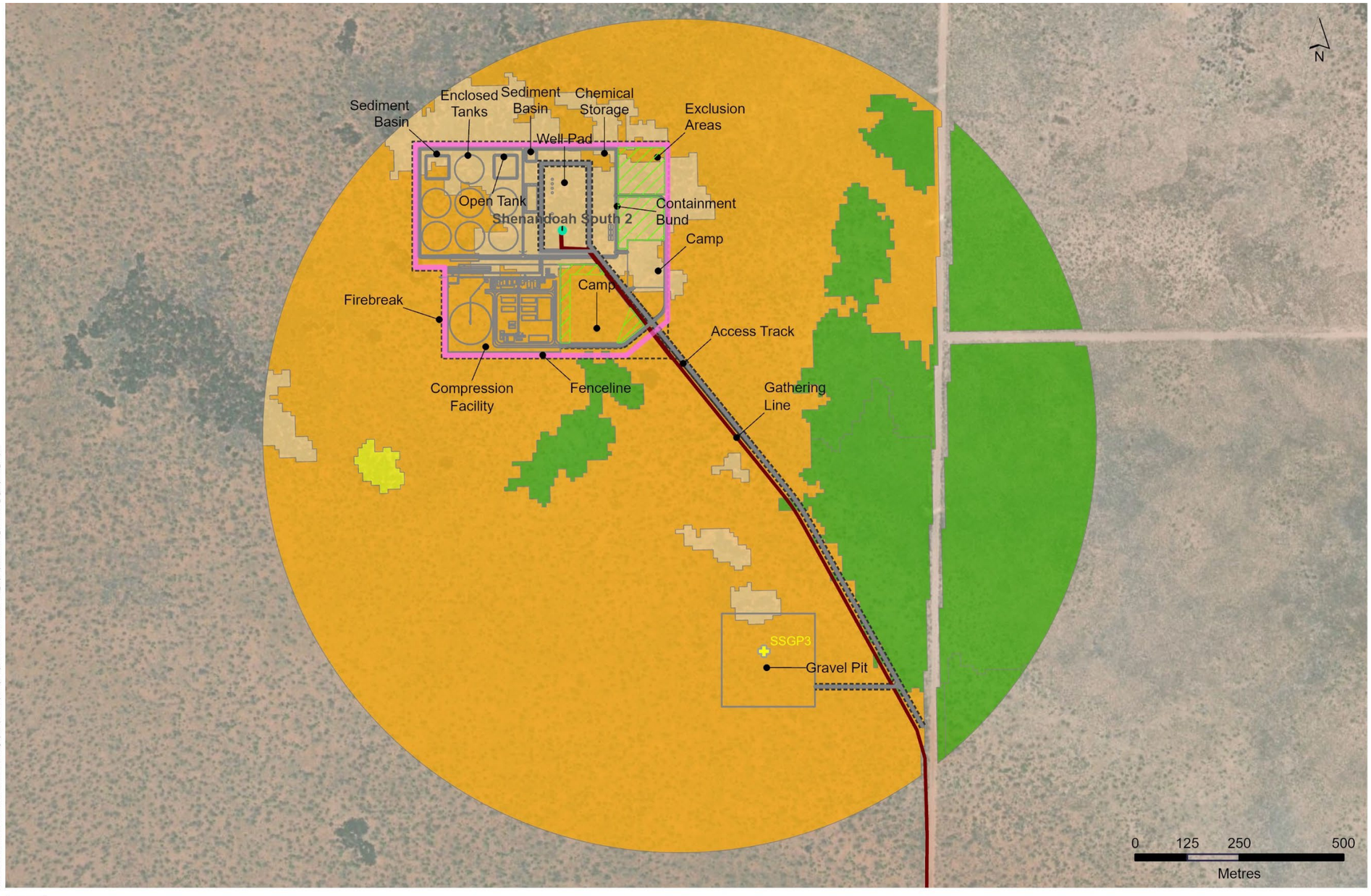

Figure 2: Vegetation communities at Shenandoah S2

Table 2: Summary of existing environment and surrounds Shenandoah S2

Shenandoah S2		**Survey photos of the vegetation/habitat of the surrounding environment**	
Location	GDA94, Zone 53, 355291E, 8140676N		
Landform and soil	5YR 3/4 dark reddish brown (upper) to 5YR 3/3 dark reddish brown clay loam, sandy. Well drained on flat surface, no slope (0%).		
Vegetation community	**2a:** *Corymbia dichromophloia* ± *Erythrophleum chlorostachys* open woodland over *Acacia difficilis* ± *Terminalia canescens, Erythrophleum chlorostachys* open shrubland over hummock grassland.		
Vegetation description	*Corymbia dichromophloia* ± *Erythrophleum chlorostachys* mid high open woodland, over *Acacia difficilis* ± *Terminalia canescens, Erythrophleum chlorostachys* mid high open shrubland, over *Triodia bitextura*, *Aristida hygrometrica*, *Chrysopogon fallax* mid high hummock grassland		
Dominant flora species	*Corymbia dichromophloia*, *Erythrophleum chlorostachys* *Erythrophleum chlorostachys*, *Acacia difficilis*, *Terminalia canescens* *Triodia bitextura*		
Habitat condition	Moderate - Common tree hollows and falling logs. Mistletoe and flowering plants absent. Shallow leaf litter. Termite mounds: Nil. Fire damage > 2 years ago. No erosion. Minor cattle impacts. Ground cover: 55% vegetation, 2% leaf litter, 43% bare.		

Shenandoah S2	**Survey photos of the vegetation/habitat of the surrounding environment**
Weeds	No Weeds of National Significance present.
Potential listed threatened species (Young *et. al,* 2022)	Crested Shrike-tit (*Falcunculus frontatus whitei*), Gouldian Finch (*Erythrura gouldiae*), Plains Death Adder (*Acanthophis hawkei*), Yellow Spotted Monitor (*Varanus panoptes*), Grey Falcon (*Falco hypoleucos*), Common Brushtail Possum (*Trichosurus vulpecula arnhemensis*), Mertens' Water Monitor (*Varanus mertensi*)
Hydrogeology	Groundwater resources and use is primarily from the Cambrian Limestone Aquifers (the Anthony Lagoon Formation and Gum Ridge Formation) with the shallower undifferentiated Cretaceous or perched alluvium systems being unsaturated.

Key environmental risks

The environmental, heritage and social risks associated with the Project activities have been assessed using the Tamboran risk assessment framework. The risk assessment presents the range of potential impacts, corresponding mitigation measures and risk ratings based on their assessed worst-case consequence and likelihood of occurrence. Key risks assessed under this EMP include:

- management of wastewater streams and chemicals to prevent impacts to surface water, aquifers, soils, flora and fauna
- SPCF integrity i.e. loss of primary containment associated with a process safety event or sabotage
- managing the risk of increase traffic and potential incidents
- managing the risk of bushfire in the immediate Project area
- mitigating the introduction and spread of weeds
- mitigating impacts to a sacred site or culturally sensitive area
- exceedance of Scope 1 GHG emissions above 100,000 t/CO_2-e per financial year (i.e. the Safeguard trigger).

It was considered that with the appropriate controls implemented to mitigate the impacts there were no residual risks above a rating of medium (Table 3).

Table 3: Summary of risk ratings with environmental controls applied

	Environmental risk rating with applied controls			
	Low	**Medium**	**High**	**Very high**
Total 33	27	6	0	0

The medium residual risks identified during the risk assessment that form part of this EMP include:

1. Accidental ignition of fire during civil construction, impacting listed threatened habitats, flora and fauna – risk ID 10.
2. Accidental ignition by site activities, impacting a sacred site or culturally sensitive area – risk ID 15.
3. Introduction and spread of weeds, or bushfire from accidental ignition resulting in a reduction in land productivity – risk ID 18.
4. Vehicle (light or heavy) accident resulting from increased traffic movements – risk ID 22.
5. A loss of primary containment (process safety event or sabotage) impacting workers and the broader environment from a range or risk sources, such as: the rupture of high-pressure piping, a gas leak with or without ignition, operating a high-pressure gas processing plant and equipment, or sabotage resulting in an uncontrolled release of gas – risk ID 23.
6. Increased nuisance from dust and particulate emissions to regional ecosystems and fauna from traffic movements and/or bushfire from accidental ignition sources– risk ID 27.

The assessment demonstrates that 82% of the risks associated with the Project have been assessed to a low-risk rating. Five of the six medium risks identified were consistent with risks from standard construction or pastoral activities carried out across the NT (being increased traffic impacts, ignition of bushfire, and the potential spread of weeds from the proposed activities). One medium risk is consistent with the standard

operation of a gas facility. It is noted that the construction and operation of gas facilities is a stringently regulated industry, from the initial design of the facility in accordance with accepted industry codes and standards, through to independent validation of the facility and pipeline designs, and quality assurance of installed equipment.

All residual risk ratings are considered to be as low as reasonably practicable (ALARP) and acceptable through multiple safeguards, isolation barriers and emergency shutdown systems to protect the public and environment.

At completion of the Project, the site will be returned to a safe, stable and non-polluting form consistent with pre-disturbed conditions.

Stakeholder engagement

Stakeholder engagement for the Project has focused on the host traditional owners (facilitated by the NLC) and host pastoralists directly affected by the proposed activity. Contact details are as follows:

NLC [redacted]	Various	[redacted]	[redacted]
Hayfield / Shenandoah Pastoral Station [redacted]	Val Dyer	[redacted]	[redacted]

Detailed community and stakeholder engagement is ongoing and covers Tamboran's activities on a broader level and includes the information required under the Regulations. This includes providing the stakeholders of the activity description, location, impacts, potential risk, proposed environmental controls and potential impacts to the stakeholders' rights.

Further information on stakeholder engagement is provided in section 5.

Key objectives of this EMP

The scope covered in this EMP is considered an important step in confirming the technical and commercial feasibility of the underlying shale gas resources. This EMP is predicated on the beneficial use of appraisal gas in accordance with Section 57AAA of the *Petroleum Act 1984*.

Key objectives of the Project will be to collect the following information:

- Estimates of gas volumes and gas production curves to calculate the estimated ultimate recovery from the wells to maintain production from the target shales. This will be used to determine the likely amount of gas able to be produced from each well and underpins resource estimates.
- Resource continuity and variability data to assist in understanding the size of the resources and complexity of the host shale formation. This information will be used to underpin planning and design of future resource development scenarios.
- Demonstrate design suitability and operability of the temporary SPCF across seasons in the Beetaloo Sub-basin.
- Assess the financial competitiveness of the development to inform the final investment decision for future development scenarios.

- Demonstrate no impact on groundwater quality from the operation.
- Collect additional data on wastewater quality and quantity during operation of the SPCF to assess options for minimising off-site wastewater disposal through future treatment and re-use.
- Provide key data as input into future production approvals, including footprint optimisation, wastewater characterisation, reductions in GHG emission intensity, and solid and liquid waste management and recycling options.

1 Introduction

1.1 Purpose

Tamboran B2 Pty Ltd (Tamboran) is the registered holder and operator of exploration permits (EP) 98 and 117 located in the Beetaloo Sub-basin. This Environment Management Plan (EMP) represents Tamboran's application to the Northern Territory (NT) Minister for Environment for the construction and collection, use and sale of appraisal gas through the construction and operation of the temporary Sturt Plateau compression facility (SPCF) – hereafter referred to as 'the Project'.

The *Sturt Plateau Compression Facility – Appraisal Gas EMP* is designed to collect, use and sell appraisal gas recovered during E&A well exploration activities, to support and determine the future technical and commercial viability of the underlying shales within EP 98 and EP 117. The environmental benefit of the SPCF is a significant reduction in scope 1 greenhouse gas emissions generated from exploration and appraisal (E&A) activities, as well as the beneficial use of gas resources which would otherwise not be utilised.

This EMP is restricted to exploration and appraisal activities and does not cover production as defined in the NT *Petroleum Act 1984*. In summary, the regulated activity proposed in this EMP pertains to the recovery and beneficial use of appraisal gas obtained during extended well testing, in accordance with Section 57AAA of the *Petroleum Act 1984*.

The Project involves the civil, mechanical and electrical construction, commissioning, operation, maintenance and rehabilitation of the temporary appraisal gas SPCF. The SPCF is located at the Shenandoah South 2 (Shenandoah S2) site, which was approved by the Minister on 23 May 2024, as part of the TAM1-3 EMP. The EMP for this Project (TAM2-3) covers the facilities and activities from the downstream flange of the production wing valve on the wellheads to the flange that connects the SPCF to the export pipeline.

Processed gas from the SPCF will be metered and fed into a new proposed pipeline – the 38 km Sturt Plateau Pipeline that will be connected into the Amadeus Gas Pipeline (AGP). The approval and operation of the Sturt Plateau Pipeline is outside of the scope of this EMP. The boundary of the EMP therefore ends at the release of gas to this pipeline.

The EMP has been prepared in compliance with the NT Petroleum (Environment) Regulations 2016 (the "Regulations"), *Code of Practice: Onshore Petroleum Activities in the Northern Territory* (the "Code") and the Exploration Agreements between Tamboran, native title holders and the Northern Land Council (NLC). The EMP is designed to ensure that the proposed activities are carried out in such a manner that the environmental impacts and risks will be reduced to as low as reasonably practicable (ALARP) and acceptable.

Specifically, this EMP aims to:

- Address regulatory requirements.
- Provide site-specific impact management strategies to assist Tamboran in maintaining a positive position in the local community throughout its program.
- Align with the principles of Ecological Sustainable Development (ESD) through the adoption of responsible development practices that are designed to maximise social benefit, while minimising the level of impact on the surrounding ecosystems.
- Provide a description of site-specific aspects of the existing environment (physical, biological, social and cultural).

- Provide site-specific plans for monitoring and rehabilitation.
- Be a practical and usable document, with environmental management principles that are easily implemented and effective.

1.2 Proponent

Attribute	Details
Name:	Matt Kernke
Position:	Vice President Environment and Permit Approvals
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Non-operating proponent	
Name:	Philip O'Quigley
Position:	Director
Company:	Falcon Oil & Gas Australia Limited
Address:	C/- 17 Phoenix Street, Nightcliff, Northern Territory 0814 Australia
Contact details:	poquigley@falconoilandgas.com

2 Environmental legislation and other requirements

Key NT and Commonwealth legislation, agreements, operating consents, guidelines and Codes of Practice relevant to the activities described in this EMP are summarised in Table 4. This EMP has been prepared in relation to these requirements.

Table 4: Key legislation

Legislation	Requirement	How Tamboran meets the requirement	Administered by
Northern Territory			
Petroleum Act 1984	Petroleum exploration licences are required in the areas where activities are proposed.	Exploration permits obtained. Minister provides the final sign off authorising Petroleum activities.	Department of Industry, Tourism and Trade (DITT)[1] DEPWS[2] Department of Treasury and Finance[3]
	Compensation to be paid to native title holders and owners/occupiers of land where petroleum activities are proposed.	Exploration Agreements obtained with native title holders. Compensation paid to pastoralists for all activities proposed under this EMP.	
	Prescribes the provisions of the Financial Assurance Framework, which requires mandatory environmental remediation and petroleum infrastructure decommissioning securities, as well as mandatory insurance requirements for all petroleum interests.	Environmental security is assessed by the DEPWS and paid to DITT. Petroleum infrastructure decommissioning securities is assessed by DITT and paid to DITT.	DEPWS and DITT
	Outlines the framework for the fees and levies prescribed in the Petroleum Regulations 2020 (below), including publication.	Fees are paid to DITT but in some cases assessment of the fees is undertaken by DEPWS	DEPWS and DITT
	Prescribes the provisions to recover and use the petroleum during and interest holder's operations, or to sell or gift the petroleum to third parties (Section 57AAA).	This EMP has been developed to support Tamboran's application for the recovery of petroleum on an appraisal basis. Tamboran will apply for approval to recover petroleum on an appraisal basis under s 57AAA, including obtaining native title approval, consent or agreement under the Land Rights Act or the Native Title Act (s 57AAA(5)(d)). Where consent is	DITT

[1] Except provisions about royalties, provisions relating to environmental regulation of exploration and production of petroleum and Part V, Division 2.

[2] Part V, Division 2 and provisions relating to environmental regulation of exploration and production of petroleum.

[3] Provisions about royalties.

Legislation	Requirement	How Tamboran meets the requirement	Administered by
		not obtained, the sale of appraisal gas will not occur.	
NT Petroleum (Environment) Regulations 2016	Ensuring all regulated activities have an approved EMP.	This EMP has been developed to satisfy this requirement.	DEPWS
	That the EMP is developed in accordance with the NT Petroleum (Environment) Regulations 2016 (the Regulations).	Tamboran has developed this EMP in accordance with the Regulations.	
	That stakeholder engagement for the regulated activities is undertaken.	Tamboran has completed stakeholder engagement in accordance with the Regulations, as summarised in section 5 of this EMP.	
	That activities are conducted in accordance with the Code.	The EMP outlines how the activities will be conducted in accordance with the Code.	
	Reporting requirements for incidents and hydraulic fracturing.	The EMP summarises how incidents and flowback monitoring results will be reported.	
Petroleum (Transitional) Regulations 2023	Provides clarity around how and when new arrangements will apply to existing titles, applications, approvals and requirements, including a current insurance policy, new fees, levies and securities.	Fees are paid to DITT. Copy of insurance policy is submitted to DITT.	DITT
Petroleum Regulations 2020	Provides for land access agreements between interest holders and owners or occupiers of the land.	Land access agreements in place for the regulated activities described in this EMP.	DITT
	Prescribes the fees relating to the general administration of petroleum titles, including those for the grant, renewal and variation of exploration permits, retention licences and production licences (Schedule 1).	Fees are paid to DITT for the administration of all titles, permits and licences.	DITT
	Prescribes the fees for resource management, activity and infrastructure plans (Schedule 1A).	Fees are paid to DITT.	
	Describes fees and calculation processes for EMPs based on complexity of the regulated activity described in an EMP (Schedule 1B).	Fees are paid to DEPWS for all regulated activities proposed under this EMP.	DEPWS

Legislation	Requirement	How Tamboran meets the requirement	Administered by
	Prescribes the monitoring and compliance levy intended to recover the costs of a range of DITT and DEPWS monitoring and compliance activities (Schedule 4A).	A calculation tool is submitted to DEPWS, then approved and invoiced by the Energy Development Branch, DITT on the advice of DEPWS.	DEPWS and DITT
	That the WOMP must be developed in accordance with Regulation 66AA Schedule 4B.	Requirements addressed in the Well Operations Management Plan (WOMP).	DITT
	That the field management plan must be developed in accordance with Regulation 66AAB and Schedule 4C.	Requirements addressed in the field management plan.	
	Prescribes the information that must be included in a petroleum surface infrastructure plan in accordance with Regulation 66AAD and Schedule 4D.	Requirements addressed in the surface infrastructure plan.	
	Reporting requirements prescribed under Regulation 66AAN (Schedule 4E) to Regulation 66AAX(2) (Schedule 4R).	Requirements addressed through various reports provided to the regulator that a relevant to the regulated activities described in this EMP.	
Induced Seismicity Management Guideline 2022	Pursuant to section 71 of the *Petroleum Act 1984* a permittee must submit an induced seismicity management plan with the WOMP for approval by the Minister of Mining and Industry.	Requirements addressed in the WOMP.	DITT
Bushfires Management Act 2016 and Regulations	Compliance with total fire bans and fire permitting.	Tamboran will commit to complying with total fire ban requirements and will obtain all relevant permits where flaring occurs during declared fire danger periods.	Bushfires NT
	Requirements for occupiers to prevent and control fires.	Addressed through Tamboran's Bushfire Management Plan **(**Appendix A) which includes bushfire preventative and response measures.	
	Aerial burning permits.	Tamboran will acquire permits where aerial burning to manage fuel loads is proposed as a part of its ongoing bushfire management activities. Tamboran does not consider that aerial burning will be required.	

Legislation	Requirement	How Tamboran meets the requirement	Administered by
Control of Roads Act 1953 and Northern Territory Traffic Act 1987	Any proposed development which may affect the NT road network, including traffic, operation, management, capacity or safety, or result in the construction or installation of new infrastructure within the NTG road network, requires assessment and Road Agency Approval.	Tamboran will continue to engage with the Department of Infrastructure, Planning and Logistics (DIPL) regarding proposed and ongoing traffic management.	DIPL
Emergency Management Act 2013	Establishes the requirements for local, regional and Territory emergency management plans. Describes the functions and powers of the NTES, Territory Emergency Controller, Territory Recovery Controller and Territory Emergency Management Committee.	Tamboran complies with the Act through the development of an emergency response plan and the identification of NTFES as a stakeholder.	Northern Territory Emergency Service
Environment Protection Act 2019	Activities which have the potential to cause a significant impact to the environment are required to be referred to the NT EPA for assessment under the *Environment Protection Act 2019*.	Tamboran has completed a self-assessment. The level of potential environmental impact is not considered significant.	Northern Territory Environment Protection Authority (NT EPA) DEPWS
Heritage Act 2011	Requirements to avoid impacts to heritage places and objects.	Tamboran completed desktop studies and field scouts to confirm the presence / absence of heritage places and objects within the vicinity of the proposed activities.	Heritage Branch, Department of Tourism and Culture
Medicines, Poisons and Therapeutic Goods Act 2012	Establishes the requirements for minimising harm from scheduled substances and therapeutic goods. Regulates the possession, supply or administration of drugs and poisons.	Tamboran engages medical contractors who manage regulatory compliance and administration of drugs and poisons.	Department of Health
Northern Territory Aboriginal Sacred Sites Act 1989	The legislation establishes a procedure for the protection and registration of sacred sites and the issuing of sacred site clearance certificates. Access and work within sacred sites require authorisation.	All areas of Tamboran's proposed activities have had sacred site clearances completed by traditional owners. Tamboran is currently seeking to include the SPCF into the existing AAPA certificate C2024-31. An AAPA certificate to cover the SPCF is imminent.	AAPA

Legislation	Requirement	How Tamboran meets the requirement	Administered by
Public and Environmental Health Act 2011	Requirements for camp kitchens and wastewater (sewage and greywater) management and permitting in the NT.	Tamboran's camps are registered, and a wastewater works design approval for the main camp and mini-camp sewage treatment plan irrigation area has been obtained.	Department of Health
Radiation Protection Act 2004	Requirements for the management of radiation for the health and safety of community and protection of the environment.	Tamboran complies with the Act through proper handling of and disposal of drill cuttings.	Department of Health
Territory Parks and Wildlife Conservation Act 1976	Prohibits impacts to protected places, impacts to threatened flora and fauna and interference with protected wildlife.	Tamboran complies with the Act through the avoidance of impacts to protected places (essential habitat, sanctuaries, parks etc.) and flora and fauna. This is completed through ecological surveys and the controls implemented to limit the impact on wildlife.	Parks and Wildlife DEPWS
Transport of Dangerous Goods by Road and Rail (National Uniform Legislation) Regulations 2011	Regulations stipulating the transportation requirements for dangerous goods by road and rail. This includes implementing all required signage, spill management, reporting and licencing requirements for chemical transportation during drilling and stimulation activities.	Any chemical transported and stored for exploration activities is undertaken in a manner that will comply with these requirements.	NT WorkSafe, Department of the Attorney-General and Justice
Waste Management and Pollution Control Act 1998 (WMPCA)	Requirements covering general environmental duty, waste management, including waste management hierarchy, waste transportation and waste disposal requirements.	The storage, transportation and disposal of wastes will comply with the requirements of this Act. The transportation and disposal of listed wastes will only be completed by a licenced contractor and at a licenced disposal facility. Any interstate disposal will be completed with an approved consignment authority.	NT EPA
	S12 General environmental duty: Applies to activities outside of the lease area, or if a spill or leak occurs that leaves the lease area, or 1 km from the centreline of a pipeline.	Tamboran will conduct all activities outside the approved disturbance area (camp area, well pad, access tracks authorised in the EMP) in a manner that prevents environmental harm.	

Legislation	Requirement	How Tamboran meets the requirement	Administered by
	S14 Duty to notify of incidents causing or threatening to cause pollution: Applies if an incident occurs outside of the lease area, or if a spill or leak occurs that leaves the lease area, or 1 km from the centreline of a pipeline, that causes or threatens to cause material or serious environmental harm.	Tamboran will report all incidents that causes or threatens to cause pollution beyond the boundary of the authorised activity (beyond the lease or camp pad), in accordance with Section 14 of the WMPCA.	
Water Act 1992 and Water Regulations 1992	The Act requires that all groundwater take in the Beetaloo Sub-basin must have obtained a Water Extraction Licence (WEL).	Tamboran has obtained a WEL GRF10285 (450 ML/year) covering water usage for exploration activities. WELs are renewed every 10 years to support operational activities. An application to increase a WEL is covered under the Water Act and is a separate approval process to an EMP.	DEPWS
	The take of surface water for petroleum activities is prohibited.	No surface water take is proposed under this activity.	
	Prohibits wastewater releases to surface water bodies or reinjection.	No wastewater release to surface water proposed.	
	The Act requires an interest holder to obtain a permit if activities undertaken under the Act all result in interference with a waterway.	The proposed activities occur on existing EPs. No new activities will result in interference with a waterway.	
	The Act requires an interest holder to obtain a bore work permit for any new groundwater bores.	Tamboran will obtain a bore work permit for any new groundwater bores as required.	
Weeds Management Act 2001	Requires the occupier of the land (in this case Tamboran) to: • prevent the land being infested with a declared weed • prevent a declared weed or potential weed on the land spreading to other land notify the weeds officer of the presence of the declared	Tamboran will comply with the requirement of this Act through the implementation of weed prevention, detection and eradication controls through its approved Weed Management Plan (Appendix B).	DEPWS

Legislation	Requirement	How Tamboran meets the requirement	Administered by
	weed comply with any declared weed management plans.		
Work Health and Safety (National Uniform Legislation) Act 2011	Provides for a nationally consistent framework to secure the health and safety of workers and workplaces. Includes requirements for hazardous chemical assessments, hazardous chemical register, access to safety data sheets, labelling, and the use, handling, generation and storage of hazardous chemicals at a workplace.	Tamboran has a Safety Management Plan that outlines how the requirements of the Act are achieved. This includes the management of chemical storage dossiers, safety data sheets (SDS) and appropriate procedures and controls to prevent worker exposure to hazards.	NT WorkSafe, Department of the Attorney-General and Justice
Commonwealth			
Environment Protection and Biodiversity Conservation Act 1999	Requires approvals for any activity likely to have an impact on a Matter of National Environmental Significance (MNES).	A self-assessment was completed as a part of this EMP to determine whether a MNES is likely to be impacted by the proposed activities within this EMP. Impacts to MNES are not anticipated to occur.	Department of Climate Change, Energy, the Environment and Water (DCCEEW)

Legislation	Requirement	How Tamboran meets the requirement	Administered by
National Greenhouse and Energy Reporting Act 2007	An Act that requires operators who generate emissions over a threshold to report information related to greenhouse gas emissions, greenhouse gas projects, energy consumption and energy productions of corporations. The Act also introduces a Safeguard Mechanism aimed to reducing emission from large industrial facilities. It sets legislated limits—known as baselines—on the greenhouse gas emissions of these facilities. The Safeguard Mechanism applies to industrial facilities emitting more than 100,000 tonnes of carbon dioxide equivalent (CO_2-e) per year The Safeguard Mechanism requires that all emissions from the Beetaloo basin be offset with ACCU's once the 100,000 tonnes CO_2- trigger is exceeded.	All energy consumption and greenhouse gas data used/generated form this activity will be reported in accordance with this Act. Upon exceeding the 100,000 tonnes CO_2- trigger in a given financial year, all emissions in that financial year and subsequent financial years will be required to be offset.	DCCEEW
National Environment Protection Council Act 1994 (National Environment Protection (Assessment of Site Contamination) Measure 1999) (NEPM)	This Act provides a nationally consistent approach to the assessment of site contamination to ensure sound environmental management practices to protect human health and the environment.	Tamboran uses the NEPM to assess risk of contamination and for the assessment of the drilling fluids for disposal.	DCCEEW
Native Title Act 1993	Legislation that provides for ways in which future dealings affecting native title may proceed and the recognition and protection of native title. The Right to Negotiate requirements are the most relevant provisions applying to Tamboran's exploration activities.	The Right to Negotiate process was applied to the grant of Tamboran's permits, resulting in Section 31 Agreements and Exploration (Ancillary) Agreements covering Tamboran's permits. The traditional owners were and continue to be represented by the NLC. Tamboran continues to implement the Exploration Agreements, in collaboration with the NLC, with all work programs being reviewed and approved by traditional owners. This includes engagement with	Prime Minister and Cabinet (Divisions 6 and 7 of Part 2, and Part 11) Attorney-General's Department (except to the extent administered by the Minister responsible for Indigenous Affairs)

Legislation	Requirement	How Tamboran meets the requirement	Administered by
		the NLC as the nominated representative of the Native Title Holders. Tamboran has engaged with traditional owners on the activities proposed in this EMP in accordance with the requirements of the Exploration Agreement. This includes on country meetings where the proposed activities covered under this plan have been discussed.	

2.1 Ecologically Sustainable Development (ESD)

The EMP is consistent with the principles of ESD, through the adoption of responsible practices that are designed to maximise social benefit, while minimising the level of impact on the surrounding ecosystems.[4]

Tamboran's exploration activities align with the principles of ESD:

- Exploration and appraisal activities are an essential step in defining a potential future commercial resource which can generate sustainable, long-term benefits to the local community, to the Barkly region generally and more broadly into the rest of the NT (Principles 1, 2, 3 and 5).
- Complying with the Code and industry best practice to reduce the risk to the environment and communities to an acceptable level. Noting the Inquiry Panel's Final Report Statement that "… provided that all of the recommendations made in this Report are adopted and implemented in their entirety, not only should the risks associated with an onshore shale gas industry be minimised to an acceptable level, in some instances, they can be avoided altogether." (Scientific Inquiry into Hydraulic Fracturing in the Northern Territory 2018) (all ESD Principles).
- The activities that are the subject of the EMP do not constitute threats of serious or irreversible environmental damage and there is no impact on the conservation of biological diversity and ecological integrity (Principles 2, 4, 6 and 7). This has been confirmed through various inquiries/ research program including the independent Scientific Inquiry into Hydraulic Fracturing of Onshore Unconventional Reservoirs in the Northern Territory and Commonwealth Geological and Bioregional Assessment Program.
- Beyond royalty payments to the NT Government (as owner of the natural resource), and payments to native title holders (as per Exploration Agreements) and host pastoralists (as per Access and Compensation Agreements), Tamboran seeks to maximise broad-based local participation in education, training, employment and enterprise opportunities engendered by its presence (Principles 1 and 5).
- Prioritising the use of local employment to deliver exploration activities (principles 1 and 5).
- Obtaining sacred site clearances from host traditional owners through open engagement with custodians, the statutory representative body – the NLC and AAPA (Principles 1, 4 and 5).
- Obtaining Land Access Agreements with host pastoralists (Principles 1 and 5).
- Prioritising the beneficial use of gas to minimise greenhouse gas emissions (Principles 1A and 7).
- Providing low carbon intensity fuels to domestic and international parties to support the energy transition to renewables and other low emission fuels (Principles 1 and 4).

3 Description of regulated activities

This EMP covers the regulated activities required to enable Tamboran to complete a series of E&A activities over 5 years, as summarised in Table 5. These activities include:

- Civil construction activities, including bulk earth works to level and grade the hard stand area in preparation for installation of foundations, the majority of which will be driven steel pilings to minimise the use of concrete.
- Construction of a camp (2.0 ha) and fencing / firebreak (1.0 ha) to support the SPCF.

[4] Referred to in the NT Petroleum (Environment) Regulations 2016 and the *Petroleum Act 1984* and set out in sections 18 to 24 of the *Environment Protection Act 2019*.

- Construction, operation, maintenance and decommissioning of the SPCF and ancillary infrastructure that captures and converts appraisal gas from E&A wells to clean gas, (delivered into the AGP via the Sturt Plateau Pipeline).
- Tie in of the SPCF to the existing approved gathering networks between Kyalla 117 N2 and Shenandoah S2 to receive / manage wastewater.
- Connection the compression facility inlet separator to the Shenandoah S2 wastewater storage area via a new wastewater pipe
- All ancillary tie-in activities to the Sturt Plateau Pipeline, necessary to support the regulated activities. Compressed gas collected at the site will be metered and feed into the Sturt Plateau Pipeline.

Approval for the 38 km Sturt Plateau Pipeline, linking to the AGP is not part of this EMP scope.

3.1 Activity summary

The activities proposed under this EMP are summarised in Table 5. Some figures, such as water use, are estimates and may be higher or lower depending on operational requirements.

Table 5: Site activity summary

Activity	Parameter	Description
Civil construction activities to support the temporary SPCF	Civil construction activities	• Civil construction activities to support the temporary SPCF located on the repurposed 5.0 ha laydown hardstand area on the Shenandoah S2 site. • Civil construction includes including construction of temporary footings (pilings) / foundations to support the structures that make up the temporary SPCF, of stormwater drains, sediment basins and erosion and sediment controls on the site. • Construction of a 2.0 ha camp (see below). • Construction of 1.0 ha fencing and firebreaks around SPCF (see below).
	Access tracks	• Use of existing access tracks approved under the TAM1-3 EMP with no additional surface disturbance.
	Gravel pits	• Gravel will be sourced from Tamboran's existing approved gravel pits on EP 117 and EP 98 (SSGP1, SSGP2 and SSGP3), as approved under the TAM1-3 EMP.

Structural, mechanical and electrical construction, commissioning, operations and maintenance of the temporary SPCF	SPCF facility	• Construction, commissioning, operation and maintenance of the temporary SPCF on the existing 5 ha Shenandoah S2 laydown area. The SPCF includes:
		  • Concrete and steel pile foundations
		  • Skid mounted compression packages
		  • Gas and water pipe work and pipe racks
		  • Flare and flare exclusion zone

Activity	Parameter	Description
		• Slug catcher, inlet cooler and inlet scrubber to remove entrained water within the gas stream • Triethylene glycol (TEG) dehydration package • Gas metering station • Office and ablutions facilities • Power generation, including usage of produced appraisal gas • Small workshops and laydown • Electrical switch boards and control room • Water systems – service water, potable water and safety showers • Flowback separation and wastewater management • Facility oily water treatment and waste oil storage system • Stormwater management • Chemical and oil storage areas • Gas, water and utility air pipework • Diesel back-up power generation • Chemical and fuel handling, storage and use • Mercury and H_2S removal units (if required)
Appraisal gas sale	50 TJ/day	• Sale of up to 50 TJ/day of appraisal gas into the proposed Sturt Plateau Pipeline that will connect the SPCF to the AGP.
Camp operations	~150-person camp (2.0 ha)	• Construction and operation of a 2.0 ha camp on the Shenandoah S2 location to support the SPCF. • Camp will accommodate up to 150 people during construction, reducing to <30 people during SPCF operations. Additional camp capacity may be brought online for plant maintenance or to accommodate other works in the area associated with scope under the approved EMP TAM 1-3. • Additional / overflow accommodation will be available on Shenandoah S2 and Kyalla 117 N2.
Water extraction	~60 ML (~12 ML per annum)	• Use of existing water extraction bores located on the adjacent Shenandoah S2 well pad. • Groundwater extraction under existing groundwater extraction licence (WEL GRF1028). • ~32 ML of water for civil construction activities such as dust suppression surface conditioning and camps. • Operational water usage is estimated to be approximately 28 ML, predominantly used for evaporative cooling.
E&A well tie into the SPCF	Pipeline tie-in and gathering lines	• Construction of underground pipeline connecting the Shenandoah S2 well test package to the SPCF.

Activity	Parameter	Description
		• Connection of the Kyalla 117 N2 - Shenandoah S2 gathering lines to the SPCF.
SPCF tie into the Shenandoah S2 wastewater storage tanks	200 m underground gathering line	• Connection of the SPCF to the Shenandoah S2 wastewater tanks to manage wastewater collected in the slug catcher / inlet separators.
Operation of gathering lines	4.5 km gathering line	• The SPCF will tie into the proposed Kyalla 117 N2-Shenandoah S2 gathering lines described in the TAM1-3 EMP.
Traffic	23 traffic movement per day	Up to 23 traffic movements per day, per month during construction and 3 movements per day during operations.
Low impact monitoring activities		Monitoring activities (including groundwater, stormwater, soils, leak detection, and all other low impact ancillary programs).
Site decommissioning	SPCF	• De-energising and blowdown of all equipment and pipework. • Decommissioning and removal of all surface infrastructure and wastes from site including the removal of all ancillary infrastructure.
Total Project disturbance and rehabilitation (approx.)	8.0 ha total Project footprint including: • 5.0 ha (existing disturbance) for the SPCF • 2.0 ha (new disturbance) for the SPCF camp • 1.0 ha (new disturbance) fencing and firebreak	A revised Rehabilitation Management Plan is provided as Appendix L. Rehabilitation of the site will be integrated into the overall Shenandoah S2 site rehabilitation.

3.1.1 Workforce

The indicative workforce numbers across construction, commissioning and operation are provided below:

Activity	Workforce
Construction	
Civils phase (contouring, concrete or piling)	5 – 22
Structural, mechanical and piping	2 – 50
Electrical and instrumentation (concurrently with structural mechanical and piping)	3 – 30
Commissioning (concurrently with operations)	2 – 35
Operation	~10

Approximately 95% of the workforce would be on a 3-week fly-in-fly-out (FIFO) roster with the balance being drive-in-drive-out (DIDO). The civil construction workforce will be primarily sourced from the

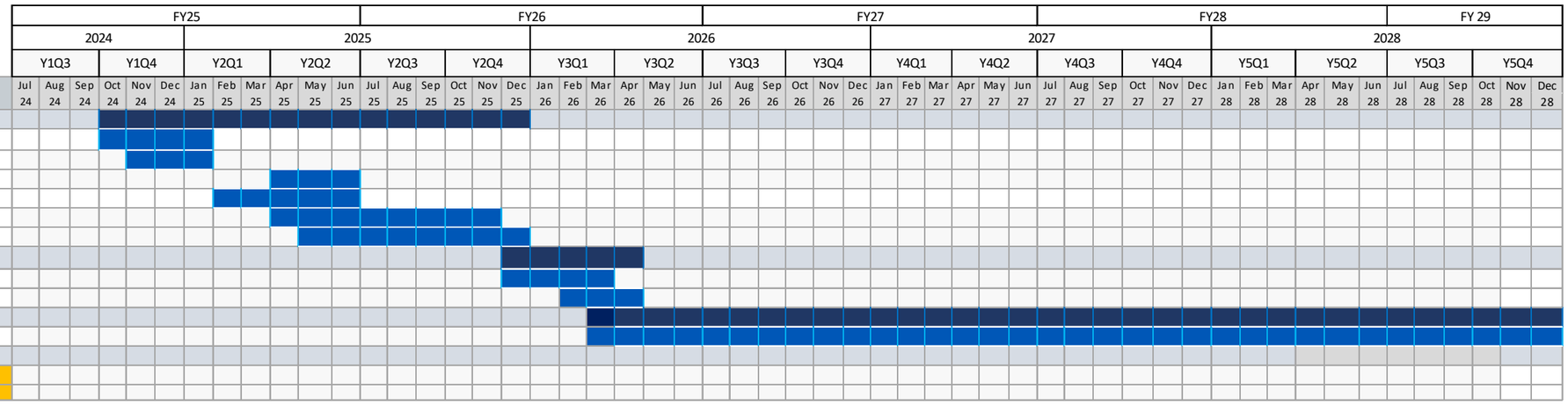
Northern Territory (anticipated to be 100%), compared with between 5 % - 10% local sourcing for the SPCF construction due to the requirement for specialty expertise. The operational workforce will be a 60:40 split between interstate specialty expertise and local hire, respectively.

3.2 Schedule

The anticipated key activity dates are provided in Figure 3. It should be noted that the timeframes and order of activities are indicative, with final dates and decisions to complete activities dependent on a range of additional considerations, including approval, access, commercial and joint venture constraints. An update on the Project will be provided to DEPWS monthly.

Subject to approval, earth moving and foundation construction work for the SPCF is expected to commence in the second half of 2024. Construction activity will continue through to late 2025, with material pauses in work over the 2024/2025 wet season. Commissioning and operationalising of the SPCF is planned to take place in the first half of 2026.

Tasks	Start date	End date
Construction - Sturt Plateau compression facility	**18/10/24**	**23/12/25**
Access tracks, grading and contouring	18/10/24	17/01/25
Piling and concrete (pre-wet season)	15/11/24	17/01/25
Piling and concrete (post wet season)	14/04/25	6/06/25
Offsite fabrication	3/02/25	20/06/25
Structural, mechanical and pipework	30/04/25	11/11/25
Electrical and instrumentation	28/05/25	23/12/25
Commissioning - Sturt Plateau compression facility	**10/12/25**	**29/04/26**
Precommissioning	10/12/25	4/03/26
Gas commissioning	5/03/26	29/04/26
Operation	**30/04/26**	**31/12/28**
Appraisal gas sale - SPCF	30/04/26	31/12/28
Decommissioning	**2/01/29**	**31/12/29**
Decommissioning - SPCF	2/01/29	3/07/29
Rehabilitation of site	2/01/29	31/12/29



NOTES:

Activity is not shown on the Gantt chart, as it extends past the 5 year life of the EMP and will require submission of an EMP revision. Only estimated timing of the activity is given.

Figure 3: Indicative schedule of activities

3.3 Site settings

3.3.1 Site selection

The SPCF facility is proposed to be built upon the existing 5.0 ha laydown area on the Shenandoah S2 site to minimise additional vegetation clearance. The laydown area is to be constructed in July 2024 for the storage of material (primarily proppant, casing and equipment) required for the drilling and stimulation of wells on the Shenandoah S2 location. The disturbance of the site has been previously assessed and approved under the TAM1-3 EMP.

The selection of the site was undertaken in accordance with the NT Land Clearing Guidelines, with particular attention paid to the implementation of buffers to protect drainage lines, watercourses or sensitive vegetation communities and to improve public amenity (DEPWS 2021a). An additional noise and air quality impact assessment was completed to assess the operation of the facility on receptors, such as homesteads, Aboriginal community living areas and communities. These assessments are provided in section 3.12.

Approximate separation distances to the nearest environmental and community receptors from the Shenandoah S2 site, including other Tamboran sites, are shown in Figure 4 and summarised in the following sections.

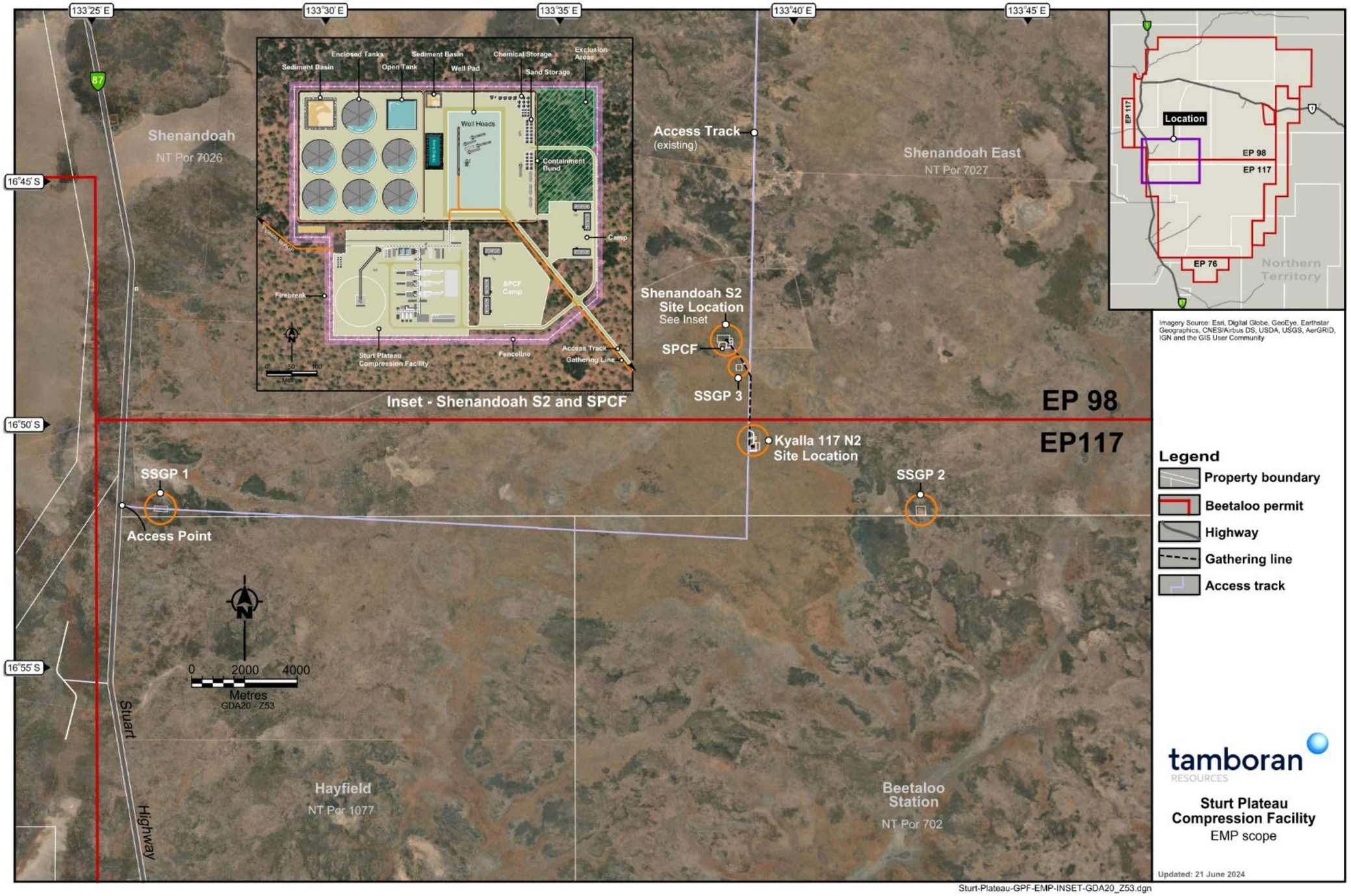


Figure 4: Location and overview of the SPCF in relation to other Tamboran activities in the vicinity

3.3.2 Location and disturbance summary of activity

The Project is located on the Shenandoah and Shenandoah East pastoral stations within EP 117 and EP 98 (Figure 4). The boundary of this EMP is defined as the area which may be affected by the E&A activities within the vicinity of the Project, as summarised in Table 6 and illustrated in Figure 4.

Importantly, the surface disturbance for the location of the SPCF is approved under the TAM1-3 EMP.

Table 6: Approximate location of infrastructure on EP 98 & EP 117 relevant to the Project

Infrastructure	EP	Zone*	Easting (approx.)	Northing (approx.)
Shenandoah S2 well pad, camp pad and access track**	98	53	355291	8140676
SPCF site**	98	53	355194.96	8141323.49
SPCF camp	98	53	355408.98	8141316
Kyalla 117 helipad, camp pad and access tracks**	117	53	356379.72	8137498.48
Gathering line: Kyalla 117 N2 to/from Shenandoah S2 (start to end)**	117 & 98	53	356274 355060	8137505 8140071
Gravel pit SSGP1**	117	53	333877.96	8135080.04
Gravel pit SSGP2**	117	53	362753.93	8135089.25
Gravel pit SSGP3**	98	53	355823.97	8140510.08
*Universal Transverse Mercator (UTM) geographic coordinate system is Geocentric Datum of Australia (GDA) 94. ** Previously approval under the TAM1-3 EMP.				

3.3.2.1 Surface disturbance – cumulative impact

As outlined above, an additional disturbance of 2.0 ha is proposed under this EMP for the SPCF camp, and an additional 1.0 ha is proposed for fencing and a firebreak around the perimeter of the Project.

The combined surface disturbance from all Tamboran B2 Pty Ltd activities is ~328 ha across 3 EPs (18,555 km^2), or ~0.018% of the total EP surface area, includes the 8.0 ha for this Project.

The cumulative impact of disturbance from Tamboran B2 Pty Ltd and third-party operators was previously assessed under the TAM1-3 EMP. Table 7 shows the estimated cumulative clearing across Tamboran's and neighbouring EPs by onshore petroleum operators. Onshore petroleum activities have a disturbance below <0.02% of the total surface area of all current operational EPs. This figure (~891 ha) is highly conservative, as it indicates approved clearing areas and not actual clearing undertaken. Compared to the approved clearing (2003 – 2023) on neighbouring pastoral stations within the Barkly/Gulf districts (~26,000 ha), land clearing for onshore petroleum activities is negligible.[5]

[5] See pastoral land clearing applications and permits: https://nt.gov.au/property/land-clearing/pastoral-land/pastoral-land-clearing-applications-and-permits.

Table 7: Approximate cumulative surface disturbance (%) vs EPs (all interest holders)

Interest holder	EP	Exploration permit areas		Clearing	Land clearing
		km²	ha	ha	%
Tamboran	117	6,375	637,500	144.76	0.0227
	98	10,300	1,030,000	175.50	0.0167
	76	1,880	188,000	7.65	0.0041
Sweetpea (a wholly owned subsidiary of Tamboran)	136	4,181	418,100	212.00	0.0507
Santos	161	13,350	1,335,000	99.20	0.0074
Imperial	187	2,998	299,800	252.00	0.0841
TOTAL		**39,084**	**3,908,400**	**891.11**	**0.0227**

3.3.3 Proximity to environmental and community receptors – Shenandoah S2

The Shenandoah S2 site is characterised as a mixture of eucalypt woodland, with areas of Lancewood (*Acacia shirleyi*) / Bullwaddy (*Macropteranthes kekwickii*) vegetation (refer section 4.2.2). Proximity of the site to environmental and community receptors and features of interest is provided in Figure 5 and below in Table 8. The closest receptor to the site includes a mapped water course 27 km to the west and a pastoral bore ~2.5 km to the north-west.

Table 8: Environmental and community receptors – approximate separation distances (km)

Receptor	Distance from Shenandoah S2 (km)
Nearest pastoral bore	2.5
Nearest homestead	17
Nearest community	28 Dunmarra
Jingaloo community living area	35
Lily Hole community living area	50
Stuart Highway	22
Carpentaria Highway	57
Bullwaddy Conservation Reserve	63
Frew Ponds	32
Lake Woods	100
Nearest mapped water course	27
Archaeological site	No archaeological sites recorded

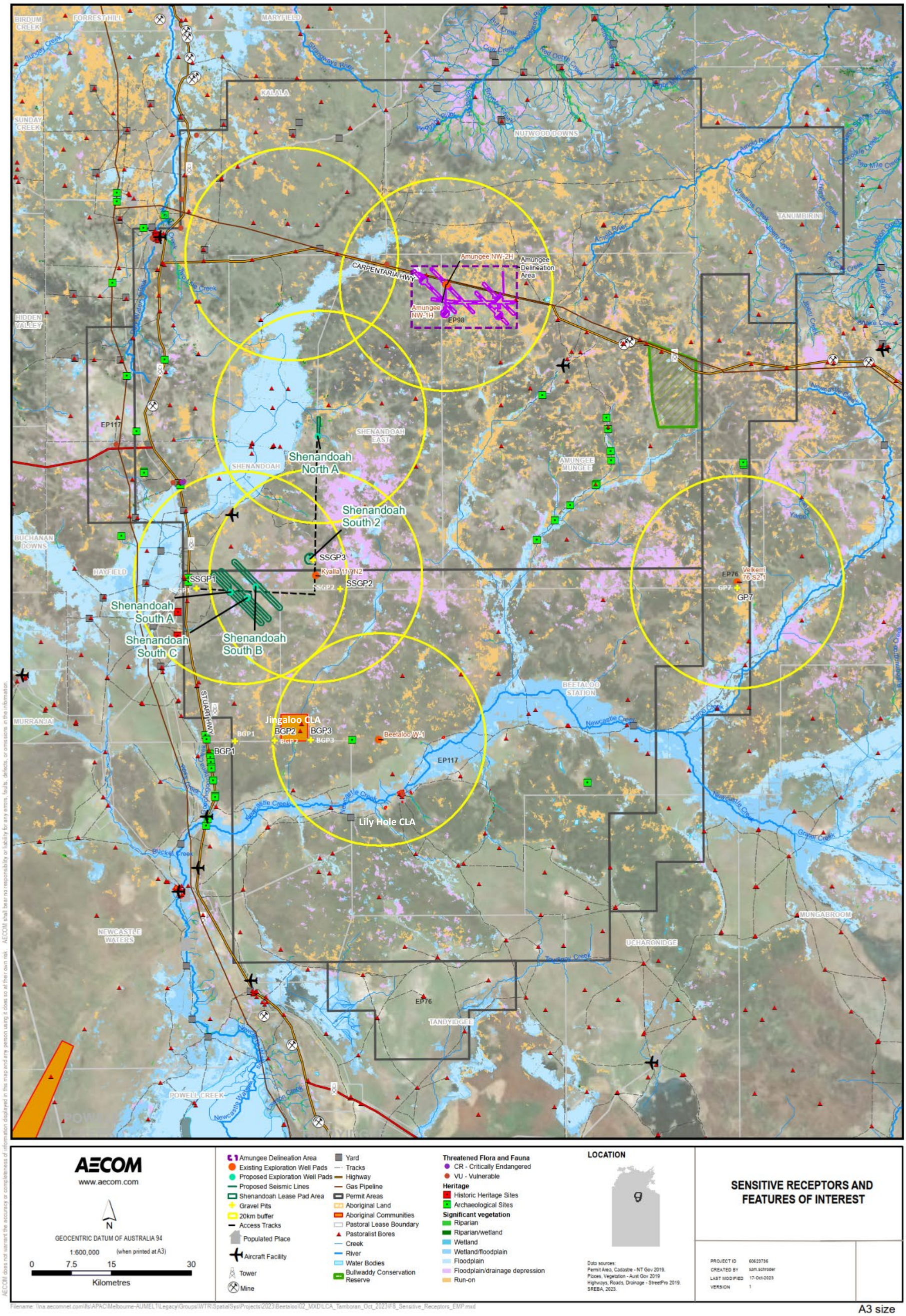


Figure 5: Proximity of the SPCF (adjacent to Shenanodah S2) to environmental and community receptors and features of interest, including other nearby Tamboran activities

3.4 Groundwater bores

Groundwater bores installed at the Shenandoah S2 well pad will be used to service the SPCF. The disturbance for and installation of these bores is covered under the approved TAM1-3 EMP.

All groundwater take will be authorised under a Water Extraction Licence (WEL). Tamboran's approved WEL GRF10285 targets the Gum Ridge formation, within the Cambrian Limestone Aquifers (CLA). Tamboran has increased the WEL licence take to 450 ML/year, in accordance with the *Water Act 1992*.

3.5 Civil construction and maintenance

3.5.1 Clearing

The Project has a total disturbance area of 8.0 ha, however only 3.0 ha of new clearing is required, as detailed below:

- 5.0 ha (existing cleared area): Tamboran will repurpose the Shenandoah S2 laydown area on EP 98, approved under the TAM1-3 EMP to accommodate the SPCF and ancillary infrastructure.
- 2.0 ha (new clearing): SPCF camp.
- 1.0 ha (new clearing): Fencing and firebreak.

A conceptual site layout of the Shenandoah S2 location with the SPCF facilities is provided as Figure 6.

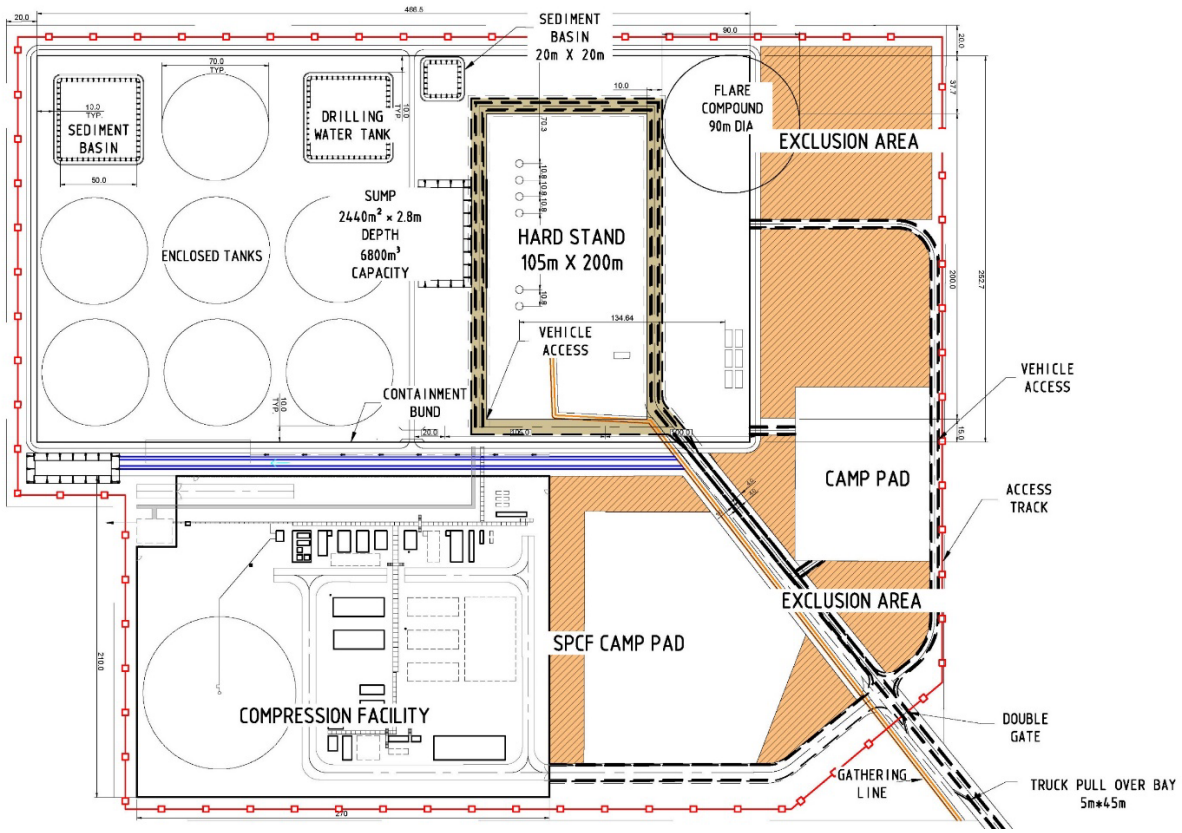


Figure 6: Conceptual layout of the Shenandoah S2 site, showing the SPCF; exclusion areas are not cleared

3.5.2 Access tracks

There are no new access tracks proposed under this EMP.

Site access from the Stuart Highway will be via existing pastoral tracks and access tracks approved under the TAM1-3 EMP. All ongoing management and maintenance of the existing access tracks will be delivered under the TAM1-3 EMP.

3.5.3 Gravel pits

There are no new gravel pits proposed under this EMP.

Gravel will be sourced from existing approved gravel pits, including SSGP3 (5.0 ha) on EP 98 – SSGP1 (2.5 ha) and SSGP2 (6.25 ha) on EP 117. All ongoing management and maintenance of the existing gravel pits will be delivered under the TAM1-3 EMP.

3.5.4 Foundation installation

Minor earth works are required to contour and grade the existing hard stand area, in preparation for the foundations for the SPCF. Most of the foundations will be driven steel pilings, to minimise the use of concrete. These pilings will be constructed using a small piling rig and will typically take 4-6 weeks to install. An example of piling footings is provided in Figure 7.

Figure 7: Example of compressor units with driven pilings

3.6 Extended E&A well appraisal

Each E&A well drilled and stimulated on the Shenandoah S2 and Kyalla 117 N2 pads will put into extended appraisal for a period of up to 36 months (notionally January 2026 to December 2028), with the produced

gas diverted to the SPCF. Figure 8 shows a detailed schematic (not to scale) of the infrastructure required to support the extended appraisal activities.

Temporary surface facilities will be constructed at each of the well pads to separate fluids (typically limited to flowback water) and gas near the well head. Surface infrastructure on the Shenandoah S2 and Kyalla 117 N2 sites may include the following equipment:

- Separator (separates gas from flowback fluid).
- Surface pipe work and manifolds.
- Flow meters.
- Well gauges and monitoring equipment.

The appraisal gas extracted from each well will initially be directed through an onsite separator which will separate out the gases, fluids and solids so that they can be measured and managed separately. Gas from the separators will be transferred via the existing approved gathering lines to the SPCF for processing, while fluids will be directed to the Shenandoah S2 wastewater storage area (approved under the TAM1-3 EMP*).* Processed gas will be exported to the AGP via the Sturt Plateau Pipeline (Figure 8).

As water production rates declines from each well (typically after 90 to 180 days), the associated separator package may be removed as water separation is no longer required. The wells will be allowed to flow via the gas gathering lines directly to the SPCF inlet separator where any flowback will be separated and directed to the wastewater tanks on Shenandoah S2.

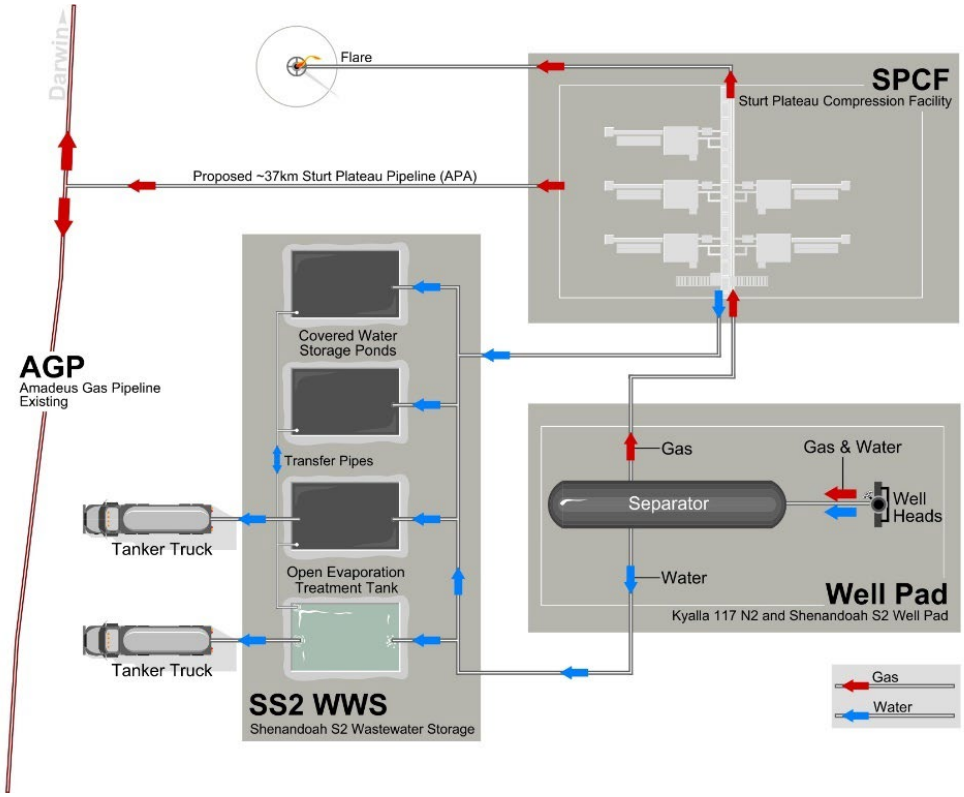


Figure 8: Post well test schematic, showing the transfer of fluids and gas from the extended E&A well appraisal

3.7 SPCF processing and infrastructure

3.7.1 Overview

The SPCF will take gas from the gas gathering network, condition it and increase the gas pressure for discharge into the Sturt Plateau Pipeline to transport to the gas to the AGP high-pressure sales gas pipeline. The compressor station will run 24 hours per day, 7 days per week.

Figure 9 outlines the key components of the SPCF, including tie-in to the proposed Sturt Plateau Pipeline export to Darwin and/or Tennant Creek (in yellow), which is outside the scope of this EMP but shown for context. The key process steps within the SPCF consist of:

- **Water removal** – this usually consists of a slug catcher and inlet scrubber which are a series of steel vessels designed to remove any entrained water from the raw gas stream prior to the compression stage. Compressors are designed for gas flow only, and so precautions are required to ensure removal of any entrained liquids.
- **Compression** – a series of industrial compressors designed to increase the pressure from the low gathering pipeline (2,100 kPag) pressures to the high pressures needed for long distance transport on the sales gas transmission pipelines (9,600 kPag). Compressors can be powered by either gas engines or electric drives, due to the lack of electricity infrastructure in the area the SPCF will use gas engines.
- **Cooling and liquids removal** – a series of air-cooled heat exchangers to reduce the temperature of the gas following the compression stage, with steel knock out pots designed to separate any additional moisture that may be present following compression.
- **Mercury removal** – a steel vessel with an inert absorbent designed to remove any trace quantities of mercury from the gas stream. Small quantities of mercury are common in natural gas and need to be removed as over time the mercury can damage pipelines and vessels.
- **Dehydration** – the final stage is to remove trace amounts of moisture to reduce the risk of corrosion in the sales gas pipelines, and to ensure the gas complies with Australian gas quality standards. Typically, a glycol based liquid desiccant such as triethylene glycol (TEG) is used to remove moisture from the gas stream to meet the moisture content requirements.
- **Export** – by this stage the gas is fully ready for export from the SPCF and will be delivered into the Sturt Plateau Pipeline via a set of flow meters to measure the instantaneous flow rate, a moisture analyser to ensure the gas meets the moisture specification, and a gas chromatograph that measures the gas quality to determine the heating value.

A flare system will be used to safely dispose of gas in abnormal conditions during SPCF operations (e.g. emergency situations or during maintenance). The flare will be equipped with a pilot and ignition system. A cleared exclusion zone will be installed around the flare to prevent heat radiation damage to personnel, equipment or the environment (refer section 3.7.9).

A more detailed description of each SPCF component is provided in the following sections.

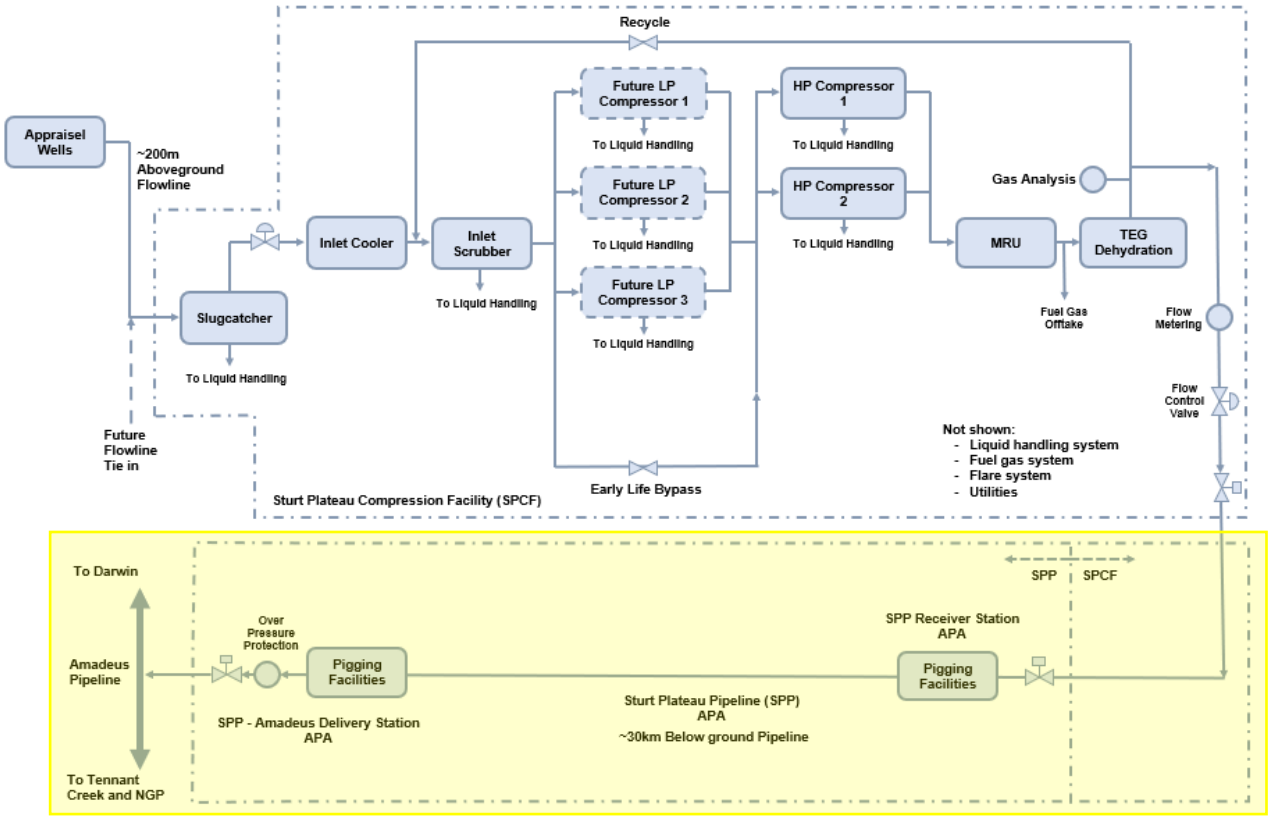


Figure 9: Indicative schematic outlining the key components of the SPCF, including tie-in to the Sturt Plateau Pipeline and AGP (yellow)

3.7.2 Gas compression facility (SPCF)

Compressors, generators and infrastructure will predominantly be skid mounted to enable installation on pilings and easy removal at the completion of the program. The proposed SPCF and ancillary infrastructure comprises:

- Inlet separation system (e.g. slug catcher, inlet cooler and inlet scrubber)
- Gas pipework and piping racks
- Compressors
- Gas fired power generation, with diesel back-up generator
- Flare and flare exclusion zone
- Mercury removal unit
- TEG dehydration package
- Production chemical storage and distribution
- Gas metering
- Oily water separation and treatment
- Office and ablutions
- Workshops and laydown
- Wastewater transfer to the Shenandoah S2 well pad storage/treatment tanks

- Gas and water pipework designed to tie into:
  - the existing groundwater, wastewater and gathering network facilities on Shenandoah S2
  - the Sturt Plateau Pipeline lateral pipeline that connects into the AGP.

A conceptual site layout of the of the SPCF in relation to existing infrastructure on the Shenandoah S2 site, is provided previously as Figure 6. An example of a similar gas compression facility is provided as Figure 10.

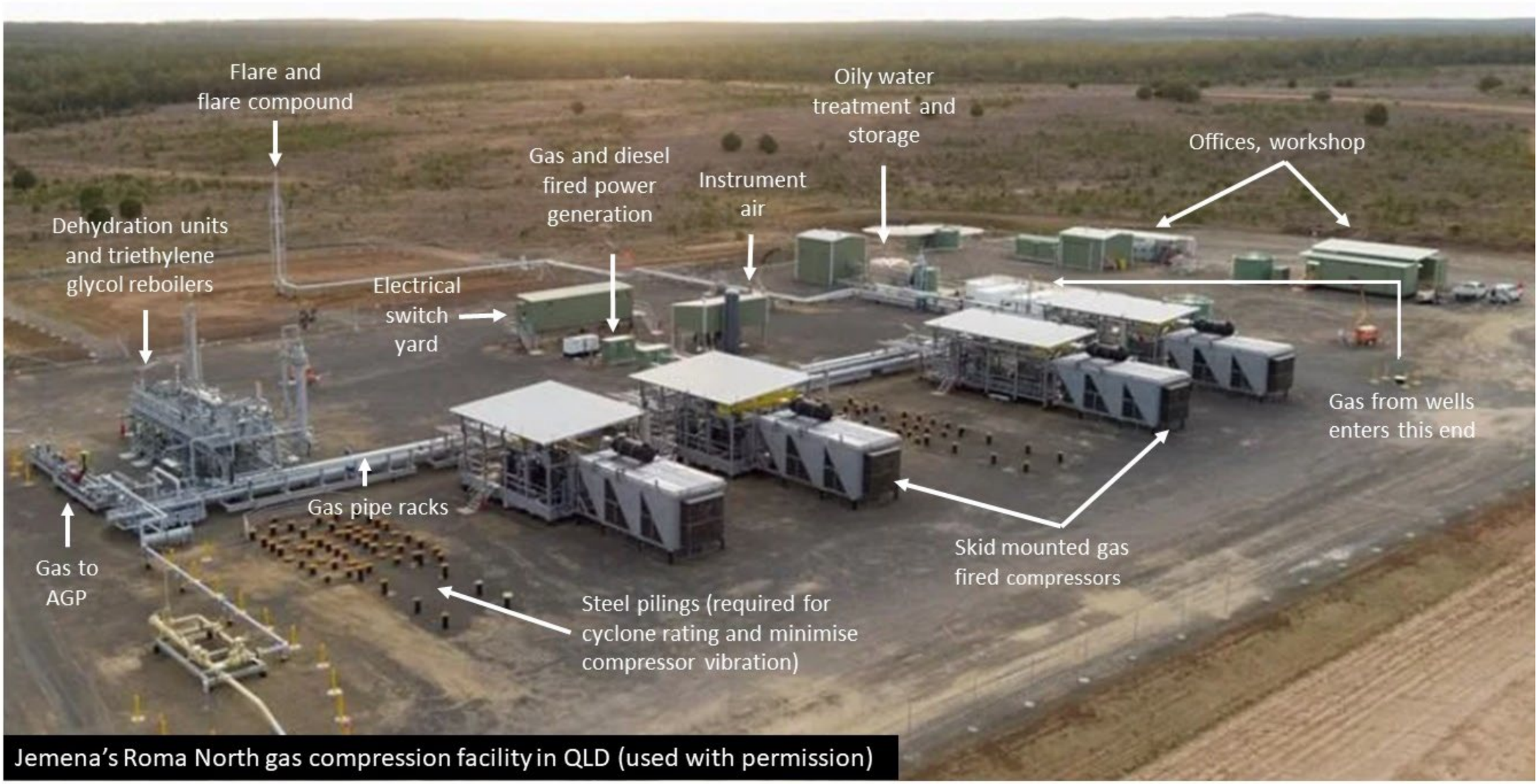


Figure 10: Example of a similar gas compression facility

3.7.3 Gathering lines

The SPCF will be connected to the existing gathering lines that have been constructed under the approved the TAM1-3 EMP. The gathering lines will be tied into the SPCF at the inlet to the facility.

These gathering lines will be constructed, operated, maintained and abandoned in line with the *"Code of Practice for Upstream Polyethylene Gathering Lines in the CSG Industry and Companion Papers"*, August 2019 (APGA 2019).

Approval for the gathering network has been received under the TAM1-3 EMP. Figure 11 shows the two approved gathering networks between Kyalla 117 N2 – Shenandoah S2.

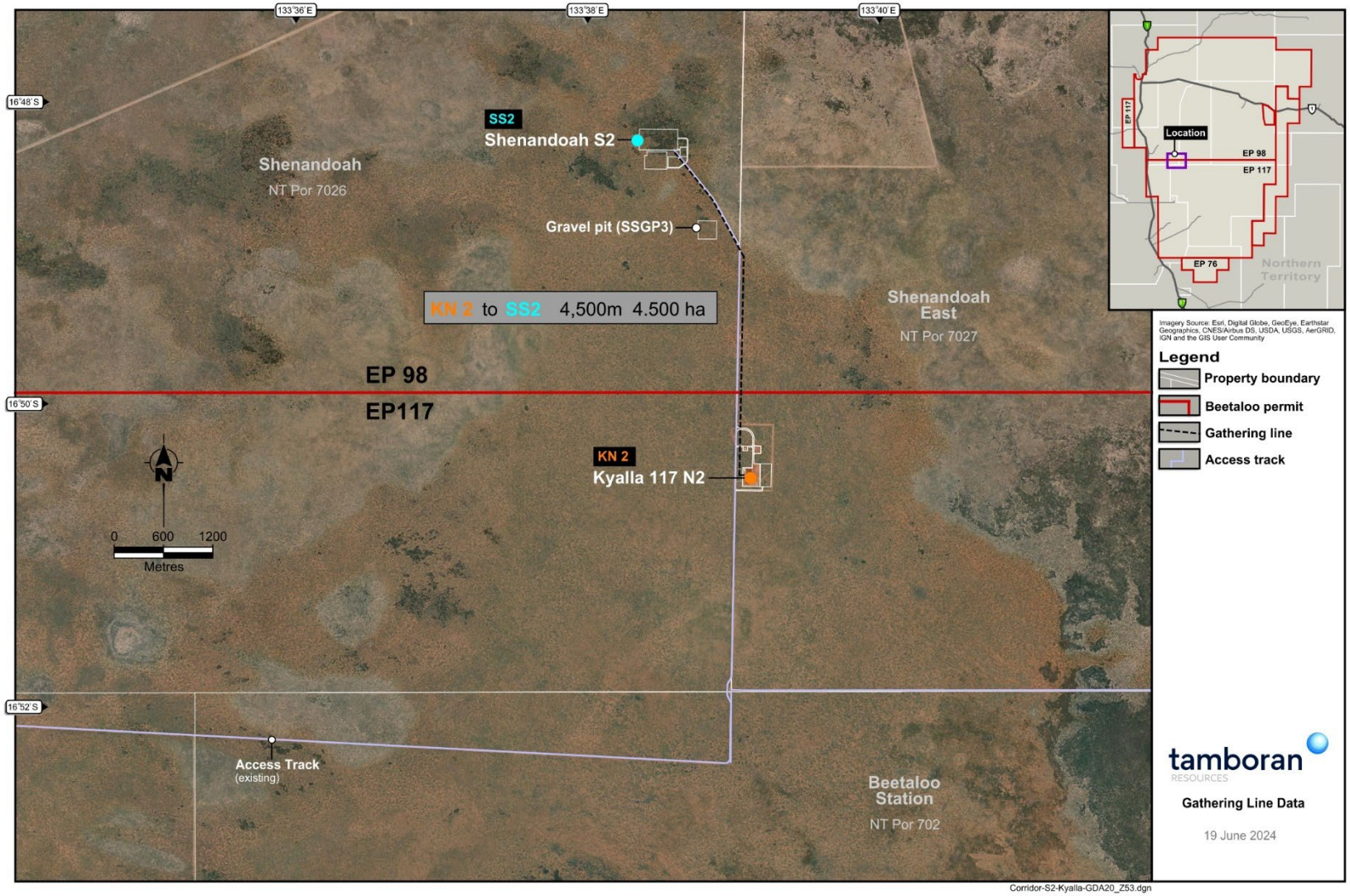


Figure 11: Gathering lines between the Shenandoah S2 and Kyalla 117 N2 well sites

3.7.4 Inlet separation system

Gas will be transported from appraisal wells via gathering lines and flowlines from the surrounding Shenandoah South area which have been drilled and stimulated under the TAM1-3 EMP. The natural gas will have entrained water, being primarily water vapour that condenses from the gas stream as it cools and traces of flowback water. This fluid will require separation prior to compression. As previously noted, flowback wastewater may be either separated on the well pad or separated at the SPCF.

An inlet separation system will be provided at the SPCF inlet comprising a slug catcher, inlet cooler (if flowing gas temperatures are higher than approximately 50° C) and inlet scrubber to remove entrained fluid (a mixture of flowback wastewater and water condensation produced from the gas stream). The expected total wastewater stream from the raw gas is 40,000 L/day (peak) at the commencement of production. Wastewater will be pumped directly to enclosed tanks located on the adjacent Shenandoah S2 well pad via above or below ground pipelines.

Further overview of the system is provided in the following sections.

3.7.4.1 Slug catcher

A slug is an uneven distribution of liquid and gas in a pipeline. Pipelines transport both gas and liquids in two-phase flow. Liquids tend to settle in the bottom of pipelines, while the gases occupy the top section. Under certain conditions, the liquids and gases may group together to form slugs. When the liquid slug exits a pipeline, it can overload the gas/liquid handling capabilities at the plant. In this situation, the plant needs a slug catcher.

A slug catcher is a wide segment in a pipeline to hold condensation/ carried over flowback wastewater. It contains sufficient buffer volume to handle the largest expected slug from the gathering system (Figure 12). The slug catcher is the first piece of equipment at the end of the inlet flowline but before the processing facility / plant. The primary purpose of the unit is to perform the initial bulk gas-liquid separation to prevent damage to the compressors. Slug catchers, by nature, are a form of risk management.

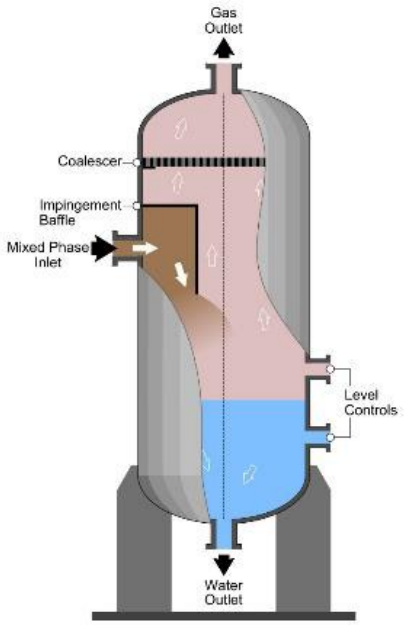


Figure 12: Typical vertical slug catcher operation

3.7.4.2 Inlet separator

The separator or scrubber is the primary fluid separation equipment in a gas compression train. The primary reasons for gas separation are:

- Compressors require a liquid-free gas for efficient operation
- Gas measurement device results are less accurate when there is entrained liquid in the gas
- Gas sales agreement usually requires that the gas contain no liquid

The separator removes well stream liquid(s) (flowback and condensation) from gas components prior to compression. Separators can be horizontal or vertical, depending on, the liquid feed content. The SPCF has a relatively small inlet separator following the slug catcher owing to the low liquid loading and for the SPCF is termed an inlet scrubber (owing to its size). The inlet scrubber further reduces moisture levels and has different demisting components that are designed to remove smaller liquid droplet sizes below 10 microns.

All liquids separated by the inlet scrubber will be directed to the wastewater liquid handling system as described in section 3.7.7. The wastewater is then pumped to the Shenandoah S2 wastewater storage tanks on the well pad, as outlined in Section 3.7.20.

3.7.5 Compressors

The SPCF will contain up to 5 gas fired compressor units consisting of 3 low pressure compression packages and 2 high pressure compression packages. (An example of a similar sized facility is previously provided in Figure 10).

The engine and components will be a 4-stroke cycle, water-cooled, and turbo-charged gas engine. Gas fired reciprocating compressors are used where flow rates are low, and the pressure ratio is high. Reciprocating compressors operate efficiently over a wide range of pressures and flow rates (up to the power limit) and can operate in multiple stages to achieve higher compression ratios. Each compressor will be mounted on an individual skid and installed on footings (Figure 13). Compressor skids are self-bunded, with a drain designed to collect any oily water from the units. The oily water is directed into the liquid handling system as described in section 3.7.7, where any oil from the machines will be removed from the wastewater. Wastewater is then transferred to the enclosed wastewater tanks on Shenandoah S2 well pad. Approximately 10 L of oily water will be produced and treated per day, which will be in managed in accordance with section 3.7.7.

The SPCF package designs shall comply with relevant Australian and International Standards, for example ISO 13631 (Petroleum and natural gas industries – Packaged reciprocating gas compressors), AS 3814 (Industrial and commercial gas-fired appliances) , AS 5601 (Gas Installations). Compressors will use a gas type seal to minimise the amount of fugitive gas lost from the compressors. Compressor seals will be maintained every 26,000 hours or every 36 months, in compliance with section D.5.7 of the Code.

Each compressor may be started up, stopped or continuously operated during any 24-hour period. This shall be allowed for in the package design and component selection including the supply of lubricating oil and coolant heaters to enable start-up under all possible ambient conditions.

A cooling unit will be attached to each compressor to reduce the gas temperature post compression. The cooling unit consists of large fans (and water mists if required), which are designed to ensure the temperature of the gas stays within the target specification.

Fuel gas for the compressors will be sourced from the gas line post the mercury removal unit, with fuel gas consumption representing approximately 3% of produced gas. Catalytic convertors will be installed on the units to reduce NOx. Maintenance of the catalytic convertor will be performed in accordance with manufacturers recommendation.

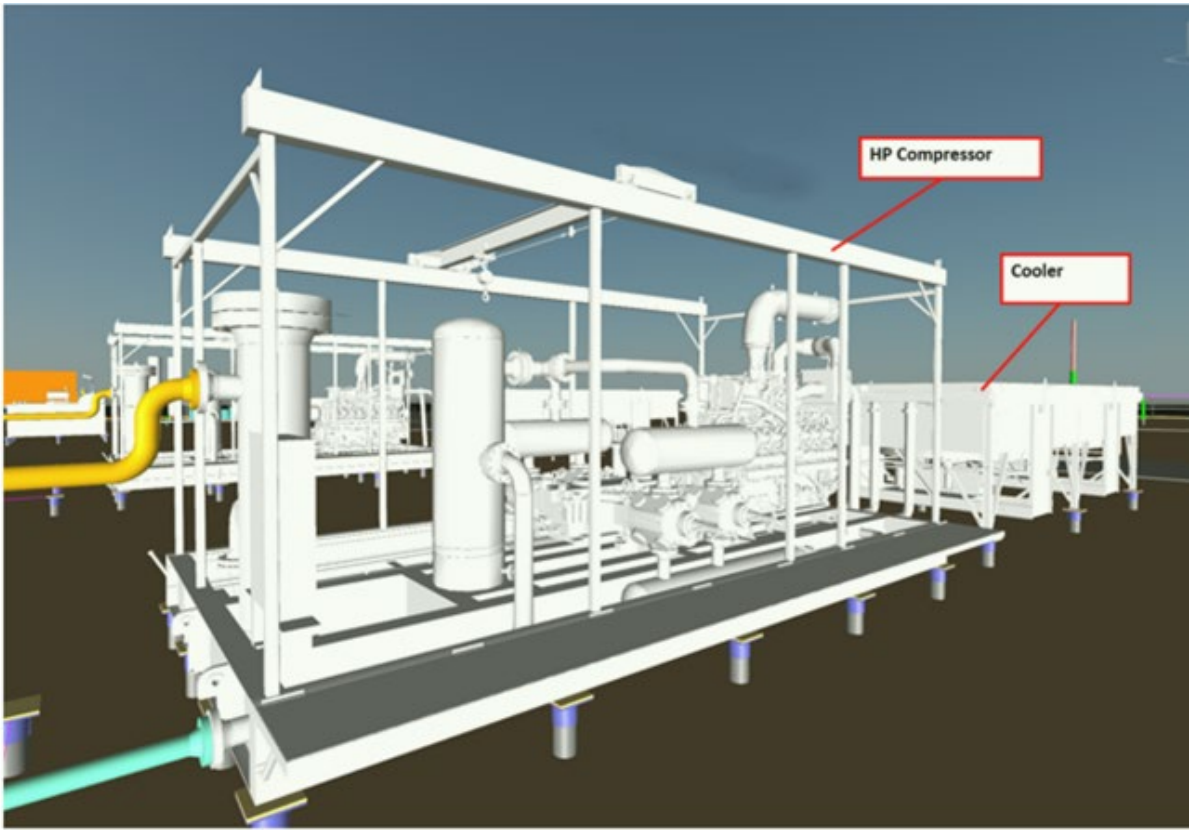


Figure 13: Example of a skid mounted gas compression package

3.7.6 Triethylene glycol (TEG) dehydration unit

The dehydration of natural gas is the removal of residual water vapour from the compressed the gas stream to ensure the gas complies with Australian quality standards. The process is necessary to ensure efficient operation of gas transmission lines. The removal of the water vapour prevents the formation of gas hydrates and reduces corrosion in pipelines. It also improves the efficiency of pipelines by reducing liquid accumulations at low spots in the lines.

A triethylene glycol (TEG) liquid desiccant is used to remove the last traces of water from the gas stream. TEG has a high affinity for water vapour and has other desirable properties such as non-corrosiveness, ease of regeneration and low chemical losses.

The key equipment items comprising the TEG dehydration unit are the reboiler and contactor (Figure 14). TEG liquid is constantly pumped through the contactor, where water vapour transfers from the gas to the TEG liquid; the TEG liquid flows from the contactor to the reboiler, where the water is removed from the TEG by heating the TEG above the boiling point of water, the TEG is then cooled before returning to the contactor. The boiled water is released to the atmosphere as a small steam emission (as water vapour).

A small volume of “stripping gas” is also added to the reboiler to increase TEG recovery rates. This stripping gas and small volumes of entrained methane within the saturated TEG is vented. To minimise wastage of gas and the associated methane emissions, stripping rates are kept as low as possible.

Figure 14: Example of a TEG unit (courtesy of GLP Group)

3.7.7 SPCF process liquid handling system

The SPCF process liquid handling system shall receive liquids from pressurised vessels across the facility to remove hydrocarbons and other contaminants from the wastewater. This water consists of any separated flowback, or water condensation collected within the plant. The liquid handling system contains several stages to remove any entrained gas and liquid hydrocarbons before the wastewater is pumped to the Shenandoah S2 wastewater tanks. Wastewater inputs into the liquids handling system are shown in Figure 15 and include:

- Slug catcher (flowback water)
- Inlet scrubber (flowback water)
- HP compressor package (condensation water)
- Mercury removal unit (condensation water)
- Flare knock out drum (condensation water)

Any separated oil is stored within the oily water storage tank (referred to as the skim oil tank) with secondary containment. Oily water is then collected by licenced contractors and managed in accordance with section 3.16.

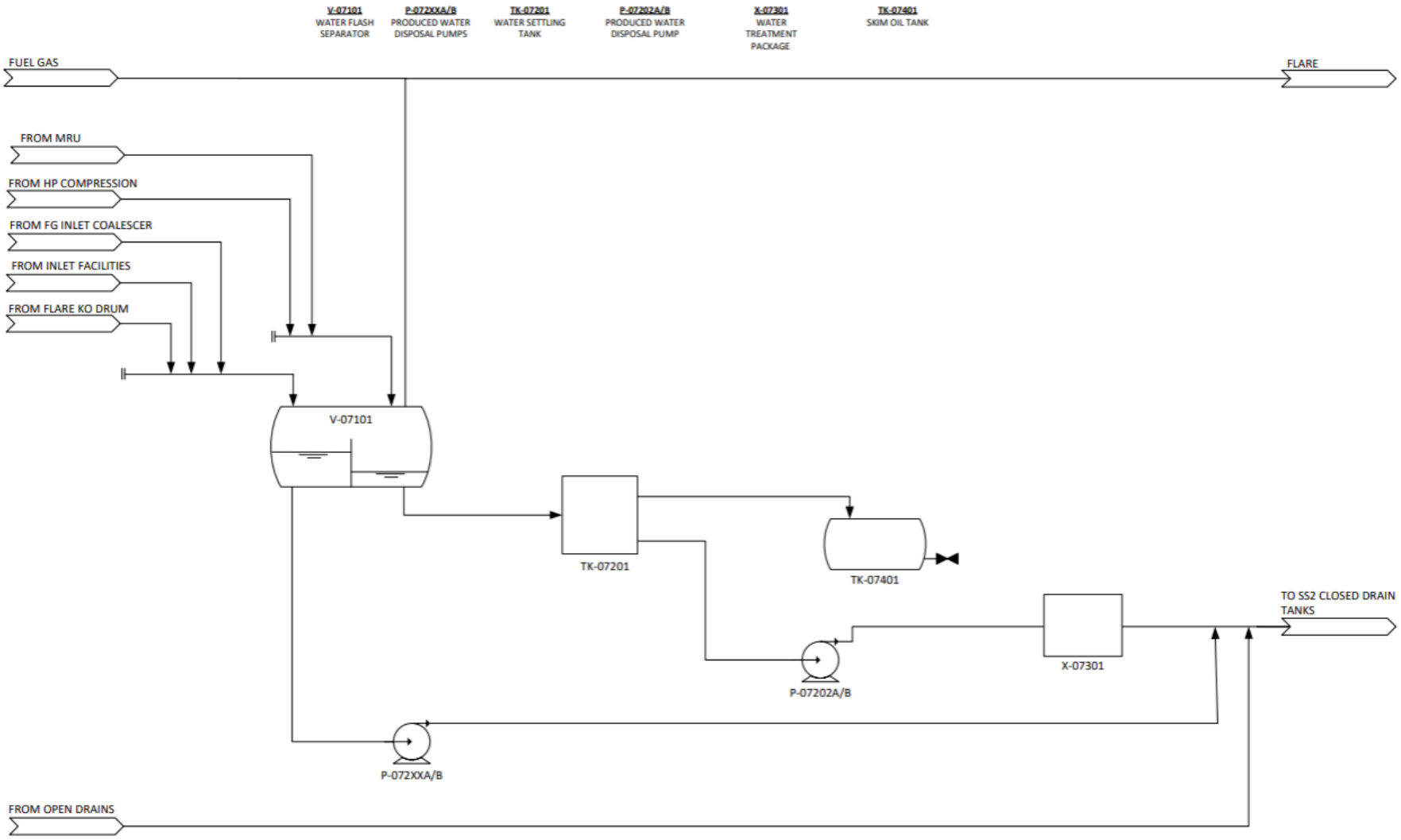


Figure 15: Flow diagram of the liquid handling system

3.7.7.1 Water flash separator (V-07101)

The liquid initially flows into the water flash separator which is designed to remove dissolved gases. The gases are directed to the flare for disposal and the remaining liquid flows to the water settling tank. The water flash separator shall be furnished with an internal weir. All drain lines managing flowback and water condensation will be directed to the first compartment separated from the drains managing oily water (such as lube oil from the compressors). Oily water shall be directed to the second compartment to minimise contamination of flow back/condensation water with lube oil and thereby reduce demand on water treatment systems.

The following process water streams will be routed to compartment 1 of the water flash separator:

- Slug catcher (V-01101) liquids
- Inlet scrubber (V-01103) liquids

While the following process water streams that will contain lube oil will be routed to compartment 2 of the water flash separator:

- MRU inlet coalescer liquids
- Compressor drain sump liquids
- HP compressor unit 1 & 2 liquids

The degassed liquids in compartment 2 of the water flash separator (containing lube oil) are gravity drained to the water settling tank.

The degassed liquids in compartment 1 of the water flash separator (free of lube oil) will be routed to the water transfer pumps and pumped to the Shenandoah S2 wastewater tanks on the well pad.

3.7.7.2 Water settling tank (TK-07201)

An AS1692 atmospheric water settling tank shall be furnished to remove bulk hydrocarbons via gravity separation targeting 40 mg/litre free hydrocarbon. The underground oil/water separation tank is double lined PVC or glass reinforced plastics (GRP) not metal. The tanks are not susceptible to rust and exhibit excellent corrosion resistant properties. The tank is fabricated with a resin rich corrosion barrier internal layer and an external resin-rich water penetration barrier using a three chamber underground tank or equivalent.

The sizing of the tank shall target a residence time (minimum 4 hours), based on the maximum foreseeable inflow rates, to achieve maximum possible gravity separation performance. The tank is fitted with high level alarms and instrument trips to prevent overflow due to high flow or failure of the water outlet pumps.

The wastewater is transferred from the bottom of the vessel to the water treatment package (X-07301) by a centrifugal pump (2 x 100% pumps to be provided for duty/standby operation) operating under gap control. Separation of the bulk oil from the aqueous phase shall be achieved by an overflow weir that skims the bulk oil floating on top of the water. The bulk oil is transferred with a gravity drain line to the skim oil tank. The control system shall control the water outflow rate from the bottom of the vessel via the water pumps to facilitate the effective skimming of the bulk oil over the weir in the water settling tank.

3.7.7.3 Water treatment package (X-07301)

The water treatment package uses bentonite clay-based powder, which chemically removes emulsified oil, heavy metals, phosphates and suspended solids from the wastewater stream. The system is sized to remove trace impurities from the produced water to meet the required evaporation pond water quality requirements at the peak average water flow rate. The package shall be designed by a third party with details to be confirmed during detailed design. A typical water treatment package is shown in Figure 16, which will be located in the SPCF under cover.

Figure 16: Example of a fully automated, skid mounted water treatment package / system, which will be located in the SPCF under cover (source: Baldwin Industrial Systems 2024)

3.7.7.4 Skim oil tank (TK-07401)

The skim oil tank shall collect and store skim oil from the water settling tank. It shall be sized to provide sufficient storage volume based on expected gas production and compressor lube oil carryover such that load-out frequency aligns with Tamboran's maintenance strategy. The required minimum duration between loadouts shall be monthly based on 100% of expected lubricator oil flow rate or minimum 5,000 L.

The skim oil tank will have secondary containment, with waste oil managed in accordance with section 3.16.

3.7.8 Other liquid waste handling

The SPCF will have a separate drainage system to collect waste liquids from various bunded areas and drip trays around the facility that are used to contain liquid hydrocarbon/chemical inventories. These liquids are directed to an underground water/oil separator tank for treatment and disposal (Figure 17). The

underground tank is a double skinned two chamber tank with a total volume of 6,200 L and achieves a water discharge quality of less than 5 parts per million (ppm) of oil and hydrocarbons, complying with European Standard EN 858.1: 2006 (Separator Systems for Light Liquids).

The separated wastewater level is continually monitored by the SPCF control system (level transmitter level indicator controller) and when the water level reaches a pre-determined level the pumps (duty and standby) will start automatically to discharge the water to the wastewater storage tanks on Shenandoah S2 well pad. The pumps have a capacity of 6 L/s. The greatest source of water will be stormwater that collects in the dedicated bunded areas and trays.

The level of the oil and hydrocarbon liquids retained in the separator are monitored by the control system and periodically sucked out using a vacuum truck and transferred to the skim oil tank when the level reaches the high set point. The volume of hydrocarbon liquids collected is expected to be very low during normal operations (<30 L/day) and this may increase in temporary upset conditions, but still within the capacity of the tank.

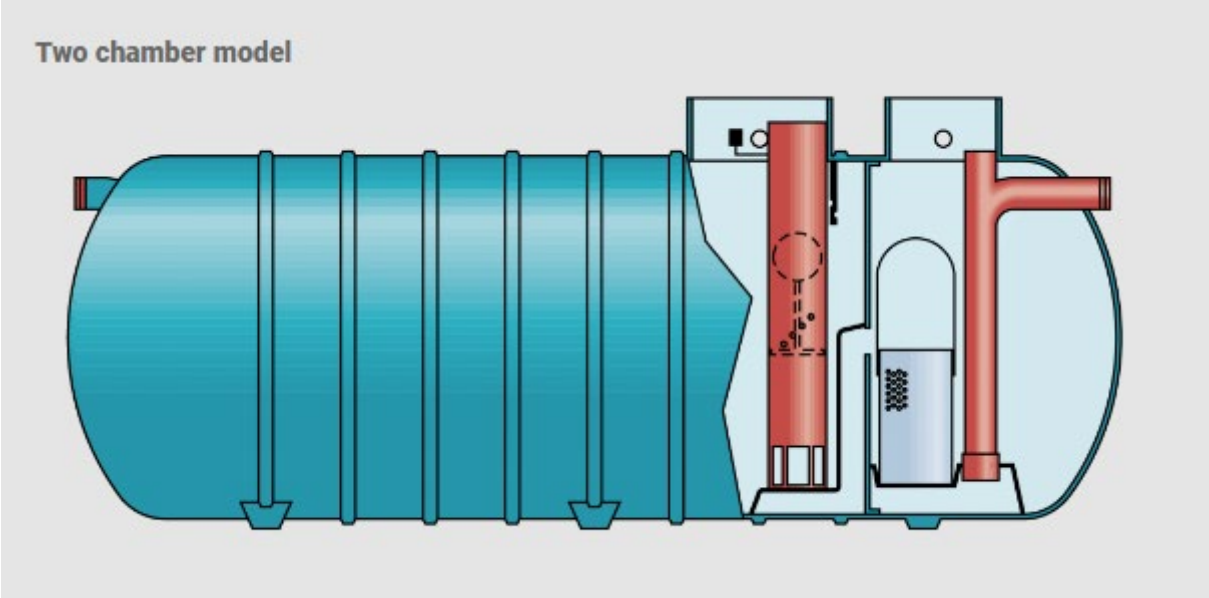


Figure 17: Example underground, two chamber separator (souce: SPEL Products, 2024)

3.7.9 Flaring

No routine flaring will be undertaken. Flaring will only be undertaken during the following situations:

- During initial plant commissioning
- During plant trips or emergency situations
- During equipment blow downs for maintenance.

Where extended periods of flaring are proposed due to maintenance or extended plant breakdown (greater than 24 hours), wells will be shut in to reduce flared gas volumes.

A vertical flare stack with a sonic flare tip shall be provided, located to avoid exposing personnel and equipment to high thermal radiation levels. Gas disposed of through the flare system shall be metered via an ultrasonic flare meter.

The flare tip shall be provided with a redundant flare pilot to ensure a flame is maintained. Temperature sensors will be used to detect flameout. A flare ignition panel shall be provided to ignite the pilot on first start-up and provide automatic restart of the pilots.

The flare package shall be smokeless and low flame visibility during normal operation, with a combustion of 98% or greater.

The flare stack shall be controlled by a local relay control panel with hardwired input/output feedback to the program control system.

- The flare will be located at least 45 m from the surrounding vegetation.
- A Bushfire Management Plan implemented outlining the controls and communication requirements (Appendix A).

3.7.10 Mercury removal unit (MRU)

Mercury is a common contaminant within gas streams that may require removal to comply with the gas sales specification. To date, mercury levels within the Velkerri shale gas stream have not been detected at levels that warrant removal. Should mercury levels be observed at levels that exceed the sales gas specification (7 µg/m^3), a mercury removal unit (MRU) may be installed. Mercury usually occurs in gas streams as an elemental (metallic), organic and inorganic compounds. Removal of mercury at the source, reduces the risk of corrosion, leakage into the environment, build-up in condensate streams and the associated gas pipelines.

The installation of an MRU would be undertaken as a preventative measure to mitigate the unlikely event that future gas from E&A wells contains traces of mercury. The removal of mercury to non-detectable levels is vital in ensuring the structural integrity of equipment, thus reducing the possibility of unscheduled shutdowns and prevent fires.

An MRU would be installed downstream of the HP compression to remove the trace mercury from the raw gas stream to meet sales gas requirements before entering the dehydration package. This unit will include an MRU inlet coalescing filter, MRU guard bed and MRU outlet dust filter. The coalescing filters will aim to remove 99.98% of aerosols larger than 1 micron and 99.98% of particulates greater than 3 microns to protect the mercury guard bed from free liquid attack.

Any captured mercury will be contained, handled by licenced contractors and disposed of in accordance with the WMPC Act as described in section 3.16. Typically, mercury clean out would either occur annually or every 2 years.

Figure 18: Example of a mercury removal unit, designed to be skid mounted (encon industries, n.d.)

3.7.11 H_2S Removal

H_2S is present in all natural gas at various levels and may need to be removed from the gas stream to protect piping and equipment from corrosion where concentrations are high enough. H_2S levels in the Velkerri shale are low, typically 2ppm. To reduce the risk of pipe corrosion, H_2S Scavenger chemical will be injected into the process at the facility inlet (downstream of the SPCF Isolation valve). The H2S Scavenger removes the H_2S from the gas and drops out as a liquid via the Slugcatcher.

The H_2S Scavenger injection skid consists of a small storage tank and a pneumatic pump to pump the chemical into the process piping.

The calculated H2S Scavenger rate is 60 L/d (based on the observed concentration of H_2S concentration of 2ppm).

The H_2S Scavenger and relevant products will join the wastewater stream directed to the wastewater tanks on Shenandoah South 2 .

3.7.12 Utilities, including office, warehouse, workshop, laydown areas for chemicals and fuel storage

General utilities such as portable site office(s), warehouse and workshop will be constructed on site to support the SPCF. Storage areas for chemicals and fuels will be fully bunded in accordance with Australian Standards.

3.7.13 Instrument air

Instrument air is a supply of compressed, high purity air that is treated and conditioned for use in process control instruments and equipment, such as the reliability of pneumatic controls, instrumentation and small pumps. Instrument air is generated through several small air compressors consisting of a compressor

and a storage unit. The use of instrument air reduces the use of natural gas pressured pneumatic devices, which are a source of fugitive emissions, and complies with section D.5.7.2 of the Code.

It is crucial to maintain the quality of instrument air, as substandard or contaminated air can result in the malfunction of delicate equipment, leading to potential safety concerns and negatively impacting the overall efficiency of an operation.

3.7.14 Power supply

Electrical power generation systems will be required to run the fin fan coolers, TEG reboiler heater, fuel gas heater instrument air package, flow meters, gas analysers, control rooms, control system, safety systems, offices and other equipment within the compression facilities.

The primary power supply for the Project will be gas-fired, with a diesel backup generator.

3.7.15 SPCF gas leak detection

Compressor units will be fitted with point gas detectors. The gas detection system shall be designed to provide early warning of the migration of gas from hazardous to non-hazardous areas. Triggering of the gas detection system will initiate an emergency shutdown and a time delay blowdown with a high priority alarm.

3.7.16 Lightning protection

The SPCF lightning protection system shall be designed in accordance with AS/NZS 1768.

For satisfactory lightning protection, the earth grid shall be tested for verification and electrical resistance to ground of less than 10 ohms, as per AS/NZS 1768 and AS3000. Protection level is to be determined in detailed design and shall be applied to all site structures. All structures on site shall be directly bonded to the earth grid.

The surge and lightning protection system shall be bonded to the main earth grid. Surge protection shall be used for all communication circuits entering enclosures.

3.7.17 SPCF wastewater gathering lines

A wastewater gathering line will be constructed to transfer wastewater form the SPCF to the Shenandoah S2 wastewater tanks. The wastewater gathering line will be constructed, operated, maintained and abandoned in line with the *"Code of Practice Upstream Polyethylene Gathering Networks – CSG Industry Version 5.0"*, August 2019 (APGA 2019). It is anticipated that a 6 – 10-inch buried, or aboveground wastewater gathering line will be used. This gathering line will be located on the existing SPCF facility and Shenandoah S2 wastewater storage area.

The following methodology for gathering line installation is extracted from APGA, 2019.

3.7.17.1 Material selection and design

Materials used for the construction of the gathering network will comply with section 3 of the APGA Code of Practice for Upstream Polyethylene Gathering Networks (PEGN Code). HDPE 100 (or equivalent) will be used for all pipelines, due to their high toughness, excellent resistance to slow crack growth and rapid crack propagation. They also have an inherent resistance to water and chemicals. PE pipelines are the material of choice for many water, wastewater, gas and other applications as evidenced through their day to day use throughout society.

PE pipes shall be manufactured in accordance with AS/NZS 4130 and shall be third party certified by a JAS-ANZ accredited certifier under the StandardsMark, GasMark or WaterMark schemes or equivalent. Marking and product traceability shall be in accordance with the Standard. Appendix A of AS/NZS 4130 shall be used as the basis for demonstrating conformity. Gathering networks for wastewater transfer shall be Series 1 conforming to AS/NZS 4130. A design, risk assessment and testing regime, in line with the PEGN Code, will ensure suitable material selection and selection of facility overpressure protection equipment to reduce the probability of leaks to ALARP.

3.7.17.2 Pipe stringing and pipe jointing

The pipe will be either stick (~12 m lengths) or coils of up to 100 m. The pipe will be strung out connecting the SPCF inlet to the Shenandoah S2 wastewater storage area.

Polyethylene pipe or fittings can be joined only by heat fusion (welding) or mechanical fittings.

There are two types of heat fusion joints currently used – butt fusion welding and electrofusion welding. Pipe jointing is a skilled operation, with skilled service providers engaged to complete specific procedures necessary to achieve a successful joint. Tamboran will approve jointing procedures for the service provider before construction begins.

Data loggers will be used to verify conformance to the nominated welding parameters. A unique weld numbering system will be established to identify each production weld and tie-in for traceability records.

Butt welding

The most widely used method for joining individual lengths of polyethylene pipe is by heat fusion of the pipe butt ends (Figure 19).

Figure 19: Standard butt fusion join (source: APGA, 2019)

This technique, which precludes the need for specially modified pipe ends or couplings, produces a permanent, economical and flow-efficient connection. Welding parameters used will follow Plastics Industry Pipe Association of Australia Guideline POP 003, which provides guidelines for butt fusion welding parameters. The welding temperatures for polyethylene pipe used in constructing gathering lines are not high enough to be considered a potential cause for ignition.

The following procedures will be adopted to ensure the integrity of the fusion welds:

a) The welding contractor shall have:
   - Demonstrated experience in fusion welding of polyethylene pipe
   - Suitably sized equipment which has been maintained in good condition with calibration status documentation available
   - Qualified operators who have a current log detailing project and welding experience

b) Assessment of the proposed welding procedures:

- Pre-qualified welding procedures for pipe class and diameters being proposed for the project and the welding machines or control box which will be used, and destructive weld testing data may be considered
- Carry out trial welds on the actual pipe to be used for the contract and have these destructively tested to meet the specified performance requirements (testing and minimum performance requirements are detailed in Section 7 – Inspection and Testing)
- Determine and document the agreed welding parameters, procedures, and welding equipment (this may also include the use of welding tents, pipe end covers etc.); and
- The agreed welding parameters, procedures and welding equipment become the contract requirements and should not be varied without additional evaluation and testing

c) Determine quality control and assurance requirements, including but not limited to:

- Inspection for wall thickness and welding zone preparation
- Internal inspection of pipe for obstruction and cleanliness. Including the removal of swarf after machining welding face for butt welding
- Maintaining a detailed welding log for each weld (including unique weld ID and GPS location record keeping)
- Destructive testing of a percentage of welds
- Visual and non-destructive assessment of each weld

d) Continuously review process and results.

- Butt fusion welding is a skilled operation; several very specific procedures need to be carried out to achieve a successful joint. All operators carrying out butt fusion welding will be trained by appropriately registered training organisations, meeting the prerequisite training requirements of PMBWELD 301.

Electrofusion welding

Electrofusion is the method by which the heat is applied. The electrofusion joint is heated internally by a conductor at the joint interface. Heat is created as an electric current that is applied to the conductive material in the fitting. Polyethylene pipe-to-pipe connections made using the electrofusion process requires electrofusion couplings.

Electrofusion fittings shall conform to Australian Standards (AS) / New Zealand Standards (NZS) 4129 and shall be third-party certified by a Joint Accreditation System of Australia and New Zealand accredited certifier under the StandardsMark, GasMark, WaterMark schemes, or equivalent.

To consistently make satisfactory electrofusion joints, it is essential to follow the jointing procedure, emphasising pipe surface preparation, cleanliness, joint restraint during the fusion and cooling cycles, and temperature control.

Electrofusion is a skilled operation; several very specific procedures need to be carried out to achieve a successful joint. Tamboran will approve welding procedures before construction begins. All operators carrying out electrofusion welding will be trained by appropriate RTOs, meeting the prerequisite training requirements of PMBWELD 302.

Mechanical joints

Where fusion joints are not appropriate, mechanical fittings can be used, particularly for smaller polyethylene pipes. Three basic fittings can be used:

- Flanges
- Mechanical compression joints
- Mechanical couplings

When jointing of polyethylene pipe is required to other materials, a flanged joint is generally the most practical for field jointing. Otherwise, a material transition fitting can be considered and welded in.

Tamboran will preferentially use flanges for jointing to other materials, over other jointing methods, such as mechanical compression joints and mechanical couplings. A typical flange connection is shown in Figure 20.

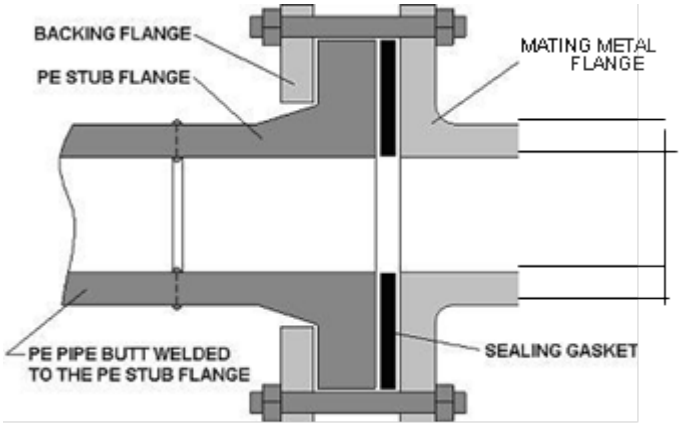


Figure 20: Typical flanged connection (source: APGA, 2019)

3.7.17.3 Buried pipeline trenching and bedding

For buried gathering lines, a trench will be excavated to a depth that will give 750 mm depth of cover (DOC) over the wastewater pipeline will be installed, except where the pipeline crosses an access track, where it will have a DOC of no less than 1200 mm.

Trench excavation will be carried out using a trenching machine, excavator with an attachment or similar. In both instances, the objective is to achieve a trench bottom free of rocks, stones or other material with an angular profile that may cause damage to the pipe and a trench profile in continuous contact with the pipe. When such conditions are achieved, the pipe will be laid directly on the trench bed; if this is not achievable from the direct trenching operations, bedding will be applied into the trench to achieve the same.

3.7.17.4 Pipe placement in trench

The pipe will be lowered into the trench without excessive strain and laid with sufficient slack to allow for contraction caused by temperature changes.

Polyethylene pipe up to approximately 160 mm diameter can usually be placed in the trench manually. Heavier, larger diameter pipe will require handling equipment to lift, move, and carefully lower the pipe into the trench.

3.7.17.5 Backfilling and compaction

After the pipe is laid into the trench, backfilling will commence using excavated material.

- The initial material will be screened to ensure it is free of rocks, stones or other material with an angular profile that may cause damage to the pipe.
- The balance of the trench will be backfilled and compacted using excavated material.
- Compaction shall be performed to ensure the required compaction level is achieved while ensuring that any stress placed upon the pipe is acceptable.
- The standard of backfill and compaction shall minimise subsequent soil movement and prevent subsidence of the trenched area.
- The permeability of the backfilled and compacted trench shall be like that of the unexcavated material to minimise damage along the trench invert and potential "tunnel' erosion.
- Where scouring could occur in a trench, barriers shall be installed to prevent scouring. Barriers shall be built of non-degradable foam, sandbags or other approved material.

3.7.17.6 Pressure/leak testing

All new components of the wastewater pipeline shall be subject to a pressure test to validate mechanical strength and detect leakage of the network before commissioning.

The polyethylene gathering networks' pressure testing will be broken into separate tests, i.e., a strength test and a leak test. The strength test proves the pipe's integrity and identifies any large leaks or defects in the network being tested. The leak test determines if there are any small leaks in the network. The leak test shall be undertaken after the successful completion of a strength test.

Due to the visco-elastic nature of polyethylene, it is not practical to conduct such tests in a manner that ensures no pressure change. Variations of atmospheric pressure, the temperature of the test fluid in the pipe, and material creep significantly affect the test pressure. Therefore, it is necessary to permit some drop in measured pressure over the test period.

All records of pressure, strength and leak testing shall be retained for each section of pipeline completed.

Pressure test safety

Pressure testing is considered one of the significant hazards in the development of a polyethylene network.

Pressure testing equipment will be fitted with regulators and pressure safety valves to ensure the pipeline is not over-pressured during testing. The primary safety control for pressure testing is quality assurance/quality control conformance, primarily in material selection and welding. The secondary safety control measure is the introduction and use of calculated exclusion zones.

Test plan

A test plan will be developed for all pressure tests. This plan can be a general document to cover most cases. However, in all cases, the test's risks and hazards shall be understood and managed.

The testing plan shall be able to:

- Ensure the implementation of all risk controls.
- Ensure that a job safety analysis is completed, and all items identified are adhered to.

- Ensure that all relevant equipment has a current calibration certificate from a recognised and certified testing agency.
- Ensure that all measuring equipment is located at a suitable distance from the test section to conform with exclusion zone requirements.
- Ensure that the EMP is followed for the disposal of the test fluids and other wastes.
- The person or persons responsible for the preparation of the test plan shall have appropriate qualifications and experience.

Strength test

- The strength test intends to prove the pipe's integrity and identify any large leaks or defects in the pipeline being tested. The pipe shall be considered to have passed the strength test if, at the end of the test period, the test section's pressure is above Maximum Allowable Operating Pressure (MAOP), and there is no evidence of a sudden pressure drop. After completing the strength test, the pipe shall then be subject to a leak test process.

The criteria for pneumatic strength testing is shown in Table 9.

Table 9: Strength test criteria (source: APGA, 2019)

Pneumatic strength test	Acceptance criteria
Starting pressure fp x MAOP Test pressure to remain between fp x MAOP and MAOP during the test.	Structural integrity maintained for 6 hours while pressure held between fp x MAOP and MAOP.

Leak test

The leak test intends to determine if there are any small leaks in the pipeline. The 24-hour leak test shall be undertaken after successful completion of a strength test.

Exclusion zones are generally not required for leak tests as the network has been proven to have adequate structural integrity with no significant leaks. However, it is recommended that exclusion zones be maintained around above-ground pipe sections and testing equipment to keep unauthorised people out of the area during leak testing activities.

The minimum starting test pressure at which the leak test is performed shall be the nominated MAOP of the test network.

The leak test may be completed with compressed air or raw water sourced from the Gum Ridge. Where hydrotesting is completed, approximately 75,000 L of water will be generated. The water will be managed in accordance with section 3.7.18.1.

The criteria for strength testing is shown in Table 10.

Table 10: Leak test criteria (source: APGA, 2019)

Pneumatic leak test method	Acceptance criteria
Allowable pressure loss (Pneumatic pressure decay test)	The acceptance volume loss is 1 litre/hour/actual m^3 volume of test fluid. NOTE: The word “fluid” in this context means air or another gaseous medium.

Pneumatic leak test method	Acceptance criteria
Details of this test method and calculations are described in CP-8-003 Leak Test Methods and Appendix B1 of the PEGN Code, respectively.	

3.7.17.7 Commissioning

Commissioning is broadly defined as the range of activities required between mechanical completion of the plant or network and its handover for operation; it involves introducing process fluids and the functional and performance testing of all related equipment and systems before handover.

Commissioning will always be preceded by acceptance pressure testing of the relevant network section. As this gathering network is very simple in design and operation, the commissioning plan will be equally simplistic.

Commissioning will ensure that both the polyethylene pipes and all associated facilities are checked and verified by a competent and qualified inspector to ensure that they are fit for the nominated operating envelopes for all gathering networks. Such facilities shall include valves, flanges, protective devices (pressure safety valves), electrical and instrumentation equipment where applicable.

The pipeline shall not be considered ready to commence or recommence operation until, as a minimum, the following checklist has been completed:

1. The strength and leak test requirements have been achieved and documented.
2. The MAOP has been established and pressure protection implemented.
3. If tie-in welds to existing facilities have not been subjected to the above, then such welds have been subjected to the requirements of Section 7.5.1 (including Appendix C), 7.7.1, 7.8 and 7.9 of the PEGN Code.
4. All components have been tested for satisfactory operation.
5. Sufficient operating, maintenance and emergency personnel have been trained and qualified as competent.

Records of the commissioning checklist for the pipeline line shall be retained, noting this may be incorporated into the broader SPCF commissioning document.

3.7.17.8 Operational flow monitoring and leak detection

The wastewater pipeline will be operated manually and remotely with flow meters installed to monitor wastewater flows. Valves will be located at the inlet and outlet to shut in the pipeline should a leak be detected.

Magnetic flow meters (or equivalent) are anticipated to be used on the inlet and outlet of the SPCF wastewater pipeline. The meters have an accuracy of ±0.2% to ±0.5% instrument span for each instrument during typical transfer operations. Pressure transmitters would also be utilised at the inlet and outlet with an accuracy of ±0.2% of instrument span. All meters shall be maintained in accordance with the manufacturer specifications to ensure accuracy.

A leak detection system (ATMOS Pipe or equivalent system) will be utilised to detect leaks from the line. This monitoring is based on volumetric balance measurement for leak detection during transfer operations.

The system response time for a gathering line (~250 m long) would be <10 minutes, based on a 1% leak.

The theoretical leak rate based on a response within 10 minutes is 1% x flowrate x 10min. Assuming a peak flowrate during initial flowback operations of 1.6 ML/day, the minimum detection would be 110 L.

A mass balance of flowback transfers over a 24-hour period will also be set up to detect sustained minor leaks.

The leak detection system will have alarms and automatic shut off protocols. Sites will have telemetry on selected valves to enable remote shut-off of gathering pipelines in the event of a leak alarm.

If there is a suspected leak detected, the system will alarm, and transfer operations stopped until the imbalance in flow is investigated and rectified. If the imbalance is the result of a spill from the pipeline, the system will not be restarted until the leak is repaired and an investigation is carried out as to how the leak occurred and how it will be prevented from re-occurring.

The reporting of any "wastewater gathering line leak" events from the gathering line network will be recorded and reported in line with the SMP (Appendix D).

3.7.17.9 Abandonment

The pipelines will be abandoned in accordance with the Code of Practice: Upstream Polyethylene Gathering Networks – CSG Industry (APGA, 2019).

The network shall be disconnected from all wastewater sources present in other pipes and flushed clear of wastewater into the wastewater tanks on Shenandoah S2.

All surface infrastructure and instrumentation shall be removed, and the pipeline removed using an excavator. The void will be backfilled with onsite material.

3.7.18 SPCF commissioning

Pre-commissioning of the facility involves pre-commissioning checks and development of procedures by a dedicated commissioning team. This stage is followed by equipment calibration and loop testing, control system checks and finally energisation of the facility.

The commissioning of the facility will consist of pressure testing the processing equipment, piping and valves throughout the plant. The pressure testing procedure will use clean water as the pressure medium and will include the following steps:

- Isolation and blinding of the equipment, pipe or valve that is undergoing the testing.
- Draining and venting of any fluids that are present.
- Inspecting the equipment for any visible damages or defects.
- Hydrotesting while venting of any trapped air to ensure a uniform pressure distribution during testing.
- Pressurisation of the water will occur at a predetermined rate.
- The equipment will hold the pressure for a predetermined time to detect any leaks or pressure drops.
- A visual inspection of the equipment will be conducted for any leaks, damage of deformation.
- Depressurisation occurs and a final inspection is conducted.

- The equipment is cleaned and dried to remove the water with hydrotest water managed in accordance with section 3.7.17.

The atmospheric pressure equipment of the plant will undergo water leak tests. Such components include water piping and valving, and tanks. This testing will include filling the equipment will water, holding the water in the equipment for a pre-determined time to detect any leaks.

This will be followed by a nitrogen purge to remove air and moisture from the facility's equipment before introducing the feed gas.

Gas commissioning involves the start-up and run tests of the compressors and TEG packages. Each of these packages will have a specific commissioning procedure specified by the vendor.

The first introduction of gas into the SPCF will involve a gradual introduction of gas replacing the nitrogen / purge gas used in the previous step. The gas will flow throughout the facility and be directed to the flare at the facility outlet, whilst confirming no leaks are present during this process.

Once no leaks are confirmed and instrumentations are online, the recycle valve will open and the flare valve will close to start-up the major packages in the plant (e.g. compressors and TEG packages). Once the gas has been confirmed to be on specification for sales gas export, the facility outlet valve will open and recycle valve will close.

Typical commissioning period is less than 4 weeks.

3.7.18.1 Hydrotesting water

Hydrotesting will be completed on pipe work within the plant to ensure any leaks are identified prior to commissioning. Most of the water used to perform hydrotesting (~15,000 L) will be re-used (e.g. for dust suppression), with any unused groundwater released through a controlled discharge to the SPCF sediment basin for release to the surrounding land. Where scale or corrosion inhibitors are added to water used in hydrotesting, the water will be directed to wastewater tanks or disposed of at a licenced wastewater facility.

The quality of the hydrotest water is likely to be similar the groundwater, with a pH of between 6.5 to 9, and an electrical conductivity of less than 1,600 µs/cm. A lower pH limit of 5.2 has been used as a basis for the limit, consistent with regional rainwater pH levels.

Where hydrotest water is proposed to be released from the site, it will be tested prior to discharge and records retained. The release limits are summarised in Table 11 and have been based upon previous modelling completed to assess the changing soil salinities and the potential for impact on the receiving vegetation types. The model used the maximum observed Gum Ridge Salinity of 1,600 µs/cm (1,046 mg/L Total Dissolved Solids) released over a 5-year period. These included estimates of stormwater collected and discharged from the site over the period. This modelling is extremely conservative as it: a) assumed all water ran off from the site and b) that all water was of a quality consistent with the Gum Ridge. In theory, the amount of water released from the site is likely to be significantly lower and of quality consistent with rainwater.

To understand the sensitivity of the receiving vegetation to salinity, a literature review was completed (EHS Support, 2024). The receiving environment is characterised by native grasses (including spinifex and tussock), with trees commonly found in the project area moderately to highly tolerant to salinity. Eucalyptus species are known for their salt tolerance and can withstand salinity levels up to 8,000 µs/cm (and greater). For example, *Eucalyptus camaldulensis* is present in the area and is tolerant to salinity up to

8,000 µs/cm.[6] Several of the eucalyptus species in the area including *Eucalyptus microtheca* and *Eucalyptus camaldulensis* are specifically noted in the Salinity Management Handbook (Queensland Government) as suitable for saline discharge sites.[7] Acacia and Melaleuca species found in the area can tolerate at least 2,000 µs/cm and greater than 16,000 µs/cm. *Corymbia* (Bloodwood) generally exhibit moderate to low salinity tolerance compared to eucalypts, but still greater than 2,000 µs/cm and up to 4,000 µs/cm.

The modelling confirmed that the salinity of the receiving soils post release is within the anticipated range for the receiving vegetation species (EHS Support, 2024).

Releases will be undertaken in a manner that prevents erosion or the discharge of groundwater directly to surface waters.

Table 11: Hydrotest discharge quality release limits

Monitoring parameter	Release limit
Electrical conductivity	1,600 µs/cm
pH	5.2 – 9.0
Volume	Record retained

3.7.19 Maintenance

The SPCF will be a manned facility with ongoing planned maintenance occurring in accordance with a maintenance schedule. During normal and routine operations, the SPCF will be crewed with operator/maintainers who will work on a FIFO/DIDO basis on a typical rotation of two to three weeks at the SPCF. A typical crew size for routine operations will be 3 – 5 operator/maintainers to cover 24 hour/7 day per week operations. Routine operations will include, but not be limited to, monitoring and controlling the wells, testing the individual well flow rates (water and gas), monitoring and controlling the SPCF process, routine maintenance such as changing lubricating oil, changing filters, performing critical function testing of safety critical equipment and managing chemical injection and chemical inventories.

More complex maintenance and repair activities will be conducted on a campaign basis with dedicated teams mobilised to the SPCF. Typical campaigns will be one to two weeks in duration covering planned maintenance activities (e.g. compressor maintenance). It is expected there would be two to three planned maintenance campaigns per year. Unplanned maintenance campaigns may also be required to repair unexpected breakdowns of equipment. Maintenance crew sizes would typically be 10 – 15 personnel, including specialist equipment such as cranes.

3.7.20 SPCF decommissioning

All infrastructure at the SPCF is required for the duration of the extended appraisal period, therefore decommissioning will occur at the end of appraisal period. Decommissioning, followed by rehabilitation (refer section 7.7) will take place in a planned sequence as some surface infrastructure will be required to support both phases (for example, the administration offices, ablutions facilities, fuel and chemical storages, camp). As such, these facilities will be removed towards the end of the rehabilitation phase. Gathering lines will be decommissioned / abandoned in accordance with section 3.7.17.9.

[6] https://www.agric.wa.gov.au/soil-salinity/salinity-tolerance-plants-agriculture-and-revegetation-western-australia.

[7] Table 43 Salinity Management Handbook, Queensland.

Most of the processing infrastructure associated with the SPCF will be modular/demountable and will therefore be able to be removed for re-deployment elsewhere or sold as an asset. As such, minimal waste will be generated during the decommissioning phase. The decommissioning of the facility will be a relatively straightforward and rapid process.

The majority of surface infrastructure for the SPCF will be constructed on engineered pile foundations with only small amounts of in-situ poured concrete. Decommissioning of the infrastructure at the SPCF will involve the following general steps (as noted above some infrastructure will be required to support the rehabilitation activities, therefore the implementation of these steps will be staggered):

- Demolition/removal of the following infrastructure to the natural ground level:
  - Built support infrastructure, including the workshop, stores, administration facilities, camp, etc, (including slabs, footings and services).
  - Built processing infrastructure including the compressors, separation equipment, and all other processing modules, above ground pipeline connections.
  - Removal of piled foundations.
  - Services transmission infrastructure where present – water/power etc.
- Undertake contaminated land assessment near hydrocarbon and chemical storage areas, as infrastructure areas represent the primary areas at the SPCF where contaminated material could potentially accumulate. Significant contamination is considered unlikely due to the incident reporting and management procedures in place during the operations, which require that hydrocarbon spills are contained, reported and remediated. In addition, all processing equipment is bunded in a way to capture any spilt hydrocarbons or chemicals.
- Undertake removal of contaminated material/other actions as determined by the contaminated land assessment.
- Removal of subsurface waste vessels – e.g. oil/water separator.
- Scalp surficial sheeting material from hardstand areas down to the engineered pad/subsoil level. All removed sheeting material will be disposed of appropriately.
- Remove surface sheeting (e.g. gravel sheeting) from carparks, laydown areas and access roads (where not being retained).
- Undertake earthworks to achieve required grades for all disturbed areas/pads (including pad surfaces and any cut/fill batters) where required. Pads will typically remain at the design grade (<2%), while any batters will be levelled to a maximum of 20% (or as otherwise designed by a suitably qualified person).
- Complete rehabilitation in accordance with section 7.7 and the Rehabilitation Management Plan (RMP) (Appendix L).

3.7.21 Wastewater management

Wastewater generated under this EMP is restricted to the SPCF process wastewater and incidental flowback water directed to the Shenandoah S2 wastewater storage area from the inlet separator. To avoid duplication between approvals, the management of flowback wastewater generated from extended appraisal is covered under the approved TAM1-3 EMP.

The following wastewater streams from the SPCF include:

- Water condensation and oily water from drip trays and bunds as described in sections 3.7.7 and 3.7.8.
- Water used for hydrotesting (section 3.7.18.1).
- Flowback wastewater separated within the SPCF inlet separation system defined in section 3.7.4.2. Noting that the SPCF does not produce flowback, rather it provides an additional separation point where any flowback encountered will be distributed to the Shenandoah S2 wastewater storage area.

A project-wide Wastewater Management Plan (WWMP) has been developed to manage wastewater generated under this EMP. The WWMP has been developed in accordance with the Code and covers all wastewater streams associated with Tamboran's broader exploration and appraisal program.

The SPCF or extended appraisal program does not materially increase wastewater volumes or types generated from the activity. As outlined above, flowback wastewater, predominantly generated in the first 90 days of extended appraisal activities, is accounted for in the approved TAM1-3 EMP. Volumes generated beyond 90 days of appraisal are expected to be small.

The following sections provides an overview of the wastewater management strategy, with further information provided in the WWMP (Appendix E).

3.7.21.1 Wastewater volumes

The SPCF wastewater volumes generated from liquids handling (oily water and condensation) under this EMP are estimated to be 0.03 ML/month.

Flowback wastewater volumes are consistent with the volumes described in the TAM1-3 EMP, with approximately 90% of anticipated flowback volumes previously accounted for. Under the extended appraisal for the SPCF, an additional 10% of the anticipated flowback will be generated from each well produced over the 36-month appraisal program.

Total wastewater storage volumes are expected to peak at 28 ML, which is less than the maximum figure of 34 ML predicted in the TAM1-3 EMP. This difference is based on the updated timing of the appraisal of wells within 2024 and 2025, and reduced wastewater recovery percentages (11% versus 15%) expected based on current Shenandoah S-1H well results.

3.7.21.2 Quality

The main wastewater stream from the SPCF will be residual flowback wastewater from the SPCF inlet separator. Separated flowback will be transfer over to the Shenandoah S2 wastewater tanks for storage. The quality of this water is expected to be consistent with the existing description of flowback wastewater provided in the TAM1-3 EMP. A summary of this wastewater quality is provided in Table 12.

Wastewater from other process areas within the SPCF and liquid handling (drainage) systems (from bunds and drip trays) will typically be low EC water (rainwater or Gum Ridge formation water used for washdowns) with trace levels of residual hydrocarbons. Process water will pass through oily/water separator and treatment process as described in section 3.7.8. The wastewater from these streams is anticipated to have a discharge quality of less than 5 parts per million (ppm) of hydrocarbons, complying with European Standard EN 858.1: 2006 (Separator Systems for Light Liquids).

Table 12: Indicative water quality based on flowback levels

Parameter	Flowback levels
BTEX compounds	Total BTEX levels are anticipated to be low. BTEX within the Shenandoah S-1H well flowback were below detection level. Low rang BTEX of several ug/L could be foreseeable µg/L
Total nitrogen (as N)	Maximum value of 61.1 mg/l observed within flowback at Shenandoah S-1H
Salinity (TDS)	Saline with maximum total dissolved solids levels of 35,000mg/L recorded
pH	Slightly acidic with a median pH value of 6.61
Major ions	Flowback predominantly Na (max 9,080mg/l) and Cl (max 16,700mg/l) dominated, with elevated Bromine (304Mg/L)
Dissolved metals	All detected dissolved metal concentrations within the flowback were low, except for barium (max 33.9 mg/L) and boron (max 22.2 mg/L)
PAH	All values in the flowback below laboratory Limit of Reporting (LOR)
Petrol hydrocarbons	All fractions of TPH are anticipated to be elevated (ug/l to mg/l levels)
Phenolic compounds	Low level of phenolic compounds detected in flowback- no phenols detected in Shenandoah S-1H well
Radionuclides	Maximum Gross Alpha Activity and Gross Beta Activity of 10.7 Bq/L and 7.49 Bq/L encountered in the flowback, the anticipated source is likely to be radium-226

3.7.21.3 Wastewater storage

Wastewater management of volumes separated and transferred from the SPCF will be integrated into the broader Tamboran Shenandoah S2 and Beetaloo Basin wastewater management framework. All wastewater produced by the project will be transferred to the wastewater storage tanks on Shenandoah S2 well pad constructed and operated under the TAM1-3 EMP.

Enclosed tank and treatment capacity will be managed (added or removed) to meet operational and mandatory Code requirements, as outlined under the approved TAM1-3 EMP. The wastewater storage volume onsite peaks at approximately 28 ML in 2026 coinciding with the commissioning of the plant and wells, reducing to 1.3 ML in early 2029. These figures are highly conservative and are consistent with the estimates provided in the approved TAM1-3 EMP.

Depending on the tank design, some may be periodically converted to enclosed tanks (have lids installed) and vice versa, as flowback volume increase/decrease. This ensures maximum evaporation potential, whilst ensuring sufficient enclosed tank storage is available at any point in time.

Anticipated wastewater storage volumes and tank numbers are provided in Table 13. Total maximum available open and enclosed wet season flowback storage on Shenandoah S2 (excluding freeboard) is predicted to be ~65.6 ML, approximately double the predicted flowback generated on site and sufficient capacity to contain the annual wastewater volumes generated by the SPCF. Tank capacity will vary depending on the stages of operation at the site, including operation of the SPCF. Once recovery rates are known, wastewater storage volumes may be optimised (removed or added).

During the dry season, flowback is treated in open treatment tanks to reduce the wastewater volume as much as possible. Enclosed tanks will be constructed on-site with enough capacity to store the 1:1000 ARI wet season freeboard for all open flowback wastewater tanks operating on-site (effectively doubling onsite freeboard). The total available dry season open, and enclosed wastewater tank storage volume per site (accounting for freeboard) is ~72.5 ML, which is sufficient capacity to contain the annual wastewater volumes generated by the SPCF.

Tamboran will continue to manage freshwater and flowback volumes across the basin by transferring between inventories between sites to enable the use of existing storage infrastructure. Flowback and other wastewater will be transferred between the wastewater gathering network (refer section 3.7.3). Periodic trucking to off-site approved disposal locations and to other approved exploration sites within the Basin may also be undertaken to manage fluid levels.

Additional information regarding wastewater management during the wet season and dry season, is provided in the following section.

Table 13: Anticipated maximum wet season and dry season wastewater tank set-up, operating capacity and freeboard levels

Tank type	Tank dimensions (m^2)	Tank maximum operating capacity (ML)	Tank wet season freeboard volume (ML)	Total storage availability (ML) (minus freeboard)
Wet season				
5 x 13 ML C ring enclosed tanks (bladders)	3,629	13.0	N/A	51.0
2x 5.3 ML enclosed tanks (contingent tank type used for additional ad hoc storage)	3,058	5.3	N/A	8.6
3 x 5.3 ML open treatment tanks	3,058	2.0	2.0	6.0
Total tank storage capacity (minus freeboard)				**65.6**
Dry season				
5 x 13 ML C ring enclosed tanks (bladders)	3,629	13.0	N/A	51.0
2x 5.3 ML enclosed tanks (contingent tank type used for additional ad hoc storage)	3,058	5.3	N/A	8.6
3 x 5.3 ML open treatment tanks	3,058	4.3	1.0	12.9
Total tank storage capacity (minus freeboard)				**72.5**
NOTE: All tanks, enclosed or open have a maximum operating level, which is taken into account in the total storage availability volume.				

3.7.21.4 Wastewater operating and disposal strategy

The key focus of managing wastewater from the SPCF will be the efficient separation and transfer of wastewater to the Shenandoah S2 wastewater storage area via the wastewater pipeline (section 3.7.17). Leak detection and routine inspections on this pipeline will ensure any leaks are promptly identified and rectified.

Once wastewater is transferred to the Shenandoah S2 wastewater storage area, it will be managed under the approved TAM1-3 EMP and the WWMP (Appendix E). All water from the SPCF will be considered as flowback and managed accordingly.

3.7.22 Site water balance

A water balance has been prepared updating the anticipated volumes of water to be generated under the operation of the SPCF and extended appraisal program. Estimates cover the camp sewage treatment

facilities, SPCF process wastewater and well flowback. This water balance should be considered indicative and designed to provide a general overview of the main wastewater volumes generated during the activity. Actual water volumes generated and stored are affected by a range of variables, including climatic variables, time of year activities are completed, number of wells brought online at one time, flowback recovery rates, stimulation volume etc.

Maximum volumes of wastewater generated from the Project are expected to be consistent with the existing approved TAM1-3 EMP, peaking at 10.7 ML in 2026. As outlined above, the generation of process wastewater from the SPCF itself is anticipated to be minor and will not affect the wastewater balance outlined in the existing approved TAM1-3 EMP.

The water balance includes predicted average monthly rainfall and evaporation rates for the region to generate evaporation rates from open tanks.

A summary of the site water balance for the Project is provided in Figure 21.

Summary	Month	2024 Jul	2024 Aug	2024 Sep	2024 Oct	2024 Nov	2024 Dec	2025 Jan	2025 Feb	2025 Mar	2025 Apr	2025 May	2025 Jun	2025 Jul	2025 Aug	2025 Sep	2025 Oct	2025 Nov	2025 Dec
Raw Water usage																			
SPCF civil construction	ML				0.5	0.5		0.5			0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SPCF construction camp	ML				0.5	0.5	0.5				0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
SPCF operation	ML																		0.6
SPCF camp	ML																		0.2
Dust suppression	ML				0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Total	**ML**				**1.6**	**1.6**	**1.1**	**1.1**	**0.6**	**0.6**	**1.5**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**2.4**
Wastewater generated																			
From wells	ML				7.9	4.8	1.6	1.1	0.2	0.2	0.0	0.0	7.9	0.0	0.0	0.0	8.1	0.0	0.0
SPCF wastewater	ML																		
Camps	ML				0.5	0.5	0.5	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	**ML**		**0.0**	**0.0**	**8.4**	**5.2**	**2.1**	**1.1**	**0.2**	**0.7**	**0.5**	**0.5**	**8.4**	**0.5**	**0.5**	**0.5**	**8.6**	**0.5**	**0.5**
Wastewater storage onsite																			
Wastewater tanks	ML				6.1	9.0	9.5	9.9	9.9	9.2	7.8	6.3	13.0	11.7	10.0	8.2	14.4	12.7	11.5
Total onsite wastewater	**ML**				**6.1**	**9.0**	**9.5**	**9.9**	**9.9**	**9.2**	**7.8**	**6.3**	**13.0**	**11.7**	**10.0**	**8.2**	**14.4**	**12.7**	**11.5**
Wastewater trucked offsite	ML																		

Summary	Month	2026 Jan	2026 Feb	2026 Mar	2026 Apr	2026 May	2026 Jun	2026 Jul	2026 Aug	2026 Sep	2026 Oct	2026 Nov	2026 Dec	2027 Jan	2027 Feb	2027 Mar	2027 Apr	2027 May	2027 Jun	2027 Jul	2027 Aug	2027 Sep	2027 Oct	2027 Nov	2027 Dec
Raw Water usage																									
SPCF civil construction	ML																								
SPCF construction camp	ML																								
SPCF operation	ML	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
SPCF camp	ML	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Dust suppression	ML	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	**ML**	**1.0**	**0.9**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**0.9**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Wastewater generated																									
From wells	ML	9.5	6.4	2.2	10.2	5.1	1.5	0.5	0.2	8.0	4.8	1.9	1.1	0.2	0.2	0.2	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SPCF wastewater	ML	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Camps	ML	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Total	**ML**	**10.1**	**6.9**	**2.8**	**10.7**	**5.6**	**2.0**	**1.0**	**0.7**	**8.5**	**5.3**	**2.5**	**1.7**	**0.7**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**
Wastewater storage onsite																									
Wastewater tanks	ML	20.4	26.5	28.0	8.7	12.3	12.5	11.7	10.2	16.4	19.3	19.5	19.5	19.0	19.0	18.4	17.0	15.6	14.4	13.0	11.5	9.7	7.9	6.2	5.1
Total onsite wastewater	**ML**	**20.4**	**26.5**	**28.0**	**8.7**	**12.3**	**12.5**	**11.7**	**10.2**	**16.4**	**19.3**	**19.5**	**19.5**	**19.0**	**19.0**	**18.4**	**17.0**	**15.6**	**14.4**	**13.0**	**11.5**	**9.7**	**7.9**	**6.2**	**5.1**
Wastewater trucked offsite	ML																								

Summary	Month	2028 Jan	2028 Feb	2028 Mar	2028 Apr	2028 May	2028 Jun	2028 Jul	2028 Aug	2028 Sep	2028 Oct	2028 Nov	2028 Dec	2029 Jan	2029 Feb	2029 Mar	2029 Apr	2029 May	2029 Jun	2029 Jul	2029 Aug	2029 Sep	2029 Oct	2029 Nov	2029 Dec
Raw Water usage																									
SPCF civil construction	ML																								
SPCF construction camp	ML																								
SPCF operation	ML	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SPCF camp	ML	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dust suppression	ML	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**ML**	**1.0**	**0.9**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**0.4**	**0.4**										
Wastewater generated																									
From wells	ML	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SPCF wastewater	ML	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Camps	ML	0.5	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4										
Total	**ML**	**0.6**	**0.5**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.5**	**0.4**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Wastewater storage onsite																									
Wastewater tanks	ML	4.5	4.3	3.5	2.2	2.2	1.6	1.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0									
Total onsite wastewater	**ML**	**4.5**	**4.3**	**3.5**	**2.2**	**2.2**	**1.6**	**1.0**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**									
Wastewater trucked offsite	ML																								

Figure 21: Indicative water balance for the SPCF

3.7.23 SPCF stormwater management

The SPCF site will be operated in a manner that minimises the contamination of stormwater and overland flow. Stormwater is typically characterised by low electrical conductivity (<100 µs/cm) and will contain sediment sourced from the cleared Project area. The following describes how stormwater is managed on the site:

- The SPCF pad has been designed to divert stormwater around the pad to prevent contamination.
- The majority of the SPCF pad is sheeted with gravel for all-weather access, which limits the exposure of erodible material.
- The SPCF will be separated from the adjacent Shenandoah S2 wastewater storage area.
- Stormwater will be diverted to a sediment basin on the SPCF site to allow suspended solids from collected stormwater to settle prior to spilling to the surrounding area.
- Sediment basins will be tested weekly during the wet season and per release event during the dry season for parameters defined in Table 14.
- All stormwater above the specified limit will be treated as wastewater and pumped to the wastewater tanks on Shenandoah S2 to be managed in accordance with section 3.7.20.
- Erosion and sediment control plan (ESCP) implemented (Appendix F).

Table 14: Stormwater off-site release and dust suppresion re-use limits

Monitoring parameter	Release limit
Electrical conductivity	1,600 µs/cm
pH	5.2 – 9.0
Visible hydrocarbons, sheens, foaming or discolouration.	No visible oil, grease or other hydrocarbons No visible foams caused by surfactants and detergents No visible abnormal discoloration

3.7.24 Stormwater limit justification

The main purpose of monitoring stormwater quality is to identify if stormwater runoff quality has been impacted by either wastewater, oil or chemicals stored / managed onsite.

Flowback has an elevated electrical conductivity (EC) of ~32,000 µs/cm and spills / leaks will result in stormwater being elevated. The conductivity is approximately 1,000 times higher than rainwater, which was tested at 33 µs/cm at Daly Water on the March 20, 2024.The difference in EC between rainwater, stormwater and other water used on site (such as the Gum Ridge formation) makes it the most suitable indicator.

EC measurements can be easily collected using standard equipment, is reliable and reproducible. Should the EC of stormwater collected in the sediment basin be exceeded, this will be recorded as an incident, fluid transferred to wastewater tanks, an investigation onto the source of the contamination initiated (such as inspection of wastewater tanks and chemical storages) and additional laboratory testing will be undertaken to determine the source of the elevated level. The stormwater will be tested in accordance with the suite identified in C.8 of the Code. Laboratory testing is not considered an appropriate method of confirming contamination given the long sample analysis times and the inability to hold stormwater for extended periods without impacting the integrity of the site.

The proposed limit of 1,600 µs/cm was chosen as this aligned with the EC of the Gum Ridge formation (the main source of water used on proposed sites and the ANZECC short term irrigation guideline value for moderately sensitive crops (Table 9.2.5 of the ANZEC Guidelines (2000) Volume 3, Chapter 9, Primary industries). The Gum Ridge water is used in construction water, dust suppression and is discharged to the sediment basin as a part of the facility hydrotesting (where the water is not practicable to be re-used). Thus, placing a separate limit on the sediment basin for stormwater and hydrotest water would be extremely difficult.

Irrigation salinity values were considered relevant due to the absence of adjacent watercourses, with the protection of soils the most relevant environmental value (EV). The ANZECC method (and associated references) is the only method available in Australia to evaluate the potential risk of application of water to land. The methods evaluate the impact of water to receptors such as terrestrial ecosystems, crops, and stock. The method is used across Australia for this kind of evaluation.

To assess the potential impact of a stormwater release at the specific limit, modelling was completed to assess the changing soil salinities and the potential for impact on the receiving vegetation types. The model used the maximum observed Gum Ridge Salinity of 1,600 µs/cm (1,046 mg/L Total Dissolved Solids) released over a 5-year period. These included estimates of stormwater collected and discharged from the site over the period, as well as the periodic release of hydrotest water. This modelling is extremely conservative as it: a) assumed all water ran off from the site; and b) that all water was of a quality consistent with the Gum Ridge Formation. In theory, the amount of water released form site is likely to be significantly lower and of quality consistent with rainwater.

To understand the sensitive of the receiving vegetation to salinity, a literature review was completed. the receiving environment is characterised by Native grasses (including spinifex and tussock), with trees commonly found in the project area are moderately to highly tolerant to salinity. Eucalyptus species are known for their salt tolerance and can withstand salinity levels up to 8,000 µs/cm and greater. For example, *Eucalyptus camaldulensis* is present in the area (Table 19 of the Land Condition Report) is tolerant to salinity up to 8,000 µs/cm.[8] Several of the eucalyptus species in the area including *Eucalyptus microtheca* and *Eucalyptus camaldulensis* are specifically noted in the Salinity Management Handbook (Queensland Government) as suitable for saline discharge sites.[9] Acacian and Melaleuca species found in the area can tolerate at least 2,000 µs/cm and greater than 16,000 µs/cm. *Corymbia* (Bloodwood) generally exhibit moderate to low salinity tolerance compared to eucalypts, but still greater than 2,000 µs/cm and up to 4,000 µs/cm.

Modelling of 3 scenarios in accordance with ANZECC defined methodology was undertaken using meteorological data, indicative well site and indicative data on receiving soils. The scenarios included:

1. During wet season operations (October to April inclusive). Water is only associated with rainfall.
2. Hydrotest during wet season operations (October to April inclusive). Conservatively assumes hydrotest is undertaken during the wettest months (e.g. December to April inclusive).
3. Hydrotesting during the dry season. Negligible rain.

[8] https://www.agric.wa.gov.au/soil-salinity/salinity-tolerance-plants-agriculture-and-revegetation-western-australia

[9] Table 43 Salinity Management Handbook, Queensland

The results of the modelling indicates the maximum root zone salinity will be in the order of 1.6 dS/m (for a sandy loam) to 1.7 dS/m (for a clay). This is below the likely vegetation root zone salinity of the vegetation type in the area as previous discussed.

Elevated levels of Na^+ in irrigation water can lead to sodicity problems in the soil profile under irrigation. An estimation of sodicity levels in irrigation water can be predicted using the sodium adsorption ratio (SAR). This is calculated using the following equation, where ionic concentrations are in mmolec/L:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}} \quad (4.2)$$

The inputs and results are shown in Table 15. The SAR calculated from the analytical results for sodium, magnesium, and calcium is consistent with that reported by the laboratory (2.24).

Table 15: Calculation of sodium adsorption ratio (SAR) based on observed Gum Ridge

Parameter	Average value	Maximum value	Comment
Sodium (Na)	87 mg/L	107 mg/L	
Calcium (Ca)	72 mg/L	109 mg/L	
Magnesium (Mg)	33 mg/L	49 mg/L	
Sodium	3.8 meq/L	4.6 meq/L	Conversion – divide by 23
Calcium	3.6 meq/L	5.4 meq/L	Conversion – divide by 20
Magnesium	2.7 meq/L	4.0 meq/L	Conversion – divide by 12.2
SAR	= Na[] / sqrt((Ca[] + Mg[])/2) = 2.1	= Na[] / sqrt((Ca[] + Mg[])/2) = 2.1	Inputs in meq/L

The SAR for the Gum Ridge Formation was calculated at 2, which when combined with the EC values, falls to the right of the dashed line of the figure provided in the ANZECC guideline below (Figure 22). This result indicates that the release is unlikely to cause soil structural problems.

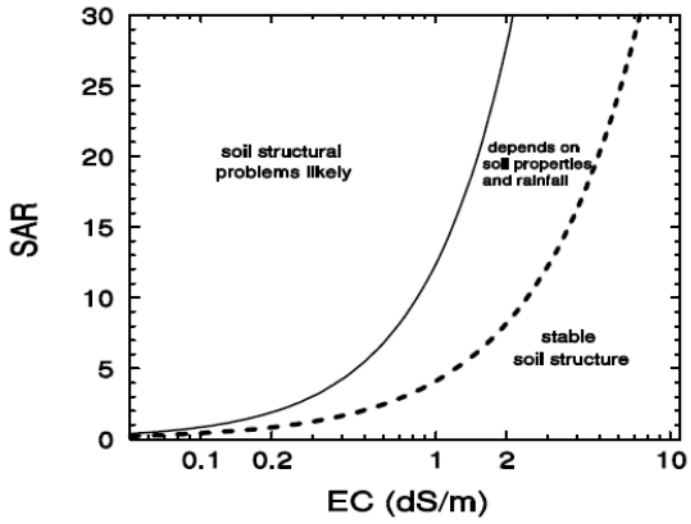


Figure 22: Relationship between SAR and EC of irrigation water for prediction of soil structural stability (from DNR 1997a, adapted from DNR 1997b; note that 1 dS/m = 1,000 µS/cm)

The proposed pH limit is a suitable indicator for a range of chemicals used in the process, including acids (hydrochloric acid, hypochlorite, acetic acid, etc) and bases (sodium hydroxide). The proposed minimum pH is reflective of observed regional rainfall pH levels, with pH levels of 5.24 observed at Daly Waters on 20 March 2024. Tamboran has observed pH levels on its enclosed tank lids and sediment basins around the pH of 5 level. Given the large volume of rainwater that falls on a site in a very short period, the pH in the sediment basin is anticipated to be low, before increasing as they interact with the receiving soils. This has been observed in sediment basins onsite, with pH increasing from 5.2 to 6.5 over several hours after a rainfall event due to the low buffer capacity of rainwater. Given the existing pH of rainwater is approximately 5.2, we believe this to be an appropriate release limit for stormwater.

The proposed visible limits are designed to identify visual evidence of contamination, primarily associated with onsite storages/usage of fuels, oils, and chemicals (such as oils, coolants, glycols etc). This combined with the pH and EC limit, ensure the majority of chemicals are likely to be detected, including all wastewater streams.

When assessing whether the release limit could result in wastewater being released from the site, the following should be considered.

- The salinity difference between wastewater and stormwater is significant and will result in rapid increases in salinity should contamination occur.
- The code requires mandatory inspection of tanks and secondary containment during the wet season- leaks and spills will be detected daily.
- Wastewater is not authorised to be released to waters- it is prohibited under the Water Act and Code.
- any large spill would be detected, limiting the potential impact of an event.
- Any small leak impacting site stormwater quality is anticipated to be small and temporary. The leak would be detected promptly through other inspection and wastewater tracking mechanism.
- The modelled salinity at the limit for 5 years does not result in a changed soil salinities beyond the sensitivity of the receiving vegetation.

- The presence of other metals or metalloids would be diluted by either the size of the spill and/or the volume of stormwater runoff. Given the short nature of the release and likely dilution, these are not anticipated to represent any material risk of harm.

3.8 Chemical and fuel management

Several chemicals will be used during the separation and gas processing phases in the SPCF. All chemicals used in Australia must be approved for use by the Federal Government Department of Health and be listed on the Australian Inventory of Chemical Substances (AICS) which is maintained under the National Industrial Chemicals Notification and Assessment Scheme (NICNAS).

3.8.1 Chemical types

Fuels and chemicals will be stored in bunded facilities and in accordance with Australian Standards and the relevant safety data sheet specifications. All refuelling facilities, or storage facilities for hydrocarbons and chemicals will be in appropriately designed sites and comply with relevant Australian Standards, codes and Workplace Health and Safety requirements (e.g. *AS 1940: The storage and handling of flammable and combustible liquids*). Materials will be stored within bunded areas with a storage capacity of 110% of the largest storage vessel. Bunding will have floors and walls lined with impermeable material.

Fuels and chemicals used on site and approximate volumes, include:

- Lubricants: ~6,600 L/pa
- Triethylene glycol ~150,000 L/pa
- Methanol 36,000 L/pa
- H_2S scavenger 160,000 L/pa
- Biocide: 2,000 L/pa
- Bulk diesel: to fuel equipment and generate power: 50,000 L/pa.
- Engine coolants: ~25,000 L/pa
- Hydraulic oil: ~25,000 L/pa
- Engine oil: ~10,000 L/pa
- Typical workshop and maintenance chemicals including greases, paints, solvents and other oils: 100 L/pa each.
- Degreasers and domestic cleaning chemicals: 200 L/pa.
- Corrosion inhibiters: prevents equipment from rusting: 9,000 L/pa.
- Chemical inhibitors: such as iron or scale prevention: not planned but may be required based on production experience ~5,000 L/pa
- Condensate: trace levels only in the produced gas expected.

3.9 Groundwater supply and use

Water sourced for the EMP activities will be extracted from the existing Gum Ridge Formation bores at Shenandoah S2. An average of 11.3 ML/year of water will be extracted from the Gum Ridge Formation to support the Project per annum (Table 16).

Table 16: Predicted water take per annum

Year	ML/annum
2024	4.3
2025	17.4
2026	11.6
2027	11.6
2028	11.6
2029	0.8
Total	57.2

The anticipated groundwater take over the life of the Project consists of the following breakdown per activity:

- 11.9 ML for camp operations
- 22.7 ML civil construction, dust suppression
- 22.6 ML general SPCF operations

The extraction of water for all activities associated with this Project will be covered under Tamboran's current Water Extraction Licence (WEL) GRF10285, which permits the take of 450 ML/year from the Gum Ridge Formation. The current WEL (450 ML/annum) statement of reason is available from DEPWS Water Resources website at http://www.ntlis.nt.gov.au/walaps-portal/report/current/gwel.

The approved groundwater take of 450 ML/annum from the Gum Ridge Formation, represents 5.6% of the 8,000ML/annum allocated available groundwater take from the Gum Ridge Formation for the petroleum industry for the Georgina Basin water management zone (NTG, 2024a). Modelling completed to support the recent increase to GRF10285 confirms that the proposed increased take will not cause any material reductions in water levels. The impact assessment for Tamboran's WEL is publicly available as a part of the Notice of Intent : https://www.ntlis.nt.gov.au/walaps-portal/documents/application/41291402?tags=NOD,NOI,SOD.

All groundwater take will be metered with continuous flow meters and reported to DEPWS as per the WEL conditions. Water take records will be retained to ensure the water take volumes are not exceeded. Groundwater will be used to supply potable water, with on-site water treatment used to provide water in accordance with the Australian Drinking Water Guidelines.

3.10 Routine site maintenance

Civil maintenance will be performed periodically to ensure the site remains functional, safe and non-polluting. Activities to be completed periodically include:

- Vegetation management on the SPCF pad
- Firebreak maintenance
- Access track resurfacing and maintenance
- SPCF pad resurfacing
- Water extraction bore maintenance
- Erosion and sediment control maintenance and repair

- Weed management

3.11 Greenhouse gas emissions

Long term appraisal data is required to demonstrate the commerciality of onshore shale production. This data is critical in understanding the production profiles of the shales, to ensure that any decision to invest substantial capital into a full-scale development has a high degree of commercial and technical certainty.

With the success of the Shenandoah S -1H well, Tamboran now intends to undertake longer term (up to 36 month) appraisal of wells on the Shenandoah S2 and Kyalla 117 N2 sites. These wells will be drilled, stimulated with data gathered progressively under the approved the TAM1-3 EMP.

To minimise the generation of scope 1 greenhouse gas emissions through flaring, the SPCF will be constructed to allow appraisal to be beneficially used rather than flared. The SPCF will compress and dehydrate the gas, prior to it being discharged into the proposed APA Sturt Plateau Pipeline where it will be sent to Darwin for domestic electricity supply via the AGP.

The annual summary of emissions is provided in Table 17. The detailed breakdown of all emissions is provided in Table 18. The maximum emissions generated during the operation of the SPCF is anticipated to peak at approximately 58,000 tCO_2-e in the financial year (FY) 2026 period. Based on the current emissions estimates, the emissions from the operation of the SPCF are unlikely to exceed the NT Large Emitter Policy and NGERS Safeguard Mechanisms 100 $ktCO_2$-e trigger.

The SCPF will consist of modern gas fired compression facilities with the design focusing on avoidance of venting and flaring to minimise emissions. The avoidance of venting will primarily focus on selecting low emission technology, such as low emission compressor rod packing seals and the use of instrument air powered pneumatic pumps, instrumentation and valves. Flaring will be avoided by field shut-ins during SPCF upsets and maintenance. Unlike wells drilled into other unconventional gas resources (such as coal seam gas), shale wells can typically be shut-in rapidly and for extended periods without any material reduction in performance. This allows the field to be shut-in during plant upsets or maintenance, avoiding the need for flaring. A small allocation has been made each year to accommodate up to 14 days of flaring total. This allocation is designed to provide a level of flexibility where flaring may be required to support the operation of the facility (i.e. during plant commissioning, testing or specific maintenance activities). Performance measures have been included in section 6.6 to track the commitment to limit flaring.

Emissions associated with power generation are the second largest emission source from the Project, which are difficult to avoid where there is limited access to local electricity generation or transmission infrastructure. To power the compressors and ancillary infrastructure, approximately 3% of the produced gas will be used for onsite power generation. In the future, electrified compressors are likely to further lower the scope 1 emissions intensity of compression facilities. This will require significant investment into local/renewable energy generation and transmission, which is not feasible to be delivered during a small scale, temporary appraisal gas sale program such as the SCPF.

The broader emission reduction strategies for the Project will be implemented under a Methane Emission Management Plan (MEMP) which is provided in Appendix G. A summary of the abatement measures include:

- Appraisal gas beneficially used rather than flared which is expected to reduce appraisal scope 1 emissions by approximately 95%, avoiding up to 1.1 million tCO_2-e per year compared to flaring.
- No routine flaring from the SPCF during operation; wells will be shut-in during compressor plant trips to reduce flaring.

- All pneumatic devices and chemical injection pumps within the SPCF are instrument air powered, with no gas used (Code D.5.7.2 (c)).
- Flanges, valves and fittings are all API compliant and gas tight (Code D.5.9).
- Hydrotesting and pressure testing of SPCF equipment to ensure any leaks are identified and fixed prior to commissioning (Code D.5.9).
- Restrictions on venting, with no routine cold venting (Code D.5.9).
- Compressor rod packings to be replaced every 26,000 hours or 36 months, whichever is sooner (Code D.5.7.2 (b)).
- Compression and equipment blowdowns sent to flare to mitigate venting.
- Quarterly leak detection and repair program on the SPCF to detect, repair and report leaks (Code D.5.3).

In addition to monitoring emissions from drilling, stimulation and well testing activities, baseline assessments have been completed by CSIRO in the vicinity of the well pad as per the Code.

Table 17: EMP estimated greenhouse gas emissions breakdown per financial year, including offset requirements

Emission financial year	SPCF emissions (tCO_2-e)
FY 2025	4,081
FY 2026	50,709
FY 2027	58,078
FY 2028	58,077
FY2029	29,935
Total	**200,880**

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Table 18: Greenhouse gas calculation for the proposed activities

Activity	Anticipated volume	Anticipated tCO2-e)	Estimate methodology and assumptions
Diesel combustion – civil construction, foundations and plant construction	1,300 KL	3,116.5	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 – camps	905 KL	4430	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 – SPCF operations back-up generator	200 KL	210.8	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

Activity	Anticipated volume	Anticipated tCO2-e)	Estimate methodology and assumptions
Diesel combustion – transport to cover the Project mobilisation and transport activities	354 KL	1245	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
Fugitive emissions – onshore natural gas wellheads	50 TJ/day	1265.5	NGERS Determination - 3.73A Method 1—onshore natural gas production, other than emissions that are vented or flared—wellheads • CO_2 Factor $1.32x10^{-3}$ tCO_2-e/ equipment hour • CH_4 Factor $2.60x10^{-6}$ tCO_2-e/ equipment hour
Fugitive emissions – separators	2 separators	63	NGERS Determination -3.73LA Method 2—natural gas gathering and boosting, other than emissions that are vented or flared—natural gas gathering and boosting stations – gas separators • CO_2 Factor $1.24x10^{-3}$ tCO_2-e/ equipment hour • CH_4 Factor $3.08x10^{-6}$ tCO_2-e/ equipment hour Assumes 95% equipment availability.
Fugitive emissions from gathering pipeline	4.5 km	78.5	1. NGERS Determination 3.73LB Method 2—onshore natural gas production, other than emissions that are vented or flared—onshore gas gathering and boosting pipelines Onshore has gathering and boosting pipeline (plastic) • CO_2 Factor $6.99x10^{-4}$ tCO_2-e/ hour/km of gathering pipeline • CH_4 Factor $2.85x10^{-6}$ tCO_2-e/ hour/km of gathering pipeline 2. 4.5km of gathering between Kyalla 117 N2 and Shenandoah S2
Fugitive emissions from wastewater	53.6	72	1. NGERS Determination: 3.73NB Method 2—produced water (other than emissions that are vented or flared) 2. Emissions factor WP × 0.0016 + 0.4342

Activity	Anticipated volume	Anticipated tCO2-e)	Estimate methodology and assumptions
			3. Assume 750PSI separator pressure and 20,000mg/L TDS
Fugitive emissions – reciprocating compressor	5	555	1. NGERS Determination -3.73LA Method 2—natural gas gathering and boosting, other than emissions that are vented or flared—natural gas gathering and boosting stations Reciprocating compressors • CO_2 Factor $1.14x10^{-4}$ tCO_2-e/ equipment hour • CH_4 Factor $4.6x10^{-2}$ tCO_2-e/ equipment hour Assumes all (5) reciprocating compressors are constructed and operational for 95% of time.
Fugitive emissions – compressor start up emissions	15 events	905.6	Subdivision 3.3.9A.9—Natural gas production—emissions that are vented—vessel blowdowns, compressor starts and compressor blowdowns Table 6-33 Gathering sediment emission factor for other non-routine releases. Compressor starts 0.16/tonnes CH4/ start
Fugitive emissions – metering stations	1 station	23	1. NGERS Determination -3.73LA Method 2—natural gas gathering and boosting, other than emissions that are vented or flared—natural gas gathering and boosting stations metering installations and associated piping • CO_2 Factor $2.45x10^{-6}$ tCO_2-e/ equipment hour • CH_4 Factor $9.86x10^{-4}$ tCO_2-e/ equipment hour
Fugitive emissions – TEG dehydration emissions	50 TJ/day	8462.5	NGERS Determination: Division 3.3.9C- Natural gas processing (emissions that are vented or flared). Section 3.88G Method 1- emissions from system upsets, accidents and deliberate releases from process vents- gas processing API Compendium of GHG Emissions Methodologies for the Natural Gas and Oil Industry Table 6-17 Production segment uncontrolled gas dehydration methane emission factors excludes glycol gas-assisted pump emissions 0.18667 tonnes CH4/106 sm3 gas processed • Methane % converted from 78.8% to 92% (92%/78.8%)
Fugitive emissions – pressure relief valves	20 valves	0.4	NGERS Determination: Division 3.3.9C- Natural gas processing (emissions that are vented or flared). Section 3.88G Method 1- emissions from system upsets, accidents and deliberate releases from process vents- gas processing API Compendium of GHG Emissions Methodologies for the Natural Gas and Oil Industry Table 6-17 Production segment uncontrolled gas dehydration methane emission factor excludes glycl gas-assisted pump emissions 0.18667 tonnes CH4/106 sm^3 gas processed

Activity	Anticipated volume	Anticipated tCO2-e)	Estimate methodology and assumptions
			• Converted to 92% methane (92/78.8%)
Fugitive emissions – equipment vents	6.7 kg/hr	4907.6	NGERS Determination: Division 3.3.9C- Natural gas processing (emissions that are vented or flared). Section 3.88G Method 1- emissions from system upsets, accidents and deliberate releases from process vents- gas processing API Compendium of GHG Emissions Methodologies for the Natural Gas and Oil Industry API 6.4.6.1 Equipment and process blowdowns) Compressor distance piece vent (2 vents @ 3 kg/hour), oily water separator vent (1 vent @ 0.5 kg/hr, GC and moisture analyser vent (2 @ 0.1 kg/hr)
Fugitive emissions – flanges	450 flanges	868.5	1. NGERS Determination -3.73C Method 3—natural gas gathering and boosting, other than emissions that are vented or flared—natural gas gathering and boosting stations- Flanges- gas production • CO_2 Factor $4.78x10^{-8}$ tCO_2-e/ equipment hour • CH_4 Factor $1.23x10^{-5}$ tCO_2-e/ equipment hour 2. Engineering estimate of number of flanges through the plant- 450 flanges
Fugitive emissions – valves	100 valves	8.65	1. NGERS Determination -3.73C Method 3—natural gas gathering and boosting, other than emissions that are vented or flared—natural gas gathering and boosting stations- Valves gas production • CO_2 Factor $4.21x10^{-7}$ tCO_2-e/ equipment hour • CH_4 Factor $1.08x10^{-4}$ tCO_2-e/ equipment hour 2. Engineering estimate of number of valves through the plant- 100 valves.
Fugitive emissions – equipment blowdowns without flare	3 events	789.6	NGERS Determination: Division 3.3.9C- Natural gas processing (emissions that are vented or flared). Section 3.88G Method 1- emissions from system upsets, accidents and deliberate releases from process vents- gas processing API Compendium of GHG Emissions Methodologies for the Natural Gas and Oil Industry API 6.4.6.1 Equipment and process blowdowns Assumes 4.7tCH4 per blowdown representing full gas plant blowdown twice per year (other releases sent to flare).
Flared natural gas emissions – SPCF plant commissioning, upsets and maintenance- Total TJ flared	1,375 TJ	89,379	Flared estimate using forecasted P50 success case of 4.5 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:

Activity	Anticipated volume	Anticipated tCO2-e)	Estimate methodology and assumptions
			• 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
Compressor and power generation fuel gas usage	1642.5 TJ	84,252	1. NGERS Determination: Division 2.3.2 Method 1 emissions of carbon dioxide, methane and nitrous oxide, section 2.2 Method 1—emissions of carbon dioxide, methane and nitrous oxide and schedule 1 Part 2 Fuel combustion- gaseous fuels Stationary energy purposes- Unprocessed natural gas. 2. Compressor fuel gas consumption 2.8% and assume 0.2% fuel gas for onsite power generation making a 3% fuel gas consumption rate for the facility.
Fugitive emissions-onsite sewage treatment	30 people days/year	14.75	Section 5.3 Estimating emissions from wastewater treatment: NATIONAL GREENHOUSE ACCOUNTS FACTORS Australian National Greenhouse Accounts August 2022.
Land clearing	3.0 ha	231	TAGG 2013 Appendix E vegetation clearing methodology.
Total tCO_2-e		200,880	

^ Based on Global Warming Potential (GWP) of 28 tCO_2-e/tCH_4 (Clean Energy Regulator 2020)

* https://www.api.org/~/media/files/ehs/climate-change/2009_ghg_=11201compendium.ashx

3.11.1 GHG cumulative emissions

The cumulative annual emissions for Tamboran's activities are predicted to be 193,066 tCO_2-e in FY 2025 (Table 19). This peak in emissions during 2025 is associated with the proposed well testing approved under the TAM1-3 EMP. The well testing in 2025 is required to test wells prior to the construction and commissioning of the SPCF. Emissions from the Project will be restricted to construction during the 2025 period, estimated to be 4,081 tCO_2-e. In the FY 26/27/28 and 29 periods, the cumulative emissions total will fall under the 100 $KtCO_2$-e thresholds, with emissions under the TAM1-3 EMP scaled back to keep total emissions under the trigger. This results in no material net increase in scope 1 emissions associated with the activities outlined in this EMP.

The potential (residual- not offset) maximum scope 1 emissions (for 2025) of Tamboran's activities represent 1.35% [10] of the total NT GHG emissions for 2021 or 0.04% of Australia's total emission for the March 2022 quarter[11]. Total contributions fall to 0.69% demonstrating the reduction in scope 1 emissions associated with the sale of appraisal gas.

Based on the life cycle 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). This life cycle analysis is based upon the existing QLD Coal Seam Gas industry, which does not include abatement of LNG emissions or the deployment of substantial upstream emission reduction technology (other than electrification of gas processing facilities).

A future Beetaloo 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 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) and 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. This is reflected by Tamboran's ongoing commitment to invest in both renewable energy sources and firming fuels such as natural gas.

Table 19: Cumulative 2023-2027 financial year worst case greenhouse gas emission assessment by period for approved, proposed and potential future exploration activities

Activity	FY 25	FY26	FY27	FY28	FY29	Comments
Beetaloo W-1 EMP	46	46	46	46	46	No material emissions anticipated.
Velkerri 76 S2 civil construction	46	46	46	46	46	No material emissions anticipated.
Velkerri 76 S2-1H drilling, stimulation and well testing [12]	0	0	0	0	0	No material emissions anticipated.
Amungee multi-well (Amungee NW NW-3H;	46	46	46	46	46	No material emissions anticipated – activities restricted to ongoing wastewater management.

[10] https://www.greenhouseaccounts.climatechange.gov.au/

[11] Quarterly Update of Australia's National Greenhouse Gas Inventory: March 2022 (dcceew.gov.au).

[12] Based on the drilling of a horizontal and 90 day well test @4.5TJ/day.

Activity	FY 25	FY26	FY27	FY28	FY29	Comments
Velkerri 76 S2-2H and S2-3H)						
Amungee delineation EMP	0	0	0	0	0	No material emissions anticipated.
Shenandoah South E&A Program EMP	188,847	45,928	38,826	36,208	57,706	Activities include all those required to construct, drill, stimulate and well test the E&A wells over the FY 2025-2029 period. Wells drilled in FY 2026/27/28 and 29 will have limited flaring – restricted to initial well clean up where gathering lines are not available.
Emissions related to activities Introduced by this EMP						
Sturt Plateau Appraisal Gas Compression Facility EMP (TAM2-3) EP 98 & EP 117	4081	50,709	58,078	58,077	29,935	Activities associated with the construction, commissioning and operation of the SPCF facility.
Total annual emissions (tCO_2e)	**193,066**	**96,775**	**97,041**	**94,423**	**87,779**	

3.11.2 Residual emissions offsets

Table 20 provides a summary of cumulative anticipated greenhouse gas emissions breakdown per financial year, along with the estimated offset requirements and total residual emissions.

In accordance with the updated NGERS safeguard mechanism requirements released in 2023, an activity becomes a “facility” once the emission threshold has been triggered. The safeguard mechanism requires a facility to have all scope 1 emissions offset in the year triggered, using Australian Carbon Credit Units (ACCU’s) granted under the Commonwealth *Carbon Credits (Carbon Farming Initiative) Act 2011*.

Tamboran also proposes to offset a percentage of residual greenhouse gas emissions where they are generated below the safeguard trigger level to meet the NT net zero by 2050 target. Tamboran will offset any residual emissions as per the following:

- That residual emissions be offset using carbon credit units approved by the Commonwealth Clean Energy Regulator or the Commonwealth's Climate Active Carbon Neutral Standard.
- 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 2025: 11.1% of total emissions offset
    - Financial year 2026: 14.7% of total emissions offset
    - Financial year 2027: 18.4% of total emissions offset
    - Financial year 2028: 22.1% of total emissions offset
    - Financial year 2029: 25.8% of total emissions offset

- Actual emission levels produced during a financial year must be estimated in accordance with the National Greenhouse and Energy Reporting Scheme (NGERS) reporting methodology.
- 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.
- Offsets shall be secured and retired within 6 months of the end of a financial year. Noting any emission offset under the NGERS Safeguard mechanism will satisfy any obligation under the NT Large emitters policy and vice versa. This will avoid double counting.
- An appropriately qualified independent person with extensive carbon accounting experience shall verify the actual emission levels generated, the procurement and retirement of the required offset volumes for emission generated in the specified financial year.
- A report from the 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.
- The GGAP will be updated annually based on actual emissions from the preceding year to ensure currency.

Table 20: Estimated cumulative greenhouse gas emissions, offsets and residual emission levels

Emission period	Cumulative tCO_2-e	Potential emission offset requirements (tCO_2)	Total cumulative residual emissions tCO_2 (Total emissions minus offsets)
FY 2025	193,066	193,066*	0*
FY 2026	96,775	14,226	82,549
FY 2027	97,042	17,856	79,186
FY 2028	94,423	20,867	73,556
FY 2029	87,778	22,646	65,132
Total	**568,064**	**268,661***	**300,323***
*Assumes the NGERS safeguard 100 $ktCO_2$ trigger has been reached and offset requirements triggered.			

3.12 Noise assessment

Noise modelling and assessment has been completed to predict noise levels from the most significant noise sources during the operation of the SPCF, in accordance with the WMPC Act and NT Noise Management Framework Guideline (NT EPA 2018). A total of 5 noise receptors were assessed. The noise modelling predictions for the operational scenarios indicate that the relevant external noise limits would be achieved at all assessed receptors.

For the noise assessment, the following two scenarios with different operational equipment packages were assessed:

- Normal operation: HP and LP compression.
- Station shutdown with associated flaring.

Figure 23 shows the location of the SPCF in relation to the 5 noise receptors listed below, including their approximate distance from the SPCF:

- Dunmarra Roadhouse (27 km)
- Shenandoah homestead (17 km)
- Stuart Highway East homestead (38 km)
- Jingaloo Aboriginal community (34 km)
- Beetaloo homestead (49 km)

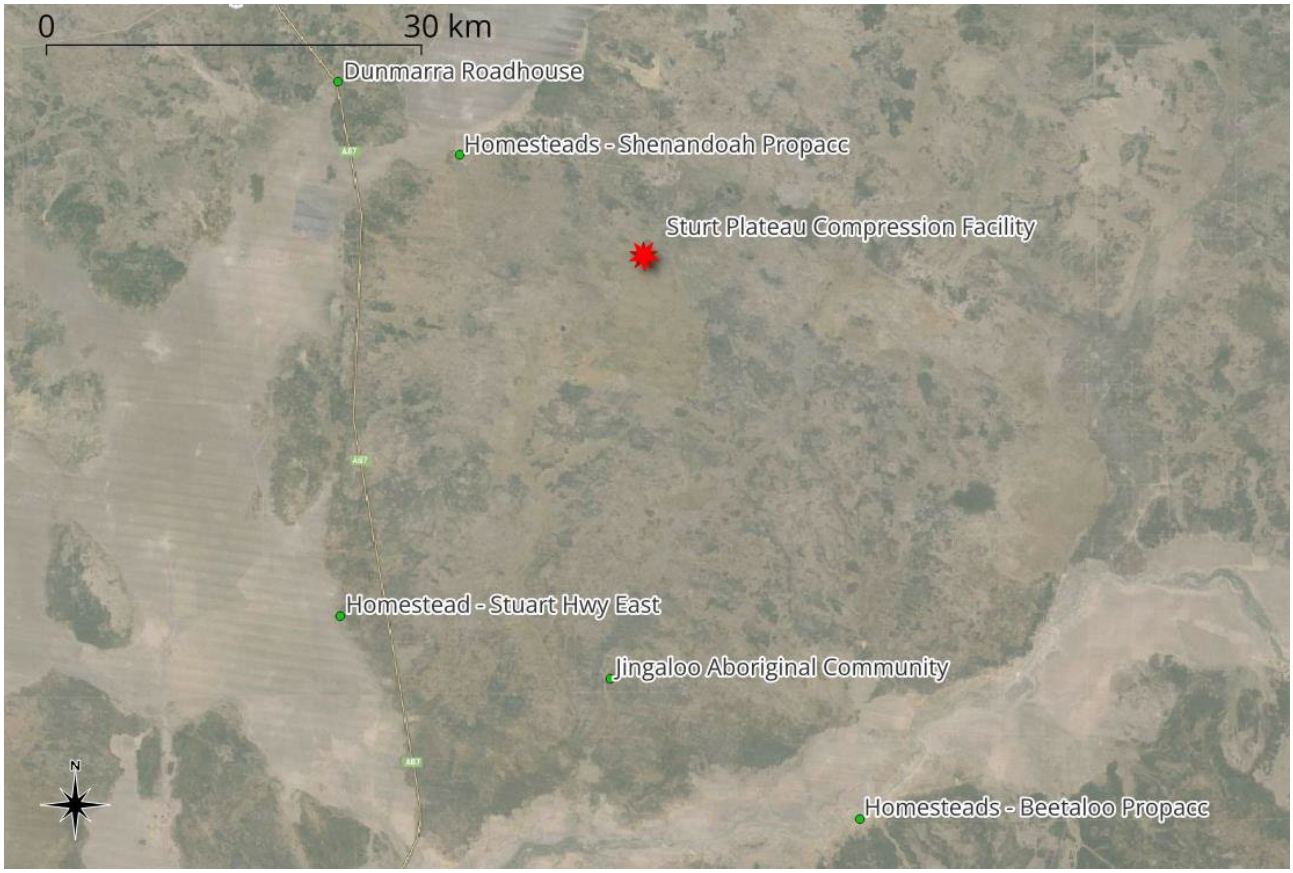


Figure 23: Location of the SPCF in relation to the 5 noise receptors

It is noted that the distance from the SPCF to each sensitive receptor listed above is significant, and noise from the Project activities would not be expected to carry these distances.

Under Section 2 of the Noise Management Guideline, noise levels for commercial and industrial activities, which include the operation of acoustically significant balance of plant, are required to achieve prescribed noise levels at noise sensitive receptors.

There are two (2) categories of noise levels, a 'project intrusiveness noise level' and a 'recommended maximum assigned amenity noise level':

- The intrusiveness noise level is defined in relation to the level and character of the existing noise environment and is designed to prevent significant changes in noise levels with the introduction of new or additional commercial and industrial activity.
- The assigned amenity noise levels are levels of noise that would typically not adversely impact amenity and manage the potential for noise impacts associated with the cumulative increase in noise as a result of industrial and commercial development.

Section A1.2 of the Noise Management Guideline stipulates minimum assumed rating background noise levels (RBLs), which have been used in the construction activities noise assessment and are provided in Table 21.

Table 21: Minimum assumed RBLs

Time of day	Minimum assumed RBL (dBA)
Day	25
Evening	30
Night	30

The following assumptions were applied to derive the noise assessment criteria for the proposed project:

- In the absence of measured RBL, Section A1.2 of the Noise Management Guideline stipulates minimum assumed RBLs (Table 22), which have been used in the operational phase noise assessment.
- Given the project setting, it's likely that the existing background noise levels would already meet or be below the 'Minimum assumed RBLs'. Therefore, these minimum assumed RBLs are adopted to establish the project noise criteria.
- The operation of the SPCF will be 24 hours per day, seven days per week, and will therefore occur during the daytime, evening and night-time periods.
- There would be no other dominant sources of industrial noise at the assessed residential community, i.e. the SPCF would be the primary source of noise regulated by the Noise Management Guideline.
- The lowest value of the project intrusiveness noise level and the recommended assigned amenity noise level was applied as the project specific noise level.

Table 22: Noise levels for the assessment of SPCF operational noise pollution at residential receptors

Time of day	Minimum assumed rating background level[1]	SPCF intrusiveness noise level[2]	Assigned amenity noise levels[3]	SPCF specific noise level
Day time	35	40	45	40
Evening	30	35	40	35
Night-time	30	35	35	35

[1] As defined from Table 2.1 of the Noise Management Guideline.

[2] The SPCF intrusiveness noise level is the background noise level plus 5 dB.

[3] Assigned amenity noise levels are adopted from the 'Recommended maximum assigned amenity noise levels' (as defined for 'Residential – Rural' from Table 2.2 of the Noise Management Guideline) minus 5 dBA.

Noise levels are highly conservative with the assessment adopting the night-time noise limit of L_{Aeq} (Equivalent Continuous Sound Pressure Level) as the primary assessment limit. Compliance to the most stringent noise limit for the night-time period would also achieve compliance at other times when the noise limits will be higher.

3.12.1 Noise sources

The key noise emission sources for the proposed gas compression facility are summarised in Table 23. The noise emission data has been referenced from the supplied source pressure level of each equipment, or noise emissions levels measured by SLR Consulting at other similar gas compression facilities.

Table 23: Noise emissions sources

Source	# of units	Source height[1] (m)	Sound power level (total per unit, dBA L_{Aeq})
Scenario 1: Normal operation			
Gas compressor – Ariel JGC/4	5[2]	3	110
Gas compressor engine – CAT3608	5	3	112
Gas compressor engine exhaust	5	10	118
Gas compressor engine inlet – CAT3608[3]	5	5	113
Gas compressor engine turbo – CAT3608	5	5	103
Coolers – 75 kW (paired per compressor)	10	4	94
Chemical injection skid	1	2	87
Inlet pressure reduction	1	2	104
Air cooled heat exchanger	4	4	96
Air compressor package	1	2	92
Diesel generator	1	3	105
Gas genset facades	2	3	77
Gas genset inlet	2	3.5	90
Gas genset exhaust	2	3.5	88
Scenario 2: Shut down			
Diesel generator	1	3	105
80 MMSCFD 6 tip ground flare	1	30	141

[1] Height in metres above ground level.

[2] Among 5 unit, 3 is in operation and 2 is backup.

[3] Includes standard acoustic silencer on each unit.

3.12.2 Meteorological conditions

The effect of meteorological conditions (wind, atmospheric stability/temperature inversions, temperature and humidity) on noise propagation from the operation of compression facility has been considered in accordance with the Noise Management Guideline. In the absence of completing a full meteorological analysis, a sensitivity analysis has been performed on various iterations of wind speeds and atmospheric stability class (temperature inversions) to determine the combination for the adopted adverse meteorological condition scenario for this assessment. From this sensitive analysis, the weather conditions used to assess the effect of neutral and adverse meteorological conditions are shown in Table 24.

Table 24: Meteorological conditions – neutral versus adverse

Parameter	Neutral weather	Worst case
Temperature	30°C	20°C
Humidity	70%	90%
Pascal stability class	D	F
Wind speed	0 m/s	2 m/s (source > receiver)

3.12.3 Modelling results

Predictions of operational noise level from compression facility (at the representative sensitive receptor only) have been undertaken for both neutral and adverse weather conditions. Table 25 summarises the predicted noise levels. Noting the 24 hours, 7-days operational status of the assessed noise sources related to compression facility, predictions under adverse weather conditions are considered most applicable to the evening and night-time periods as these are the time periods that temperature inversion are most likely to occur.

Table 25: Predicated SPCF operational noise levels

Receptor	Classification	Noise limit L_{Aeq} (external) (dBA)		Predicated noise level (dBA L_{Aeq})			
				Commissioning		Operations (typical worst case)	
		Day	Evening; night-time	Neutral weather	Adverse weather	Neutral weather	Adverse weather
Shenandoah homestead	Residential	40	35	<5	<5	<5	<5
Jingaloo Aboriginal community	Non-residential	55	45/40	<5	<5	<5	<5
Beetaloo homestead	Residential	40	35	<5	<5	<5	<5
Stuart Highway East homestead	Residential	40	35	<5	<5	<5	<5
Dunmarra Roadhouse	Non-residential	55	45/40	<5	<5	<5	<5

As shown in Table 25 above, all representative receptors are predicted to comply with the relevant external operational noise limits during the assessed compression facility operational phase activities. As previously noted, this is as per expectations due to the significant distance between the Project site and the respective sensitive receptors. Noise contour plots for the operational scenarios under adverse weather conditions are shown in Figure 24 and Figure 25.

Figure 24: Grid noise map of scenario 1 normal operation (adverse weather conditions)

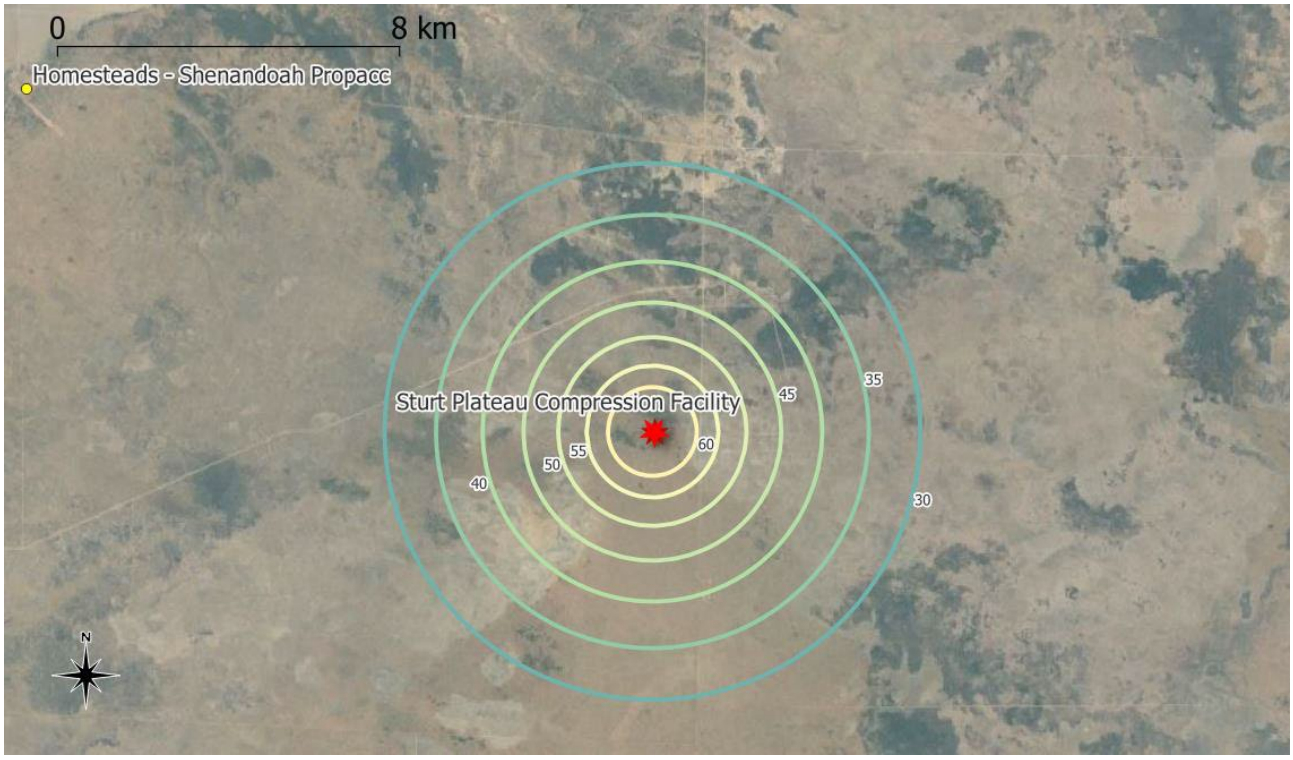


Figure 25: Grid noise map of scenaro 2 station shutdown (adverse weather conditions)

3.13 Air emissions assessment

An air quality impact assessment was completed by Katestone Environmental (2024) in accordance with relevant regulatory requirements including the National Environment Protection (Ambient Air Quality) Measure (Air NEPM) 2021 and (in the absence of specific NT guidelines) the New South Wales Environment Protection Authority's Approved methods for the modelling and assessment of air pollutants in New South Wales (NSW EPA, 2022).

The assessment included a preparation of a site-specific meteorological data file suitable for use in a dispersion model, generated by coupling the prognostic model TAPM (developed by the CSIRO, version 4.0.5) with the diagnostic meteorological model CALMET.

Dispersion modelling of emissions to air from the site infrastructure was undertaken using the CALPUFF dispersion model (version 7) to predict the ground-level concentrations of priority pollutants nitrogen dioxide (NO_2) and carbon monoxide (CO) likely to occur across a Cartesian grid and at the location of the nearest sensitive receptors (Homesteads, communities and local aboriginal living areas) due to the SPCF in isolation, and due to the SPCF with the addition of representative ambient (cumulative) background concentrations determined using monitoring data.

Oxides of nitrogen (NO_x) and CO were used as key indicator contaminants of concern, as they were the highest concentrated pollutants anticipated to be generated by the compressors. Trace air pollutants associated with the combustion of natural gas and diesel (e.g. back-up generators) in the infrastructure at the SPCF may include volatile organic compounds (VOCs), fine particulate matter (particulate matter with a diameter less than 10 micrometres (PM_{10}) and less than 2.5 micrometres ($PM_{2.5}$)), sulfur dioxide (SO_2), and hydrogen sulfide (H_2S). Typically, if maximum concentrations of NO_2 and CO are below the relevant air quality criteria at sensitive receptor locations, maximum concentrations of all trace pollutants associated with fuel combustion will also comply with the relevant air quality criteria.

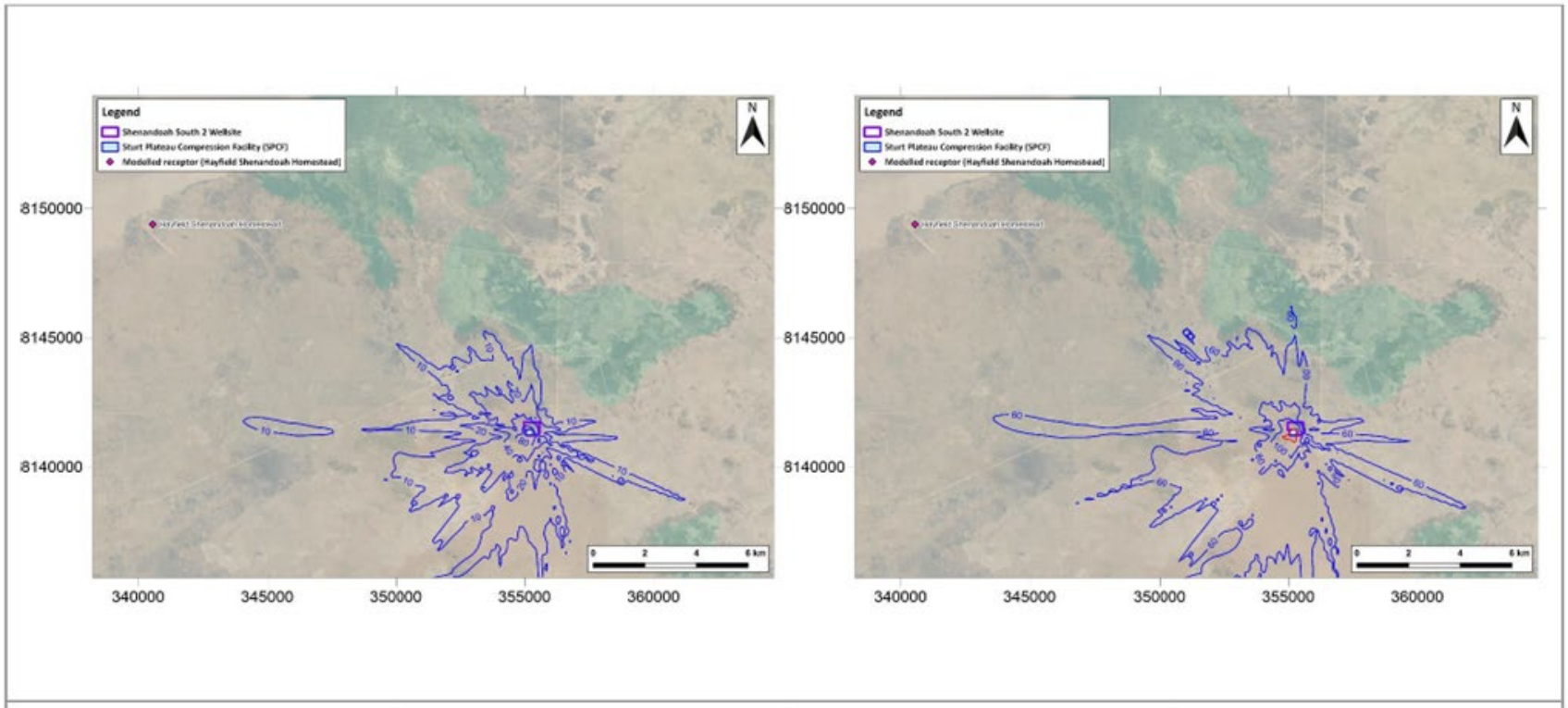
When assessing the risks of other pollutants like VOC's or Mercury from the raw gas stream, a key consideration is the observed concentration and the limited venting of raw gas proposed. Independent testing completed as a part of the Shenandoah South -1H well in March 2024 confirmed the gas produced from the Velkerri shale in the Shenandoah South area is primarily methane (~91.7%), with ethane (2.6%), Carbon Dioxide (3.9%), Nitrogen (1.7%) and propane (0.1%) making up the remainder of the gas composition. Speciated VOC analysis on the gas was completed using the USEPA TO-15 method with BTEX levels typically less than 3-4mg/m^3 . There were no material level of all other VOC's with all levels being at or below the limit of detection. Field mercury levels were also low, with concentrations observed at 0.2µg/$m^{3,}$. Given the concentration of these contaminants is low and level of venting is minimal, the assessment focussed on emissions of NO_2 and CO as the key pollutants of interest for the site.

The assessment considered cumulative impacts to air quality from all sources of pollutant emissions to air at the SPCF under the following circumstances:

- Routine operations: continuous and concurrent operation of all the proposed compressors, generators, back-up diesel engine generators, and a pilot/purge flare.
- Upset operations involving the full station blowdown of flare.

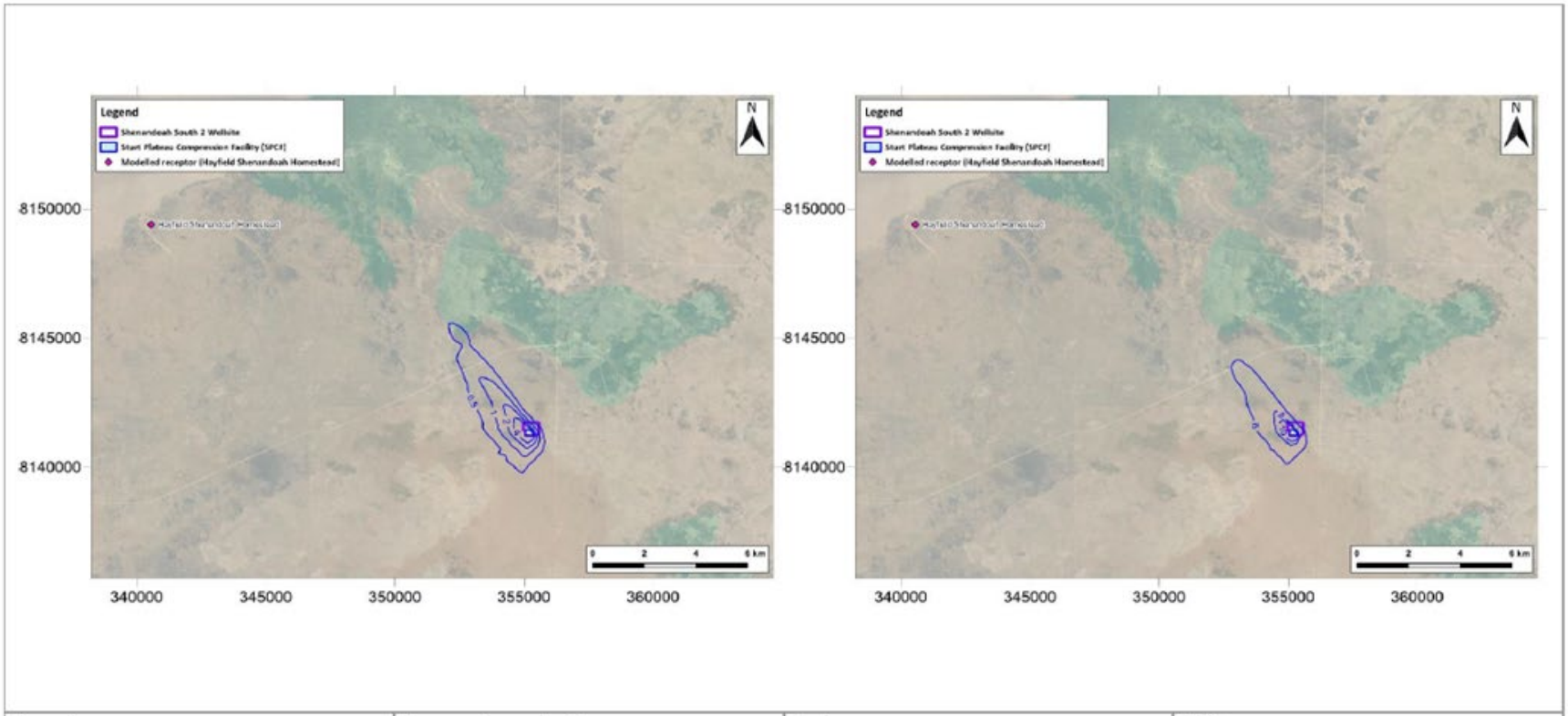
The results of the dispersion modelling are graphically shown in from Figure 26 to Figure 29. The results show that the ground-level concentrations due to routine and upset operations at the SPCF, comply with the Air NEPM standards for NO_2 and CO at the nearest sensitive receptor. There are no exceedance of the standards beyond the immediate vicinity of the facility. It can, therefore, be concluded with reasonable certainty that maximum ground-level concentrations will also comply with the relevant air quality criteria

for all trace air pollutants at the nearest sensitive receptor, including VOCs, fine particulate matter (PM_{10} and $PM_{2.5}$), SO_2, and H_2S. The impacts to air quality from the facility are therefore assessed as minor.



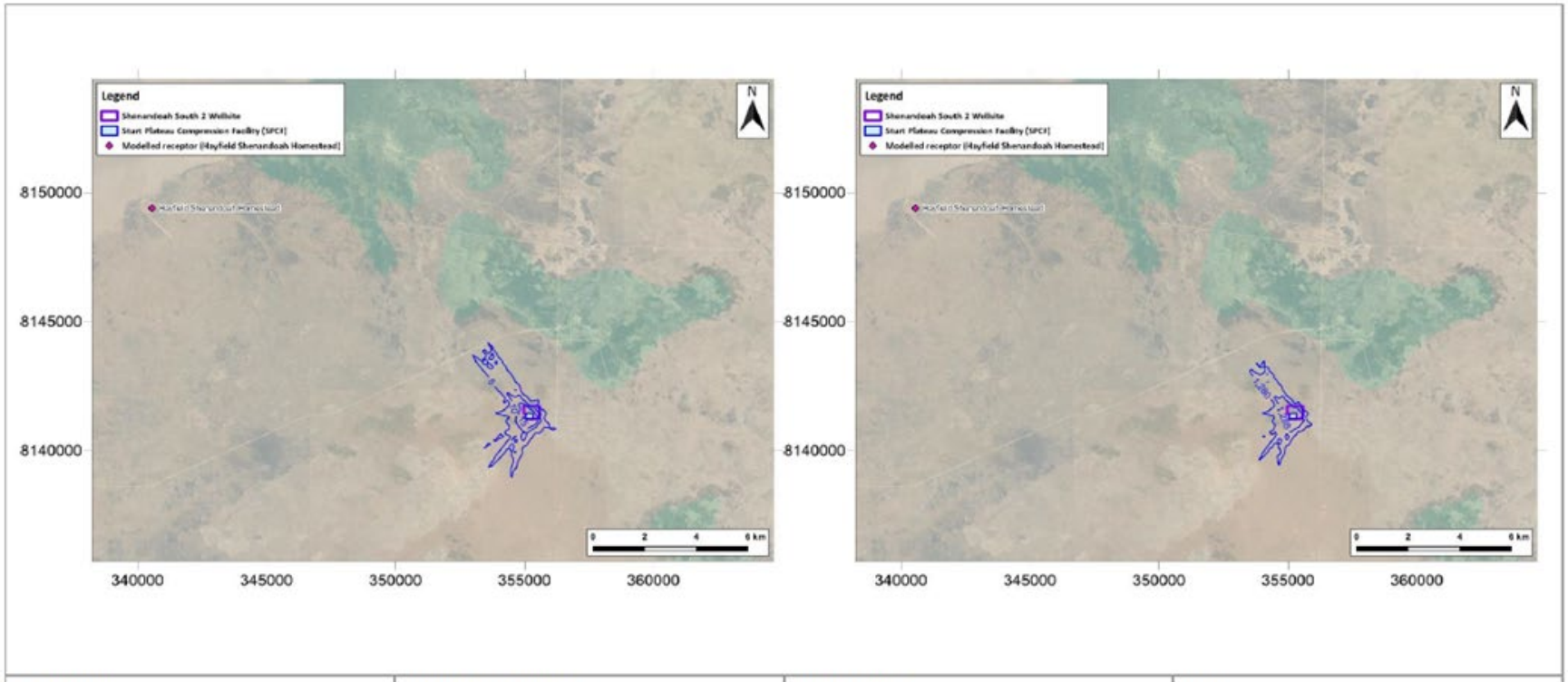
Location:	Averaging period:	Data source:	Units:
Beetaloo Basin, Northern Territory	1-hour	CALPUFF	µg/m³
Type:	**Objective:**	**Prepared by:**	**Date:**
Maximum contour	164 µg/m³ (red contour)	Sarah Richardson	July 2024

Figure 26: Predicted 1 hour average ground level concentration of NO_2 due to the routine operation of the proposed infrastrcture at the SPCF (left) and with ambient background (right)



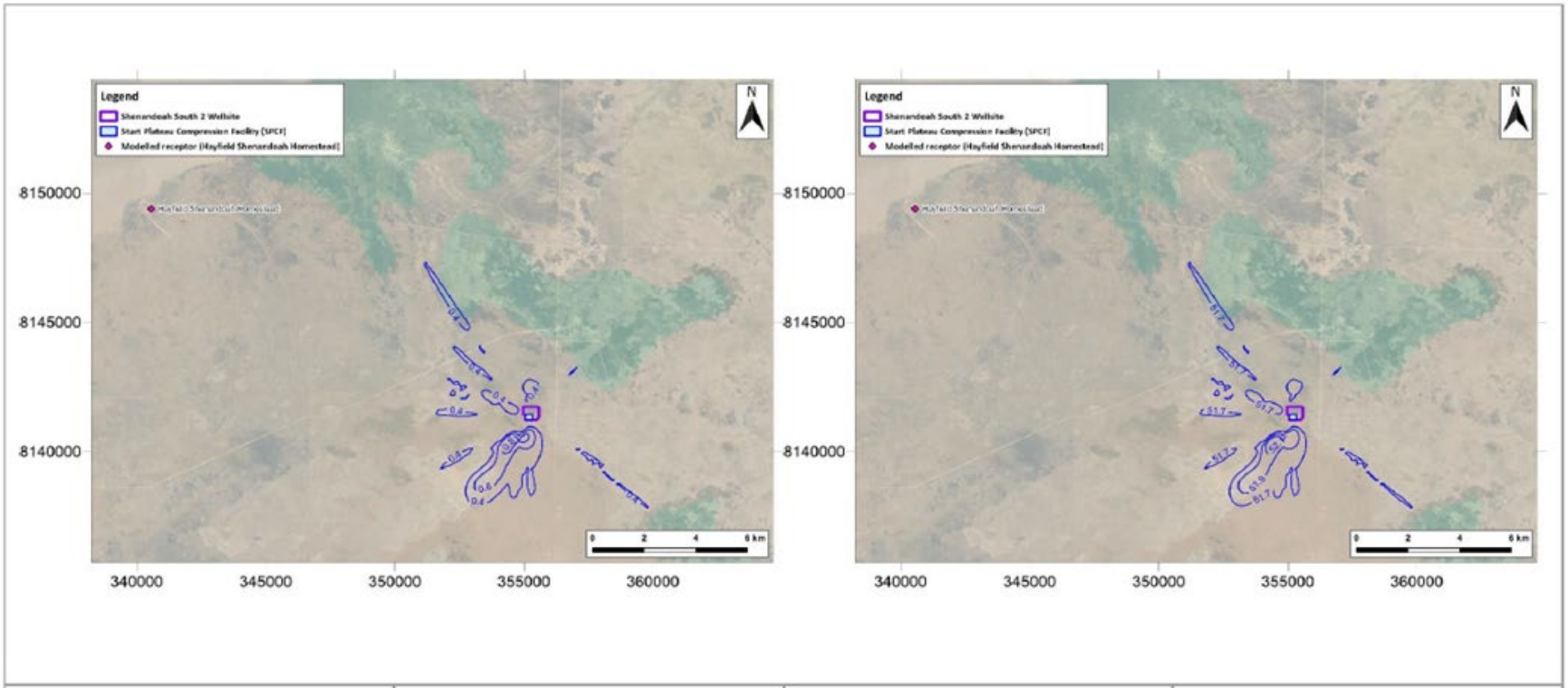
Location: Beetaloo Basin, Northern Territory	**Averaging period:** 1-hour	**Data source:** CALPUFF	**Units:** µg/m³
Type: Annual average contour	**Objective:** 31 µg/m³	**Prepared by:** Sarah Richardson	**Date:** July 2024

Figure 27: Predicted annual average ground level concentration of NO_2 due to the routine operation of the proposed infrastrcture at the SPCF (left) and with ambient background (right)



Location:	Averaging period:	Data source:	Units:
Beetaloo Basin, Northern Territory	8-hour	CALPUFF	µg/m³
Type:	**Objective:**	**Prepared by:**	**Date:**
Maximum contour	11,000 µg/m³	Sarah Richardson	July 2024

Figure 28: Predicted maximum 8-hour average concentration of CO due to routine operation of the proposed infrastructure at the SPCF in isolation (left) and with background (right)



Location:	Averaging period:	Data source:	Units:
Beetaloo Basin, Northern Territory	1-hour	CALPUFF	µg/m³
Type:	**Objective:**	**Prepared by:**	**Date:**
Maximum contour	164 µg/m³	Sarah Richardson	July 2024

Figure 29: Predicted maximum 1-hour average concentration of NO_2 due to the upset operation (blowdown) of the flare at the SPCF in isolation (left) and with ambient background (right)

3.14 Wet season operations

Operation of the SPCF will continue through the wet season (defined by the Code as 1 October to 30 April inclusive). The 30-year average annual rainfall of the region is between 600 m – 1,000 m (BOM, 2024) (Figure 30). Where wet season operations are ongoing the existing operation risk following risk controls will be implemented:

- Chemicals, fuels, equipment, tanks and materials required for ongoing operations will be stored on-site prior to the onset of the wet season, with limited wet season transports undertaken.
- All equipment required to respond to emergency situations will be on-site; this will be dictated by a pre-wet season risk assessment (based on the nature of activities underway)
- All chemicals storage areas will be bunded, with covers used (where safe and appropriate) to prevent rain ingress and bund overflows.
- Wastewater will be managed in accordance with the provisions under the approved TAM1-3 EMP.
- Helicopters will be used to transport people and supplies into and out of the site when prolonged access is restricted.
- To reduce the risk of transportation of wastewater and chemicals during the wet season to ALARP, transportation will be undertaken in accordance with the following:
    - Risk assessment completed for all wet season transportation of chemicals and wastes prior to the commencement of the transport activity.
    - Transportation will not occur on tracks where the surface is not safe to allow transportation vehicles to drive upon.
    - Wastewater and chemical transportation will not be undertaken through flooded waterways/crossings.
    - The transportation of wastewater/ chemicals during rainfall events will be avoided.
    - Driving on unsealed roads and access tracks will be avoided 24 hours following a >20 mm rainfall event.
    - After a >20 mm rainfall event, or when the integrity of any unsealed road may be compromised due to prolonged rainfall, each unsealed access track proposed to be used for wastewater/ chemical transportation will be inspected to ensure the integrity of the road is sufficient to allow safe passage of the proposed transport vehicle.
    - Chemicals will not be unloaded during rainfall events.
- SPCF compressors and equipment where leaks may form are to be bunded, with an integrated liquid waste handling system designed to prevent all off-site release of chemicals and contaminated stormwater.
- Most of the stormwater diverted from the SPCF will be retained on-site via the sediment basin and tested weekly during the wet season to identify potential contamination.
- Overland flow will be diverted around the SPCF.

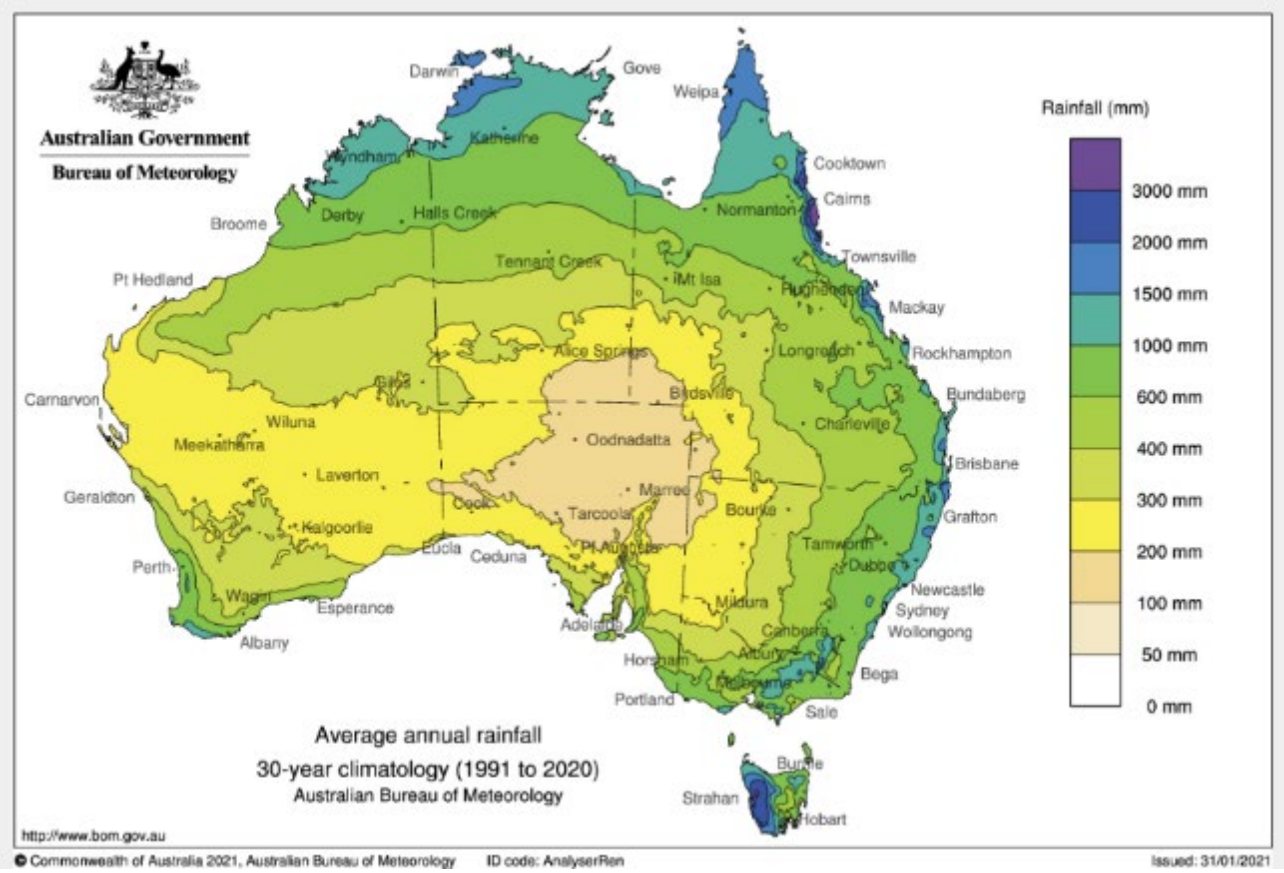


Figure 30: Rainfall averages for Daly Waters (source BOM, 2024)

3.15 Helicopter operations

If access to the site is prevented during operations, helicopters will be used to move people and supplies into and out of the site. Helicopter activities are an existing, approved activity at the sites. Helicopter activities ensures the site can be manned during all activities, regardless of the season.

The use of helicopters in the NT for transportation is a standard activity and ensures that personnel and material can be moved to and from the site during periods of wet weather or in emergencies.

All helicopter movements will be managed under an aviation standard and journey management plan. This plan addresses aircraft selection, maintenance, pilot qualifications, flight routes and procedures.

Audits are completed prior to the engagement of a helicopter service provider and at least annually. This ensures compliance with Tamboran's aviation standard and reduction of risks to ALARP.

3.16 Waste management

Waste management methods for the Project are summarised in Table 26. Waste is managed in accordance with the internationally accepted guide for prioritising waste management practices, with the objective of achieving optimal environmental outcomes. The remote location of the Project and limited volume of several of the waste streams that will be generated dictates the practical waste management options available. Waste will be managed in accordance with the following hierarchy principals:

- **Avoid:** eliminate the generation of wastes through design modification
- **Reduce**: reduce unnecessary resource use or substitute a less resource intensive product or service
- **Re-use**: reuse a waste without further processing

- **Recycle**: recover resources from a waste
- **Treatment**: treat the waste to reduce the hazard of the waste prior to disposal
- **Disposal**: dispose of waste if there is no viable alternative
- Waste transfer certificates will be retained and provided to DEPWS upon completion of the Project.
- Wastewater is managed in accordance with section 3.7.20.

Table 26: Waste and disposal methods

Activity	Disposal method
Sewage, grey and stormwater	**Treatment:** Grey water and sewage treated and disposed of on-site in an approved, portable treatment system accordance with Department of Health Code of Practice for small on-site sewage and sullage treatment systems and disposal for reuse of sewage effluent. Sewage treated will be surface irrigated to a dedicated, fenced area. The area will be left vegetated, with no clearing required. Sludge removed from site and disposed of at an appropriately licenced facility. Uncontaminated stormwater will be tested (refer section 3.7.23) and either released off-site or re-used for dust suppression.
Food waste, paper and plastic	**Disposal:** Collected in dedicated waste bins for back-loading to an approved landfill.
Glass and cans	**Recycled:** Collected in separate waste bins for recycling at an off-site facility.
Chemical bags and cardboard packaging materials	**Recycled:** Compacted and collected at rig site for transport to a licenced recycling centre.
Scrap metals	**Recycled:** Collected in designated skip for recycling at an approved location.
Used chemical and fuel drums	**Recycled:** Collected in designated skip for recycling at an approved location.
Chemical wastes	**Re-use/disposal:** Collected in approved containers for disposal at approved landfill or returned to supplier or recycled.
Timber pallets (skids)	**Recycled:** Recycled at an approved facility
Vehicle tyres	**Disposal:** Disposed of at an approved landfill
Oily rags, oil-contaminated material, filters and any hydrocarbon material	**Recycled/disposal:** Oil from machinery or encountered during drilling. Collected in suitable containers for disposal at approved landfill or recycled at an approved recycling facility.
SPCF wastewater	**Recycled, treatment and disposal:** Highly saline wastewater collected in a series of open and closed tanks. Where possible, wastewater will be recycled to reduce raw water requirements. Where wastewater cannot be recycled, it will be evaporated on-site using mechanical evaporators and then disposed of off-site at a licenced facility interstate. On-site treatment could potentially include other mechanical treatment options, such as brine crystallisers and thermal combustion units.
Spill contaminated soils and water	**Disposal:** All contaminated material (solids and liquids) will be disposed of off-site at a licenced facility.

Activity	Disposal method
Stormwater	**Discharged/recycled/disposal:** All stormwater will be collected on-site in a designated sediment retention system. Stormwater will be tested and either released off-site or recovered and either recycled within the drilling process or disposed of at a licenced wastewater treatment facility in accordance with the *NT Waste Management and Pollution Control Act 1998*.
Mercury	**Disposal:** Where an MRU is installed, mercury will be collected, treated and recycled by a third-party licensed waste treatment facility, in accordance with the WMPC Act. This may include treatment through advanced distillation and retort technologies that use mechanical and thermal processes, to extract and stabilise the mercury into a non-toxic compound for safe and sustainable disposal.

3.17 Camps

The Project will construct a purpose built 2.0 ha, 150-person camp on the Shenandoah S2 site to accommodate SPCF construction workers. This camp is referred to as the SPCF camp. A smaller, 20-person operations camp will be constructed upon completion of the SCPF construction to support ongoing facility operations and maintenance. This operations camp will be located on the Shenandoah S2 camp pad.

The approved camps at the Shenandoah S2 site and Kyalla 117 N2 (authorised under the TAM1-3 EMP) may be used where capacity exists.

Each camp will typically contain:

- accommodation
- ablutions and septic(s) waste treatment and irrigation
- recreation room
- kitchen and mess
- freezer unit
- site office
- generator and diesel storage
- water tank
- water treatment facility (RO plant)

Each camp has its own sewage treatment plant and wastewater treatment plant. A notification of installation of wastewater management system outside a building control area will be submitted to the Department of Health after the installation of each system with a capacity above 2,000 L/day. Treated water is dispersed via drainage away from the camp to the designated irrigation area. The designated irrigation areas are located adjacent to the camp pad and exploration well pad. These areas are approximately 100 m x 100 m (smaller for the operations camp) and are within the broader well site fence, which will exclude livestock access.

The existing and proposed camp infrastructure is temporary and portable and powered by diesel generators. The potable water supply for the camps may either be sourced from third party providers and stored onsite or can be sourced from groundwater bores established for drilling activities and treated to

the appropriate drinking water standards (2011 National Health and Medical Research Council Australian Drinking Water Guidelines). Should onsite treatment of raw water to produce potable water be required, a temporary reverse osmosis (RO) water treatment plant may be used. The plant will produce approximately 20 KL of potable water per day.

The RO reject water will be captured in a bunded poly tank and periodically transferred to a wastewater tank. The volume and destination of the water transferred will be tracked and the water managed in accordance with section 3.13 of the TAM1-3 EMP. The RO reject will form part of the mixed wastewater stream managed at the Shenandoah S2 wastewater tanks approved and operated under the TAM1-3 EMP as described in section 3.7.18.

All camp kitchens will be registered under the *NT Food Act 2004* and comply with all food hygiene requirements.

The domestic solid waste generated by camp activities will be removed by a waste contractor in accordance with the NT WMPCA.

There is potential for pest species to be attracted to increased site activities causing an increased abundance in the landscape. Pest controls that shall be implemented include:

- Camp wastes to be storage to be animal proof.
- All food scraps to be removed from site and disposed of at a licenced facility.
- Food scraps to be frozen and stored within freezer during wet season.
- Targeted rodent control around the camp areas.
- Water sources are reduced around camps through centralised mess halls.

All feral animal observations will be tracked in the incident management system. Where ongoing feral animal presence is detected at Tamboran site, additional controls will be investigated in consultation with the pastoralist (such as fencing, removal of water sources, etc.). However, experience from existing activities has not detected increased feral animal prevalence, with only 1 feral dog and cat identified in 6 months of camp operations.

For an estimate and breakdown of workforce numbers across activities refer section 3.1.1.

3.18 Traffic

The periods of highest traffic generated from exploration and appraisal activities will generally occur over a short duration and are associated with the mobilisation and demobilisation of equipment, construction and during the transport of prefabricated installations for SPCF. The peak maximum anticipated traffic flow increase associated with the activity is conservatively (high) estimated at approximately 18 vehicles per day, which has been inflated to 23 vehicle movements per day as a worst-case traffic volume (see section 3.18.2).

To assess the potential impact on pastoralist and tourism amenity and experience, a Traffic Impact Assessment (TIA) is discussed below. This assessment includes heavy equipment mobilisation to and from site and is a suitable conservative scenario to assess the potential associated traffic impacts.

The TIA involved the following steps:

- Identification of project traffic movements including approach and departure direction.

- Existing traffic levels and road Level of Service.
- Assessment of total traffic levels and potential impacts.
- Determine required impact-mitigating treatments.
- The results of the TIA are discussed below.

3.18.1 Identification of project traffic movements

Access to the Project site is via the Stuart Highway, approximately 23 km south of the town of Dunmarra. The Stuart Highway is a 130 km/hour posted speed limit in the vicinity of the Project. The Stuart Highway will also be upgraded and sealed to DIPL specifications. A road corridor permit and traffic control will mitigate the risk to road users.

The peak maximum traffic flow increase associated with the Project activity will be approximately 18 vehicles per day during construction and 3 vehicle movements per day during operation. Movements during construction will primarily consist of heavy equipment mobilisation and demobilisation from site, movement of the construction workforce during shift change overs and delivery of the prefabricated, skid mounted infrastructure.

Peak construction movements fall between April – September 2025. Average daily traffic additions from the Project during this period are likely to be 13 – 18 movements per day. Daily transport volumes have largely been reduced by using on-site/regional camps, with buses used to facilitate crew change overs.

3.18.2 Existing traffic levels, road capacity and level of service

Existing traffic figures were obtained from for station RTVDC020 in the DIPL Annual Traffic Report 2023 (DIPL 2023), showing Average Annual Daily Traffic (AADT) figures for the Stuart Highway. The station is located approximately 20 km north of Elliott and 65 km south of the access point to the Kyalla 117 access track. It can be assumed that the traffic figures at the site will be similar.

The total daily traffic flows on the Stuart Highway from the 2023 annual survey data are estimated as 398. The total traffic flows are split relatively evenly between north and south bound traffic (Figure 31). For previous traffic impact assessments, Tamboran inflated the annual traffic figures to account of peak dry season traffic. However, given the estimated daily traffic numbers for this Project account for less than a 4.0% increase in the number of vehicles per day (i.e. <23 vehicles per day), this assessment uses the existing traffic and an applied >4.0% increase in vehicles per day, as a worse case traffic volume in the vicinity of the turn-off to the Shenandoah S2 site.

AUSTROADS guidelines (Austroads 2020) were used to determine the typical capacity that would be expected by traffic on the Stuart Highway to maintain a free-flow Level of Service (LOS). The capacity of roads is based on the maximum rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of lane or roadway during a given timeframe. The Level of Service relates to the operating conditions encountered by traffic as defined in the AUSTROADS guidelines (Austroads 2020). This data was then used to determine the capacity of the Stuart Highway to maintain a Category A (free flowing) LOS for the site. A conservative 700 – 1,000 vehicle/hr/lane figure was used to determine the vehicle movement capacity.

In an urban situation it can be assumed that the peak hour volumes will be about 10% of the daily traffic volumes. However, the remoteness of this site means that a peak hour is not realistic and has not been considered. Due to the low volumes that are likely to be spread over the duration of the day, this is considered appropriate.

Rural Coverage Count Stations — Year: 2023

Table: 4.1 AADT For Coverage Stations - 10 Year Period — Region: Tennant Creek

Road Name / Location	ADT Station	Direction	Units	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Carpentaria Highway	RTVDC033	Inbound	Veh	51		42		46		41		50	
5km East of Tablelands Highway		Outbound	Veh	46		42		47		37		48	
		Both	Veh	97		84		93		78		98	
Nathan River Road	RTVDC034	Inbound	Veh	9		4		6		11		14	
2km North of Ryans Bend Road		Outbound	Veh	7		5		6		9		18	
		Both	Veh	16		9		12		20		32	
Newcastle Waters Road	RTVDC037	Inbound	Veh		40		39		29		52		75
2km West of Stuart Highway		Outbound	Veh		50		51		33		45		68
		Both	Veh		90		90		62		97		143
Old Bing Bong Road	RTVDC035	Inbound	Veh	73		59		67		38		75	
5km North of Borroloola		Outbound	Veh	75		49		68		39		74	
		Both	Veh	148		108		135		77		149	
Ranken Road	RTVDC028	Inbound	Veh		1		2		3		1		4
5km East of Brunette Downs		Outbound	Veh		2		3		1		1		4
		Both	Veh		3		5		4		2		8
Stuart Highway	**RTVDC020**	Inbound	Veh	222	229	223	280	262	233	174	284	292	220
20km North of Elliott		Outbound	Veh	213	213	222	271	247	227	167	263	273	178
		Both	Veh	435	442	445	551	509	460	341	547	565	398
Stuart Highway	RTVDC021	Inbound	Veh	206	183	198	185	225	235	152	151	216	189
15km South of Wauchope		Outbound	Veh	192	170	186	161	213	195	154	143	273	180
		Both	Veh	398	353	384	346	438	430	306	294	489	369
Stuart Highway	RTVDC022	Inbound	Veh	189	163	208	197	197	189	129	206	202	213
30km North of Barrow Creek		Outbound	Veh	188	142	191	171	184	150	133	211	175	188
		Both	Veh	377	305	399	368	381	339	262	417	377	401

Figure 31: Traffic flows on the Stuart Highway at ADT station RTVOC020, approximately 65 km south of the site access turn-in (DIPL, 2023)

3.18.3 Assessment of total traffic levels, road capacity and LOS

The total anticipated peak traffic volume for the Project has been determined at 421 vehicles per day for the Stuart Highway. This includes the additional (inflated >4%) peak Project vehicle movements of 23 vehicles per day.

The total volume of traffic is considerably lower than the capacity of the Stuart Highway, with any reduction in LOS from the volume of project traffic considered extremely unlikely.

Traffic LOS may also be impacted through changes in traffic compositions, with the volume of trucks affecting the road capacity greater than light vehicles. To assess the changes in traffic composition, vehicle category data obtained from the DIPL Annual Traffic Report 2023 were assessed against expected total project traffic figures. The assessment is provided in Table 27.

Table 27: Traffic impact summary for the Stuart Highway – existing versus proposed additional (adapted from DIPL, 2023)

Vehicle category	Existing vehicles per day (vpd) and % (approx.)	Proposed additional vehicles per day (vpd)	Total vehicles per day (vpd) during activity and % (approx.)
Short (light vehicles)	206 vpd (49%)	11 vpd	217vpd (49%)
Medium (heavy vehicles or short towing)	130 vpd (31%)	6 vpd	137 vpd (31%)

Vehicle category	Existing vehicles per day (vpd) and % (approx.)	Proposed additional vehicles per day (vpd)	Total vehicles per day (vpd) during activity and % (approx.)
Long (heavy vehicles)	34 vpd (8%)	1 vpd	35 vpd (8%)
Medium combination (heavy vehicles)	13 vpd (3%)	1 vpd	14 vpd (3%)
Large combination (heavy vehicles)	38 vpd (9%)	3 vpd	41 vpd (9%)

The results in Table 27 demonstrate that there are no significant changes in traffic composition associated with the Project, and there is unlikely to be any significantly impact upon the road's capacity and LOS.

3.18.4 Traffic risk management strategies

The management of risks of injury to staff, contractors and the community is a key focus of every Tamboran activity. To reduce the risks associated transport, the following controls are implemented:

- Avoiding vehicle movements where possible (such as the use of buses and aircraft)
- Driving at night to be avoided
- Driver training for all employees and contractors performing work
- Zero alcohol and drug policy – with all staff breath tested when on-site and random drug tests completed.
- Fatigue management policy – with mandatory breaks required for every 2 hours and maximum 10 hours in a single 24-hour period working hours (unless the driver of a fatigue regulated heavy vehicle, where the driver must then comply with the applicable law for fatigue management where the vehicle is operated).
- Chain of responsibility training for all logistics/supply chain roles to ensure they understand their obligations to ensure the safety of their transport activities under the Heavy Vehicle National Law
- Journey management plan requirements for all remote journeys, with all journeys lodged with the Tamboran HSE team.
- Requirements to comply with the National Transport Code Load Restraint Guide.
- Contractor and employee driver performance tracking and reporting, with all breaches investigated, formally documented and disciplinary actions taken.

In addition to the above requirements, Tamboran has also implemented the following additional controls:

- Current use of the intersection of the site access track with the Stuart Highway was previously approved by DIPL with traffic management in place where required. Ongoing engagement with DIPL is underway covering all future exploration activities and intersection upgrades, including obtaining approval under the Planning Scheme 2020, which is separate to the approval required under the Petroleum (Environment) Regulation 2016.
- Large loads to have their own journey management plan outlining proposed controls, including fatigue management, route selection. load constraint, speed restrictions, pilot requirements etc.
- Communication with local pastoralists when heavy/multiple transports are likely to occur.
- The use of camps reduces vehicle movements between the site and local communities.

Other potential risks and controls associated with traffic are discussed further in section 6.

3.19 Cumulative impact summary

This section provides a summary of the cumulative impacts associated with the proposed activity in accordance with Section 3b of the Regulations. These include cumulative impacts associated with groundwater extraction, flora and fauna, greenhouse gas generation, traffic and social impacts. The assessment of cumulative impacts is summarised in Table 28.

Table 28: Summary of cumulative impacts addressed within the EMP

Aspect	Summary	EMP section
Water	Groundwater extraction cumulative impacts assessed under the WEL GRF 10285. This includes water use for Tamboran's future exploration program, adjacent petroleum operators and surrounding users. No material impacts on surrounding users expected.	Section 3.9
Flora and fauna	There is minimal (3.0 ha) of new clearing associated with this EMP. Impacts associated with the introduction of weeds are managed through the weed management plan. All other petroleum operators and pastoralists are required to have a weed management plan.	Section 3.3 Section 4.2
Greenhouse gases	Cumulative emissions from all Tamboran's FY 2024-2028 activities have been provided. Emission levels are mainly attributed to flaring. In a development scenario, gas production is likely to have 50% less emissions than coal, thus playing an important role as a transition or firming fuel to support large scale renewable energy supply.	Section 3.11
Traffic	Impacts of traffic are anticipated to be minor, with no reduction in level of service of the Carpentaria Highway. Maximum peak traffic level assessment considers cumulative user traffic load, with project movements anticipated to be 44 movements per day during demobilisation.	Section 3.18
Social	Risk associated with increased competition for labour from exploration activities, including other petroleum operators is low and well within the capacity of existing service providers. Ongoing engagement with local and regional businesses is underway, providing information and updates on the status of any future projects. Increased industrialisation of landscape resulting in a loss of amenity and tourism value considered low due to limited extent of petroleum activities, including from other petroleum or mining operators.	Section 4.4

3.20 Monitoring

A series of monitoring programs has been developed under this EMP to:

- monitor and detect changes in environmental values associated with Tamboran's activities
- characterise the quality and volumes of produced gas.
- report on rehabilitation progress.

An overview of each of the monitoring programs is provided in Table 29.

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Table 29: Monitoring program summary

Monitoring program	Purpose	Monitoring points	Parameters	Frequency	Investigation thresholds	Reference document
Hydrotesting	Monitor	Release point of fluid proposed to be released from test- includes gathering lines and wastewater tanks	Electrical conductivity and pH	Each activity	EC- 1600 µs/cm pH 5.2 – 9.0	N/A
Secondary containment inspections	Monitor impact to surrounding soils	SPCF	Visual inspection of chemical storage and wastewater management system	Weekly during the dry season and daily during the wet season	N/A	N/A
Groundwater take	Groundwater volume	Each groundwater extraction bore	Litres	Continuous flow meter	400 ML/year[13]	NT Water Act
Gathering/wastewater line inspections	Detect water leaks from gathering lines	Each gathering/wastewater line section	Visual observations for: • Subsidence and erosion along the gathering line • Leaks from vents, drain and valve pits • Unusual wet patches, salt scalding or stressed/dead vegetation along the pipeline	Monthly for buried gathering/ wastewater lines (when in operation); weekly for above ground lines (when in operation)	Visual evidence that suggests a leak may be present.	Code Cl D.5.2.2(a)

[13] This volume is set at 400 ML/site assuming Tamboran's groundwater extraction permit be amended to increase groundwater take per annum to 450 ML and noting that the groundwater take for this Project is estimated to be approximately 12 ML/annum.

Monitoring program	Purpose	Monitoring points	Parameters	Frequency	Investigation thresholds	Reference document
Stormwater	Manage stormwater collected during activities	Sediment basin release point	Field EC and pH Visible oil, grease, other hydrocarbons, foams or abnormal discoloration	Weekly during the wet season or per each release during dry season.	Off-site release and dust suppression limits: • pH 5.2-9.0 • EC 1600 µs/cm	N/A
Erosion and sediment control	To detect the presence of erosion and sedimentation from infrastructure	Inspection of all disturbed areas, including well pads, access tracks, gravel pits, laydown yards, camp pads, etc.	Visual inspection of infrastructure and erosion and sediment controls	Visual inspections pre- and post-wet season	Visible erosion or failure of erosion and sediment control	Erosion and Sediment Control Plan (ESCP)
Weeds	Identify weeds potentially introduced or spread by Tamboran's activities	Inspection of all SPCF site.	Visual inspection	Visual inspections post-wet season.	Positive confirmation of the detection of a weed of national significance species within Tamboran's disturbance footprint. An increase in existing weed density and spatial extent.	Weed Management Plan (WMP)
Methane emission monitoring program	To identify and rectify gas leaks	SPCF and pipelines	Methane (part per million (ppm))	Quarterly	>500 ppm standard	Methane Emission Management Plan (MEMP)

Monitoring program	Purpose	Monitoring points	Parameters	Frequency	Investigation thresholds	Reference document
	To monitor combustion efficiency	Flare	Gas volume	Daily during operation of the flare	N/A	
Post rehabilitation	Monitor ongoing rehabilitation success	Inspection of the rehabilitated Project site	Visual inspections of: • Canopy cover % • Ground cover % • Species diversity • Erosion	Annually	Decline in rehabilitation criteria value compared to previous year results	Section 7.7 and Rehabilitation Management Plan (RMP) (Appendix L)[14]

[14] **NOTE:** Rehabilitation of this site is incorporated into the overall rehabilitation of the Shenandoah S2 site under the approved TAM1-3 EMP and the RMP (Appendix L) has been updated accordingly.

3.20.1 Investigation and response framework

Where an exceedance of a monitoring program investigation trigger is observed from one of the monitoring programs outlined in Table 29, an investigation and response will be implemented as summarised in Figure 32.

The investigation and response process will be divided into the following components:

- Verification – is the result real?
- Evaluation – is the result related to petroleum activities?
- Remediation or management – what is the potential impact?
- Ongoing monitoring.

The initial step in the process is *verification* of the measurement. This process begins with a check on integrity of the measurement, including a review of the protocol used to collect the measurement, calibration of equipment and the integrity of the monitoring infrastructure itself (such as the integrity of a monitoring bore). If the original data point is found to be correct, then a risk-based (appropriate to the scale and nature of the exceedances) investigation of the results is conducted, and an evaluation phase is initiated.

The *evaluation* phase will have two major goals; to identify the origin or source of the trigger exceedance and characterise the potential effects on environmental factors to reduce or eliminate negative consequences. This phase of investigation is conducted in a manner consistent with the type of threshold exceedance observed. Simple exceedances of water quality triggers during stormwater releases for example, may require simple investigations into the procedures and processes contributing to the event. Groundwater threshold exceedances may require more detailed assessment, whereby a comprehensive set of information is accessed and utilised, including a review of operational activities, the influence of other regional activities (e.g. mining or pastoral activities), changes in climatic conditions etc. Detailed investigation may include the identification of knowledge and/or data gaps and collection of additional data to fill these gaps and bring the issue into proper context.

If the *evaluation* phase of the investigation identifies the issue as being natural or not associated with petroleum activities, then the result is documented, and monitoring continues. This may lead to the revision of a trigger or threshold. However, if the results indicate an influence of a petroleum activity, an assessment of risks is undertaken to assess the potential impact on environmental factors. This will involve a more in-depth evaluation or characterisation of the affected area and potential source. Regulatory notification may be required in accordance with section 8.6.

If the *evaluation* phase of the investigation indicates the influence of a petroleum activity, then mitigation measures may need to be implemented to prevent ongoing impacts to an environmental factor. These mitigation measures will be appropriate to the nature of the incident and will be based upon a risk assessment and technical feasibility assessments. Such mitigation measures may include:

- Stopping the activity and/or
- Modifying the activity to directly address the source of harm (i.e. additional procedures, training, ceasing or redesigning an activity) and/or
- Implementation of mitigation measures to reduce the potential effects (i.e. make good agreements, direct removal and treatment of contaminants etc.).

Upon implementation of mitigation measures, further *evaluation* through increased monitoring is undertaken to determine the success of the mitigation measures. If a positive result is observed, and trends

begin to stabilise or reverse, then the result is documented and a return to regular monitoring occurs. If not, then the continued operation of the identified activity or activities causing the effected may need to be reviewed and adjusted in consultation with the regulator and other affected parties.

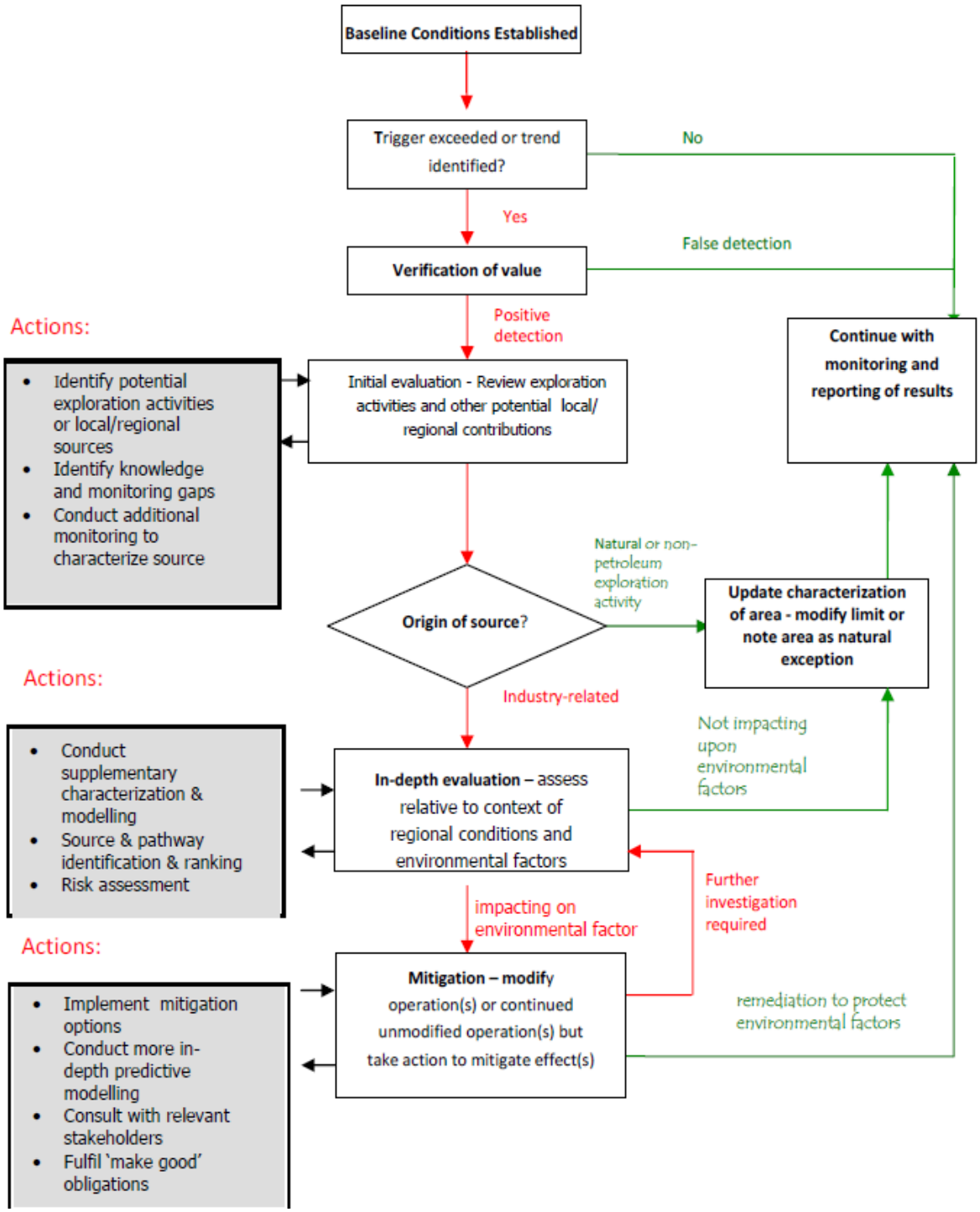
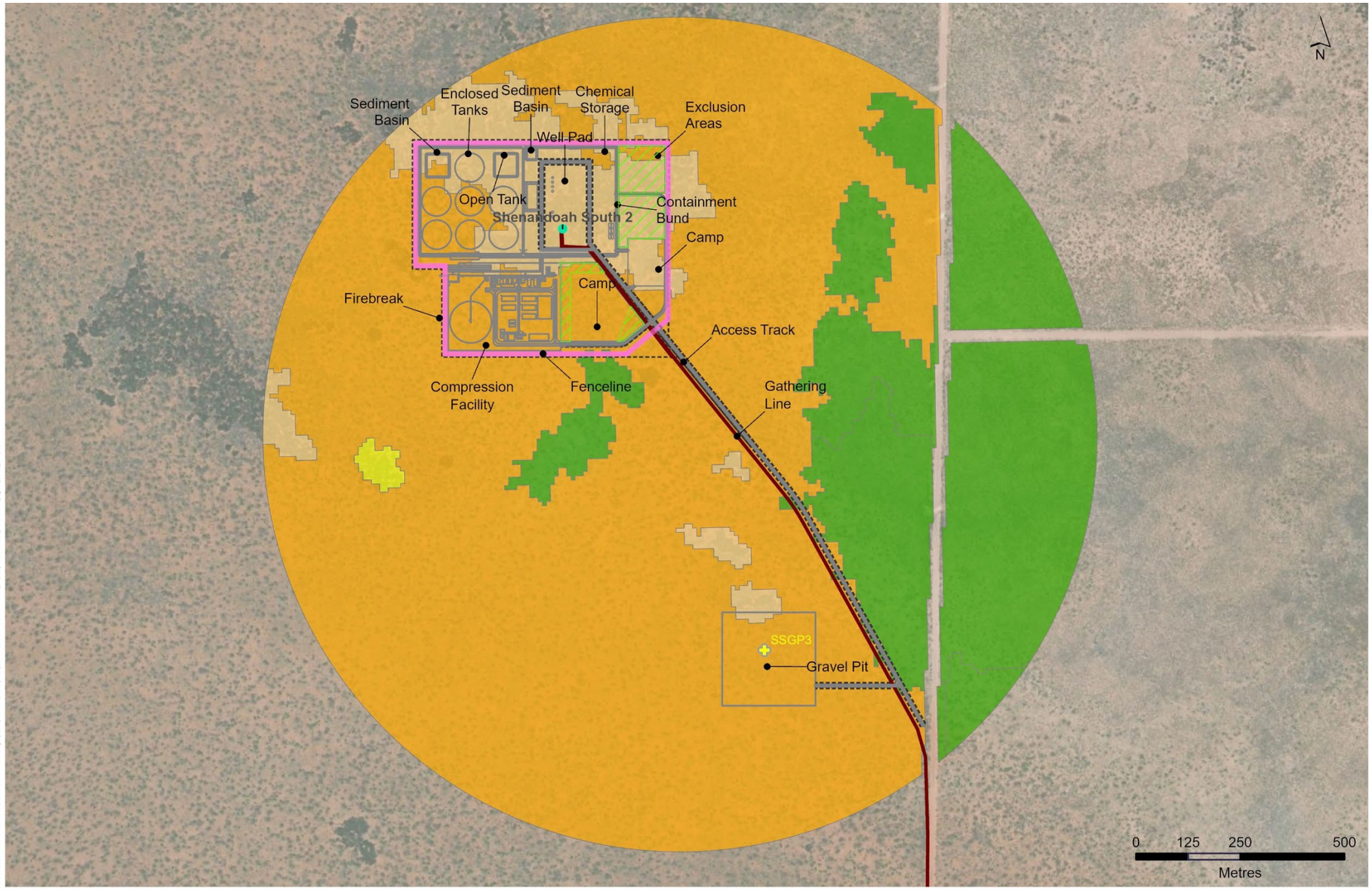


Figure 32: Investigation and response process

4 Description of the existing environment

The full description of the biological environment of the Project site (Shenandoah S2) is provided in the following sections. The description is drawn from the land condition assessment and heritage assessment completed in March-April 2023 by AECOM (AECOM, 2024a; 2024b). An overview of the Shenandoah S2 survey site and surrounds is shown in Figure 33. An abridged version of the AECOM (2024a; 2024b) reports covering the Shenandoah S2 site (i.e. the LCA and Cultural Heritage Assessment) are provided as Appendix H and Appendix I, respectively.

This information is provided for context, as there is only minor clearing of an additional 3.0 ha proposed under this EMP and the Shenandoah S2 site has been fully assessed and approved under the TAM1-3 EMP.



Legend

- Proposed Exploration Well Pads
- 2a - Corymbia dichromophloia ± Erythrophleum chlorostachys open woodland over Acacia difficilis ± Terminalia canescens, Erythrophleum chlorostachys open shrubland over hummock grassland
- 2b - Acacia shirleyi, Corymbia dichromophloia ± Eucalyptus leucophloia, open woodland over Macropteranthes kekwickii, Petalostigma pubescens, Hakea arborescens open shrubland over tussock grassland
- 3a - Eucalyptus chlorophylla, Corymbia polycarpa ± Corymbia confertiflora open woodland over Erythrophleum chlorostachys, Acacia holosericea, Acacia difficilis open shrubland over tussock grassland
- 4d - Eucalyptus camaldulensis low woodland over Melaleuca viridiflora sparse shrubland over open tussock grassland
- Exclusion Areas

Figure 33: Vegetation groups for the Shenandoah S2 site

4.1 Physical environment

4.1.1 Climate

The climate of the permit areas is arid to semi-arid, with rainfall decreasing in frequency and quantity from north to south. The climate is monsoon influenced, with a distinctive wet summer between October and April, and a dry winter season between May and September, with September and April being transitional months with occasional rainfall.

Mean annual rainfall in the north of the Beetaloo exploration area is recorded at 678 mm at Daly Waters (DEPWS, 2022). The southern portion of the permit areas records an average annual rainfall of 536 mm at Newcastle Waters and 602 mm at Elliott. Approximately 90% of the rainfall occurs during the wet season from November to April but primarily in December to March (DEPWS, 2022).

The area is characterised by an average net precipitation deficit of -2,150 mm per year based on evaporation and rainfall data for Daly Water and Elliott (BOM, 2017a; Fulton and Knapton, 2015).

4.1.2 1:1000 wet season annual re-occurrence interval calculations

Monthly rainfall totals were analysed from the Scientific Information for Land Owners data to interpolate rainfall data from 1900 to the present day. Consistent with industry accepted methodology associated with practices (such as dam risk assessments which calculates the wet season based on your geographical location) 3 months was determined applicable.

The highest 3-month rainfall period during the wet and dry seasons was predicted for every year from 1900 till 2018. These values were then used to fit a Log Pearson III distribution to the data to allow us to extrapolate to the 1,000 year, 3-month duration wet season (Figure 34) and 3-month dry season (Figure 35). This method is consistent with the Australian Rainfall & Runoff methodologies. The median 1 in 1,000-year 3-month wet season is 1,289 mm and 3-month dry season is 300 mm. These figures do not include any evaporation and are therefore considered extremely conservative.

Based on the assessment, a 1,300 mm wet season and 300 mm dry season freeboard will be applied to all open sumps and tanks.

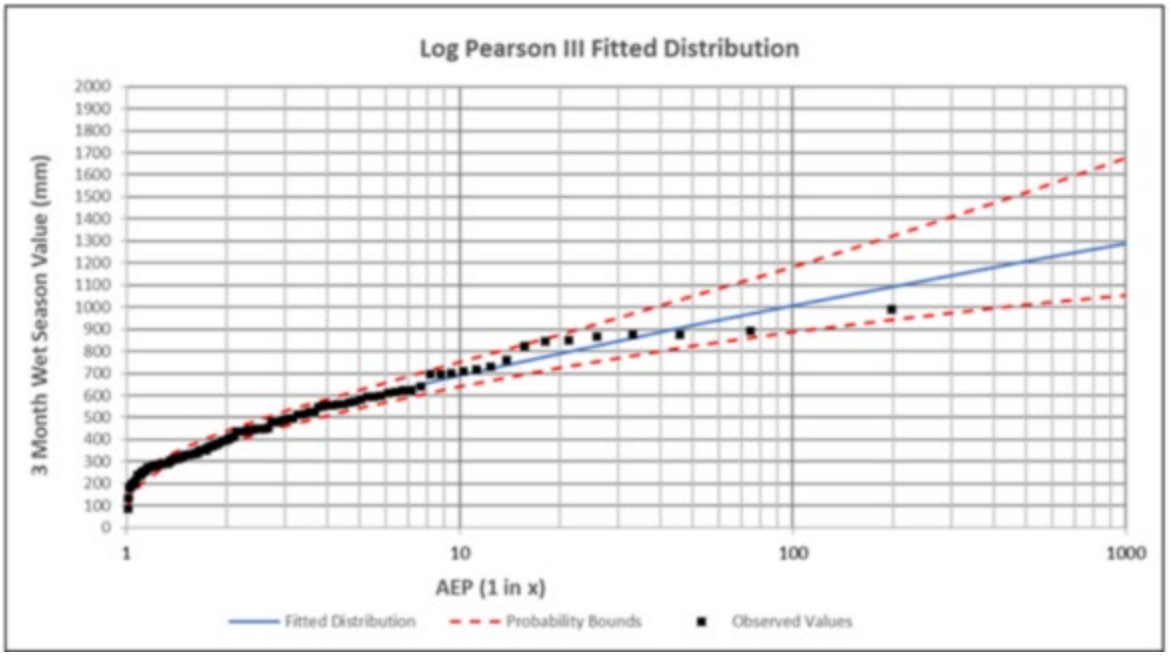


Figure 34: Log Pearson determination of 1:1000 wet season ARI

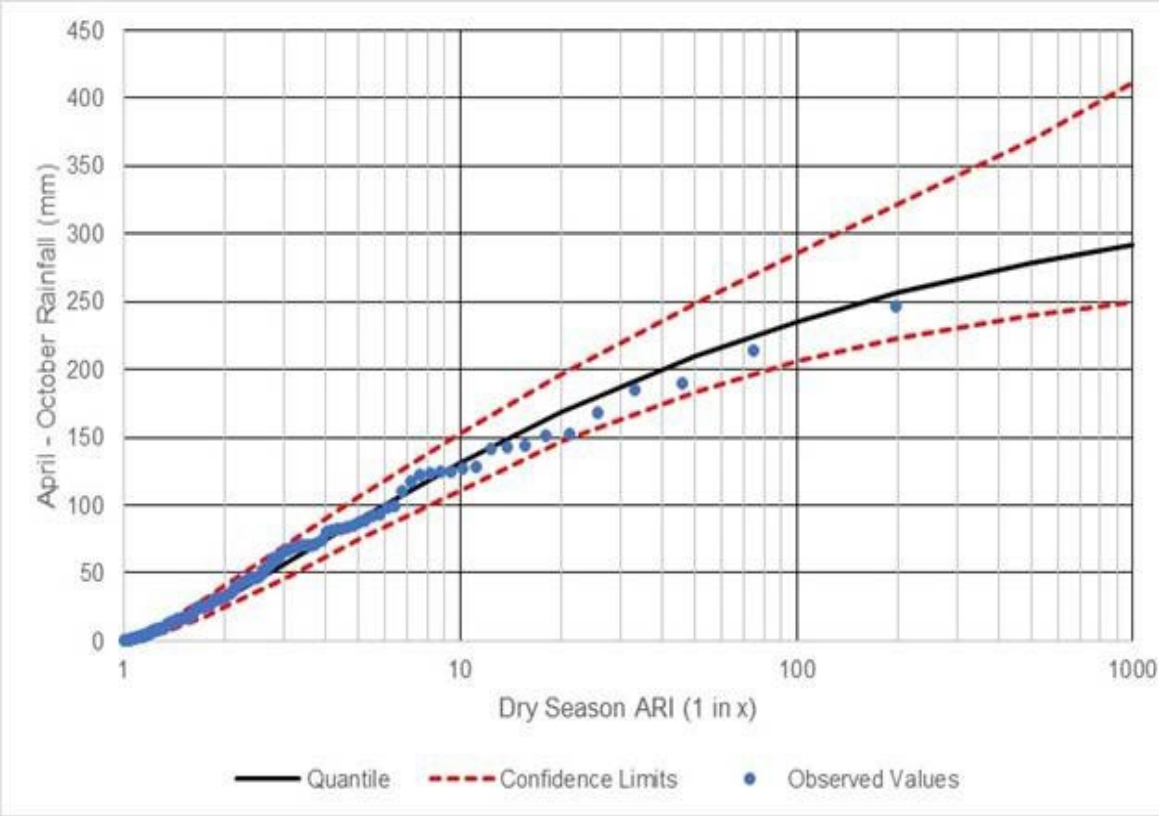


Figure 35: Log Pearson determination of 1:1000 dry season ARI

4.1.3 Geology

The geology of the Beetaloo Sub-basin continues to undergo stratigraphic refinement and characterisation, as new data sets become available. This section largely draws on the Technical Appendix for the Geological and Bioregional Assessment Program; a collaborative study between the CSIRO, Geoscience Australia, BOM and the Department of the Environment and Energy, reported in Orr *et al.,* (2020).

The Beetaloo Sub-basin comprises a thick sequence of mudstone and sandstone formations (Roper Group) that were deposited during the Mesopreterozoic era,[15] approximately 1,500 – 1,300 million years ago (Ma) (Orr *et al.*, 2020). The highly prospective source shales of the Kyalla and middle Velkerri formations, lie within the Roper Group, which is estimated to reach more than 5,000 m in thickness in the centre of the Sub-basin and estimated to be thinner outside the formally defined Beetaloo Sub-basin (Orr *et al.,* 2020).

The Roper Group is overlain unconformably by the yet to be formally defined Neoproterozoic Group. Unconformably overlying the Neoproterozoic group is the Georgina Basin (Cambrian) sedimentary package, which includes widespread extrusive flood basalts and a thick limestone sequence that forms the CLA, a significant water supply aquifer (Orr *et al.,* 2020).

The Georgina Basin is capped unconformably by a thin section of Cretaceous mudstone and sandstone (Albian aged ~100 – 113 Ma) and recent alluvial and laterite deposits. The shale and sandstone layers of the Beetaloo Sub-basin - specifically the Kyalla Formation and Velkerri Formation — hosts the gas plays that are the target for petroleum exploration activities in the area (DEPWS, 2022a).

[15] A geologic era that occurred from 1,600 to 1,000 million years ago. Known as the first era of Earth's geologic history.

The proposed wells will be completed in the Velkerri formation. Organic richness within the Velkerri formation is generally confined to three to four main shale intervals, the A, A-B, B and C shales. The E&A wells will likely be located in the Velkerri B Shale (as per the Amungee NW-1H well), although other shales (A, A-B or C) may be targeted in the future.

The Velkerri Formation Amungee Member is overlain with thick series of low permeability units (mudstone, siltstones, tight sandstone and Volcanic units) which include the Velkerri Formation Wyworrie Member, Kyalla Formation, Shenandoah-East Formation, and Antrim Plateau Volcanics (Fulton & Knapton, 2015). These formations provide thick and multilayered effective geological barriers, with the Gum Ridge Formation separated from the target formations by >1500 m. The effectiveness of geological barriers to fracture height growth will be assessed prior to stimulation with geomechanical data from core analysis, wireline log data and modelling.

4.1.4 Soils

The Sturt Plateau bioregion covers an area of 103,857 km^2 and comprises undulating plains on sandstones, with mostly neutral sandy red and yellow earth soils (ANRA, 2008; DEPWS, 2022a).

The soil types located within the plateau range from the very strongly leached lateritic soils of the Tertiary land surface to the calcareous desert soils and desert loams in the southern drier areas, through to cracking clays in the south-east (AECOM, 2024a).

The lateritic plains, located with the permit area, are classed as very strongly leached soils of the Tertiary land surface. The three main soil types located within the permit area (AECOM, 2024a), include:

1. Tertiary Lateritic Red Earths: which occur on the gently undulating topography. The soil profile can be described as:

A-Horizon	Grey-brown sandy loam
B-Horizon	Reddish-brown sandy clay loam
C-Horizon	Red-brown to red light clay, overlying heavy ferruginous gravel and massive laterite

2. Tertiary Lateritic Red Sands: which occur on gently undulating to undulating topography of the Tertiary Lateritic Plain, formed from sandstones and complex parent materials of the deep sandy soils. The soil profile can be described as

A-Horizon	Grey-brown to brown sand
B-Horizon	Brown sand
C-Horizon	Red-brown to yellow-brown sand overlying pisolitic ferruginous gravel and massive laterite. Altered colouring of highly siliceous parent sandstone is only evident in the mottled and pallid zones

3. Tertiary Lateritic Podzolic Soils: formed on the gently undulating topography over a variety of rocks. These soils are located in the northern section of the Barkly Basin. The soil profile can be described as

A-Horizon	Grey sand
B-Horizon	Yellowish-grey sand

C-Horizon	Yellow-grey sandy loam with ferruginous gravel overlying massive laterite, mottled and pallid zones

Table 30 and Table 31 present the erosion risk rating based on average monthly rainfall for Daly Waters and Newcastle Waters, using the rating system provided in the International Erosion Control Association (2008) Table 4.4.2. Erosion mitigations, include the sheeting of hardstand areas, the installation of a stormwater basin on all well pads during construction activities, and limited clearing or major civil construction activities (Section 3.7) planned to occur during periods of high rainfall (e.g. December – March). Based on the implementation of these mitigations, which predominantly coincide with dry season activities, the overall risk of erosion is considered very low.

Table 30: Erosion risk rating based on average monthly rainfall at Daly Waters

Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	165.4	165.4	120.1	23.6	5.0	5.6	1.5	1.7	4.9	22.5	59.4	110
Erosion Risk*	H	H	H	VL	VL	VL	VL	VL	VL	VL	M	H

* E = Extreme (>225 mm); H = High (100+ to 225 mm); M = Moderate (45+ to 100 mm); L = Low (30+ to 45 mm); VL = Very Low (0 to 30 mm)

Table 31: Erosion risk rating based on average monthly rainfall at Newcastle Waters

Item	Jan	Feb	Mar	Apr	May	June	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	125.5	130.9	93.7	24.6	9.3	5.3	3.4	1.0	5.4	20.9	35.7	77.3
Erosion Risk*	H	H	M	VL	VL	VL	VL	VL	VL	VL	L	M

*E = extreme (>225 mm); H = High (100+ to 225 mm); M = Moderate (45+ to 100 mm); L = Low (30+ to 45 mm); VL = Very Low (0 to 30 mm)

4.1.5 Seismicity

Large earthquakes are relatively rare in Australia with an earthquake exceeding magnitude 7 on the Richter scale occurring somewhere in Australia only once every 100 years (SRC 2017).

As shown in Figure 36, earthquakes are comparably rare in the Beetaloo and in the vicinity of the regulated activities, aside from those areas around Tennant Creek and west of Alice Springs. The distribution of earthquakes between 1901 – 2011, of ≥ 3 magnitude largely occur north-west, south-west and south-east (in the Simpson Desert) of Alice Springs; and predominantly in, or to the west of Tennant Creek (McCue 2013). On 22 January 1988, several earthquakes with a magnitude of 6.2-6.4 occurred in a 12-hour period in Tennant Creek, resulting in thousands of aftershocks. By 2013, while the rate of aftershocks has decreased, it had not returned to its pre-1987 level (McCue 2013).

In the Beetaloo, there have been no earthquakes over magnitude 3 measured since records began. The area is not prone to seismic activity and there is no evidence of recent earthquake activity as most faults and the major subsurface structure are confined to Cambrian or older strata.

The issue of induced seismicity from hydraulic fracture stimulation (HFS) activities has gained increasing exposure due to some high magnitude events in Oklahoma. However, the United States Geological Survey has stated very clearly that HFS is not causing most of the induced earthquakes and has pointed out that wastewater disposal via reinjection is the primary cause of recent earthquakes in the Central USA (USGS 2017). Davies *et al.,* (2013) illustrates that induced seismicity directly attributed to HFS operations is of such low occurrence that the documented cases are statistical anomalies rather than commonly occurring phenomena.

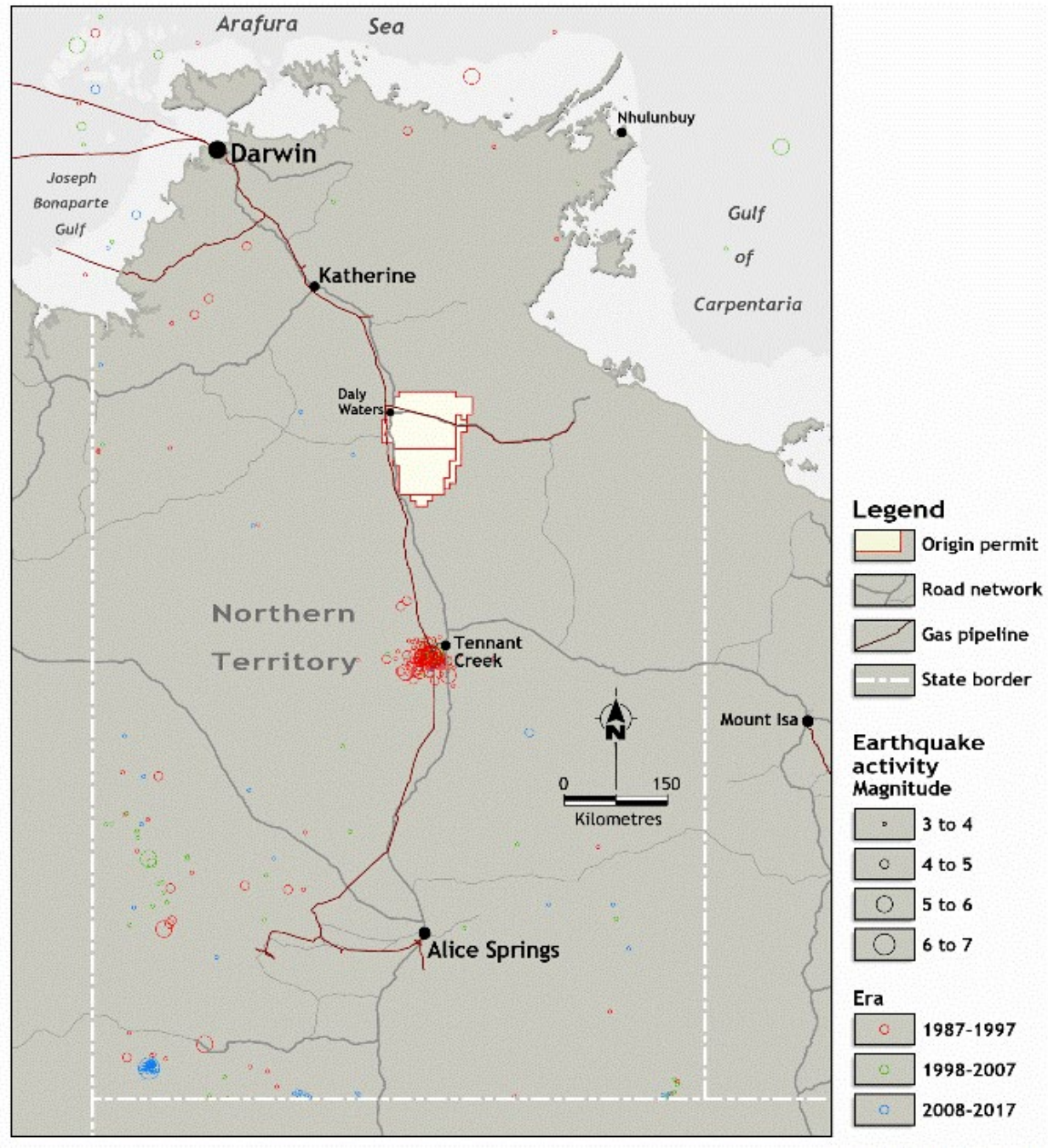


Figure 36: Earthquakes greater than magnitude 3 from 1987 to 2017 across the NT showing an absence of seismic activity in the Beetaloo area (adapted from McCue, 2013)

4.1.6 Hydrology

Figure 37 shows the location of the Shenandoah S2 site within a regional catchment perspective and in relation to other Tamboran sites.

The Shenandoah S2 site falls within the Georgina Basin Water Management Area (DEPWS, 2022). The Georgina Basin Water Management Area covers the southern half of EP 98 (south of the Carpentaria Highway), the majority of EP 76 and a large portion of EP 117; it is internally drained by Newcastle Creek and several small ephemeral creeks. Newcastle Creek ultimately flows into Lake Woods, which is located south of the Newcastle Waters Station. Lake Woods covers an area of inundation of approximately 50,000 ha (500 km^2) in normal rainfall years, extending to 80,000 ha (800 km^2) in exceptionally wet years, after which it can retain water for several years (HLA-Envirosciences Pty Ltd, 2005). Lake Woods is described as a major quasi-permanent surface water body and is listed on the NT Government Sites of Conservation Significance and on the Directory of Important Wetlands in Australia (HLA, 2006e). Some semi-permanent and many ephemeral waterholes are located across the permit area (HLA, 2006e).

There are no creeks intersecting the Shenandoah S2 site. Nor are there any occurrences of palustrine (non-riverine or non-channel systems) and floodplain systems, with shallow depressions in the vicinity of the site (Figure 38).

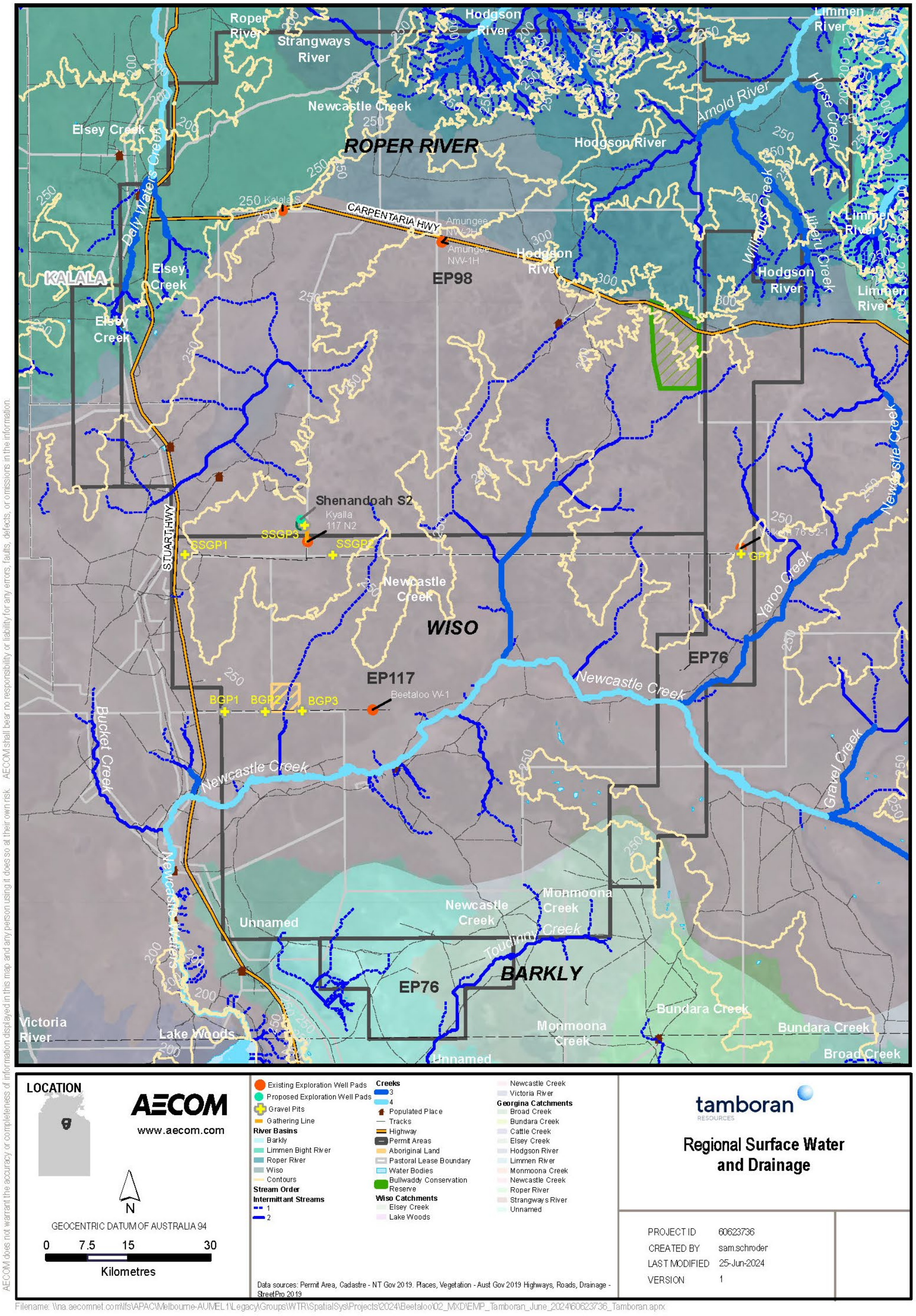
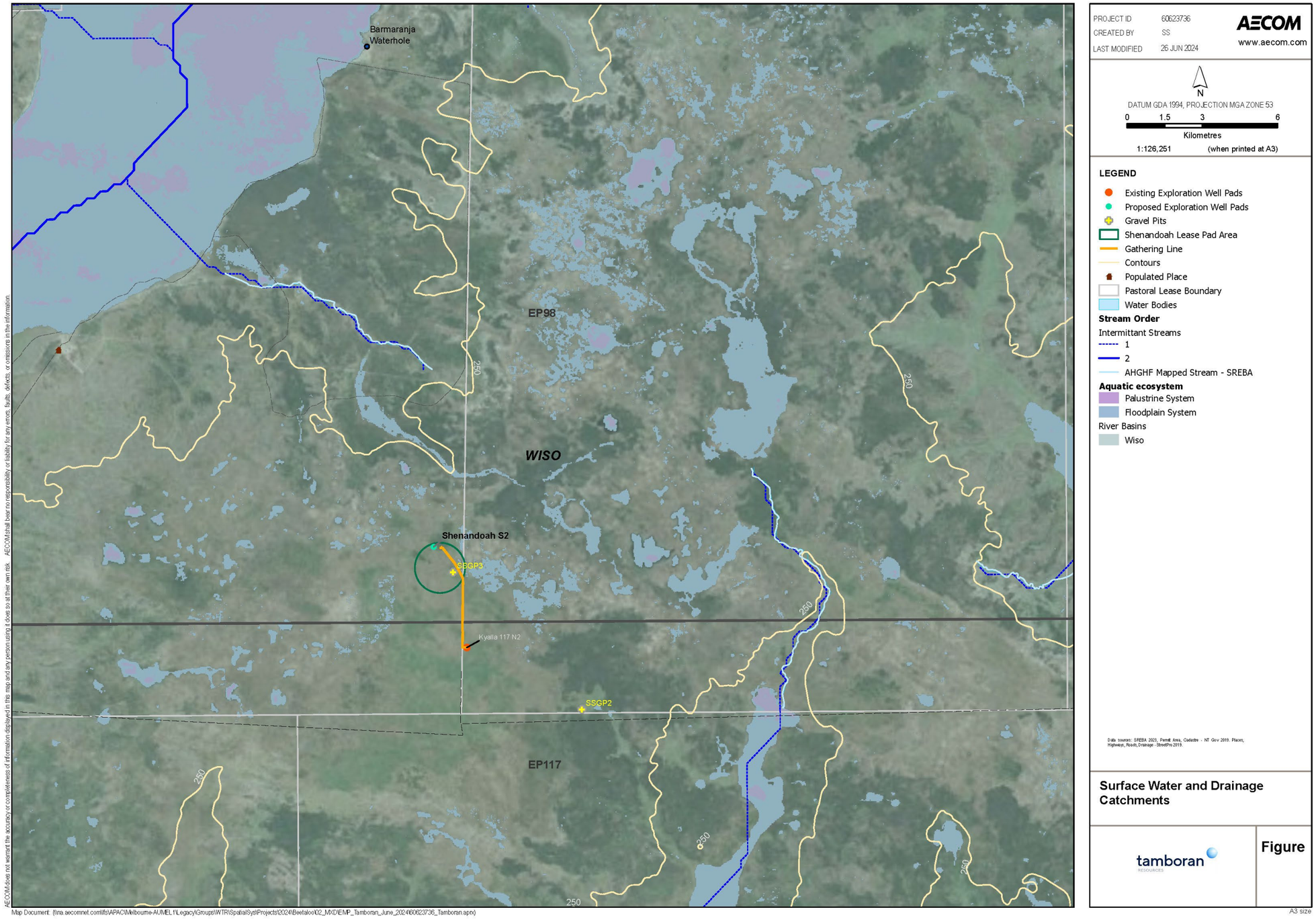


Figure 37: Regional surface water and drainage catchments for Shenandoah S2 site



PROJECT ID 60623736
CREATED BY SS
LAST MODIFIED 26 JUN 2024

AECOM
www.aecom.com

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DATUM GDA 1994, PROJECTION MGA ZONE 53

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LEGEND

- Existing Exploration Well Pads
- Proposed Exploration Well Pads
- Gravel Pits
- Shenandoah Lease Pad Area
- Gathering Line
- Contours
- Populated Place
- Pastoral Lease Boundary
- Water Bodies

Stream Order

Intermittant Streams
- 1
- 2
- AHGHF Mapped Stream - SREBA

Aquatic ecosystem
- Palustrine System
- Floodplain System

River Basins
- Wiso

Data sources: SREBA 2023, Permit Area, Cadastre - NT Gov 2019. Places, Highways, Roads, Drainage - StreetPro 2019.

Surface Water and Drainage Catchments

tamboran RESOURCES

Figure

A3 size

Figure 38: Surface water and drainage catchments in the vicinity of the Shenandoah S2 site

4.1.7 Flood risk assessment

The extent of inundation within the permit area depends on the severity of the wet season and can range from remaining completely dry to widespread flooding. As a part of the land condition assessment, AECOM (2024a) assessed the 1% Annual Exceedance Probability (AEP) flood depths and levels to determine the risk of flood inundation during the 100-year flood event from a local or regional flooding for the Shenandoah S2 site (Table 32).

Table 32: 1% AEP Results for the Project site

Well pad	SRTM ground elevation (m AHD)[1]	Maximum water depth (m)	1%AEP Flood level at nearest channel (m AHD)
Shenandoah S2	267.5	-	267.3
[1] AHD – Australian Height Datum			

The greatest risk of flooding to the Shenandoah S2 site is potentially from local catchment sheet-flow (rainfall immediately over the area draining to the site). The site bund is typically ~0.5 m in height, meaning it should be protected from widespread inundation. The local catchment runoff from major storm events is the considering factor for the establishment of well pad finish levels. Well pad designs take this into consideration for the final placement in the landscape.

The hydraulic assessment of the Shenandoah S2 site indicates the risk of inundation in the 1% AEP from a regional and local catchment flood event is low (Figure 39). The position of the well pad on a ridge between two local flow paths reduces the risk of inundation from regional catchment flows.

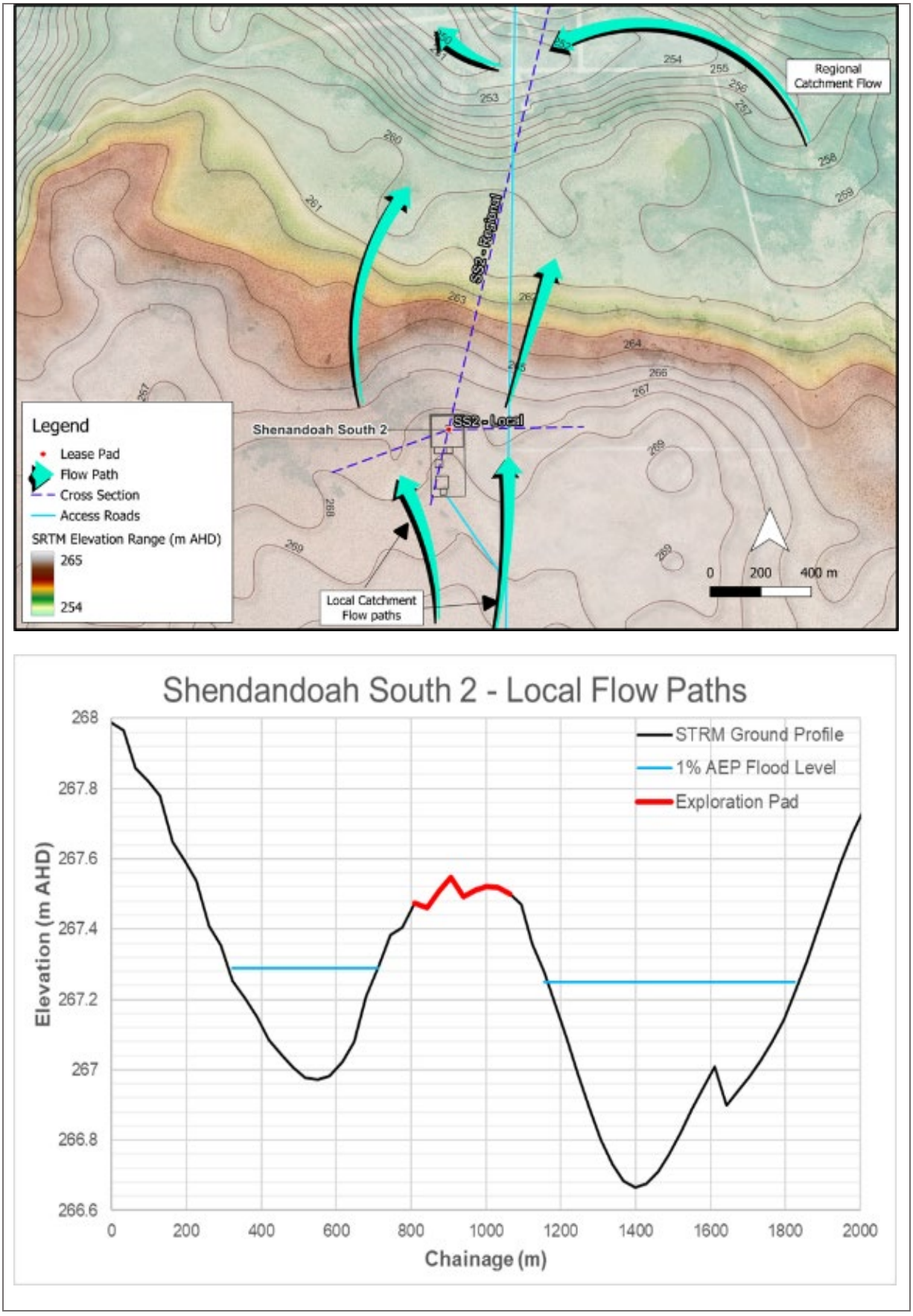


Figure 39: Hydraulic assessment for the Shenandoah S2 site

4.1.8 Hydrogeology

Within the Beetaloo exploration area, groundwater use is primarily from the Cambrian Limestone Aquifer (CLA) with minor, localised use from formations where shallower groundwater is intersected, where the CLA is too deep, or where the CLA is absent from erosion. This includes:

- Overlying Cretaceous sediments where it is saturated in the central south of the Beetaloo Sub-basin.
- Antrim Plateau Volcanics in the north-west.
- Bukalara Sandstone in the north-east.

Table 33 summarises the stratigraphy based on previous drilling at the Kyalla 117 N2. Descriptions of the stratigraphic units have been revised to align with the generalised hydrostratigraphy presented in DEPWS (2022a).

Table 33: Summary hydrostratigraphy based on encountered depths at Kyalla 117 N2 (adapted from DEPWS, 2022a)

Province	Period / age	Formation		Aquifer status	Encountered Depths[1] (approx. top and bottom) (m)	Regional yield (L/s)	Avg regional EC (µs/cm)
CARPENTARIA BASIN	CRETACEOUS 145 – 66 Ms	Undifferentiated		Local-scale aquifer	0 – 70.0	0.3 – 4.0	1,800
GEORGINA BASIN	CAMBRIAN 497 – 630 Ma	Cambrian Limestone Aquifer (CLA)	Anthony Lagoon Formation	Regional aquifer	70.0 – 191.4	1.0 – 10.0	1,600
			Gum Ridge Formation	Regional aquifer	191.4 – 399.5	>20.0	1,400
		Antrim Plateau Volcanics		Regional aquitard	399.5 – 499.0	<2.0	900
		Bukalara Sandstone		Local aquifer (not regionally connected)	499.0 – 506.7	0.3 – 5.0	1,000
BEETALOO SUB-BASIN (ROPER GROUP)	UNKNOWN	Hayfield formation		Regional aquifer	506.7 – 899.33	ID	32,000
		Jamison Sandstone		Local aquifer (not regionally connected)	891.33 – 988.97	ID	138,000
	MESO PROTEROZOIC 1,430-1,500 Ma	Kyalla Formation		Regional aquitard	988.97 – 1,851.75	ID	ID
		Moroak Sandstone		Local aquifer (not regionally connected)	1,851.75 – not determined	0.5 – 5.0	131,000
		Velkerri Formation		Regional aquitard	700 – 900	–	–
		Bessie Creek Sandstone		Local aquifer (not regionally connected)	450	0.5 – 5.0	–

The CLA, comprising the Gum Ridge Formation and the Anthony Lagoon Beds, is an extensive, multi-layered regional aquifer system covering at least 200,000 km^2 that forms the principal water resource in the Beetaloo Sub-basin, (DEPWS, 2022a).

The CLA is a highly productive aquifer that has high regional connectivity due to the development of significant fracture and karstic secondary porosity (DEPWS, 2022a). Across parts of the Beetaloo Sub-Basin, undifferentiated Cretaceous deposits from the uppermost aquifer are targeted for stock use. Notably, a basal sandstone unit immediately overlying the CLA produces yields of at least 10 L/s (DEPWS, 2022a). Shallow, perched groundwater has also been recorded in the laterised zone within the permit area with groundwater levels recorded between 1 and 6 mBGL. These systems are dynamic with periodic saturation resulting from recharge during the wet season with no documented groundwater use.

Near the Kyalla 117 N2 site, for example, both aquifer units have a standing water level of approximately 114 m below top of casing. The limestone in the CLA is commonly fractured and cavernous; in the Katherine region, bore yields of up to 100 L/s have been recorded from this aquifer (DEPWS, 2022a). Such high yielding sections were encountered when drilling the Kyalla 117 N2-1 E&A well through the Anthony Lagoon and Gum Ridge Formation, with total losses of drilling fluid circulation at specific intervals.

Approximately 80% of groundwater bores drilled in the basin screen the CLA and the aquifer supplies water for the pastoral industry and local communities including Elliott, Daly Waters, Larrimah and Newcastle Waters. The CLA contains a significant but largely undeveloped groundwater resource with the estimated sustainable yield from the Georgina Basin under the *Georgina Water Allocation Plan 2023 – 2031* reported to be 210,000 ML per year (NTG, 2023). Fulton and Knapton (2015) estimated groundwater use in the Beetaloo Sub-basin to be at 6,000 ML/year, and primarily used for agricultural production. Recent estimated current water usage (licenced and unlicenced) is approximately 11,230 ML and 3,800 ML for the Georgina Basin and Wiso Basin, respectively (NTG, 2023). As previously demonstrated in section 3.9, future groundwater extraction has been assessed by the NTG, demonstrating negligible impact to groundwater allocations for Aboriginal land, neighbouring entitlements and GDEs (refer section 3.9 and section 4.2.4.4).

The Antrim Plateau Volcanics conformably underlies the CLA in the north and central part of the Beetaloo Sub-basin. Across much of the Basin it consists of sequences of massive basalt flows with negligible primary porosity. In the north-west of the Basin, where the formation is shallow and fractured, it forms a marginal aquifer, however, reported use is primarily from a sandstone sequence at the contact with the Gum Ridge Formation (Fulton and Knapton, 2015). There is no reported use within the 3 petroleum EPs held by Tamboran.

The Bukalara Sandstone forms a fractured and weathered aquifer where it outcrops beyond the north-east margin of the Beetaloo Sub-basin. The formation consists of quartz sandstone with shale interbeds and probable enhanced permeability in these areas due to jointing within the sandstone. No use is reported from the formation away from the north-east margin of the Beetaloo Sub-basin where it is at considerable depth (Fulton and Knapton, 2015). This unit, if present, will be protected through intermediate casing and cement.

The regional groundwater flow direction in the CLA is north-west toward Mataranka, where the aquifer discharges into the Roper River and supports significant groundwater dependent ecosystems (aquatic, riparian and floodplain) including the Roper River at Elsey National Park and Red Lily/57 Mile Waterhole. These discharge features occur around 100 km north-west of the Beetaloo Sub-basin. Dry season flow in the Roper River has been gauged at 95,000 – 126,000 ML/yr and provides an estimate of the magnitude of groundwater discharge from the CLA. Large decadal changes in the discharge to the Roper River suggest that most recharge input occurs close to the discharge zone (i.e. beyond the Beetaloo Sub-basin region). Groundwater recharge mechanisms to the CLA are poorly characterised but are likely to be dominated by infiltration through sinkholes and preferential recharge through soil cavities (AECOM, 2024a).

Limited information exists on the hydrogeological characteristics of the deeper Roper Group and undefined Neoproterozoic group sequence is available as it occurs at depth within the Beetaloo Sub-basin. This unit lies below the Georgina Basin which contains the CLA and other important aquifers. The deeper sandstone dominated formations may behave as aquifers, however, drilling results suggest these formations have limited potential as groundwater resources due to their depth and very high salinity. Groundwater in the Roper Group and undefined Neoproterozoic group is highly saline (>100,000 mg/L chlorides) and contrasts with the shallower, utilised aquifers of the Georgina Basin sediments in which groundwater is generally of drinking water quality (AECOM, 2024a).

4.2 Biological environment

4.2.1 Bioregions

The Project falls within the Sturt Plateau Bioregion. The bioregion is characterised by undulating plains on sandstone with predominantly neutral sandy red and yellow earth soils. Dominant vegetation is eucalypt woodland, which include extensive areas of Lancewood (*Acacia shirleyi*), Bullwaddy (*Macropteranthes kekwickii*) vegetation and associated fauna, including the Spectacled Hare-Wallaby (*Lagorchestes conspicillatus*). Land condition in the bioregion is moderate to good but is threatened by impacts from weeds, feral animals, pastoralism and changed fire regimes.

4.2.2 Vegetation communities

Surveys of the vegetation communities of the proposed activity locations within the Shenandoah South E&A program were completed in March-April 2023 by AECOM (2024a). Data has also been used from previous baseline assessments completed in 2004, 2006 (HLA-Envirosciences Pty Ltd, 2005; HLA, 2006a; HLA, 2007), 2010, 2014, 2016 ,2018 and 2021 (AECOM, 2011; 2014; 2016; 2018; and 2021).

The Project (e.g. the Shenandoah S2 site) was evaluated during the 2022 and 2023 scouting. This includes detailed habitat assessments which identify vegetation community, dominant flora species at each stratum, habitat condition, disturbance factors (fire, weeds, erosion, feral fauna species), and fauna attributes (e.g. tree hollows, logs, grass cover, mistletoe abundance).

The SREBA Terrestrial Ecosystems Baseline Report identified 51 vegetation communities and 21 broad vegetation groups (BVG) comprising the final vegetation classification for the study area (Young *et al.*, 2022). Regionally and within the vicinity of the regulated activities, 21 vegetation communities are noted (Figure 40). Significant vegetation communities identified by the SREBA Baseline Report were also identified during the surveys for other proposed Tamboran activities, including surface catchments (e.g. wetland, floodplains/drainage depressions and run-on areas). However, the Shenandoah S2 site lies outside these areas (Figure 41).

Based on the SREBA definition of significant vegetation (DEWPS 2022a), it is considered that the floodplains and drainage depressions in the vicinity of the Project site are not classified as high value wetlands, however they do have important ecological values for the local flora and fauna. The floodplains, drainage depressions and run-on areas are generally not considered sensitive to impacts from adjacent land use due to the relatively large spatial extent (DEPWS 2022a).

A summary of the LCA for the Shenandoah S2 site is provided in Table 34. Community 2a *Corymbia dichromophloia* ± *Erythrophleum chlorostachys* open woodland is the most widespread vegetation community within the Shenandoah S2 site (84.08%; 264.09 ha). Approximately 0.7% of area within Shenandoah S2 was identified as tracks and therefore not classified in a vegetation community type. This equals 2.19 ha of a total area of ~314.12 ha in Shenandoah S2. Approximately 75% of vegetation communities assessed during the March-April 2023 scouting survey do not occur within the Shenandoah S2 site, which is equal to ~943 ha if a total area of ~1,257 ha (AECOM 2024a).

The 4 vegetation communities (2a, 2b, 3a and 4b) identified from 66 vegetation sites recorded during the March 2023 LCA surveys (adapted from AECOM, 2024a) are described in Table 35 – Table 38. These data provide an overview of the vegetation communities associated with the proposed well pad area, including the site of the SPCF.

Potential risks and impacts to the environment have been identified and assessed previously based on environmental conditions observed during the field survey. The overall disturbance footprint for the SPCF on the Shenandoah S2 site is 5.0 ha, which has been assessed and approved under the TAM1-3 EMP.

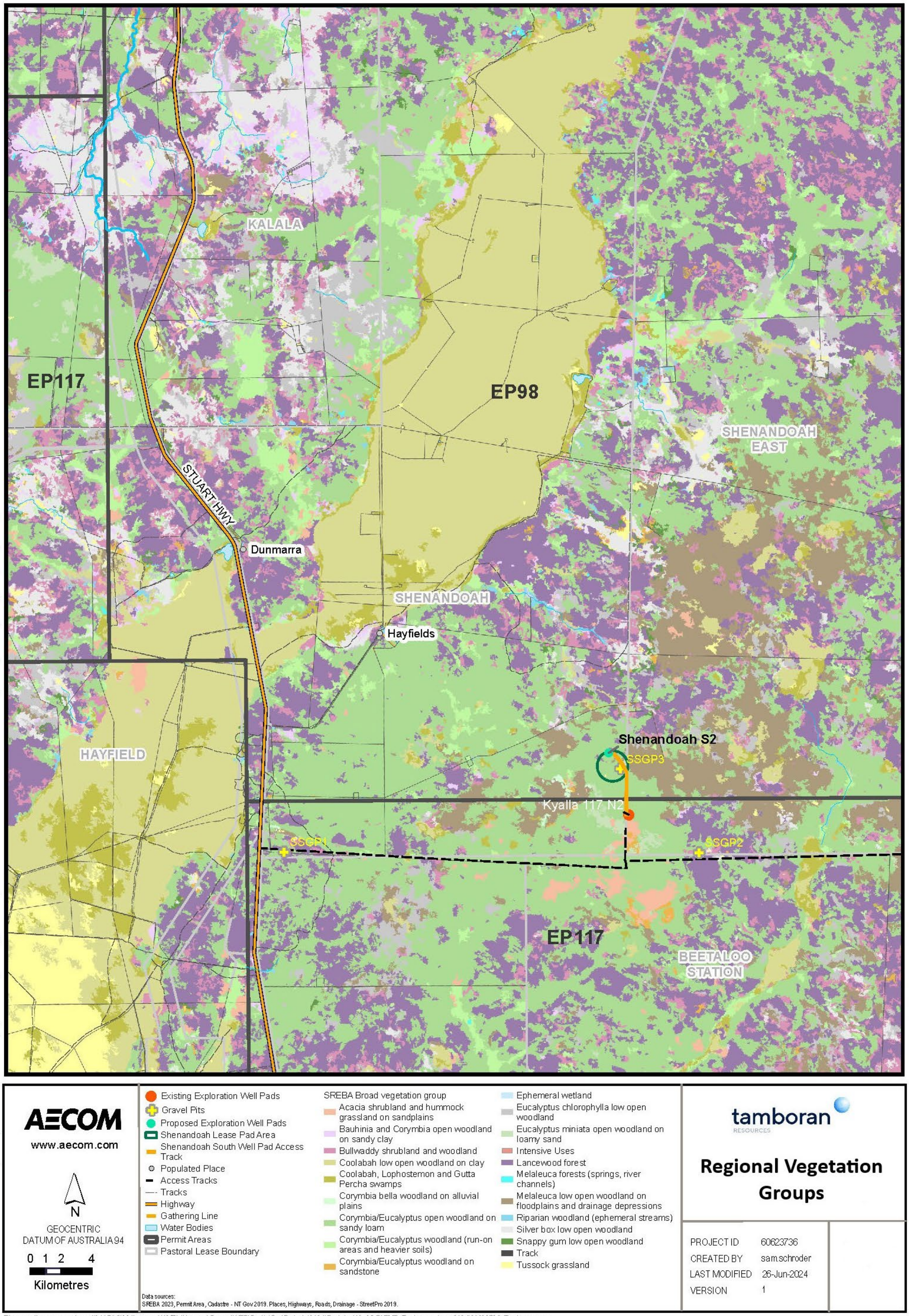


Figure 40: Shenandoah S2 regional vegetation community boundaries adapted from SREBA (DEPWS 2022b)

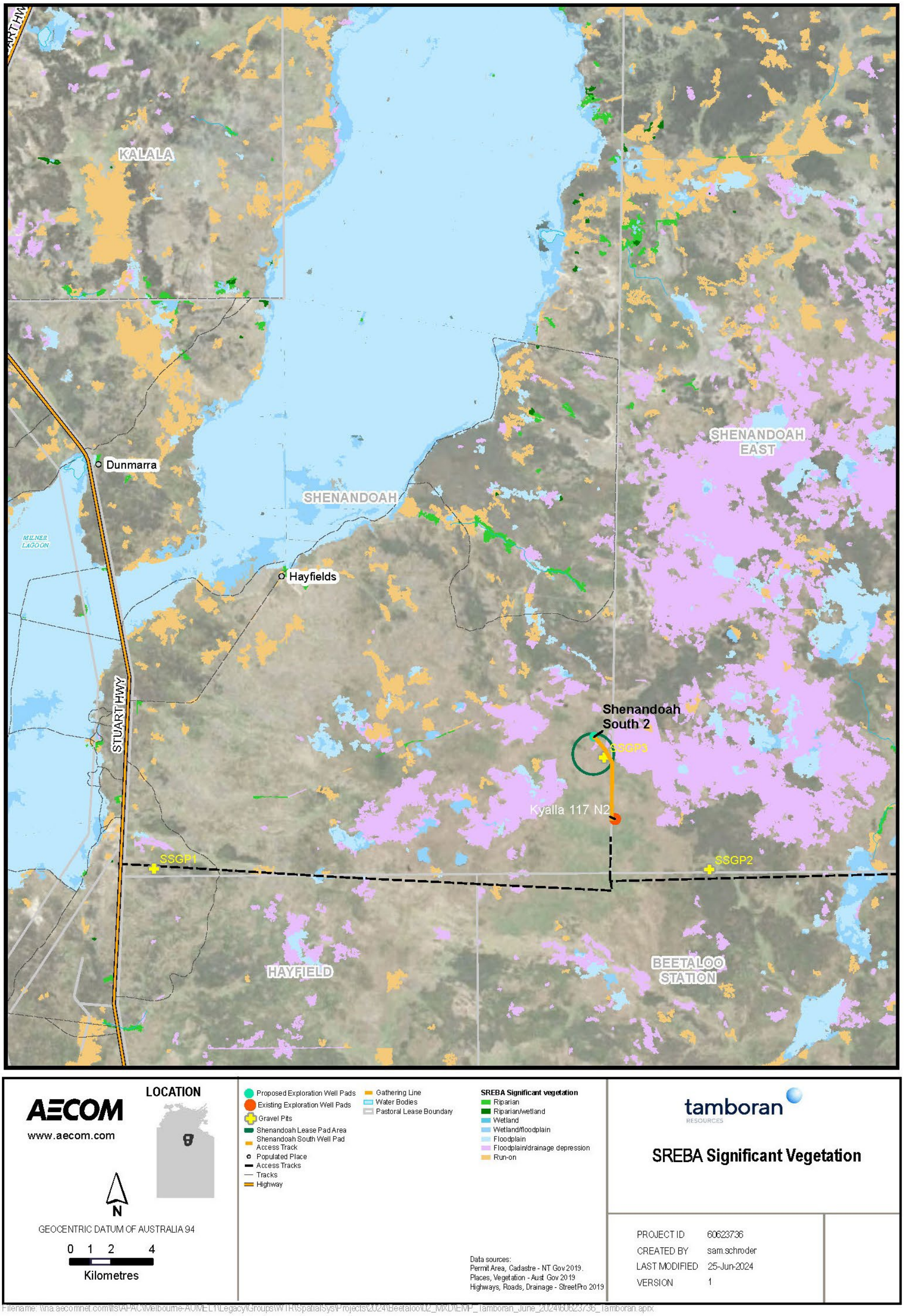


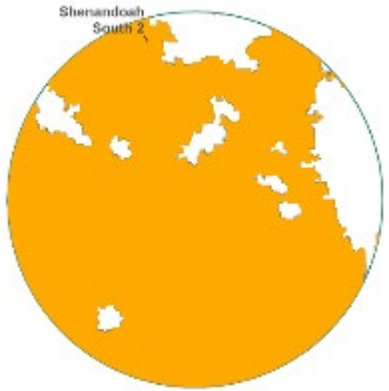
Figure 41: Shenandoah S2 significant vegetation communities, adapted from SREBA (DEPWS 2022b)

Table 34: Summary of existing environment and surrounds – Shendandoah S2

<table>
<tr><td colspan="3">Shenandoah S2</td></tr>
<tr><td>Location</td><td>GDA94, Zone 53, 355291E, 8140676N</td><td rowspan="4">Survey photos of the vegetation/habitat of the surrounding environment
  
   </td></tr>
<tr><td>Landform and soil</td><td>5YR 3/4 dark reddish brown (upper) to 5YR 3/3 dark reddish brown clay loam, sandy. Well drained on flat surface, no slope (0%).</td></tr>
<tr><td>Vegetation community</td><td>2a: Corymbia dichromophloia ± Erythrophleum chlorostachys open woodland over Acacia difficilis ± Terminalia canescens, Erythrophleum chlorostachys open shrubland over hummock grassland</td></tr>
<tr><td>Vegetation description</td><td>Corymbia dichromophloia ± Erythrophleum chlorostachys mid high open woodland, over Acacia difficilis ± Terminalia canescens, Erythrophleum chlorostachys mid high open shrubland, over Triodia bitextura, Aristida hygrometrica, Chrysopogon fallax mid high hummock grassland</td></tr>
<tr><td>Dominant flora species</td><td>Corymbia dichromophloia, Erythrophleum chlorostachys
Erythrophleum chlorostachys, Acacia difficilis, Terminalia canescens
Triodia bitextura</td></tr>
<tr><td>Habitat condition</td><td>Moderate - Common tree hollows and falling logs. Mistletoe and flowering plants absent. Shallow leaf litter. Termite mounds: Nil. Fire damage > 2 years ago. No erosion. Minor cattle impacts. Ground cover: 55% vegetation, 2% leaf litter, 43% bare.</td></tr>
<tr><td>Weeds</td><td colspan="2">No Weeds of National Significance present.</td></tr>
</table>

Shenandoah S2	
Potential listed threatened species (Young *et al.*, 2022)	Crested Shrike-tit (*Falcunculus frontatus whitei*), Gouldian Finch (*Erythrura gouldiae*), Plains Death Adder (*Acanthophis hawkei*), Yellow Spotted Monitor (*Varanus panoptes*), Grey Falcon (*Falco hypoleucos*), Common Brushtail Possum (*Trichosurus vulpecula arnhemensis*), Mertens' Water Monitor (*Varanus mertensi*)
Hydrogeology	Groundwater resources and use is primarily from the Cambrian Limestone Aquifers (the Anthony Lagoon Formation and Gum Ridge Formation) with the shallower undifferentiated Cretaceous or perched alluvium systems being unsaturated.

Table 35: Community 2a

Community 2a - *Corymbia dichromophloia* ± *Erythrophleum chlorostachys* mid high open woodland, over *Acacia difficilis* ± *Terminalia canescens*, *Erythrophleum chlorostachys* mid high open shrubland, over *Triodia bitextura*, *Aristida hygrometrica*, *Chrysopogon fallax* mid high hummock grassland	
Upper 1: Mid high open woodland dominated by *Corymbia dichromophloia* ± *Erythrophleum chlorostachys*	
Mid 1: Mid high open shrubland dominated by *Acacia difficilis* ± *Terminalia canescens, Erythrophleum*	
Ground 1: Mid high hummock grassland dominated by *Triodia bitextura*, *Aristida hygrometrica*, *Chrysopogon fallax*	
	
Other common species	
Upper stratum (U1): *Acacia shirleyi, Eucalyptus chlorophylla*	

Community 2a - *Corymbia dichromophloia* ± *Erythrophleum chlorostachys* mid high open woodland, over *Acacia difficilis* ± *Terminalia canescens*, *Erythrophleum chlorostachys* mid high open shrubland, over *Triodia bitextura*, *Aristida hygrometrica*, *Chrysopogon fallax* mid high hummock grassland
Mid stratum (M1): *Grevillea parallela, Dodonaea hispidula, Ehretia saligna, Acacia drepanocarpa subsp. latifolia, Acacia thomsonii, Acacia gonoclada, Brachychiton diversifolius, Brachychiton paradoxus, Grewia savannicola, Macropteranthes kekwickii, Persoonia falcata, Petalostigma pubescens, Wrightia saligna*
Ground stratum (G1): *Aristida inaequiglumis, Setaria surgens, Corchorus sidoides, Eriachne ciliata, Mnesithea formosa*
Landform: Lateritic Plains and Rises -associated with deeply weathered profiles (laterite) including sand sheets and other depositional products, sandy and earth soils
Soil: Brown sandy loam kandosol soils.
Area of vegetation community within the Shenandoah S2 area: 264.09 ha
Percentage of vegetation community within the Shenandoah S2 area: 84.08%

Table 36: Community 2b

Community 2b - *Acacia shirleyi, Corymbia dichromophloia* ± *Eucalyptus leucophloia, Corymbia polycarpa* mid high open woodland, over M*acropteranthes kekwickii, Petalostigma pubescens, Hakea arborescens* mid high open shrubland, over *Chrysopogon fallax, Mnesithea formosa, Eriachne ciliata* mid high tussock grassland
Upper 1: Mid high open woodland dominated by *Acacia shirleyi, Corymbia dichromophloia* ± *Eucalyptus leucophloia, Corymbia polycarpa*
Mid 1: Mid high open shrubland dominated by *Macropteranthes kekwickii, Petalostigma pubescens, Hakea arborescens*
Ground 1: Mid high tussock grassland dominated by *Chrysopogon fallax, Mnesithea formosa, Eriachne ciliata*

Community 2b - *Acacia shirleyi, Corymbia dichromophloia* ± *Eucalyptus leucophloia, Corymbia polycarpa* mid high open woodland, over M*acropteranthes kekwickii, Petalostigma pubescens, Hakea arborescens* mid high open shrubland, over *Chrysopogon fallax, Mnesithea formosa, Eriachne ciliata* mid high tussock grassland	
	
Other common species	
Upper stratum (U1): *Ventilago viminalis*	
Mid stratum (M1): *Calytrix exstipulata, Eucalyptus chlorophylla, Terminalia volucris*	
Ground stratum (G1): *Sorghum intrans, Eulalia aurea*	
Landform: Lateritic Plains and Rises -associated with deeply weathered profiles (laterite) including sand sheets and other depositional products, sandy and earth soils	
Soil: Brown sandy loam kandosol soils.	
Area of vegetation community within the Shenandoah S2 area: 20.90 ha	
Percentage of vegetation community within the Shenandoah S2 area: 6.65%	

Table 37: Community 3a

Community 3a - *Corymbia polycarpa*, *Eucalyptus chlorophylla*, *Acacia shirleyi* mid high open woodland, over *Acacia difficilis, Macropteranthes kekwickii, Erythrophleum chlorostachys* mid high open shrubland, over *Aristida* sp1, *Aristida* sp3 mid high open tussock grassland	
Upper 1: Mid high open woodland dominated by *Corymbia polycarpa, Eucalyptus chlorophylla, Acacia shirleyi*	
Mid 1: Mid high open shrubland dominated by *Acacia difficilis, Macropteranthes kekwickii, Erythrophleum chlorostachys*	
Ground 1: Mid high open tussock grassland dominated by *Aristida hygrometrica, Aristida contorta*	
	
Other common species	
Upper stratum (U1): *Erythrophleum chlorostachys, Acacia shirleyi* (Shen North sites)	
Mid stratum (M1): *Atalaya hemiglauca*	
Ground stratum (G1): *Pterocaulon serrulatum, Grewia savannicola*	
Landform: Lateritic Plains and Rises -associated with deeply weathered profiles (laterite) including sand sheets and other depositional products, sandy and earth soils	
Soil: Brown sandy loam kandosol soils.	
Area of vegetation community within the Shenandoah S2 area: 0.96 ha	
Percentage of vegetation community within the Shenandoah S2 area: 0.31%	

Table 38: Community 4d

Community 4d - *Eucalyptus camaldulensis* low woodland over *Melaleuca viridiflora* mid high sparse shrubland over *Dactyloctenium radulans, Eragrostis cumingii* mid high open tussock grassland	
Upper 1: Low woodland dominated by *Eucalyptus camaldulensis*	
Mid 1: Mid high sparse shrubland dominated by *Melaleuca viridiflora*	
Ground 1: Mid high open tussock grassland dominated by *Dactyloctenium radulans*, *Eragrostis cumingii*	
	
Other common species	
Upper stratum (U1): -	
Mid stratum (M1): -	
Ground stratum (G1): -	
Landform: Riparian creek lines with sandy and alluvial soils	
Soil: Brown sandy clay soils.	
Area of vegetation community within the Shenandoah S2 area: 25.97 ha	
Percentage of vegetation community within the Shenandoah S2 area: 8.67%	

4.2.2.1 Flora

A search of the DCCEEW Protected Matters database of nationally significant fauna (PMST) and the NT Government flora atlas database was undertaken for the exploration area, with a 10 km buffer applied. No threatened vegetation communities are listed as likely to occur within the Shenandoah South E&A program, which is supported by the SREBA (DEPWS, 2022a) surveys that indicate no threatened plant species were known to occur or were considered likely to occur within the Beetaloo Sub-basin.[16]

Overall, the SREBA surveys contributed 15,419 new plant records within the SREBA study area. A total of 1,818 plant species have been recorded within the Beetaloo exploration area (Young, *et al.,* 2022). The 2022 SREBA survey indicates that disturbance was prevalent across all broad vegetation groups, despite efforts to select "best on offer" vegetation sites. Primary contributors to disturbance include fire, cattle, pigs and weeds (Young, *et al.,* 2022).

The field survey undertaken during April 2023 recorded 1,372 individual flora species. The survey focused on recording dominant species to describe vegetation communities rather than undertake a comprehensive floristic assessment. No threatened flora were identified during the LCA.

4.2.2.2 Habitat fragmentation

As outlined in DEPWS (2022) *"…vegetation communities and habitats may vary in their sensitivity to degradation, fragmentation and loss as a result of onshore gas and other development."*

Impacts identified in SREBA (DEPWS, 2022a), include land clearing, inappropriate fire regimes, weed incursion and grazing by introduced herbivores, which can lead to long term loss of species abundance and richness. The cumulative impacts of clearing from a regional perspective have been discussed in section 3.3.2.1. Currently onshore gas develop represents ~3% of all clearing in the Barkly/Gulf Region (2003 – 2023).

Nevertheless, Tamboran continues to minimise its impacts and reduce the potential for habitat fragmentation, through key mitigations including use of centralised sites; construction of multi well pads; use of existing pastoral access tracks; active fire management; and active weed management.

4.2.2.3 Weeds

Baseline weed surveys completed during the land condition assessments, and annual surveys within the Tamboran EPs have recorded a low number and density of weed species, indicating that the overall land condition is generally good. Three declared weed species, *Calotropis procera* (Rubber bush), *Parkinsonia aculeata* (Parkinsonia) and *Mesosphaerum suaveolens* (Hyptis), have been recorded during previous Kyalla baseline surveys.

No weeds were detected within the Shenandoah South E&A program during the December 2022 and March-April 2023 field surveys. The areas traversed during field surveys are displayed in Figure 42, including the Shenandoah S2 site.

High-risk weeds have been determined through consideration of the following criteria:

- Weed species that has been confirmed in the area within the relevant Regional Weed Strategies and Plans, or through field surveys

[16] Noting that *Carex fascicularis* a densely-tufted perennial sedge (Vulnerable; TPWC Act) and *Spermacoce reticulata* an annual herb (restricted range species) were both recorded on the Hayfield Station (DEPWS 2022) approximately 30 – 34 km south-west of the proposed regulated activities. *Carex fascicularis* was recorded near a flowing creek (HAY18); *Spermacoce reticulata* was recorded in a Lancewood low open forest (HAY01).

- Weed species listed in a statutory plan that are near Tamboran tenure
- Weed species that are at risk of introduction using machinery sourced from other regions in the NT or from other states

There are four classes of weeds under the NT *Weed Management Act 2001*, which was amended in May 2022. The classes are described as:

a. *it is necessary to eradicate the plant*
b. *it is necessary to prevent the growing and spreading of the plant*
c. *it is necessary to prevent the introduction of the plant into the Territory or a part of the Territory*
d. *it is necessary to prevent the plant being spread by the actions of persons.*

Based on the available data for the weeds likely to occur within the vicinity of the Shenandoah S2 site, there are no weeds of Class D status in the area.

Table 39 provides a list of weed species that are known to occur or likely to occur Shenandoah South E&A program based on a desktop review of the following sources:

- Mapping data provided by the Weed Management Branch, DEPWS.
- Guidelines for the Management of the Weeds of Beetaloo 2018 (DENR 2019).
- DCCEEW *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Report database.
- Current and previous data collected by AECOM and Tamboran's weed contractor in the permit area.

Table 39: NT listed weeds known or likely to occur within the Shenandoah S2 site

Scientific Name	Common Name	Category of priority	Status*
Alternanthera pungens	Khaki Weed	4	Class B and C
Andropogon gayanus	Gamba Grass	1	Class A and C, Weed of National Significance (WoNS)
Azadirachta indica	Neem	2	Class B and C
Calotropis procera	Rubber Bush	1	Class B and C (south of 16°30' S latitude)
Cenchrus ciliaris	Buffel Grass	3	Declared weed
Cenchrus echinatus	Mossman River Grass	3	Class B and C
Datura ferox	Fierce Thornapple	3	Class A and C
Mesosphaerum suaveolens	Hyptis	4	Class B and C
Jatropha gossypiifolia	Bellyache Bush	1	Class A/B and C, WoNS
Parkinsonia aculeata	Parkinsonia	2	Class B and C, WoNS
Sida acuta	Spinyhead Sida	4	Class B and C
Sida cordifolia	Flannel Weed	4	Class B and C

Scientific Name	Common Name	Category of priority	Status*
Sida rhombifolia	Paddy's Lucerne	4	Class B and C
Tamarix aphylla	Athel Pine	2	Class A/B and C, WoNS
Themeda quadrivalvis	Grader Grass	5	Class B and C, WoNS
Tribulus terrestris	Caltrop	4	Class B and C
Vachellia nilotica	Prickly Acacia	1	Class A and C, WoNS
* All Class A and B weeds are also Class C weeds.			

Weed surveys undertaken in the vicinity of the Project area previously during May 2022 field survey focused on the edge of tracks, disturbance areas and along the Stuart and Carpentaria Highway. The following weeds were recorded during the May 2022 field survey:

- Hyptis (*Mesosphaerum suaveolens*)
- Sida (*Sida acuta*)
- Annual Mission grass (*Cenchrus pedicellatus*) - environmental weed of concern

The class B weed Hyptis was observed along the Carpentaria Highway and along fence line tracks. Sida was observed predominantly in areas heavily disturbed by cattle, such as where drinking troughs were located. This emphasises the importance of the weed hygiene declaration, which is in force for all vehicles and equipment entering Tamboran's sites.

Additional information on the full list of weeds and control measures implemented across Tamboran's EPs is provided in the WMP (Appendix B). Weeds will continue to be managed in accordance with the WMP (Appendix B) and the Code.

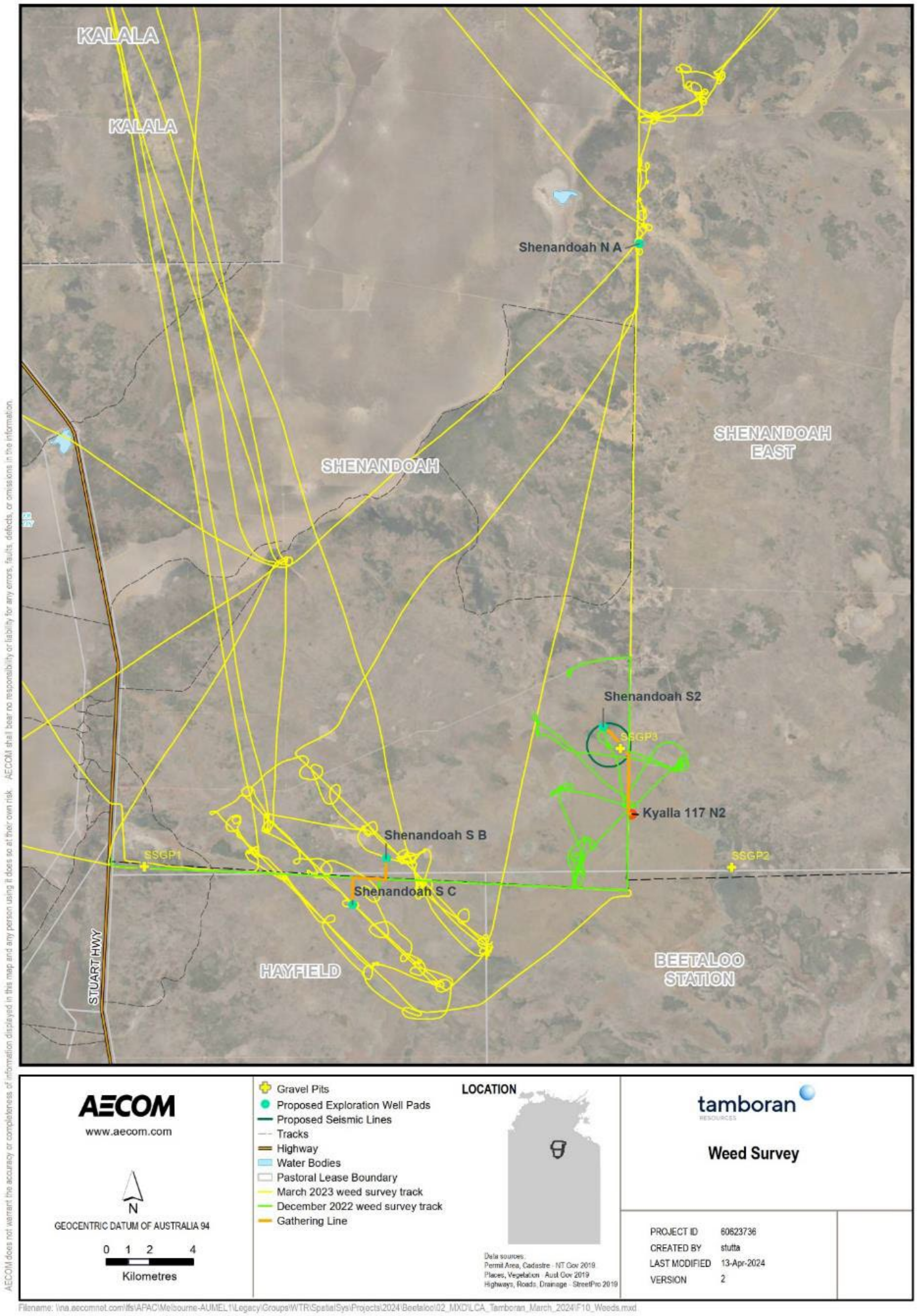


Figure 42: March 2023 weed survey tracks, in the vicinity of the Shenandoah S2 site and other approved Tamboran sites

4.2.3 Air quality

4.2.3.1 GHG survey

The GHG baseline study completed as part of the SREBA, undertook 3 mobile survey campaigns across more than 14,000 km between October 2021 and June 2022 (Ong, *et al.,* 2022). The aim of the study was to establish GHG across the Beetaloo Sub-basin study area and establish reference sites and a program for ongoing monitoring.

Importantly the study assessed wet and dry season fluctuations in methane concentrations, which varied from between 1.863 and 1.868 ppm (dry season) and 1.845 ppm (wet season) (Ong, *et al.,* 2022). The seasonal increase in methane concentrations in the dry is predominantly attributed to Top End fire regimes, discussed below. Overall, the results of the SREBA GHG baseline study were found to be comparative to the findings of the initial CSIRO Gas Industry Social and Environmental Research Alliance (GISERA) study completed in 2018/19, and seasonal national reference trends across Australia (Ong, *et al.,* 2022).

The two main sources of elevated methane concentrations detected during this study that are relevant to the location of the Shenandoah South E&A project, were cattle 51,650 t/year and fire 5,360 t/year (Ong, *et al.,* 2022).

Tamboran has a sound understanding of the fire regime prevalent within the region of its assets. During the dry season, Tamboran is in constant communication with pastoralists and conducts continuous reviews of the North Australia Fire Information (NAFI) website to ensure ongoing protection of life and assets.

4.2.3.2 Baseline air quality assessment program

Five (5) ambient air locations were set up across the Beetaloo Sub-basin as a part of the SREBA to collect Particulate matter, nitrogen oxides (NO_x), sulfur dioxide (SO_2), Volatile Organic Compounds (VOC) and meteorological conditions (Browell *et al.*, 2022). This includes stations as Elliott, Daly Waters and the Bullwaddy Conservation area. A copy of the report is provided here: Territory Stories - Environmental Health Interim Baseline Report: Air Quality Strategic Regional Environmental and Baseline Assessment for the Beetaloo Sub-basin.

Monitoring confirmed the undeveloped nature of the Beetaloo Sub-basin, with low levels of all gases sampled below the relevant National Environmental Protection Measures (NEPM). A summary of the maximum results against the relevant NEPM standard is provide in Table 40. Maximum particulate matter readings were recorded above the NEPM guidelines, which is consistent with air quality in the NT which is affected by episodic fire events (Table 41).

The results confirm Tamboran's exploration activities are unlikely to cause any levels to go above the NEPM guidelines.

Table 40: Summary of gaseous pollutants collected during the SREBA survey (Browell *et al.*, 2022)

Pollutant	NEPM standard (µg/m^3)	Maximum observed concentration (µg/m^3)	Location
NO_x	31	3.4	Elliott
SO_2	57	2	Daly Waters
Formaldehyde	54	0.9	Daly Waters
Benzene	10	0.03	Mataranka, Daly Waters
Toluene	411	0.21	Manbulloo
Xylenes	947	0.04	Manbulloo

Table 41: Particulate concentrations for monitoring period (adapted from Browell *et al.*, 2022)

Parameter	Averaging period	Limit (µg/m³)	Mataranka	Manbulloo	Bullwaddy	Elliott	Daly Waters
PM_{10}	Annual average[1]	25	39	56	14	8.3	8.7
	24 hr maximum	50	156	199	31	23.0	27.0
$PM_{.2.5}$	Annual average[1]	8	-	54	13	7.6	8.2
	24 hr maximum	25	-	195	30	21.0	27.0

[1] Annual average has been calculated for data measured to date and should be considered indicative only.

Figures shown in red are above NEPM maximum standard concentration limits for pollutants.

4.2.3.3 Fire regime

Fire is a natural occurrence in most Australian ecosystems and plays an important role in their ecology. Fire management practices by the Pastoralists, generally exclude fire from the Mitchell grasslands (dominated by *Astrebla* spp.*)* to maintain forage throughout the dry season (HLA-Envirosciences Pty Ltd, 2005). Mitchell grasslands are located west of the Shenandoah S2 site in the floodplain area. Fires are more frequent in the Sturt Plateau in the eucalypt/corymbia and acacia woodlands where the Shenandoah S2 site is located.

Historically most high intensity fires within EP 98 and 117 occur during the dry season (HLA-Envirosciences Pty Ltd, 2005). Wet season fires have occurred within the EPs; however, these fires are likely to be patchy and of lower intensity, depending on the state of curing of the fuel load. Land condition assessments indicate low intensity fire events >2 years ago at Shenandoah S2. Fire frequency was highest in areas of woodland and less frequent in areas of dense Lancewood and Bullwaddy shrubland (AECOM, 2024). Figure 43 shows the fire frequency within the exploration areas over the past 10 years (2014 - 2023). Fire has occurred 4 to 6 times at the site within the last 10 years.

A BMP has been developed to manage bushfire risks associated with the proposed regulated activities within the Shenandoah S2 site (Appendix A). The plan provides the hazard reduction strategies, resources and response to bushfire emergencies.

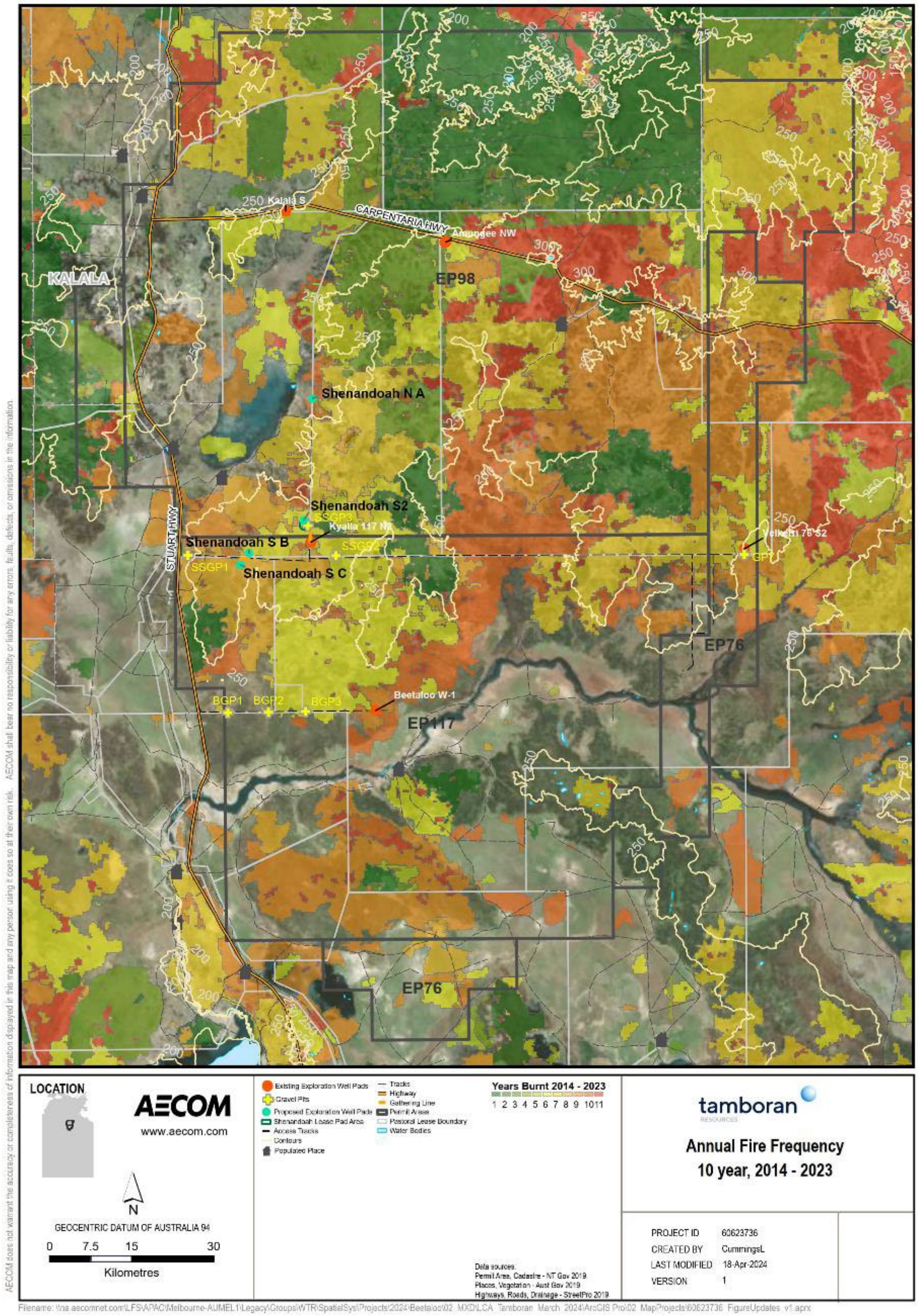


Figure 43: Fire frequency map, including sites which were assessed during LCA

4.2.4 Fauna

A review of the 2022 SREBA data reveals that a total of 354 vertebrate species were recorded from all surveys and incidental observations during the SREBA and GBA studies in the Beetaloo Sub-basin, indicating relatively high total vertebrate species richness but no species endemism within the SREBA study area (DEPWS, 2022b). Species consisted of 202 bird, 99 reptiles, 39 mammals and 14 amphibians (DEPWS, 2022b).

The Shenandoah S2 site primarily comprises open woodland consisting of mixed Eucalyptus/ Corymbia species with a mixed tussock grass understorey. A large stand of Bullwaddy/ Lancewood communities occur to the east of the site (refer section 4.2.2 and Table 36). In the wider landscape, including proposed access tracks, additional vegetation types include those associated with drainage lines, grasslands/floodplains and Acacia sp. shrublands.

Eucalyptus/Corymbia sp. woodland provides habitat for a range of species. The proposed disturbance areas had high native grass cover and included numerous species suitable for granivorous birds (seed eaters). Dense leaf litter and numerous logs provide suitable refuge and foraging sites for fauna such as reptiles. Although most of the species found in this vegetation type are widespread in the tropical savannas of the Northern Territory, some such as the threatened Crested Shrike-tit (*Falcunculus frontatus whitei*) are rare and known to utilise this habitat (Ward, 2008). Hollow-bearing trees are a feature of the Shenandoah S2 site, providing important habitat for many fauna species. Where practicable clearing of large hollow-bearing trees as avoided to reduce the impact to native wildlife within the EPs.

No fauna sightings to enable identification were recorded within the vicinity of the Shenandoah S2 site during the April 2023 field survey.

4.2.4.1 Threatened fauna

A search of the DCCEEW Protected Matters database of nationally significant fauna (PMST) and records from the NT Government Fauna Atlas database (NR Maps) was undertaken at 10 km and 50 km of the proposed lease areas and access tracks. The search results indicate the potential presence of 18 fauna species listed as threatened under the EPBC Act and/or the TPWC Act. These included eight birds, five mammals and two reptiles.

The likelihood of occurrence assessment is based on the availability of suitable habitat within the permit area, records in the vicinity and distributional data. Therefore, many of the threatened and migratory fauna species indicated in databases as ‘occurring’ or ‘likely to occur’ have been assessed as unlikely to occur within the project area. As some areas in the proposed well pad area have not been subject to intensive survey and some species are very cryptic, a conservative approach has been taken to assess species presence. A full description of each species, their distribution and habitat associations are provided in Table 42.

No core habitat for threatened fauna was identified at the Shenandoah S2 site. However, some species may occur and are known to occur in the wider landscape. Threatened species that potentially occur include:

- Gouldian Finch *Erythrura gouldiae* (Endangered EPBC Act, Vulnerable TPWC Act)
- Grey Falcon *Falco hypoleucos* (Vulnerable EPBC Act and TPWC Act)
- Northern Shrike-tit *Falcunculus whitei* (Vulnerable EPBC Act)
- Painted Honeyeater *Grantiella picta* (Vulnerable EPBC Act and TPWC Act)
- Pale Field-rat *Rattus tunneyi* (Vulnerable TPWC Act)
- Common Brushtail Possum (northern) *Trichosurus vulpecula arnhemensis* (Vulnerable EPBC Act)

- Plains Death Adder *Acanthopsis hawkei* (Vulnerable EPBC ACT and TPWC Act)
- Northern Blue-tongue Skink *Tiliqua scincoides intermedia* (Critically Endangered EPBC Act)
- Yellow-spotted Monitor *Varanus panoptes* (Vulnerable TPWC Act)

As records of species may be limited in remote areas the precautionary principle has been applied during the assessment. There are some species that have been assessed as possibly occurring even though their primary habitat is not found within the proposed sites or access tracks. These include species that are associated with ephemeral wetlands, low lying areas that may be seasonally inundated and creeks. During the wet and early dry season these areas may sustain threatened species such as wetland birds (including migratory species).

Gouldian Finch

Research has shown that critical components of suitable habitat for the Gouldian Finch include suitable nesting trees during the breeding season (particularly *Eucalyptus tintinnans*, *E. brevifolia* or *E. leucophloia*), a water source and a diverse range of favoured annual and perennial grasses (Dostine & Franklin, 2002).

No nesting habitat was recorded during the surveys, and it is unlikely this species breeds in close vicinity to the exploration lease areas within the Shenandoah South E&A Program. During the wet season, Gouldian Finches move from breeding habitat on hillsides with suitable trees down to lower lying areas where they forage on perennial grasses such as *Triodia* sp., *Alloteropsis semialata*, and *Chrysopogon fallax* (Palmer *et al.,* 2012). Some of the perennial grasses were recorded during recent surveys so potential foraging habitat is present; however, there are limited records in the vicinity.

The proposed exploration lease areas, gravel pits and vegetation sites were surveyed for Gouldian Finch, congruent with the Crested Shrike-tit surveys. Call playback was not undertaken for Gouldian Finch. Primary nesting trees such as *Eucalyptus brevifolia*, *Eucalyptus leucophloia* and *Eucalyptus tintinnans* were not observed in the area.

Habitat in the Shenandoah S2 site is moderately suitable for Gouldian Finch, but core habitat is absent. No Gouldian Finches were observed during the bird surveys, which is supported by the SREBA data which indicates that the mean probability of presences of the Gouldian Finch in the vicinity of the Shenandoah S2 site is “low” (Young *et al.,* 2022).

Grey Falcon

The Grey Falcon (*Falco hypoleucos*) is a widespread species listed as Vulnerable in the NT and considered possibly present in the study area. The species occurs in low densities throughout arid and semi-arid areas of Australia (Birdlife International, 2024; DEPWS, 2021a). The species is known to nest on repeater towers in the region, including one site located approximately 100 km south-west of the Shenandoah S2 site where the species bred in 2014 (Jonny Schoenjahn, *pers comm*., 15 December 2022).

The species is also known to nest in the tallest trees along watercourses, such as Red River Gums (*Eucalyptus camaldulensis*) (TSSC, 2020). Grey Falcon may forage within the vicinity of the Shenandoah S2 site but is unlikely to be impacted by project activities because it is unlikely suitable nesting trees will be cleared.

One repeater tower located within Tamboran’s EPs next to the Carpentaria Highway was surveyed for Grey Falcon. The species was not detected.

While the risks to the Grey Falcon are low, impacts can be reduced by avoiding impacts to large hollow bearing trees with a trunk diameter greater than 25 cm at 1.3 m above the ground (DEPWS 2021b).

Northern Shrike-tit

The Northern Shrike-tit lives in dry Eucalypt forests and woodlands where it feeds on insects from the canopy and under bark. It has been recorded in wet Melaleuca open woodlands and woodlands dominated by Nutwood (*Terminalia arostrata*) and Bloodwoods with flaky bark and ironwood (Ward, 2008). In the NT, nesting has been recorded from September through to January and nests are built in terminal branches at the top of trees (Ward *et al*., 2009). The stronghold of this species is north of the Shenandoah E&A area, with NR Maps showing only four records south of -16.25° latitude. Targeted surveys by the NT Government in the Beetaloo Sub-basin failed to detect the species south of -16.0° latitude despite significant survey effort (>30 call playback surveys) (Young *et al.,* 2022).

Although it is possible the Northern Shrike-tit may be present in the area, it is unlikely to represent an important area for this species. During the May 2022 and April 2023 field survey call-playback was undertaken for Northern Shrike-tit. Call-playback was undertaken for approximately 5 minutes at all the proposed exploration well pad areas. Following 5 minutes of call playback the area was surveyed for approximately 10 minutes with binoculars. The search area was within 50 m of where call playback was undertaken, covering an approximate 0.8 ha area. No Northern Shrike-tits have been observed during these surveys. The targeted call-playback surveys failed to detect the bird at the exploration well pads or the vegetation assessment sites.

Painted Honeyeater

The Painted Honeyeater (*Grantiella picta*) has been known to occur in region, however, given it does not breed in the NT it would only be present intermittently for foraging. Suitable habitat for the species potentially occurs within the vicinity of the Shenandoah S2 site. However, the area proposed for clearance at the site is relatively small compared to available suitable habitat within the region.

Pale Field-rat

The Pale Field-rat occurs in a wide range of habitats, including tall grasslands and woodlands (Cole & Woinarski, 2002). There are no recent records of the species within the region; however, this may reflect a lack of survey effort. Suitable habitat for the species occurs within the vicinity of the Shenandoah S2 site. The proposed area of impact is relatively small compared to available suitable habitat within the region.

Common Brushtail Possum

Recent surveys have detected Common Brushtail Possum (*Trichosurus vulpecula arnhemensis*) on Kalala Station (NTG Flora & Fauna updated as NTG Flora & Fauna, *pers comm.*, 15 December 2022). Suitable woodland habitat is contiguous through the landscape; therefore, the species potentially occurs in the vicinity of the Shenandoah S2 site.

Given the large amount of suitable habitat within the region comparative to the project footprint the risk to regional populations of the species is small.

Plains Death Adder

Suitable habitat for the Plains Death Adder consists of flat, treeless, cracking-soil riverine floodplains (Cogger, 2000). A population of the species occur in the Barkly Tableland from the Northern Territory to central-western Queensland. In the Beetaloo Sub-basin, records of the species occur close to Lake Woods, Lake Sylvester and Lake Tarrabool (Ward & Phillips, 2012*)*. The species may occur within the project area, particularly following heavy wet season rainfall.

Northern Blue-tongue Skink

The Northern Blue-tongue Skink occurs in a wide variety of vegetation communities, eucalypt woodland and savanna, sparse and dense shrubland, and spinifex and tussock grassland. Areas of dense vegetation that provide cool and moist conditions within hot, dry, and flammable landscapes are critical habitat for the survival of the species, as such habitat provides the Northern Blue-tongue Skink with food, water and protection from environmental exposure and predation. Examples of such habitat includes rainforest and vine thicket, riparian forests, well-vegetated creeks and drainage lines, well-vegetated swamps and springs, and dense thickets within floodplains, grasslands, shrublands, savannas and woodlands (DCCEEW, 2023a).

Several recent (2020 – 2022) records of the species occur within 100 km, and suitable habitat occurs within the project area. The Northern Blue-tongue Skink was recently listed as Critically Endangered under the EPBC Act in December 2023; therefore the species has not been assessed under the SREBA assessments.

Yellow-spotted Monitor

The Yellow-spotted Monitor (*Varanus panoptes*) occurs across northern Australia where it occupies a variety of habitats, including grasslands and woodlands (Ward *et al.,* 2012). Most records of this species are from the Top End, though it has been recorded in the Barkly Tablelands. The species likely occurs close to wetlands and riparian habitats within the EP; however, such habitat won't be impacted by the Project, as the Shenandoah S2 site lies on a ridge between two local flow paths reduces the risk of inundation from regional catchment flows (see section 4.1.7).

The SREBA developed a species distribution for Yellow-spotted Monitor that indicated low probability of occurrence within the immediate vicinity of the Shenandoah S2 site, but medium to high probability for the species occurrence to the north of the site (Young *et al.,* 2022).

As records of species may be limited in remote areas the precautionary principle has been applied. There are some species that have been assessed as possibly occurring even though their primary habitat is not found within the proposed sites or access tracks. These include species that are associated with ephemeral wetlands, low lying areas that may be seasonally inundated and creeks. During the wet and early dry season these areas may sustain listed threatened species such as wetland birds (including migratory species).

Table 42: Commonwealth EPBC and Terrtiory TPWC listed threatened species and likelihood occurence assessment within the new sites

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
Birds					
Curlew Sandpiper *Calidris ferruginea*	Marine Migratory	VU	In the NT this species occurs around Darwin, north to Melville Island and Cobourg Peninsula, and east and south-east to Gove. It has been recorded inland from Victoria River Downs and around Alice Springs (Higgins & Davies, 1996).	Coastal habitats, inland it has been found around lakes, dams and ephemeral/permanent waterholes.	Unlikely No suitable habitat within the project area
Red Goshawk *Erythrotriorchis radiatus*	VU	VU	Found across most of Northern Australia, in the NT most records are from the Top End but there are records from central Australia (Pizzey & Knight, 2012).	Red Goshawks occupy a range of habitats, often at ecotones, including coastal and sub-coastal tall open forest, tropical savannahs crossed by wooded or forested watercourses. In the NT, it inhabits tall open forest/woodland as well as tall riparian woodland (Aumann & Baker-Gabb, 1991).	Unlikely No records and no suitable breeding habitat within the project area
Gouldian Finch *Erythrura gouldiae*	EN	VU	Formerly widespread across northern Australia. In the NT they are found in the Top End south past Daly Waters (Palmer *et al*., 2012).	Gouldian Finches occupy different habitat types in the breeding and non-breeding season. Breeding habitat consists of hillsides with suitable nesting trees. Outside of the breeding season they are found in lowland drainages to feed on suitable perennial grasses (Dostine & Franklin, 2002).	Possible The closest record occurs 75 km east of the project area. Suitable foraging habitat is present
Grey Falcon *Falco hypoleucos*	VU	VU	This species has a widespread distribution, and records occur throughout the NT. However, most records are from arid and semi-arid regions (Pizzey & Knight, 2012).	Grey Falcon is typically found on inland drainage systems in lightly treed lowland plains, pastoral lands, timbered watercourses and, occasionally, the driest deserts (Birdlife International, 2024; DEPWS 2021a).	Possible The species may forage within the project area but is unlikely to breed

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
Northern Shrike-tit *Falcunculus frontatus whitei*	VU	NTD	This species has been recorded from widely scattered localities from near Timber Creek to the east Gulf Country, north to Kakadu National Park and in north-eastern Arnhem Land (DEPWS, 2021c).	Occupies wet and semi-arid melaleuca and eucalypt open woodlands. May be associated with bloodwoods with flaky bark and ironwood (Ward, 2008).	Possible No records in the vicinity of the project area. Sub-optimal habitat is present. Call-playback surveys failed to detect the species
Painted Honeyeater *Grantiella picta*	VU	VU	This species is migratory based on seasonal variation in occurrence. They breed on the inland slopes of the Great Dividing Range. After the breeding season they sometimes occur in the north-eastern NT, south of the Roper River (Garnett & Baker, 2021).	Painted Honeyeater inhabits woodlands dominated by Acacia and/or Eucalyptus species and open forests but prefers habitats with abundant mature trees that host mistletoes. The species specialises on the fruit of mistletoes although it may also forage on nectar and insects (Garnett *et al.*, 2011).	Possible No recent records occur close to the project area; however suitable habitat is present
Night Parrot *Pezoporus occidentalis*	EN	EN	Night Parrot was once widespread across arid and semi-arid regions. Recent confirmed records of the species come from widely separated locations in western Queensland and Western Australia (DEPWS, 2021d).	This species occupies spinifex grasslands in stony or sandy areas, in ephemeral herblands, samphire and chenopod shrublands on floodplains (DEPWS, 2021d).	Unlikely Suitable habitat does not occur within the project area. No recent records occur within the area
Princess Parrot, Alexandra's Parrot *Polytelis alexandrae*	VU	VU	This species irregularly occurs across the arid zone from near Oodnadatta in South Australia, west to near Coolgardie and the east Murchison River in Western Australia, and north to near the Fitzroy River in Western Australia and to Howell Ponds in the	Princess Parrot is usually recorded from shrubland in swales between sand dunes, with occupied sites typically having a variety of shrubs (including *Grevillea*, *Hakea*, *Cassia* and *Eremophila* species) among scattered emergent trees, with a groundcover of spinifex *Triodia* species.	Unlikely No recent records occur close to the project area. Suitable habitat limited.

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
			Northern Territory (Higgins 1999; Baxter & Henderson 2000).	The species occurs less often in woodland. The princess parrot forages on the ground and in flowering shrubs and trees (Higgins 1999; DEPWS, 2021e)	
Australian Painted Snipe *Rostratula australis*	CE	VU	Records of the species occur across the NT. More recent records come from McMinns Lagoon near Darwin, Yellow Waters in Kakadu, the Sturt Plateau, the Barkly and the Tanami (DEPWS, 2021f).	Australian Painted Snipe prefers a habitat of recently flooded temporary vegetated wetlands during the non-breeding period and brackish temporary freshwater wetlands with minimum vegetation during breeding periods. Birds usually forage in thick, low vegetated areas during the day (Curtis *et al*, 2012).	Unlikely Suitable habitat does not occur within the project area.
Masked Owl (northern) *Tyto novaehollandiae kimberli*	VU	VU	The subspecies occurs in northern Australia, although its distribution is not well known. In the NT, occurs from Cobourg south to Katherine and the VRD and east to the McArthur River (DoE, 2014).	This species inhabits tall open eucalypt forest in the NT, especially those associated with *Eucalyptus miniata* and *E. tetrodonta (*Woinarski, *et al.,* 2007*)*. Also found in riparian and monsoonal forest and rainforest (DoE, 2014).	Unlikely No recent records occur close to the project area and suitable habitat is not present.
Mammals					
Northern Quoll *Dasyurus hallucatus*	CE	EN	The species once occurred throughout most of Northern Australia although it is has declined across much of its range (Woinarski & Hill, 2012). In the NT it is found in the Top End as far southeast as Borroloola	Northern Quolls do not have highly specific habitat requirements although the most suitable appear to be rocky habitats. They occur in a variety of habitats across their range, including open forest and woodland. Daytime den sites provide important shelter. Shelter sites include rocky outcrops, tree hollows, hollow logs, termite mounds, goanna burrows and human dwellings (Woinarski & Hill, 2012).	Unlikely No recent records occur in the vicinity of the project area and habitat is sub-optimal

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
Ghost Bat *Macroderma gigas*	VU	NTD	The species' range in northern Australia is from relatively arid conditions in the Pilbara region of Western Australia to humid rainforests of northern Queensland. A large colony occurs in a series of gold mine workings at Pine Creek, NT. This species has also been recorded throughout the mainland Top End north of approximately 17° latitude (DEPWS, 2021g).	The distribution of Ghost Bats is influenced by the availability of suitable caves and mines for roost sites. The species often roosts in a deep crack or cave during the day (DEPWS, 2021g).	Unlikely Suitable habitat does not occur within the project area.
Greater Bilby *Macrotis lagotis*	VU	VU	This species occurs in south-western Queensland and in arid north-western Australia (Western Australia and NT). This species was previously widespread in arid and semi-arid Australia (Pavey, 2006). The most northern records are from Newcastle Waters and Wave Hill (Southgate & Paltridge, 1998).	In the NT, this species is found on sandy soils dominated by spinifex. Also, hummock grassland associated with low lying drainage systems and alluvial areas (Pavey, 2006). Recent surveys in the Beetaloo region have recorded Greater Bilby in Eucalyptus and Corymbia woodlands mixed tussock and hummock grasses in sandy/loam soils (Davis *et al*., 2021).	Unlikely No recent records occur in the vicinity of the project area and suitable habitat is not present.
Bare-rumped Sheath-Tailed Bat *Saccolaimus saccolaimus nudicluniatus*	CE	DD	Wide distribution from India through south-eastern Asia to the Solomon Islands, including north-eastern Queensland and the NT. Records of the species in the NT are sparsely scattered across the Top End (DEPWS, 2021h).	Previous specimens have been collected from Open *Pandanus* woodland fringing the sedgelands of the South Alligator River in Kakadu National Park, and from eucalypt woodlands and forests from coastal and adjacent inland areas (DEPWS, 2021h).	Unlikely No recent records occur in the vicinity of the project area and habitat is not suitable.
Common Brushtail Possum	VU	NTD	The Common Brushtail Possum (northern subspecies) occurs discontinuously from the Gulf of	The species occurs mainly in tall eucalypt open forests with large hollow-bearing trees, particularly where the understorey includes	Possible

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
Trichosurus vulpecula arnhemensis			Carpentaria hinterland near Borroloola, NT westward to the Kimberley, WA (TSSC, 2021).	some shrubs that bear fleshy fruits (TSSC, 2021).	Recent records of the species occur at nearby Kalala Station and suitable habitat occurs within the project area.
Pale Field-rat *Rattus tunneyi*	-	VU	Pale Field-rat inhabits higher rainfall areas of northern and eastern Australia, including the Top End of the NT (Menkhorst & Knight, 2011).	This species favours dense vegetation found along rivers where it occupies burrows in loose colonies (Cole & Woinarski, 2002). Pale Field-rat occurs within a variety of habitats including woodlands if a dense understorey of grasses is present (Menkhorst & Knight, 2011).	Possible One record from 1999 occurs approximately 55 km from the project area. Suitable habitat occurs within the project area.
Reptiles					
Plains Death Adder *Scanthophis hawkei*	VU	VU	Fragmented populations of the plains death adder are known to occur in the Mitchell Grass Downs of western Queensland, the Barkly Tableland on the NT / Queensland border and east of Darwin in the NT. In the NT this species is found in the floodplains of the Adelaide, Mary and Alligator Rivers and the Barkly Tablelands (Ward & Phillips, 2012).	Suitable habitat for the plains death adder consists of flat, treeless, cracking-soil riverine floodplains (Cogger, 2000).	Possible Moderately suitable habitat occurs within the project area. A record from 2019 occurs within 60 km of the project area.
Gulf Snapping Turtle *Elseya lavarackorum*	-	EN	Gulf Snapping Turtle is restricted to rivers draining into the Gulf of Carpentaria, including the Calvert and Nicholson River systems (DEPWS, 2021i).	The species occurs in deep pools in the upper catchments of permanently flowing spring-fed river systems, particularly in areas with intact riparian vegetation (DEPWS, 2021i).	Unlikely No rivers or large permanent water bodies occur within the project area
Northern Blue-tongue Skink	CE	-	The northern blue-tongue skink occurs across northern Australia	The northern blue-tongue skink occurs in a wide variety of ecosystems, including riparian	Possible

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
Tiliqua scincoides intermedia			from Eighty Mile Beach in Western Australia (WA), across the southern Kimberley and Top End of the NT, to approximately the Gregory Downs / Cloncurry area in western Queensland (DCCEEW, 2023a).	forest, vine scrub, monsoon rainforest, pandanus-lined gorges, melaleuca forest, eucalypt woodland and savanna, sparse and dense shrubland, and spinifex and tussock grassland. GPS tracking has shown that northern blue-tongue skinks move widely across savanna landscapes in the wet-season, but they spend most (~ 95 %) of their time in small, fragmented patches of relatively dense vegetation that provide cool, shaded, and damp conditions (DCCEEW, 2023a).	Recent records occur nearby and suitable habitat occurs within the project area.
Mertens' Water Monitor *Varanus mertensi*	EN	VU	Mertens' Water Monitor has a broad distribution that encompasses coastal and inland waters across the far north of Australia. In the NT, the species has been recorded across most of the Top End and the Gulf region (DEPWS, 2021j).	Mertens' Water Monitor is highly aquatic and rarely ventures more than 5-10 m from the edge of water. The species has been recorded in the following habitat: • Perennial and semi-permanent pools, including springs, seeps, swamps, creeks and gorges, • The margins of permanent streams, rivers and lakes, • Floodplain billabongs, lagoons, swamps and soaks, • Perennial waterholes in woodlands, • Man-made irrigation channels and the margins of dams (DCCEEW, 2023b).	Possible Sparse records at similar latitudes occur across the NT, and suitable habitat is sparsely distributed across the project area.
Mitchell's Water Monitor	-	VU	Michell's water monitor occurs across the wet-dry tropics of northern Australia from the far west	Mitchell's water monitor inhabits freshwater and saline wetlands that range from seasonal gorges in upper catchments to large rivers and	Unlikely

Species	Listed status		Distribution	Habitat	Likelihood
	Commonwealth (Cth)[1]	NT[2]			
Varanus mitchelli			Kimberley of WA across the Top End of the NT to far northwest of Queensland (DCCEEW, 2023c)	coastal floodplains. It is recorded from rivers, creeks, gorges, springs, lagoons, swamps, mangroves, and foreshores (DCCEEW, 2023c).	No recent records occur at similar latitudes and the project area appears to be south of the species current distribution.
Yellow-spotted Monitor *Varanus panoptes*	-	VU	Occurs across a broad geographic range across northern Australia. In the NT most records are from the Top End but occurs as far south as Renner Springs (Ward *et al*., 2012).	Occupies a variety of habitats including coastal beaches, floodplains, grasslands and woodlands (Ward *et al*., 2012).	Possible 2017 records occur approximately 20 km from the project area and suitable habitat is present.
Shark					
Freshwater Sawfish *Pristis pristis*	VU	VU	Freshwater Sawfish may potentially occur in all large rivers of northern Australia from the Fitzroy River, Western Australia, to the western side of Cape York Peninsula, Queensland. It is mainly confined to the main channels of large rivers (NTG Flora & Fauna updated as NTG Flora & Fauna, *pers comm.*, 15 December 2022; Jonny Schoenjahn, *pers comm*., 15 December 2022).	This species in northern Australia appears to be confined to freshwater drainages and the upper reaches of estuaries, occasionally being found as far as 400 km from the sea (Thorburn *et al*., 2007; Whitty *et al*., 2008).	Unlikely No rivers or large permanent water bodies occur within the project area.

[1] Cth Status: EN, Endangered; VU, Vulnerable as listed under the *EPBC Act*

[2] NT Status: EN, Endangered; VU, Vulnerable; NTD, Near Threatened; DD, Data Deficient as listed under the *TPWC Act.*

4.2.4.2 Marine and listed species

The EPBC Protected Matters database indicated the potential presence of 20 migratory and marine listed species within the vicinity of the Shenandoah S2 site (Table 43). Of these species, three are considered likely to occur, nine possibly occur and eight are unlikely to occur within the vicinity of the Project. Several migratory wetland bird would possibly occur within the area in ephemeral wetlands that would fill up following wet season rainfall. The Shenandoah S2 site does not contain critical habitat for any migratory or marine listed species.

Table 43: Migratory listed species potentially occurring within the new sites

Scientific name	Common name	EPBC Act	Likelihood of occurrence
Actitis hypoleucos	Common Sandpiper	Migratory, Marine	Possible
Anseranas semipalmata	Magpie Goose	Marine	Possible
Apus pacificus	Fork-tailed Swift	Migratory, Marine	Likely
Bubulcus ibis (Ardea ibis)	Cattle Egret	Marine	Likely
Calidris acuminata	Sharp-tailed Sandpiper	Migratory, Marine	Possible
Calidris ferruginea	Curlew Sandpiper	Migratory, Marine	Possible
Calidris melanotos	Pectoral Sandpiper	Migratory, Marine	Possible
Cecropis daurica	Red-rumped Swallow	Migratory, Marine	Unlikely
Charadrius veredus	Oriental Plover	Migratory, Marine	Possible
Chalcites osculans (Chrysococcyx osculans)	Black-eared Cuckoo	Marine	Possible
Cuculus optatus	Oriental Cuckoo	Migratory	Possible
Glareola maldivarum	Oriental Pratincole	Migratory, Marine	Possible
Haliaeetus leucogaster	White-bellied Sea-eagle	Marine	Unlikely
Hirundo rustica	Barn Swallow	Migratory, Marine	Unlikely
Merops ornatus	Rainbow Bee-eater	Marine	Likely
Motacilla cinerea	Grey Wagtail	Migratory, Marine	Unlikely
Motacilla flava	Yellow Wagtail	Migratory, Marine	Unlikely
Pristis pristis	Freshwater Sawfish	Migratory	Unlikely
Rostratula australis (Rostratula benghalensis)	Australian Painted Snipe	Migratory, Marine	Unlikely

4.2.4.3 Feral and pest animals

Feral animals known to occur within the region include pig (*Sus scrofa*), wild dog (*Canis lupus familiaris*), feral cat (*Felis catus*), cane toad (*Bufo marinus*), horse (*Equus caballus*), donkey (*Equus asinus*), water buffalo (*Bubalus bubalis*), camel (*Camelus dromedarius*), black rat (*Rattus rattus*), and domestic cattle (*Bos taurus*).

During December 2022 and April 2023 field survey evidence of current cattle grazing or grazing within the last 1 to 2 years was recorded at most assessed sites.

The cane toad is known to be present in the area and the Commonwealth DCCEEW recognises this species as a 'key threatening process' related to their impacts on biodiversity through predation, competition, land degradation and poisoning. In the NT, the cane toad has been implicated in the decline of several species including many reptiles such as the Plains Death Adder (*Acanthophis hawkei*), King Brown snake (*Pseudechis australis*) and *Varanus* spp. (Smith & Phillips, 2006).

Pest predators such as cats likely occur within the Project area, though their abundance is difficult to assess due to their cryptic nature. Introduced predators such as cats can impact many vertebrates (Dickman, 1996 & 2009). One of the primary concerns of introduced predators are the impacts on reptiles and ground-dwelling birds. Feral cats are also believed to be one of the factors that have led to the decline of the threatened ground-dwelling Partridge Pigeon (Woinarski *et al.,* 2007).

4.2.4.4 Groundwater dependent ecosystems

A search of the National Groundwater Dependent Ecosystems (GDE) was conducted in September 2023 (BOM, 2017b), indicating the potential for groundwater interaction/use for river/spring/wetland ecosystems across Australia. It shows the ecosystems that rely on groundwater that has been discharged to the surface, such as baseflow or spring flow.

Until recently, all known and moderate potential GDE locations occurred at distances >20 km from the vicinity of the proposed regulated activities. The impact on these units from Tamboran's total water extraction across the Beetaloo exploration area was assessed during the granting of WEL GRF10285.

Stygofauna are a form of GDE that inhabit the interstitial spaces of the cavities of alluvial, sedimentary and karstic aquifers. Data is available that can provide an indication of the likelihood of stygofauna presence, with Hose, *et al.,* (2015) outlining the following factors affecting the distribution of stygofauna:

- **Formation type:** Stygofauna are predominantly found in aquifers with large (mm or greater) pore spaces, which a more common for alluvial, karstic and some fractured rock aquifers.
- **Depth below ground level:** The abundance and diversity of stygofauna typically decreases with depth below ground, with fauna are rarely found more than 100 m below ground level (Hose, *et al.,* 2015).
- **Proximity of exchange and recharge:** Stygofauna are more abundant in areas of surface water-groundwater exchange, compared to deeper areas or those further along the groundwater flow path remote from areas of exchange or recharge

A characterisation of the stygofauna and microbiological assemblages of the Beetaloo Sub-basin was conducted as part of the Gas Industry Social and Environment Research Alliance (GISERA) (Rees *et al.,* 2020). The study collected data from 3 locations north of Elliott within the vicinity of the Shenandoah South E&A program. The study found two stygofauna specimens (*Parisia unguis* and *Bathynellaceae Bresvisomabathynella* sp.) and stygofauna eDNA from the Carpentaria Highway Roadside Bore (RN00592) located over 50 km north of the Shenandoah South E&A program area, while there were no reported

findings of stygofauna in the Hayfield homestead bore and the Sturt Plains homestead bore. However, the study did identify eDNA which may indicate stygofauna presence. The results are consistent with Hose *et al* (2015), which indicates stygofauna are likely to be present at lower abundance at the observed groundwater depth within the Shenandoah South sites (~106 m below ground level).

These results are supported by the extensive field surveys of aquatic groundwater fauna undertaken in October 2021 and May 2022, as part of the SREBA aquatic ecosystem studies (Humphreys *et al.*, 2022). A total of 66 groundwater bores were sampled, with the sites selected to obtain spatial coverage across the study area and to stratify sampling by the hydrogeological formations present (Humphreys *et al.*, 2022). Results of the surveys returned a total of 280 stygofauna specimens across 28 taxa, with the highest diversity of stygofauna detected in the Tindall limestone aquifer (Humphreys *et al.*, 2022), which lies approximately 100 km northwest of the Shanandoah South E&A Program and Kyalla 117 N2 site.

The results of the aquatic ecosystem studies (Humphreys *et al.*, 2022) further indicate that total taxa richness across 8 taxa groups occur in riverine sites in northern-draining catchments; specifically, 8 of the top 10 sites occur in the Roper catchment, with the maximum number of species (80) recorded within a seasonally flowing channel of the Little Roper River, which is over 200 km NW of the Project area.

Based on the outcomes of the studies above, the depth of the groundwater, likely low abundance of stygofauna and limited extraction draw down observed at the Kyalla extraction bores, impacts to stygofauna from extraction are considered highly unlikely. Any impacts are likely to be extremely localised, in the vicinity of metres.

This is supported by the NTG (2024) assessment Tamboran's WEL application, which is currently available for public comment. As stated in NTG (2024): *"The depth to the regional water table in the CLA aquifer ranges from 80 to 120 mbgl in the vicinities of the planned exploration sites, which indicates it is unlikely the aquifer is supporting any terrestrial or aquatic … GDEs. These groundwater depths are consistent with the findings of the … SREBA … Groundwater is considered unlikely to support terrestrial GDEs at water table depths exceeding 20 mbgl. The SREBA … identifies small, disparate areas of low to moderate confidence seasonal GDEs across the region, however these are likely to be associated with shallow, perched systems."*

Changes in groundwater quality may also result in impacts to stygofauna. Impacts to aquifers are mitigated through, for example, the following controls:

- Well design and construction to isolate aquifers.
- Use of low toxicity drilling fluid systems.
- The placement of groundwater monitoring bores on each site, used to detect changes in groundwater quality, with monitoring around existing wells not identifying any material changes in water quality likely to impact stygofauna.

Based upon the above information, the presence of significant assemblages of stygofauna in the area is considered limited and impacts considered unlikely.

4.3 Environmental and cultural sensitivities

4.3.1 Native Title

Three native title determinations have been finalised across the Shenandoah South E&A program with the most relevant being NTD21/2010 and NTD26/2010 (Table 44).

Table 44: Native title and IULA agreements current for the permit areas

Type	Site	Name	Summary
Native Title	Shenandoah S2 site	NTD21/2010 Shenandoah pastoral lease	Native title exists in parts of the determination area and is held by the Kinbininggu and Bamarrngganja groups, including persons who are members of the estate group in accordance with cl. 6 of the Determination and other Aboriginal people with rights and interests in respect of the Determination Area, in accordance with cl. 7 and cl. 8 of the Determination.
		NTD26/2010 Hayfield pastoral lease	Native title exists in parts of the determination area and is held by the Kinbininggu, Warranangku and Marlinja groups, including persons who are members of the estate group in accordance with cl. 6 of the Determination and other Aboriginal people with rights and interests in respect of the Determination Area, in accordance with cl. 7 and cl. 8 of the Determination.
		NTD27/2010 Beetaloo pastoral lease	Native title exists in parts of the determination area and is held by the Karranjinji, Bamarrnganja, Warranangku, Pinda (OT Downs) and Liga/Muwartpi groups, including persons who are members of the estate group in accordance with cl. 6 of the Determination and other Aboriginal people with rights and interests in respect of the Determination Area, in accordance with cl. 7 and cl. 8 of the Determination.

The Native Title Petroleum Exploration Agreement between Tamboran and the NLC includes clauses for the protection of sacred sites, objects and sensitive areas related to Aboriginal activities in the area, including cultural, hunting and foraging activities. The Native Title Agreement also includes clauses for the protection of the sacred sites, environment and site rehabilitation.

Tamboran is currently in negotiations with the Native Title Holders for the permission to sell appraisal gas. Consent must be obtained prior to any sale of appraisal gas, in accordance with the Exploration Agreements and the Petroleum Act. Where consent to sell appraisal gas is not achieved, Tamboran will not proceed with the proposed activities within this plan.

4.3.2 Archaeology assessment

Archaeological assessments were completed by AECOM in April 2023 (AECOM 2024b), for the proposed Shenandoah S2 site, as part of a broader survey within the Shenandoah South E&A program (Figure 44). The assessment involved a desktop review of existing heritage data from the Australian Heritage Database, the NT Heritage Branch and the AAPA, previous archaeological survey reports prepared for the local area, as well as consultation with traditional owners of the study area and field inspection. The survey was designed around the archaeological predictive model that was initially established in 2007 and has been continually refined over the last 17 years through on ground (pedestrian) and aerial surveys (AECOM, 2024b).

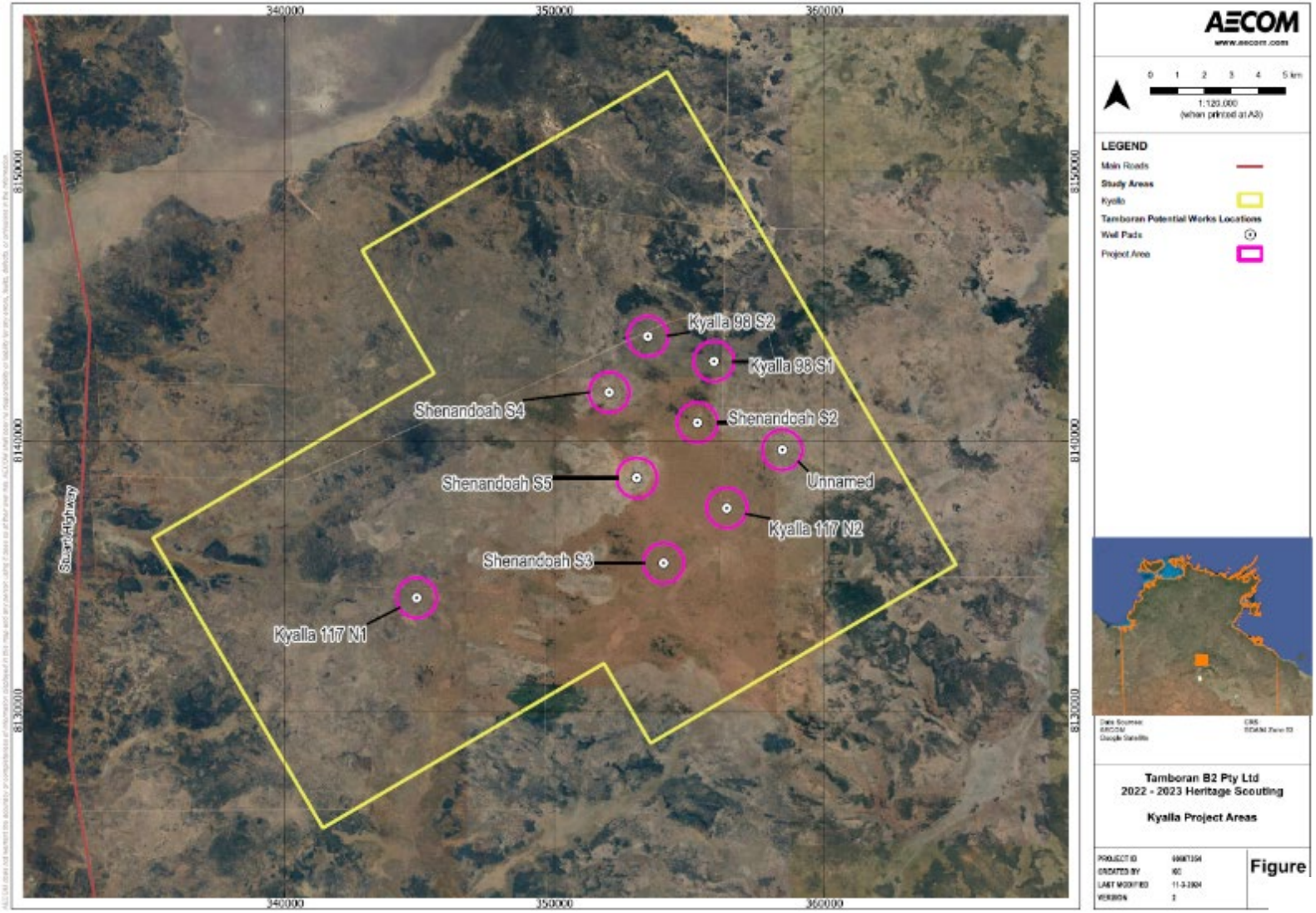


Figure 44: The Shenandoah S2 site shown in relation to other sites surveyed as part of a broader cultural heritage survey within the Shenandoah South E&A program (AECOM 2024b)

The field surveys were conducted by an AECOM archaeologist and traditional custodians to identify sensitive landforms that may have cultural significance. The archaeological surveys involved aerial surveys, and vehicle and pedestrian surveys of the Shenandoah S2 site. Based on the predictive model, there were no sensitive feature identified in the vicinity of the Shenandoah S2 site. Tamboran has implemented an "unexpected finds procedure" prior to clearing which gives added protection should a heritage find be identified during any land clearing / disturbance activities.

During the inspection, notes were taken on landform, ground surface visibility and areas of exposure. The aim of the inspection was to identify any surface expressions of Aboriginal archaeological and cultural heritage values within the proposal area. Photographic records were taken at each proposed disturbance location.

The inspection results indicated there were no sensitive areas of high priority within the Shenandoah S2 site. No artefacts or sensitive landforms of cultural significance within the area for the Shenandoah S2 site were identified (AECOM, 2024b). Figure 45 shows the general condition of the site and ground surface prior to clearing.

A cultural heritage report covering only the Shenandoah S2 site is provided as Appendix I.

a) Shenandoah S2 site context looking south

b) Shenandoah S2 ground surface

Figure 45: Shenandoah S2 a) proposed site and b) ground surface during cultural heritage surveys (AECOM, 2024b)

4.3.3 Areas of cultural significance

Sacred sites in the study area are primarily associated with drainage lines; natural landform features and stock routes, but there are also concentrations of sites nearby to old homesteads. The distribution of these sites may reflect historical patterns of Indigenous movements along drainage lines and subsequent development of stock routes on old Indigenous walking trails, or they may merely be indicative of the site clearance work undertaken along roads and tracks in the area. It is suspected that there will be a range of other sites also within the area, either not yet recorded, or known but not reported for cultural reasons.

The Shenandoah S2 location has been previously cleared for sacred sites by the Native Title Holders. Additional consultations are currently underway with the Native Title Holders for the inclusion of the SPCF at the Shenandoah S2 location, with a new AAPA certificate to be granted prior to the commencement of activities. No Restricted Work Areas (RWAs) have previously been recorded within the Shenandoah S2 site.

4.3.4 Non-indigenous heritage

In 1860, explorer John McDougall Stuart was the first European to penetrate the area now known as the 'Centre'. The first written descriptions of the area come from Stuart during his second attempt to cross the continent from south to north (HLA-Envirosciences Pty Ltd, 2005).

Development in the area began as pastoral lands with an increased interest in land settlement following the completion of the Overland Telegraph Line in 1873. Most attempts were unsuccessful with the Lancewood-Bullwaddy vegetation found to be impenetrable and the lack of surface water making the land unsuitable for cattle. Daly Waters was thus recognised as one of the last watering stops on the Murranji Stock Route.

It wasn't until the 1930s to 1950s, that the area saw regional economic growth with Daly Waters becoming a significant hub of air and mail services into the Northern Territory. The wartime years saw this role increase with Daly Waters again playing a major role in cross country transport and communication. This role continued until the early 1970s when the airport was closed to commercial traffic. The town and surrounding areas subsequently reverted to a primarily agriculture-based existence following the decline of air travel, but in recent times has seen commercial interest from the exploration for gas in the Beetaloo Sub-basin and the growth of the 'grey nomad' tourism market.

4.3.5 Heritage assessment

A search of the Australia Heritage Database identified that no statutory listed heritage places were present within the proposed Shenandoah S2 site.

Frew Ponds, a reserve paying tribute to the building and joining of the Overland Telegraph Line is located approximately 32 km west south-west of the Project site and approximately 16 km south of the access track turn-in from the Stuart Highway.

No heritage places or artefacts are registered within the proposed impact areas.

4.3.6 Protected or conservation areas

There are no conservation reserves, national parks, world heritage places, Commonwealth land, heritage places or critical habitat areas listed under the EPBC Act located within or adjacent to the Shenandoah S2 site.

The Bullwaddy Conservation Reserve lies approximately 63 km to the north-east of the Shenandoah S2 site. The EPBC Listed Lake Woods is located approximately 100 km south of the site and is listed on the Directory of Important Wetlands in Australia.

The risks to this receptor through aquifer contamination, spills, sediment release, habitat destruction have been addressed in the risk assessment presented in Appendix K. The main mitigation measures/ factors include:

- As the Project site is 100 km (direct) from Lake Woods, contamination is not likely to reach the area at any undiluted impactable state.
- Surface water flow is to the south into a tributary of Newcastle Creek which flows into Lake Woods via Newcastle Waters. Any spill would need to exceed the capacity of the site bund and travel over approximately 100 km to reach Lake Woods. A surface water spill cannot impact the Bullwaddy Conservation Area as it lies north-east of the Shenandoah S2 site and is not in the overland flow path from any of the proposed sites.

- Groundwater depth throughout the Bullwaddy Conservation Reserve is anticipated to be approximately 70 m of depth with vegetation not being able to access groundwater at this depth. The flow path (north-west) is not in alignment with the conservation area, meaning a valid contamination pathway does not exist.

4.4 Social environment

4.4.1 Social context

The proposed EMP activities will occur within the Roper Gulf regional Council area, which covers 201,000 km^2. The approximate population is estimated for the Roper Guld region of 5,592 people (Roper Gulf Council Regional Plan 2022-23).

The potential social and economic effects associated with the proposed exploration activities are minor and predominantly positive during E&A activities, with Tamboran engaging local and NT companies wherever practicable and possible to do so (refer section 5.6).

However, the SREBA found conflicting levels of engagement has led to a minimal level of understanding of the industry and low level of trust in the industry and the regulator (DEPWS 2024a). As stated in DEPWS (2024a): *"The importance of communication with all stakeholders was a strong and common theme."* This sentiment is strongly tied to the 4 main aspiration themes for the future and community values: *"safe and sustainable (and coordinated) development; strong communities; maintaining and enhancing connection to land and culture; and informed and fair local participation."*

The closest neighbouring regional towns and communities identified as being within proximity to these regulated activities include:

- Dunmarra (~30 km)
- Elliott (~80 km)
- Daly Waters (~70 km)
- Newcastle Waters (~60 km)

There is one small area of Aboriginal freehold land known as Jingaloo on EP 117, which is located approximately 80 km from the proposed Shenandoah South sites.

4.4.2 Pastoral activity

The Project is located on the Hayfield / Shenandoah East Stations. The main access to the site from Stuart Highway, traverses the Hayfield, Shenandoah, Beetaloo and Shenandoah East Stations. Within the Tamboran's Beetaloo exploration permit area there are nine pastoral properties (Table 45). All the land within the permit area is leasehold land.

Table 45: Pastoral properties in the permit area

Pastoral property	Permit areas			Contacts
	EP 76	EP 98	EP 117	
Amungee Mungee	✓	✓	✓	N/A
Hayfield / Shenandoah / Shenandoah East		✓	✓	Val Dyer [redacted] Email: [redacted] Phone: [redacted]

Pastoral property	Permit areas			Contacts
	EP 76	EP 98	EP 117	
Kalala		✓	✓	N/A
Tanumbirini	✓	✓		
Beetaloo[17]	✓		✓	N/A
Ucharonidge	✓		✓	N/A
Tandyidgee	✓	✓		
Nutwood Downs		✓		
Newcastle Waters			✓	

4.4.3 Other land uses in the area

A range of other land uses exist in the permit area or in the larger region, including a range of public utilities and facilities. These include the following:

- Tourism – Tourism is an important regional industry with the Stuart Highway being a major thoroughfare for tourists travelling in the area during the dry season. The local townships of Daily Waters, Dunmarra and Elliott provide consumables (food, fuel etc.) and accommodation. Several heritage areas of importance to regional tourism are in the broader region, including Elliott, Newcastle Waters and other heritage listed homesteads.
- Road networks – The Stuart Highway will be used to access the Project area. In addition, there are numerous gravel roads connecting properties, and internal property tracks. All properties also have firebreaks on their boundaries and internally.
- Gas pipeline – An existing third-party gas pipeline runs to the west of the Stuart Highway, along the eastern boundary of EP 117 and crosses the boundary of one part of EP 98. It also runs parallel with the Carpentaria Highway to the Gulf of Carpentaria, through EP 98 and EP 76.
- Alice Springs to Darwin Railway – The railway line runs to the west of the gas pipeline and Stuart Highway and does not cross into any of the permit areas.
- Townships – The townships of Daly Waters and Dunmarra neighbour EP 98 to the west.
- Conservation areas – including the Bullwaddy Conservation Reserve, which lies within EP 98 approximately 63 km north-east, and Lake Woods and the Junction Stock Reserve outside EP 117, approximately 100 km south.
- Heritage – There are 7 heritage sites within the exploration permit area and several heritage areas of importance to regional tourism located in the broader region, including Elliott, Newcastle Waters and heritage-listed homesteads.

The SPCF Project as described in this EMP has been specifically designed to avoid impacts to these receptors.

[17] As per site access via the main access track from the Stuart Highway.

5 Stakeholder engagement

5.1 Purpose and objectives

Tamboran's stakeholder engagement is focused on building respectful relationships with key stakeholders and developing a positive reputation founded on Tamboran's core values. Tamboran's consistent approach to stakeholder engagement has been to ensure that those persons and/or groups directly impacted/ affected and/or influenced by permit commitments have received Tamboran's full attention. Tamboran views the social acceptance and informed consent of these primary stakeholders of critical importance and relevance during this stage of low impact and small-scale exploration activities.

A stakeholder engagement plan has been implemented, which guides the way Tamboran undertakes stakeholder engagement above and beyond the requirements outlined in the Regulations.

Stakeholder engagement records for the new activities are provided in Appendix J (the Stakeholder Engagement Logs Part A and Part B); Appendix J.1.1 (pastoral) and Appendix J.1.2 (NLC). Historic stakeholder engagement records for approved regulated activities incorporated into this EMP.

5.2 Identification of stakeholders

The Regulations define stakeholder as meaning:

a) *a person or body whose rights or activities may be directly affected by the environmental impacts or environmental risks of the regulated activity proposed to be carried out; or*

b) *an agent or representative of a person or body mentioned in paragraph (a).*[18]

Tamboran's directly affected stakeholders have been, and will continue to be, consulted in a respectful, open and consistent manner. This has been the case since 2014, when Origin assumed operatorship of EP 98, EP 117 and EP 76 and again in November 2022 when Tamboran assumed operatorship of EPs 98, 117 and 76.

For this EMP, Tamboran identifies its stakeholders, in compliance with the regulations as:

- **Host traditional owners** recognised as the native title holders and/or claimants and their representative, the NLC, as described in Exploration Agreements between the parties for EP 98, EP 117 and EP 76; and
- **Host pastoralists** recognised as the landholders of the nine pastoral stations (Table 45). For the SPCF Project described in this EMP, the owners of the pastoral leases for Hayfield-Shenandoah Stations are recognised as the pastoralist stakeholders directly impacted.

Stakeholder and community engagement for the proposed activities has been held with host pastoralists and traditional owners directly affected by the proposed activities. Activities performed on EPs will be conducted in a manner consistent with the Code, which Tamboran considers an appropriate regulatory instrument for ensuring Tamboran's activities are in line with community expectations and legislative requirements.

Tamboran also recognises and engages, where appropriate with other interested parties that are not classified as directly affected under the Regulations. These include government agencies, land councils, local and regional suppliers, non-government organisations, councils and peak industry bodies.

[18] Refer section 7(3) of the Regulations.

5.3 Pastoralist stakeholder engagement

Tamboran has engaged with the pastoral stakeholders identified previously (Table 45) on an ongoing basis, including engagement with the leaseholders and/or representatives of the Hayfield / Shenandoah East Station, regarding the full range of exploration activities outlined in this EMP. Key engagement efforts Tamboran has undertaken include:

- Ongoing regular engagement with pastoralist about Tamboran's general activities.
- Providing the landholder with copies of a Stakeholder Engagement Pack (SEP) covering exploration activities and providing opportunity for the landholder to comment

Appendix J summarises Tamboran's engagement with the leaseholders of Hayfield /Shenandoah / Shenandoah East Station as a relevant stakeholder and provide information in accordance with section 7(2)(a) of the Regulations.

Appendix J.1.1 provides the specific details of communication between Tamboran and the pastoralist regarding the proposed activities.

5.4 Host traditional owner(s) engagement

Tamboran has undertaken detailed engagement with the host traditional owners through the NLC to facilitate an ongoing relationship between Tamboran and their host traditional owners. Engagement efforts undertaken by Tamboran include:

- Execution of Exploration Agreement(s) between Tamboran and native title holders for all EPs. This includes a range of additional reporting and environmental protection measures, in addition to the minimum stator requirements outlined in the NT Petroleum (Environment) Regulations.
- Provision of annual work program updates, information on proposed EMP submissions and sacred site clearances providing detailed information on the proposed regulated activities, including description, location, impacts, risks and controls.
- Execution of Sacred Site clearance and avoidance surveys on the specific areas of land. A formal NLC Sacred Site Avoidance and Anthropological Report is generated by the NLC and submitted to the AAPA to assist with the issuing of an Authority Certificate in compliance with the NT's Aboriginal Sacred Sites Act. This process is currently underway for the inclusion of the SPCF into the existing AAPA certificate C2024-31 covering Shenandoah S2.
- In person consultation between Tamboran, host traditional owners and their statutory representative body, the NLC regarding Tamboran's proposed exploration activities as a part of annual work program update meetings.
- On country meetings held with NLC and traditional owners to discuss proposed activities, schedule and address any questions. The on-country meetings conclude the engagement and consultation necessary with traditional owners prior to commencement of each years' activities.
- Ongoing consultation regarding Tamboran work programs and proposed exploration activities, including the location(s) of all areas of disturbance and answering any questions or comments on the activity and its related impacts.
- Regular site visits to walk through activities underway (such as drilling and stimulation) and answer any questions regarding E&A activities underway.

The traditional owner stakeholder engagement summary is provided in Appendix J Part A & B. Detailed records of communication between Tamboran and the host traditional owners (via NLC), regarding the proposed activities is provided in Appendix J.1.2.

The NLC is the contact point for all native title holders:

Northern Land Council
[redacted]

5.5 Stakeholder activities

Key considerations when understanding the consequences to pastoral operations and traditional owners include:

- Understanding pastoralist operations and determined native title holder custodianship of the proposed area to ensure petroleum activities can sustainably co-exist.
- Provision of payments and/or benefits to the pastoral lessee(s) and native title holders for the impact of regulated activities on the proposed activity area in accordance with the relevant agreements.

A summary of the potential consequences of the activity on stakeholders' activities and mitigation controls is provided in Table 46. This is a summary of the risks and mitigation measures discussed in Appendix K, with Appendix K referred to for the full risk assessment.

Table 46: Potential consequences of Tamboran's activities on stakeholders' activities and control measures which are outlined in the SEPs

Activity	Potential consequence to activities	Mitigations
Pastoralist		
Pastoral time	• Impact to pastoralist time as they are required to engage with Tamboran as a part of the planning and approval for the proposed activity.	• Tamboran undertakes engagement in good faith, with information provided in a variety of formats to reduce time pressures as far as reasonably practicable. • Tamboran will endeavour to minimise the amount of impost on pastoralist activities- noting a level of initial and ongoing interaction will be required between lease holders. • Tamboran proposes to compensate pastoralist for their time.
Pastoralist site access	• Exploration vehicles along access track may interact with pastoralist activities- mustering and pastoralist vehicles. • Restricted access to exploration well, compression facility and fenced area during the length of proposed activities. • Dust and noise generated from activity may cause disruption to livestock in the immediate vicinity of activity.	• Pastoralist engaged throughout exploration activity planning to incorporate pastoralist feedback into activity to reduce impacts. • Camps with workers bussed to site (where possible) to minimise vehicle movements. • Hazardous areas to be fenced and signed to communicate potential safety hazards. • Compensation to be paid for loss of available grazing land and disturbance.

Activity	Potential consequence to activities	Mitigations
Pastoral activities- grazing and mustering	• Elevated levels of noise in the immediate vicinity temporary gas compression facilities. • Disturbance of cattle in the immediate vicinity of the activity when civil construction, compression facility construction/ operation are undertaken. • Dust impacts from vehicle movements and disturbed surfaces on immediate adjacent vegetation has the potential to temporarily reduce yield. • Reduction in pastoral productivity through poor rehabilitation. • Potential introduction or spread of weeds. • Helicopter movements in vicinity of pastoral activities may disturb cattle/ mustering operations. • Potential impacts on cattle and pastoral business where gates are left open. • Potential impacts from air emissions	• Pastoralist engaged throughout exploration activity planning to minimise impact on cattle and pastoral activities. • Compensation to be paid for loss of available grazing land and disturbance. • Full fencing of well pad to restrict cattle. • Speed limits restricted to 60 km/hr. • Dust control used to reduce dust emissions. • Site to be rehabilitated back to pre-existing state, with security bond in place if company fails to rehabilitate. • Weed management plan implemented, including requirements for weed hygiene inspections and certificates on all equipment and vehicles. • 6 monthly weed monitoring and spraying of weeds using a NT Government approved treatment. • Pastoralist to notified and engaged prior to commencing helicopter movements to mitigate interference. • Induction with all exploration contractors and staff in relation to pastoral operations. This induction to be developed with input from pastoralist. • Use of grids, gate signage, inductions and regular gate monitoring and reporting to pastoralist to minimise occurrence of gates being left open. • On-going liaising with pastoralist throughout on ground operations. • Low NOx compression and infrastructure chosen to reduce air emissions.
Pastoral activities- ongoing productivity of area post rehabilitation	• Reduction in productivity due to erosion and sediment releases. • Reduction in productivity due to wastewater, chemical/fuel spills- including from gathering lines and wastewater containments (tanks and sumps). • Reduction in pastoral productivity through poor rehabilitation.	• Routine site maintenance completed to ensure functioning of erosion and sediment control. • All fuels, oils, wastewater and chemicals to be stored within secondary containment. • All spills remediated as required in the EMP/spill management plan. • Gathering and pipeline reinstatement to bring ground cover back to pipeline corridors post construction. This will

Activity	Potential consequence to activities	Mitigations
	• Potential introduction or spread of weeds.	support ongoing grazing activities (potentially increasing the yield of these area due to a lack of woody vegetation). • End of life rehabilitation to return land back to pre-existing state or as agreed to with pastoralist. • Rehabilitation security with NTG retained. • Weed management plan implemented, including requirements for weed hygiene inspections and certificates on all equipment and vehicles. • Routine weed monitoring and spraying of weeds using a NT Government approved treatment.
Pastoral access to groundwater	• No anticipated impacts as proposed groundwater take is to be covered under a WEL.	• All groundwater take to be authorised under a WEL. • Water extraction from pastoralist bores not proposed, unless specifically approved by pastoralist through an agreement. • Tamboran to allow access to water extraction bores for pastoral take (with prior agreement between the parties).
Pastoral access to surface water	• No anticipated impacts as no surface water take, interference or wastewater discharges proposed.	• No surface water proposed to be taken. • No activity proposed within watercourses.
Pastoralist's amenity	• Minor elevated levels of noise in the immediate vicinity of the infrastructure during civil construction, and operation of temporary gas processing facilities. • Dust generation creates visible amenity impact • Visual presence of infrastructure within pastoralist lease. • Potential visible hue from flare (during maintenance/ plant trip) and night-time operation of at distance.	• Site to be located away from main pastoralist entry points and homestead. • Dust suppression to be utilised where practicable • Site selection to avoid placing flares and exploration activities on regional high points. • Sale of appraisal gas will reduce visible hue. • Field turn down used to avoid extended flaring from the facility.
Native Title Holder		
Native Title Holder time	• Impact to Native Title Holders' time as they are required to engage with Tamboran as a part of the planning and approval for the proposed activity.	• Exploration agreements are in place outlining how engagement with Native Title holders is to occur. • Royalties paid in accordance with Exploration agreements.

Activity	Potential consequence to activities	Mitigations
		• Tamboran works closely with the NLC to provide information in a manner to reduce time pressures as far as reasonably practicable. • For scouting and/or activities requiring cultural managers, compensation for time is provided.
Native Title Holder site access	• Restricted access to the SPCF site and fenced area during the length of proposed activities.	• Implementing the exploration agreements with Native Title holders. • Access restrictions minimised to those nominated within the Exploration Agreement (for safety) • Native Title Holders are provided updates on proposed activities annually via the NLC. • Royalties paid in accordance with Exploration agreements. • Operational staff are in direct contact with Native Title Holders who may request access to any site. Tamboran will facilitate each access request. • Cultural managers used for scouting to identify and avoid culturally significant areas- including areas regularly used for hunting, gathering or for cultural purposes • Camps with workers bussed to site (where possible) to minimise vehicle movements. • Hazardous areas to be fenced and signed to communicate potential safety hazards.
Native Title Holder – protection of environment and country, including ongoing connection, amenity and use	• Restriction of access to operational (hazardous) areas • Clearing of vegetation for infrastructure resulting in impacts to flora and fauna • Elevated levels of noise and light in the immediate vicinity of the temporary SPCF. • Disturbance of wildlife in the immediate vicinity of the activity when works are undertaken. • Dust impacts on immediate adjacent vegetation has the potential to temporarily reduce yield, similar to existing pastoral tracks. • Reduction in productivity through poor rehabilitation.	• EMPs in place to avoid, minimise or manage environmental impacts - in particular in relation to amenity, noise, groundwater, surface water, air quality, flora and fauna. • Implementation of the exploration agreements that are in place with Native Title holders. • Securing consent through the Beneficial Use of Gas agreement and associated commitments. • Royalties paid in accordance with Exploration Agreements. • Machinery maintained in good working order with mufflers used to limit noise. • Mufflers used on the SPCF compressors.

Activity	Potential consequence to activities	Mitigations
	• Potential introduction or spread of weeds. • Helicopter movements in vicinity of activities may disturb wildlife/ access/ hunting. • Greenhouse gas emissions created by gas fired compression.	• Noise modelling completed to assess impacts to sensitive receptors, with all noise restricted to the immediate vicinity of the activity • Speed limits restricted to 60 km/hr. • Dust control used to reduce dust emissions. • Site to be rehabilitated back to pre-existing state, with security bond in place if company fails to rehabilitate. • Weed management plan implemented, including requirements for weed hygiene inspections and certificates on all equipment and vehicles. • 6 monthly weed monitoring and spraying of weeds using a NT Government approved treatment. • Annual work program meetings and reports provided to native title holders outlining the proposed activities and locations. • Induction with all exploration contractors and staff in relation to native title holders and sacred sites. • Operational staff are in direct contact with Native Title Holders who may request access to any site. Tamboran will facilitate each access request. • Low NOx compression and infrastructure chosen to reduce air emissions. • Appraisal gas will be beneficially used through sale of CNG/LNG/ piped natural gas to reduce flaring and minimise flaring to reduce scope 1 and 2 emissions. • Field turn down strategy to minimise flaring during plant trips or routine maintenance. • Site lighting to be orientated to prevent excessive offsite lighting.
Ongoing productivity of area post rehabilitation	• Reduction in productivity due to erosion and sediment releases. • Reduction in productivity due to wastewater, chemical/fuel spills- including from gathering lines and wastewater containments (tanks and sumps).	• Routine site maintenance completed to ensure functioning of erosion and sediment control. • All fuels, oils, wastewater and chemicals to be stored within secondary containment. • All spills remediated as required in the EMP/spill management plan.

Activity	Potential consequence to activities	Mitigations
	• Reduction in productivity through poor rehabilitation. • Potential introduction or spread of weeds.	• Gathering and pipeline reinstatement to bring ground cover back to pipeline corridors post construction. • End of life rehabilitation to return land back to pre-existing state. • Rehabilitation security with NTG retained. • Weed management plan implemented, including requirements for weed hygiene inspections and certificates on all equipment and vehicles. • Routine weed monitoring and spraying of weeds using a NT Government approved treatment.
Access to groundwater	• No anticipated impacts as proposed groundwater take is to be covered under a WEL. • Impacts to groundwater quality assessed in Appendix K	• All groundwater take to be authorised under a WEL. • Water extraction levels modelled with no long-term groundwater reductions anticipated. • Groundwater monitoring completed to detect impacts.
Native Title Holder access to surface water	• No anticipated impacts as no surface water take, interference or wastewater discharges proposed.	• No surface water proposed to be taken. • No activity proposed within watercourses. • Erosion and sediment controls in place to minimise sediment releases from the SPCF and access tracks • Location of infrastructure not upstream of permanent watering points used for community living areas
Native title holder sacred sites/ protected features	• Access and/or damage to sacred sites.	• No access to sacred sites proposed. • All activities to occur in areas cleared by native title holders of sacred sites. • AAPA certificates to be granted covering proposed activities.

5.6 Northern Territory business engagement

Broader engagement has occurred with local and regional business within the local communities of Daly Waters, Elliott, Katherine and the broader Northern Territory region.

Northern Territory businesses have been engaged on the scope of Tamboran's activities through information sessions and tender opportunities covering a range of material supply and support services, such as:

- people transport and logistics
- accommodation and food

- provision of temporary camps and camp services
- civil construction work
- freight and transport
- water bore drilling
- water carting and waste management
- site maintenance and inspections
- weed management and control
- equipment and materials storage
- oil country tubular goods
- environmental and civil consulting
- surveying and geotechnical assessments
- general provisions of goods and services (such as personal protective equipment and hire cars).

5.7 Ongoing stakeholder and community engagement

Tamboran is committed to continuing to engage with stakeholders regarding the exploration activities under EP 98, EP 117 and EP 76, and any associated environmental outcomes prior to, during and after performance of exploration activities.

Tamboran recognises the growing community interest in ensuring onshore natural gas development takes place in a safe and environmentally sound way and are committed to delivering operational excellence (which encapsulates our health, safety and environmental performance standards).

Tamboran has further committed to ongoing engagement with the relevant traditional owners, including annual work plan meetings and provision of draft work programs for future years of activity.

Detailed community and stakeholder engagement are underway, covering future exploration activities. This includes the following engagement activities:

Pastoralists:

- Weekly-monthly engagement with host pastoralists for which activity is proposed within the immediate timeframe, with the engagement frequency agreed to with the pastoralist.
- Quarterly engagement with future host pastoralists for which activity is proposed within the preceding year.
- Annual consultation with all pastoralists, including surrounding pastoralists with no immediate proposed activities.

Native title holders of the area in which the activity is occurring:

- Ad hoc updates for the NLC when required, informing them of progress of exploration activities underway.
- Quarterly project status updates to the NLC informing them of progress of exploration activities underway.
- Site visits by traditional owners during exploration activity so that traditional owners can have first-hand observation of key activities.

- Work program surveys conducted by traditional owners, with the support of the NLC, to review work programs and ensure protection of sacred sites and objects.
- Annual on country meetings with native title holders to discuss current work program status and future exploration activities.
- Broader community engagement that is in addition to the requirements outlined in Reg 7 of the Regulations will continue.

6 Environmental risk assessment

6.1 Tamboran's risk management approach

Tamboran uses a robust risk management process for all its activities to achieve the following key outcomes:

- Risks are understood, eliminated or reduced and controlled to an acceptable level
- Controls are owned, assured and continuously reviewed for effectiveness
- All activities are compliant with regulatory standards and are guided by best practice
- Tamboran and its stakeholders are confident in the way activities are conducted to manage risks
- The approach aligns with the findings of the NT Inquiry Final Report and associated recommendations (as implemented via the Code or legislation).

Tamboran's risk assessment process is undertaken in accordance with section 5.4.3 of International Organisation for Standardisation (ISO) 31000. Assessment of risk is completed using Tamboran's risk matrix (Figure 46) to assess and rate risks by assessing the combination of frequency of occurrence and the severity of the outcome of a potential event, including a worst-case scenario event. This allows quantification of a risk and determination can then be made about whether the risk can be accepted, or whether further mitigation is required.

Tamboran risk management processes requires regular assessment of all risks once controls are applied, the effectiveness of controls (Table 47) and the likelihood and consequence of a risk event. [19] A residual risk is either accepted in accordance with strict delegations of authority or the activity does not proceed.

Tamboran also includes site specific controls for each identified risk, which further demonstrates how it achieves a residual risk that meets its ALARP and acceptable criteria. When applying the existing controls during the risk analysis (as per ISO 31000), there is very often little material change to most risk profiles identified in the risk register (Appendix K). This is a function of the comprehensive nature of the Code, which was designed to mandate a high level of environmental performance and minimise environmental risk.

Table 47: Risk assessment ratings

Rating	Explanation
Effective	• All controls are well designed and address the cause/s of the risk. • All controls operate to the required level. • Ongoing monitoring required.

[19] Includes applying existing controls, such as compliance with regulatory requirements which are mandatory (e.g. the Code, Regulations Schedule 1, etc).

Rating	Explanation
Can be improved	• Majority of controls are well designed and address the cause/s of the risk. • Majority of controls operate to the required level. • Some of the controls can be improved. • Subject to ongoing monitoring and review
Must be improved	• Majority of controls are not well designed and do not address the root cause/s of the risk. • Majority of controls do not operate to the required level. • Majority of controls require improvement to be effective in managing the risk.

RISK MATRIX

CONSEQUENCES	IMPACT ON TAMBORAN: PEOPLE	IMPACT ON TAMBORAN: ENVIRONMENT, HERITAGE & COMMUNITY	IMPACT ON TAMBORAN: FINANCIAL ($A)	EXTERNAL RESPONSE: STAKEHOLDER	EXTERNAL RESPONSE: LAWS, REGULATION AND CIVIL ACTIONS	LIKELIHOOD: 1 REMOTE (<1% chance of occurring within the next year. Occurs as a '100-year event' or less frequent.)	2 HIGHLY UNLIKELY (<10% chance of occurring within the next year. Could occur within decades.)	3 UNLIKELY (<30% chance of occurring within the next year. Could occur within the next few years.)	4 POSSIBLE (<60% chance of occurring within the next year. Could occur within months to years.)	5 LIKELY (<90% chance of occurring within the next year. Could occur within weeks to months.)	6 HIGHLY LIKELY (Likely to happen multiple times a year)
6 CATASTROPIC	Multiple fatalities, life-threatening illness or total permanent disability to a large group of people.	Extensive, permanent damage to the environment, including species, habitats, ecosystems or area/s of cultural significance. Long- term social unrest and outrage within community.	>$50m	Multiple stakeholder groups taking coordinated action, as reflected in media channels with significant reach and influence (e.g. blockade/boycott negatively impacts substantial aspects of operations and are covered in media for more than 1 week).	Criminal charges against any director or senior executive involving jail or loss of right to manage the company. Public inquiry – requiring considerable resources and Executive Leadership time. Loss of licence to operate.	6 CATASTROPHIC: HIGH	HIGH	VERY HIGH	VERY HIGH	VERY HIGH	VERY HIGH
5 CRITICAL	A fatality or life-threatening illness or total permanent disability to one individual.	Extensive, long-term, partially reversible damage to the environment, including species, habitats, ecosystems or area/s of cultural significance. Prolonged community outrage.	>$25-50m	Multiple stakeholder groups mobilising and encouraging others to act, as reflected in media channels with significant reach and influence with substantial negative influence (e.g. social media campaign calling for protest, escalating over several days).	Criminal charges against any director, senior executive or senior manager not involving jail or loss of right to manage the company. Prolonged major litigation – exposure to significant damages / fines / costs. Suspension / restriction to operate an asset.	5 CRITICAL: MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH	VERY HIGH
4 MAJOR	Injury or illness to one or more persons, resulting in permanent partial disability.	Long-term, reversible damage to the environment, including species, habitats, ecosystems or area/s of cultural significance. High levels of tension within the community.	>$10-25m	More than one stakeholder group's opinion or view influencing other stakeholders, reported through media channels with some reach and influence (e.g. government comments in national media or in Parliament).	Criminal charges against any employee (not described above) Major litigation – exposure to damages / fines / costs.	4 MAJOR: MEDIUM	MEDIUM	MEDIUM	HIGH	VERY HIGH	VERY HIGH
3 SERIOUS*	Injury or illness that requires treatment as an in-patient in a hospital OR immediate treatment for a serious injury OR medical treatment within 48 hours of exposure to a substance.	Serious, medium –term, reversible impacts to the environment, including species, habitats, ecosystems or area/s of cultural significance. Moderate levels of community tension.	>$1-10m	More than one group offering an opinion or view, reported through media channels with reach and influence (commentary lasting one 24-hour media cycle across internet, print, television, radio).	Non-compliance with conditions of licence to operate an asset or to conduct an activity. Litigation and exposure to damages / fines / costs.	3 SERIOUS: LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	HIGH
2 MODERATE	Injury or illness to 1 or more persons resulting in medical treatment, up to 5 days lost time or alternative / restricted duties for up to 1 month.	Moderate short-term impacts to the environment, including species, habitat, ecosystems or area of cultural significance. Isolated examples of community tension.	>$250k-$1m	A single stakeholder group drawing attention to an incident, issue or approach, conveyed though media channels with potential reach and influence (e.g. some social media complaints or local media reports).	Moderate non-compliance with external mandatory obligations or breach of contractual or other legal obligations (not described above).	2 MODERATE: LOW	LOW	MEDIUM	MEDIUM	MEDIUM	MEDIUM
1 MINOR	Injury or illness requiring first aid to 1 or more persons, or a no treatment case.	Limited environmental or cultural heritage impact- readily dealt with and contained on site. Individual community member voicing concern.	<$100k	A person or organisation signalling interest in an incident or event using channels with limited reach or influence (e.g. letter of complaint).	Minor non-compliance with external mandatory obligations or breach of contractual or other legal obligations.	1 LOW: LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

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Figure 46: Tamboran's risk matrix

6.2 As Low as Reasonably Practicable (ALARP)

The risk management process requires risks to be managed to ALARP. A risk can be considered to have been reduced to ALARP when all reasonably practicable control measures (both preventative and mitigative) have been identified and implemented to reduce the risk of identified events. A key element of demonstrating ALARP is that good practice is followed, where good practice is defined as the recognised risk management practices and measures that are used by competent organisations to manage well understood hazards arising from their activities. This definition incorporates good practice as defined in codes and standards, and a consensus of good practice within the industry. ALARP is not a final position over the life of an asset or project.

The practicability and the reasonability of control measures can change over time due to changes in technology (that can make measures more readily available), industry standards (that can commoditise once-cutting-edge technology) and the socio-technical landscape (that can modify societal expectations).

In the NT context, ALARP and the definition of acceptable risk levels was a key feature of the NT Inquiry Final Report. For each aspect, acceptability criteria were defined, with recommendations outlined to reduce the potential risk to below the acceptable level. With the adoption of all recommendations by the NTG, the Code and associated regulatory changes provides a high level of inherent protection to ensure activities are undertaken in a safe and consistent manner.

Tamboran considers ALARP to be achieved where the residual risk is low, whereby any additional control measures applied will not reduce the risk any further.

If the residual risk of low is not achieved, Tamboran considers ALARP to be achieved where the following criteria have been met:

- the requirements of the Code have been met
- all reasonably practicable site-specific controls have been identified and implemented and
- the cost of further reducing the risk is unreasonable compared to the environmental benefit gained from implementing the control measure.

6.3 Risk acceptability

Tamboran uses a series of criteria (Table 48) to determine the acceptability of a risk once all controls are identified / implemented. Each risk event and final risk rating outlined in Appendix K is assessed against these criteria to determine whether Tamboran believes it is acceptable.

Table 48: Risk acceptability criteria

#	Criteria	Tamboran's acceptance threshold
1	Risk level after treatments / controls are applied	Consistent with Tamboran's risk acceptance criteria: **Very high risk** – Not acceptable. **High risk** – Residual risk may be conditionally accepted where the residual risk is ALARP and the risk is signed off by a General Manager with risk treatment applied to improve, control or further modify risk. Risk reviews are to occur annually with the intent to reduce the risk severity lower. **Medium-low risk** – Residual risk is accepted when ALARP is demonstrated.

#	Criteria	Tamboran's acceptance threshold
2	Legislative requirements and regional strategies and conservation plans	1. Consistent with legislative requirements, including Code. 2. Consistent with regional strategies and conservation/threat abatement plans.
3	Stakeholder expectations	Consistent with the commitments made in stakeholder engagement and/or agreements.
4	Industry guidelines and best practice	Is consistent with petroleum standards (such as API and the Oil and Gas UK standards), best practice and controls used in other NT industries.
5	Scientific uncertainty in the data used to determine the environmental impact or risk	**Low uncertainty:** Accepted Risks are well understood, and uncertainty is minimal. **Moderate uncertainty:** Accepted using well-established data and assessment methods. Some uncertainty exists, with routine monitoring and performance criteria in place to detect and respond to any impacts arising from a risk. **High:** Conditional acceptance – Significant uncertainty exists with data and assessment methodologies unproven. A precautionary approach will mean that uncertainty is replaced by conservative assumptions that will require additional control measures being implemented to prevent, detect and respond to any impacts arising from a risk.
6	ESD principles	Risk is consistent with the principles of ESD as defined in section 2.1. This also includes weighting to consider the social and economic benefits of the Project.

6.4 Assessment of scientific uncertainty

The Regulations require an assessment of uncertainty as a part of the risk assessment process. The assessment of potential impacts and effectiveness of controls must demonstrate that the activities are carried out in a manner consistent with the principles of ESD and the precautionary principle.

Impact and risk identification must include consideration of uncertainty regarding impacts and risks for the activity where a precautionary approach is appropriate. Uncertainty is high where confidence in the available information is low in identifying risk or the effectiveness of a management control. Additional baseline studies or other safeguards may be required to increase the accuracy of an assessment to determine the acceptability of a risk.

Scientific certainty is qualitatively assessed using a generic means of ranking the data available in accordance with Table 49. Considerations of uncertainty have been included in the risk assessment discussed in section 6.5.

Table 49: Scoring system and ranking for scientific uncertainty (EFSA, 2009)

Score	Description
Low (1)	• Comprehensive data with strong evidence in multiple peer reviewed data • Little disagreement between authors or experts • Considerable and consistent on-ground experience and/or monitoring

Score	Description
Medium (2)	• Some or incomplete data available • Evidence provided based on a small number of references • Authors or experts' conclusions vary • Limited on-ground experience and/or monitoring
High (3)	• Scarce or no data available; evidence provided in unpublished reports • Few on-ground observations • Authors and experts' conclusions vary considerably

6.5 Risk assessment outcomes

The environmental, heritage and social risks associated with the activities covered under this EMP have been assessed using the Tamboran risk assessment framework described in section 6.1. The risk assessment presents the range of potential impact-causing activities, corresponding mitigation measures and residual risk ratings based on their assessed worst-case consequence and likelihood of occurrence. The assessment also cross-references the various risk assessment outcomes in the NT Inquiry Final Report, to ensure consistency.

Site specific conditions and cumulative impacts have also been considered during the assessment. Cumulative impacts have included the following:

- Construction, operation and rehabilitation of the SPCF in combination with other Tamboran E&A activities over a 5 year period, as per the current approved tenure work plan.
- Existing land users (predominately pastoralists).

A total of 33 risk scenarios were assessed associated with SPCF activities. Within these risk scenarios, the assessment considered 61 risk sources, which may potentially result in a risk occurring. There were no residual risks above a "Medium" risk rating, with 6 risks rated "Medium" and 27 risks rated "Low. The medium residual risks scenarios and sources identified through the risk assessment include:

- Accidental ignition of fire during civil construction, impacting listed threatened habitats, flora and fauna – risk ID 10.
- Accidental ignition by site activities, impacting a sacred site or culturally sensitive area – risk ID 15.
- Introduction and spread of weeds, or bushfire from accidental ignition resulting in a reduction in land productivity – risk ID 18.
- Vehicle (light or heavy) accident resulting from increased traffic movements – risk ID 22.
- A loss of primary containment (process safety event or sabotage) impacting workers and the broader environment from a range or risk sources, such as: the rupture of high-pressure piping, a gas leak with or without ignition, operating a high-pressure gas processing plant and equipment, or sabotage resulting in an uncontrolled release of gas – risk ID 23.
- Increased nuisance from dust and particulate emissions to regional ecosystems and fauna from traffic movements and/or bushfire from accidental ignition sources– risk ID 27.

The assessment demonstrates that 82% of the risks associated with the SPCF have been assessed to a low-risk rating. Five of the six medium risks identified were consistent with standard construction or pastoralist activities carried out across the NT, being increase traffic impacts, ignition of bushfire, and the potential spread of weeds from the proposed activities. One medium risk is consistent with the standard operation of a gas facility. However, this is a stringently regulated industry, from the initial design of a hydrocarbon facility to accepted industry codes and standards, through to independent validation of the facility and pipeline designs, and quality assurance of installed equipment.

All residual risk ratings demonstrate as low as reasonably practicable (ALARP) and acceptable through multiple safeguards, isolation barriers and emergency shutdown systems to protect the public and environment.

The environmental outcomes to be achieved during the Project include no significant impacts to the following aspects:

- Ecological function and productivity of soils.
- Ecological function of surface water bodies.
- The viability of groundwater systems to support ecological, economic and community activities.
- The protection of high valued habitats and threatened flora and fauna.
- The maintenance of air quality, including the offsetting of residual GHG emissions.
- The protection and enhancement of community and cultural values, places and amenity.

At completion of the Project, the site will be returned to a safe, stable and non-polluting form consistent with pre-disturbed conditions.

The level of uncertainty for each risk was also assessed. There was no uncertainty level above “Low”, which is consistent with the scale of the activity and the knowledge of impacts associated with shale exploration activities demonstrated in the Inquiry Final Report and through the various reports published by the US EPA (e.g. US EPA 2016).

A count of the post-treatment environmental risks associated with this EMP is provided in Table 50. The risk assessment is provided in Appendix K.

Table 50: Count of environmental risks for the drilling, stimulation and seismic program

	Environmental risk rating with applied controls			
	Low	**Medium**	**High**	**Very high**
Total 33	27	6	0	0

6.6 Environmental outcomes, performance standards and measurement criteria

The following section provides the environmental outcomes, performance standards and measurement criteria of each environmental aspect, based on the risk assessment presented in Appendix K. Table 51 to Table 57 provide the environmental outcomes, performance standards and measurement criteria, based on the NT EPA’s environmental factors and objectives, to demonstrate whether controls have been effective during the activity and that the stated environmental outcomes have been achieved.

6.6.1 Land

Table 51: Environmental outcomes, performance standards and measurement criteria –terrestrial environmental quality

Environmental performance measures – terrestrial environmental quality				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
Tamboran's activities do not adversely impact l terrestrial environmental quality, with sites rehabilitated back to the current (non-petroleum) land use following the activities under this EMP.	L-1	No offsite release of wastewater or chemicals from SPCF activities into the surrounding environment.	• No reportable wastewater or chemical spills from the activity • Evidence of all spills cleaned up as soon as possible. • No offsite wastewater or chemical spills from the activity. • Weekly inspections of skid bunding to confirm it is in good working order. • Testing of stormwater (weekly during the wet season and per event during the dry season) confirms water complied with specified limits.	• Records retained of gathering line maintenance and repairs. • Incident records retained in incident management system with leak/spill location, volumes and clean up information. • Sediment basin testing spreadsheet. • All incidents logged in incident management system.
	L-2	No failure of underground oil/water separator tank (SPEL).	• Oily-water separator tank levels automated and monitored.	• Level monitoring records retained. • Waste transfer/disposal receipts retained. • All incidents logged in incident management system.
	L-3	No reportable incidents involving erosion or sediment release beyond the site boundary.	• 6 monthly erosion and sediment control inspection of disturbed areas completed identifying defects requiring immediate repair, repair prior to wet season or defects that should be monitored. • Maintenance results confirm all defects flagged as requiring immediate rectification, including reportable incidents, are rectified as soon as possible.	• Civil maintenance records of ESCP retained. • 6 monthly erosion and sediment control inspections.

Environmental performance measures – terrestrial environmental quality				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
			• Evidence of maintenance completed on demonstrating pre-wet season maintenance on erosion and sediment controls completed.	
	L-5	No uncontrolled bushfires caused by Tamboran's activities (including civil construction and SPCF activities).	• Zero reported incidents of bushfire caused by Tamboran's activities.	• Fire incident data to be retained.
	L-6	Disturbance infrastructure no longer required are rehabilitated back to pre-existing state.	• Rehabilitation of unused infrastructure to occur within 6 months of activity completion. • Annual rehabilitation monitoring completed, with recommended maintenance completed within 3 months (contingent on weather and access). • Final RMP success criteria achieved at project completion.	• Annual rehabilitation monitoring report.
	L-7	At completion of exploration activities site to be reinstated and rehabilitation implemented to return ecological function back to the pre-existing state.	• Rehabilitation of unused infrastructure to occur within 6 months of determining activity completion. • Annual rehabilitation monitoring completed, with recommended maintenance completed within 3 months (contingent on weather and access).	• Annual rehabilitation monitoring report.
Risk sources	• Soil compaction of the SPCF pad (Risk ID 7). • Soil erosion from cleared areas (Risk ID 7). • Accidental ignition of fire during civil construction (Risk ID 10). • Poor rehabilitation of the site reduces regional habitat and promotes weed invasions (Risk ID 9).			

Environmental performance measures – terrestrial environmental quality			
Environmental outcome	**Environmental performance standards**	**Measurement criteria**	**Records**
	• Contaminants in water and soil pass through the food chain and bioaccumulate in fauna causing detrimental impacts to local species and communities (Risk ID 11).		

Table 52: Environmental outcomes, performance standards and measurement criteria –terrestrial ecosystems

Environmental performance measures – terrestrial ecosystems				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
Tamboran's activities do not adversely impact surrounding vegetation, significant vegetation communities and listed threatened flora and fauna, with sites rehabilitated back to the current (non-petroleum) land use following the activities under this EMP.	EC-1	No unauthorised clearing.	• Total clearing levels within the authorised clearing levels stated in the EMP. • No clearing outside of approved areas defined in the EMP (3.0 ha new).	• Baseline surveys report (Appendix H - LCA). • Survey and spatial data collected confirms disturbance levels are within approved limits and areas.
	EC-3	No WONS (Class A and C) introduced to any Tamboran activity area that are attributed to exploration activities.	• Weed monitoring completed pre and post wet season on all disturbed areas. • Weed monitoring does not identify any newly introduced Class A and Class C WONS. • Weed control applied to all declared weeds. • Annual report demonstrates weed infestation size and density of weed outbreaks introduced by Tamboran's activities are reducing each year.	• Weed monitoring records and annual report retained.
	EC-4	Disturbed exploration infrastructure no longer required are rehabilitated back to pre-existing state.	• Rehabilitation of unused infrastructure to occur within 6 months of activity completion. • Annual rehabilitation monitoring completed, with recommended maintenance completed within 3 months (contingent on weather and access). • Final RMP success criteria achieved at project completion.	• Annual rehabilitation monitoring report.

Environmental performance measures – terrestrial ecosystems			
Environmental outcome	**Environmental performance standards**	**Measurement criteria**	**Records**
Risk sources	• Activity (vehicle and machinery) noise and lighting (Risk ID 8). • Introduction and spread of weeds in the area (Risk ID 9). • Minor land clearing activities (3.0 ha new) that could impact on listed threatened species and/or their habitat (Risk ID 9). • Poor rehabilitation of the site reduces regional habitat and promotes weed invasions (Risk ID 9). • Accidental ignition of fire during civil construction (Risk ID 10). • Contaminants in water and soil pass through the food chain and bioaccumulate in fauna causing detrimental impacts to local species and communities (Risk ID 11). • Vehicle and machinery collisions with fauna – fauna mortality results in a localised impact to listed threatened species (Risk ID 12). • Encouragement of feral animals and other pest species increases, leading to competition with native species. This includes the introduction of cane toads (Risk ID 13). • Cumulative risk from exploration activities and existing agricultural activities resulting in impacts to vegetation communities, fragmentation and poses a threat to protected flora and fauna (Risk ID 30).		

6.6.2 Water

Table 53: Environmental outcomes, performance standards and measurement criteria – hydrological processes

Environmental performance measure – hydrological processes				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
The environmental values of the underlying groundwater resources are maintained with no adverse impacts to users of the resource resulting from Tamboran's exploration activities.	GW-1	No reportable spills or leaks of wastewater and chemicals from the SPCF operation.	• No reportable wastewater or chemical spills from the activity. • Incident management system confirms spills being tracked and cleaned up as soon as possible. • All leak detection alarms responded to within 24 hours (subject to access) and all liner repairs completed as soon as possible.	• Records of releases, spills, leaks and associated clean ups are to be managed using the incident management system. • Gathering and wastewater pipeline inspection records • Records of sediment basin inspections and testing..

Environmental performance measure – hydrological processes				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
			• Testing (weekly during the wet season and per event during the dry season) confirms water complied with specified limits. • Monthly gathering/ wastewater line inspections completed.	
	GW-2	No reduction in groundwater level observed in the impact monitoring bore that results in >1 m decline in groundwater water level.	• Total groundwater extraction volume below the approved water extraction licence take.	• Groundwater take records retained and reported via WALAPs monthly.
Risk sources	• Storage, handling and transportation of chemicals, hydrocarbons and wastes/ wastewater, including during the wet season (Risk ID 1). • Surface spills from the handling and transferring of wastewater (Risk ID 1). • Storage and management of oily wastewater (Risk ID 1). • Failure of underground drain oil/water separator tank (SPEL) (Risk ID 2). • Cumulative risk from groundwater take from surrounding land users exceeds the natural recharge rate of the Basin (Risk ID 29).			
Instrument calibration	Groundwater volume: N/A approved DEPWS meter used with no calibration required.			

Table 54: Environmental outcomes, performance standards and measurement criteria – Inland water environmental quality and aquatic ecosystems

Environmental performance measure – Inland water environmental quality and aquatic ecosystems				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
Maintain the quality of surface water and aquatic ecosystems and prevent any adverse impacts from	SW-1	Stormwater released within the EMP limits with no evidence of contamination (including wastewater, hydrocarbons, chemicals and wastes).	• Weekly monitoring results of sediment basin during wet season demonstrates releases were within the EMP limits.	• Stormwater release spreadsheet.

Environmental performance measure – Inland water environmental quality and aquatic ecosystems				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
Tamboran's exploration activities.	SW-2	No releases of wastewater or chemicals off the SPCF site into surrounding drainage depressions or watercourses.	• No offsite wastewater or chemical spills from the activity. • Weekly inspections of skid bunds to confirm they are in good working order. • All leak detection alarms responded to within 24 hours (subject to access) • Testing (weekly during the wet season and per event during the dry season) confirms water complied with specified limits.	• Records of SPEL tank level and volume measurements retained. • Records of daily leak monitoring of secondary containment. • Sediment basin inspection and testing records retained
	SW-3	No reportable incidents involving erosion or sediment release beyond the site boundary into drainage depression or watercourse (extent of disturbance footprint of a site – i.e. 8.0 ha).	• Civil contractor reports demonstrate erosion and sediment controls implemented. • Daily civil construction reports show visual inspection of civil construction activities completed after 20 mm rainfall event. • 6 monthly erosion and sediment control inspection of disturbed areas completed identifying defects requiring immediate repair, repair prior to wet season or defects that should be monitored. • Maintenance results confirm all defects flagged as requiring immediate rectification, including reportable incidents, are rectified as soon as possible. • Evidence of maintenance completed on demonstrating pre-wet season	• Civil construction daily reports. • 6 monthly erosion and sediment control inspections. • Civil maintenance records of ESCP retained.

Environmental performance measure – Inland water environmental quality and aquatic ecosystems			
Environmental outcome	**Environmental performance standards**	**Measurement criteria**	**Records**
		maintenance on erosion and sediment controls completed.	
Risk sources	• Storage, handling and transportation of chemicals, hydrocarbons and wastes/ wastewater, including during the wet season (Risk ID 3). • Surface spills from storage, handling, treatment, recycling and transportation of wastewater (Risk ID 3). • Chemical and waste transportation accident (Risk ID 3). • Release of contaminated stormwater from activities to surface water, including during flooding (Risk ID 4). • Land clearing (Risk ID 5). • Runoff from sewage treatment irrigation areas (Risk ID 5). • Greywater and sewerage disposal (camps) (Risk ID 5). • Uncontrolled release of waste oily water, chemicals or fuel from site due to regional flooding (Risk ID 6). • Impact to surface hydrology changes water flows impacting the land use/productivity (Risk ID 19). • Cumulative impact from exploration activities in addition to existing surrounding land use (agriculture) reduces surface water quality (Risk ID 32).		
Instrument calibration	Management of storm water: Instrument calibrated before use. pH probe calibrated with a two-point calibration using a pH buffer of 7 and 10. EC meter calibrated with a 1413 µs/cm (or similar) standard.		

6.6.3 Air

Table 55: Environmental outcomes, performance standards and measurement criteria – air quality and atmospheric processes

Environmental performance measures – air quality and atmospheric processes				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
No reduction on local air quality and minimisation of greenhouse gas emission generated from Tamboran's exploration activities.	AQ-1	SPCF compressors tuned to ensure plant is running in accordance with manufacturers specification	• 6 monthly tuning on each compressor completed	• Compressor tuning records retained
	AQ-2	All greenhouse gases reporting in accordance with NGERS requirements.	• All emissions related data (fuel use, flaring volumes, venting volumes, wastewater volumes etc.) reported in accordance with NGERS requirements.	• Emission related data (fuel use, flare volumes, wastewater volumes etc.) retained.
	AQ-3	All offsets retired in accordance with GGAP	• All offsets to be secured and retired in accordance with GGAP. • All emission data to be audited and reported to DEPWS annually.	• Annual audit report on emissions report confirms retirement of required ACCUs.
	AQ-4	All leaks detected and repaired in accordance with Code.	• Quarterly leak detection program completed on SPCF. • Maintenance records indicate all minor leaks rectified as per Code within 30 days. • Maintenance records indicate all significant leak is repaired as per the Code within 72-hours.	• Leak detection records retained. • Leaks repairs recorded.
	AQ-5	Flare efficiency achieve 98% combustion efficiency.	• Flare efficiency calculated in compliance with US EPA 40 CFR § 60.18 exceeds 98%.	• Engineering calculation included within annual emission audit report on emissions report confirms.
	AQ-6	Maximum 14 days (total) of flaring per year, excluding commissioning	• Periods of flaring documented.	• Number of days flaring (excluding commissioning) reported in annual audit report.

Environmental performance measures – air quality and atmospheric processes				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
	AQ-7	Compressor rod packing seals maintained to minimise emissions.	• Seals replaced every 36 months or 26,000 hours- whichever is sooner	• Records of compressor seal maintenance and plant operating hours retained.
Risk sources	• Emissions from the combustion of diesel engines, gas fired compressors and generators (Risk ID 25). • Air emissions from gas and condensate flaring (Risk ID 25). • Air emissions from chemical releases during SPCF activities (Risk ID 25). • Rupture of high-pressure piping in SPCF or at the wellhead, resulting in fire, flying debris (Risk ID 26). • Gas leak into enclosed area (with ignition), causing explosion, flying debris, fire (Risk ID 26). • Lightning strike to plant causing fire (Risk ID 26). • Traffic movement (Risk ID 27). • Bushfire from accidental ignition source (Risk ID 27). • Combustion of diesel for all exploration activities, combustion of gas from gas fired compressors and generators and flaring of gas and condensate production (Risk ID 28). • Cumulative impact from the release of GHG emissions during exploration activities materially increases the NT's and Australia's Greenhouse Gas emissions and increasing climate change impacts on the environment (Risk ID 33).			
Instrument calibration	Identification and remediation of gas leaks: Gas detector calibrated monthly with a 10 ppm (or similar) methane calibration gas.			

6.6.4 People

Table 56: Environmental outcomes, performance standards and measurement criteria – community and economy, and human health

Environmental performance measures – community and economy, and human health				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
No adverse impacts to the community resulting from Tamboran's exploration activities.	CO-1	All community complaints made directly to Tamboran of nuisance investigated and resolved.	• All community complaints received directly by Tamboran responded to within 24 hours with actions to remedy nuisance implemented as soon as possible (depending on the nature of the complaint).	• Records of community complaints and actions completed.
	CO-2	>60% of addressable spend[20] to be from NT businesses.	• Project expenditure data confirms the NT business spend on the Beetaloo exploration project exceeds >60% of addressable spend[20] of the project.	• Data on NT business spend retained.
	CO-3	All vehicle accidents investigated and reported in accordance with NT Police, Fire and Emergency Services requirements.	• Zero incidents requiring an external emergency response.	• Records retained in the incident management system.
Risk sources	• Industrialisation of landscape (Risk ID 17). • Increased traffic (Risk ID 17). • Light emissions impact on community receptor (such as pastoralist) (Risk ID 17). • Influx of workers to region (Risk ID 17). • Noise emissions from activities (Risk ID 17). • Introduction and spread of weeds in the area (Risk ID 18). • Impact to surface hydrology changes water flows impacting the land use/productivity (Risk ID 19). • Loss of sense of place and connection to land and country (Risk ID 20). • Reduction in foraging and support of traditional lifestyle (Risk ID 20).			

[20] Addressable spend: a service or material that can be reasonably provided by an NT business at similar quality, timeliness and cost.

Environmental performance measures – community and economy, and human health			
Environmental outcome	**Environmental performance standards**	**Measurement criteria**	**Records**
	• Poor rehabilitation/ reinstatement of exploration infrastructure (Risk ID 20). • Disruption of agricultural operations due to ongoing access, traffic, helicopter movements, etc. (Risk ID 21). • Increased risk of vehicle accident (Risk ID 22). • Rupture of high-pressure piping in SPCF, gas leak into enclosed area (with no ignition), gas leak into enclosed area (with ignition), operating high pressure gas processing plant and equipment and uncontrolled release of gas from SPCF due to sabotage (Risk ID 23). • Exploration activities compete with agricultural industry for resources (Risk ID 24). • Flaring of gas and condensate production (Risk ID 28). • Cumulative impacts on amenity (Risk ID 31).		

Table 57: Environmental outcomes, performance standards and measurement criteria – cultural heritage

Environmental performance measures – cultural heritage				
Environmental outcome	**Environmental performance standards**		**Measurement criteria**	**Records**
No significant impact on sacred sites and environmental values because of Tamboran's exploration activities.	CH-1	No non-compliances with Native Title Holder Exploration Agreements and AAPA certificate conditions associated with SPCF.	• No non-compliances with AAPA certificate conditions including unauthorised work within RWA. No breaches of native title holders' exploration agreements associated with SPCF.	• Incidents retained where unauthorised activities are identified.
Protection of culture and heritage through ongoing engagement and consultation	CH -2	Native title holders are actively engaged on Tamboran's work program, including understanding of Tamboran's current and future exploration activities.	• Annual work program update report completed and submitted • On country meetings completed providing status of work program and future activities, including ongoing presentation of story boards and other activity information. • Indigenous business involved in at least 2 environmental monitoring programs, such as weed monitoring, groundwater monitoring, site stability monitoring.	• Records of annual work program update report retained. • Records of on country meetings retained. • Records of environmental programs completed by indigenous contractors retained.
Risk sources	• Sites disturbed directly by exploration activities (Risk ID 14). • Personnel unauthorised access to sacred site (Risk ID 14). • Accidental ignition (fire) by site activities (civil works, grinding) or site personnel (Risk ID 15). • Contaminants in water and soil pass through the food chain and bioaccumulate in fauna (livestock and native animals) causing detrimental impacts to local species and communities that rely on the animals for food/ livelihood / spiritual connection (Risk ID 16). • Cumulative impact on amenity (Risk ID 31).			

7 Management plans

The following section provides a high-level summary of the various management plans required to be implemented in accordance with the Code.

7.1 Bushfire management plan

A Bushfire Management Plan (BMP) has been developed for the Shenandoah S2 site (Appendix A). The BMP has been updated to show the SPCF and outlines the controls to prevent, detect and respond to fires associated with Tamboran's activities. Controls implemented include:

- Implementation and maintenance of firebreaks.
- Monitoring during periods of high fire danger.
- Flaring controls, including separation distances and cessation of flaring during total fire bans. Tamboran will obtain all relevant permits where flaring occurs during declared fire danger periods.
- Fire response and reporting.

7.2 Weed management plan

Exploration activities are undertaken in accordance with Tamboran's Beetaloo Weed Management Plan (Appendix B). This plan has been developed in accordance with the *Weed Management Planning Guide: Onshore Shale Gas Developments Project.*

Weed surveys have confirmed the proposed area of activity has an extremely low presence of weeds. Efforts will therefore focus on both eliminating the potential introduction of weeds into the region and preventing the spread of existing weeds.

From a cumulative impact perspective, the risks of increasing weed pressure in the area is reduced through the mandated use of weed hygiene inspections/certification for all equipment and vehicles and routine weed monitoring and maintenance. Any weeds that are introduced into the activity areas will be promptly identified and managed, reducing the potential additional stress to the region.

As the location of the SPCF is the repurposed laydown area of the Shenandoah S2 site, it will be fully integrated into the existing Shenandoah S2 site-wide weed management regime.

7.3 Spill management plan

The use of secondary containment to prevent spills during the activities is a regulatory requirement embedded in national and state chemical handling legislation and guidelines. These requirements have been further covered in the Code.

A Spill Management Plan (SMP) has been developed covering Tamboran's proposed E&A activities. This SMP is provided in Appendix D.

An example of bunding used during E&A activities is provided in Figure 47.

Figure 47: Examples of spill mats/bunds used to contain potential wastewater transfer spills

7.4 Wastewater management plan

A Wastewater Management Plan (WWMP) has been developed to satisfy the requirements of the Code. The WWMP describes how Tamboran will store wastewater to minimise risks to the environment. A copy of the WWMP is provided in Appendix E.

7.5 Erosion and sediment control plan

An Erosion and Sediment Control Plan (ESCP) has been developed to outline how the Project site will be operated to minimise the risk of erosion and sediment releases to the surrounding environment. The ESCP is provided in Appendix F.

7.6 Methane emissions management plan

A Methane Emissions Management Plan (MEMP) is required to be developed to demonstrate how methane emissions will be managed (Appendix G). The MEMP describes how Tamboran:

- Mitigates the generation of methane emissions, such as the minimisation of venting and use of reduced emission completions
- Outlines the required leak detection and repair programs
- Summarises the leak reporting requirements

7.7 Rehabilitation management plan

Once a determination has been made to decommission an asset, a site-specific rehabilitation strategy will be developed for each disturbed area, based on the criteria and methodology outlined in the RMP (Appendix L). A specific strategy for each area is required to ensure the operational history of the site is considered during rehabilitation planning (such as spills etc.). As per the Code, rehabilitation will commence within 12 months of determining an asset is no longer required.

All remaining assets will be rehabilitated in accordance with the requirements of the Code. All disturbance shall be returned to the pre-existing condition in accordance with Clause A.3.9(d) of the Code using assisted natural regeneration. This will include:

- Removal of all surface facilities (refer section 3.7.19)
- Removal of all weeds and contaminated materials/wastes
- Re-spreading of stockpiled topsoil
- Backfilling of all open sumps
- Reshaping the site to as close to natural form as possible
- Ripping or scarifying any compacted surface
- Spreading of stockpiled vegetation to aid in surface water flow control
- Where required, spreading seed of suitable local native species which have been determined through analogue sites representative of the surrounding vegetation communities
- Source native seed supply and rehabilitation services from indigenous suppliers (where available).
- Monitoring of rehabilitation success will be completed annually to assess the rehabilitation status of a site and determine where additional remedial works are required.

8 Implementation strategy

8.1 Environment, health and safety management system

Tamboran's activities are governed by a Health, Safety and Environment (HSE) policy (Figure 48). Tamboran will implement a HSEMS, which ensures we conduct our business in line with all the elements of this policy, including but not limited to:

- Risk management and compliance
- Training and competency
- Contractor management
- Safety management and emergency response.

tamboran
RESOURCES

Health, Safety and Environment Policy

Tamboran Resources Corporation (**Tamboran**) is committed to operating in a manner that prioritizes the safety of our people and the community and places an emphasis on preventing unforeseen environmental harm.

Tamboran will achieve this through:

- Creating a culture of work where it is understood that no task is too important that time cannot be taken to ensure it is performed safely and efficiently.
- Empowering our workforce (including contractors) to "stop the job" whenever they believe a task is unsafe or there is an unacceptable risk to people, the environment, or the safe operation of assets.
- Implementation of a contractor management process to ensure alignment of HSE values and safe execution of work.
- Compliance with all applicable legislative requirements, company policies, plans and processes.
- The application of our risk management framework, ensuring that all risks are identified, controlled, or eliminated where practicable.
- Ensuring HSE considerations are an integral part of planning, design, and procurement processes.
- Developing and managing our assets in an environmentally responsible manner and in accordance with ecologically sustainable development principals.
- Ensuring our people are trained and competent for the work they are undertaking.
- Managing all HSE incidents through reporting, investigation and learning with the aim of preventing re-occurrence.
- Effective communication, consultation, and promotion of worker participation to encourage all personnel to be actively engaged in HSE matters.
- Setting objectives aimed at preventing serious harm and improving HSE performance.
- Monitoring and improvement of the HSE management system that supports our people and the way we work.

Tamboran's Executive Leadership Team is committed to leading by example to influence our culture. By upholding health and safety as a core workplace value, Tamboran Resources will achieve positive outcomes for our people and the environment.

Authorised by

CEO
Joel Riddle

28 March 2024

COO
Faron Thibodeaux

28 March 2024

Governance – This policy will be reviewed every 2 years to ensure it remains relevant and effective for Tamboran Resources operations and risk profile. The Nomination and Governance Committee is responsible for undertaking this review.

Figure 48: Tamboran's Health, Safety and Environment (HSE) Policy

8.2 Roles and responsibilities

Overall roles and responsibilities for the implementation of the regulated activities described in this EMP are outlined in Table 58. There are two primary streams of responsibility which sit under the Chief Operating Officer and the Executive Vice President, Strategy and Sustainability.

Table 58: Roles and responsibilities

Role		Responsibility
Stream 1	Chief Operating Officer	Tamboran employee responsible for the overall program.
	VP Drilling and Completions	Tamboran employee responsible for operations and execution.
	Drilling Engineering Technical Advisor Drilling Engineering Lead Drilling Ops Superintendent Senior Geotechnical and Technical Advisor	Tamboran personnel responsible for well drilling, hydraulic fracture stimulation and well testing activities. These roles broadly cover a range of responsibilities, including: • Ensuring the activities are designed and implemented in accordance with the NT legislation and the Code, as well as complying with the requirements detailed in the WOMP and this EMP. • Execution of the drilling of the wells in accordance with the WOMP and drilling program, this EMP while taking rig calls from the onsite company representatives, and Health Safety and Environment (HSE) representative.
	Completions Manager and Senior Technical Advisor	Ensures all areas of drilling, completion and well testing are carried out in accordance with the WOMP, this EMP and work instruction(s). All well drilling, hydraulic fracture stimulation and well testing contractors report to this position.
	Manager Field Operations Senior HSE Manager Operating Company Representative Field HSE Advisor(s) Contract Administrator	Tamboran employees/consultants responsible executing operations in accordance with the WOMP, this EMP, Tamboran's HSEMS, contractual agreements and the exploration quality controls. These roles are ultimately responsible for ensuring all other parties are working within the HSE guidelines and provide guidance and advice to site personnel on: • Day-to-day management of the environment and implementation of this EMP, including reporting, monitoring compliance of operations of all regulated and associated activities. • Planning and implementation of Tamboran monitoring requirements including weeds, groundwater, soil and erosion, bushfire and emergency response
	Specialist contractors	Contractors engaged by Tamboran to deliver on elements of the SPCF construction and operation (plant construction, commissioning, civil construction, piling and camp operation). They are responsible for compliance with this EMP at all times during execution of their work.
Stream 2	Vice President- Environment and Approvals	Tamboran employee responsible for managing regulatory approvals and program changes and reporting and supporting operations (including HSE). Also responsible for notifying the responsible Minister(s) and the owner/occupier of the land on which the activity is to be carried out; and for communications with the regulator and key stakeholders.

Role		Responsibility
	Cultural managers	NLC representatives to provide cultural clearances during clearing and grubbing activities to ensure activities are conducted to avoid areas of cultural significance.

8.3 Contractor management

Most of the work executed under this EMP is done via contractors with oversight from a Tamboran representative. Assessing the level of capability and competency of the contractors is a major focus of the execution strategy.

The interfaces between Tamboran and contractors HSEMS are formalised and documented within the HSE bridging document. This is an operational document which is used on site to identify the systems / processes that take precedence during the execution of a work scope.

Figure 49 provides an overview of the EMP implementation process.

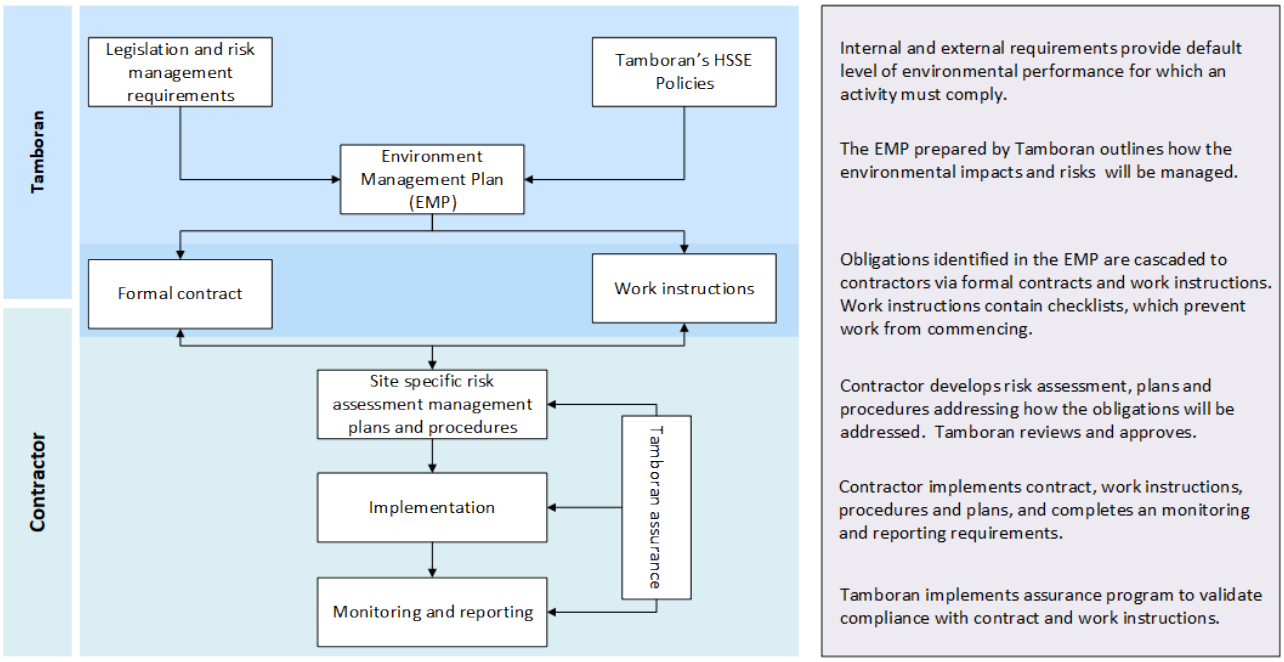

Figure 49: EMP implementation overview flowchart

8.4 Environmental commitment summary

The program environmental commitments outlined in Appendix M are sourced from the risk assessment (Appendix K) and environmental outcomes, performance standards and measurement criteria tables (section 6.6). The implementation and compliance against these risk controls will be assessed as part of the annual environmental report (refer in section 8.10).

Specific commitments will be to:

- Record information to track performance, including non-conformances and corrective actions. Inspect and monitor operational controls on-site via regular environmental monitoring.
- Assess the level of conformance with objectives and targets detailed in this EMP.

- The operating company representative/HSE advisor will undertake site inspections and direct such action as may be considered necessary to protect, minimise or rectify any environmental concerns.

8.5 Work instructions

An instrument referred to as a 'work instruction' is the mechanism used to cascade the relevant environmental commitments to Tamboran personnel and contractors. It outlines the minimum compliance requirements that must be implemented and includes:

- Key compliance and system documents.
- A list of compliance commitments with responsible parties allocated.
- A list of inspections, procedures and other tools required to implement the content of the EMP.
- Monitoring and reporting requirements.

8.6 Incident reporting and investigation

All personnel working on site (including visitors) are required to report incidents and near-misses that have the potential to, or do, affect the environment.

All environmental incidents and near misses are managed as per Tamboran's Incident Management Procedure and tracked through an online incident reporting system. Incidents are investigated with the level of investigation and methodology (5 whys, Incident Cause Analysis Method, etc) dependent on actual and potential consequence.

Personnel are also encouraged to submit hazard / observation cards to maintain a level of awareness of environmental risk and to ensure a cycle of continual improvement.

8.7 Reportable environmental incident reporting

The Regulations define a reportable incident as an incident arising from a regulated activity that has caused, or has the potential to cause, material environmental harm or serious environmental harm as defined under the Petroleum Act. This also includes any potential or actual damage to a sacred site. Environmental offences and penalties that meet these criteria are defined in s 117AAB of the Petroleum Act.

Tamboran will assess incidents as they occur to determine if they are reportable. Where an incident is reportable, DEPWS will be contacted (this may be verbal or in writing) as soon as practicable but no later than two hours after the first occurrence of the incident or after the time the interest holder becomes aware of the incident.

The Regulations define a recordable incident as an incident arising from a regulated activity that:

1. Has resulted in an environmental impact or environmental risk not specified in the current plan for the activity; or
2. Has resulted in a contravention of an environmental performance standard specified in the current plan for the activity; or
3. Is inconsistent with an environmental outcome specified in the current plan for the activity; and
4. Is not a reportable incident.

Tamboran will notify (this may be oral or in writing) DEPWS of a recordable incident as soon as practicable but no later than 15-days after the reporting period (agreed period or each 90-day period after the day on which the EMP is approved).

8.7.1 NT Waste Management and Pollution Control Act 1998 incident reporting

In accordance with the *NT Waste Management and Pollution Control (WMPC) Act 1998,* where contaminants or waste is not confined within the land on which the petroleum activities are undertaken (i.e. the approved disturbance areas where the petroleum activity is occurring), Tamboran has a duty to notify of incidents causing or threatening to cause pollution as soon as practicable, but no less than 24-hours after becoming aware of the incident.

A notifiable incident is defined as an incident that causes, or is threatening or may threaten to cause, pollution resulting in material environmental harm or serious environmental harm.

A notification must include:

a) the incident causing or threatening to cause pollution
b) the place where the incident occurred
c) the date and time of the incident
d) how the pollution has occurred, is occurring or may occur
e) the attempts made to prevent, reduce, control, rectify or clean up the pollution or resultant environmental harm caused or threatening to be caused by the incident
f) the identity of the person notifying

Tamboran shall make all notification under the WMPCA via the NT EPA Pollution Hotline 1800 064 567 and Petroleum Operations via the DEPWS email: onshoregas.depws@nt.gov.au.

8.7.2 Gas leak reporting

Each gas leak shall be classified, repaired and reported in accordance with Table 59.

Table 59: Leak classification and remediation summary

Classification	Threshold	Notification	Comments
Minor leak	>500 ppm measured at the surface of the component	All minor leaks must be documented	A minor leak is an unplanned release that does not occur during commissioning or bringing equipment back into service. These leaks should be corrected immediately as a part of commissioning.
Significant leak	>5,000 ppm (or 10% of the Lower Explosive Limit) when measured at the surface or A liquid petroleum (condensate/oil) loss	In the case of an emergency, DITT must be notified within 24 hours via the emergency response hotline number 1300 935 250. Notification must include the date of identification, nature and level of the leak, infrastructure name, number and location as	A significant leak is an unplanned release that does not occur during commissioning or bringing equipment back into service. These leaks should be corrected immediately as a part of commissioning.

Classification	Threshold	Notification	Comments
	of containment that exceeds 200 L or The leak is too large or not safe to measure. or A leak due to an unplanned release from a gathering system -subsurface pipeline that, at ground level; gives a sustained reading greater than 500 ppm (by volume) for a 15 second duration.	well as the initial actions to minimise the risk. The landowner or occupier of the property in which these leaks are occurring must be notified in the following circumstances: • if the leak cannot be repaired immediately; and • if the leak is likely to affect any of the landowner's or occupiers' facilities or activities. A written close-out report must be submitted within 5 business days of the remediation of the leak, specifying the date of identification, nature and level of leak, location and name of the operating plant, and the rectification actions taken. If finalising the remediation is delayed more than 7 business days from the identification of the leak an update must be submitted on that day. The final close out report shall be provided when all work is completed. Where environmental impacts have occurred Tamboran will notify DEPWS Petroleum Operations immediately: Onshoregas.depws@nt.gov.au.	

8.8 Monitoring, assurance and non-conformance management

In addition to regular monitoring as set out in this document, audits assessing compliance with this EMP, and associated work instruction will be undertaken by Tamboran during the execution of the activity. System deficiencies/non-compliances arising from activities will have corrective actions agreed and assigned to the relevant personnel and may be the subject of a formal non-conformance. These non-conformances or corrective actions shall be logged, and remedial actions identified and implemented. The status of corrective actions will be tracked through to closure and reported in the annual environmental report.

Audits assessing the implementation of the EMP commitments will be completed for each activity (

Table 60). The results will be included in the annual environmental report.

Table 60: EMP audit schedule

Audit Type	Scope of audit	Frequency	Responsibility
Operational assurance	Operational compliance checks to ensure risk management controls are implemented	Monthly	Tamboran HSE representative
Annual assurance	Compliance against EMP commitments and risk management controls	Annually	Tamboran HSE representative

8.9 Emergency response plan

An Emergency Response Plan (ERP) has been developed and supports all Tamboran's activities within the Beetaloo Sub-basin (Appendix N). The ERP provides the framework for managing emergencies (i.e. spills, bushfires, medical emergencies) to minimise the impacts to personnel health and safety, and the environment.

8.10 Reporting

Internal and government reporting on performance standards will be carried out by the Tamboran authorised representative, and distributed to Tamboran management and the DEPWS, in accordance with Section 35 of the Regulations. Quarterly and annual reports will be completed to summarise the compliance with this EMP, whether the environmental outcomes and performance standards in the plan were met and the details of any recordable and reportable incidents (Table 61).

Table 61: EMP reporting schedule

Frequency	Report detail	Recipient
Prior to the commencement of construction	A commencement of construction activity notification.	a) Minister for Environment (via DEPWS) b) Occupier of the land in which the activity is carried out c) Owner for the land for which the activity is to be carried out
Prior to the commencement of operation of the SPCF	A commencement of operation activity notification.	a) Minister for Environment (via DEPWS) b) Occupier of the land in which the activity is carried out c) Owner for the land for which the activity is to be carried out
Only if required	Incident report summarising reportable incidents.	DEPWS
Monthly	Monthly activity summary report.	DEPWS
Quarterly	Quarterly incident report summarising recordable incidents during the period (during operational activities) and groundwater monitoring data.	DEPWS

Frequency	Report detail	Recipient
Annually	An annual environment performance report will be prepared and submitted to the Minister covering the following: • Summary of the works completed under the EMP during the reporting period. • Summary of performance against measurement criteria. • A summary of environmental incidents that occurred during the year (i.e. reportable and recordable incidents that occurred). • Any environmental studies or research associated with the activity. • Technical improvements. • Consultation undertaken. • Annual weed management performance reporting. • Results of related research or of an ongoing monitoring program. • The relevant records outlined with section 8.11.	Tamboran management DEPWS

8.11 Record keeping

The following records will be retained within Tamboran's document management system for a period of five years:

- Records linked to measurement criteria, commitments and statutory reporting requirements.
- Induction records.
- Waste records.
- Hazardous goods manifests.
- Fuel usage.
- Weed inspections.
- Non-compliances and corrective action records.
- Internal audits and inspection records.
- Management of change records.

To the extent these documents are 'prescribed records' for the purpose of the Regulations, they will be kept for the longer of five years following the period during which the petroleum interest is in force and 15-years after the record comes into existence.

8.12 Management of change

A management of change process will be implemented to ensure any changes to the regulated activities described in this EMP are assessed and communicated to ensure no new or unintended environmental risks or impacts are introduced. This allows adaptive management and the ability to use appropriate technologies. This includes during HAZOP's, where the potential hazards are identified which may result due to deviation from the design intent.

It should be noted that changes can only be implemented where there is no new regulated activity, risk (including risk level) or impact is introduced. Where a new regulated activity, risk (including risk level) or impact is introduced, then a revision of the EMP is required under the Regulations.

Examples of changes in the location of the regulated activity that may need to be considered in the future, include, orientation of the SPCF, gathering lines, laydowns etc. For changes in location of the regulated activities listed in this EMP, the following processes will be completed:

- Stakeholder engagement.
- A land condition assessment for the new location, including ecological and heritage scouting.
- An AAPA certificate granted covering the new location.
- The relevant management plans outlined in Section 7 of this EMP will be updated as required.
- A Regulation 22 will be submitted to DEPWS to modify the EMP, where the change to the location of the regulated activity does not introduce a new or increased environmental risk or impact not provided for in the EMP.
- A Regulation 17 will be submitted to DEPWS to revise the EMP where the change to the location of the regulated activity has the potential to introduce a new or increased environmental risk or impact not provided for in the EMP.

8.13 EMP review

Implementation of this EMP will be continually monitored and revised as required based on monitoring and audit results, complaints, employee and stakeholder feedback, change to the proposed work program or a material increase in risk level.

A formal review, update and resubmission of this EMP will be undertaken every five years.

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10 Acronyms and Abbreviations

Acronym	Meaning
°C	degrees Celsius
%	percentage
AAPA	Aboriginal Areas Protection Authority
ABS	Australian Bureau of Statistics
AGP	Amadeus gas pipeline
AICS	Australian Inventory of Chemical Substances
ALA	Atlas of Living Australia
ALARP	as low as reasonably practicable
ANZECC	Australian and New Zealand Environment Conservation Council
API	American Petroleum Institute
APPEA	Australian Petroleum Production and Exploration Association
AS	Australian Standard
BMP	Bushfire Management Plan
BOM	Bureau of Meteorology
BPESC	Best Practice Erosion and Sediment Control
CAS	Chemical Abstracts Services number
CE, E, V, or NT	Critically Endangered, Endangered, Vulnerable and Near Threatened
CLA	Cambrian Limestone Aquifer
CO	carbon monoxide
Code	Code of Practice: Onshore Petroleum Activities in the Northern Territory
Cth	Commonwealth
CY	calendar year
dB	decibels
dBA	decibels A
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEPWS	Department of Environment, Parks and Water Security
DIPL	Department of Infrastructure, Planning and Logistics
DITT	Department of Industry, Trade and Tourism
DoH	Department of Health (NT)
EC	electrical conductivity
EIS	Environment Impact Statement
EMP	Environment Management Plan
EP	exploration permit (e.g. EP 76, EP 98 and EP 117)
EPA	Environment Protection Authority (NT)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* Commonwealth
ERP	Emergency Response Plan
ESC	erosion and sediment controls

Acronym	Meaning
ESCP	Erosion and Sediment Control Plan
FY	financial year
GDE	Groundwater Dependent Ecosystems
GHG	Greenhouse gas
GPS	Global Positioning Device
H_2S	hydrogen sulfide
ha	hectare
HFS	Hydraulic fracture stimulation
HSE	Health, Safety and Environment
HSEMPs	Health, Safety and Environmental Management Plans
HSEMS	Health, Safety and Environment Management System
IBA	Important Bird Area
IECA	International Erosion Control Association
ILUA	Indigenous Land Use Agreement
ISO	International Organisation for Standardisation
JV	Joint venture
km	kilometre
km^2	square kilometres
km/hr	kilometres per hour
kPag	gauge kilopascals
L_{Aeq}	Equivalent Continuous Sound Pressure Level
LOS	Level of Service
m	metre
Ma	millions of years ago
MD	measured depth
MEMP	Methane Emission Management Plan
ML	megalitre
Ml	Local magnitude
mm	millimetre
mMDRT	Meters measured depth below rotary table
MNES	Matters of National Environmental Significance
mTVDGL	metre True Vertical Depth below ground level
NATA	National Association of Testing Authorities
NEPM	National Environmental Protection Measure
NGERS	National Greenhouse and Energy Reporting Scheme
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NLC	Northern Land Council
NO_2	nitrogen dioxide

Acronym	Meaning
NO_x	oxides of nitrogen
NORMs	Naturally Occurring Radioactive Materials
NPI	National Pollutant Inventory
NT	Northern Territory
OHS	Occupational Health and Safety
ppm	parts per million
PER	Public Environment Report
$PM_{2.5}$	particulate matter with a diameter less than 2.5 micrometres
PM_{10}	particulate matter with a diameter less than 10 micrometres
RBL	rating background noise levels
RMP	Rehabilitation Management Plan
RWA	Restricted Work Area
SDS	Safety Data Sheet
Shenandoah S2	Shenandoah South 2 – well site
Shenandoah S B	Shenandoah South B – well site
Shenandoah S C	Shenandoah South C – well site
SMP	Spill Management Plan
SO_2	sulfur dioxide
SPCF	Sturt Plateau gas compression facility
SWL	Standing Water Level
tCO_2e	tonnes of carbon dioxide equivalent
TDS	Total Dissolved Solids
TIA	Traffic Impact Assessment
TJ/day	Terajoules per day
TMP	Traffic Management Plan
TO	Traditional owner
TVDSS	True Vertical Depth from Surface Sea level
TPWC Act	Territory Parks and Wildlife Conservation Act
TRH	Total Recoverable Hydrocarbons
TSS	Total Suspended Solids
VOCs	Volatile Organic Compounds
WBIV	Well barrier integrity verification
WEL	Water Extraction Licence
WIMP	Well Integrity Management Plan
WMP	Weed Management Plan
WOMP	Well Operations Management Plan
WoNS	Weed of National Significance
WWMP	Wastewater Management Plan