



Application for Licence Amendment

Part V Division 3 of the *Environmental Protection Act 1986*

Licence Number	L4467/1972/14
Licence Holder	Chevron Australia Pty Ltd
ACN	086 197 757
File Number	DER2013/000939-4
Premises	Barrow Island Oil and Gas Facility Crown Reserve 11648 BARROW ISLAND WA 6712
Date of Report	2 August 2022
Decision	Revised licence granted

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1. Decision summary

Licence L4467/1972/14 (existing licence) is held by Chevron Australia Pty Ltd (Chevron, licence holder) for the Barrow Island Oil and Gas Facility (the premises), located at Barrow Island, about 60 km off the coast of North West Australia. The Delegated Officer has determined to amend the licence to include establishment and operation of a biochar facility on the premises.

This Amendment Report documents the assessment of potential risks to the environment and public health from proposed changes to the emissions and discharges during the construction and operation of a pyrolysis plant on the premises. As a result of this assessment, Revised Licence L4467/1972/14 has been granted.

The revised licence issued as a result of this amendment supersedes the existing licence previously granted in relation to the premises.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this Amendment Report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its Regulatory Framework and relevant policy documents which are available at <https://dwer.wa.gov.au/regulatory-documents>.

2.2 Application summary

Chevron holds licence L4467/1972/14 for the Barrow Island Oil and Gas Facility located on Barrow Island, an A-Class Nature Reserve (Crown Reserve 11648). The licence authorises oil and gas production from wells and used tyre storage under categories 10 and 57 respectively of the *Environmental Protection Regulations 1987* (EP Regulations).

On 8 July 2021, Chevron submitted an application to the department to amend licence L4467/1972/14 under section 59 and 59B of the *Environmental Protection Act 1986* (EP Act). The following amendments are being sought:

- Establishment and operation of a package pyrolysis plant (biochar plant) within an existing cleared area on the premises to process cleared spinifex vegetation into biochar for use in rehabilitation activities.
- Inclusion of associated Category 37: Char manufacturing and Category 61A: Solid waste facility on the licence to authorise operation of the pyrolysis plant (Table 1).

No changes to existing licence conditions relating to Category 10 or Category 57 have been requested by the licence holder.

Table 1: Proposed category changes

Prescribed premises category and description	Assessed throughput or design capacity	Description of proposed amendment
Category 10: Oil or gas production from wells	310,886.5 tonnes per year	No change
Category 57: Used tyre storage	300 tyres	No change
Category 37: Char manufacturing	NA	Design capacity of 1,314 tpa of vegetation processed (based on a maximum input of 150kg/hr, 24/7 operation) Biochar production of up to 22 tonnes per year can be reached when operated 24/7 at design capacity.
Category 61A: Solid waste facility	NA	180,000 tonnes per annual period (predominantly spinifex grasses)

3. Background and premises overview

Barrow Island has been used for petroleum production since the 1960's. The Barrow Island Oil and Gas facility produces approximately 5,500 barrels of oil per day from around 450 oil production wells currently in operation on the island. Produced oil and water from the wells is separated with oil being stored prior to loading to ships for transport to market and produced formation water being reinjected back into the oil reservoir via disposal wells on the island.

Vegetation waste is produced on Barrow Island as a result of routine clearing, facility vegetation management, rehabilitation and other infrastructure maintenance activities occurring on the island associated with the operation of the Barrow Island Oil and Gas facility. Clearing is authorised under CPS123 granted under section 51E of the EP Act. The majority of cleared vegetation comprises spinifex grasses such as *Triodia spp* which does not readily compost and is therefore stockpiled. Vegetation stockpiles can smother undisturbed vegetation and present a fire risk. Chevron has estimated that approximately 6,000 m³ of cleared vegetation is currently stockpiled on the island.

Chevron proposes to establish a package pyrolysis plant within a previously cleared drill pad (F31A) that will be supplied and operated by Energy Farmers Australia Pty Ltd (Energy Farmers). The cleared drill pad (approximately 1,000 m²), is currently used for stockpiling of cleared vegetation. The pyrolysis plant will process cleared vegetation (predominantly spinifex) via pyrolysis (thermal decomposition of organic material in the absence of oxygen) converting it into biochar. The produced biochar will be used as an addition to topsoil blends for rehabilitation of areas on the island. Rehabilitation is undertaken in accordance with the *Prescription for the Rehabilitation of Disturbed Areas on Barrow Island* (Chevron Australia, 2020), which has been approved by the Department of Biodiversity, Conservation and Attractions.

Chevron advised the pyrolysis plant will comprise three sea containers and a water spray system (char quench).

- Container 1 will house a vegetation hopper, shredder and control cabinet.
- Container 2 will store shredded vegetation (nominal capacity of 60m³).
- Container 3 will house a pyrolysis kiln and have an external bagging station for biochar bagging and storage.
- The char quench is an automated water spray system sourcing water from a 1,000 L Intermediate Bulk Container (IBC).

The operation of the pyrolysis plant is described below based on details provided by Chevron in the application and is illustrated in Figure 1.

A telehandler will load vegetation into a hopper which delivers the vegetation to the shredder via a vertical chute (Container 1). The shredder will be capable of shredding up to 20 m³/hour of vegetation with the resultant shredded vegetation delivered via a covered auger into a conical shaped stockpile in the storage container (Container 2). A hydraulic activated push-floor will move the stockpile to the end of the container to feed the kiln.

Stockpiled vegetation will drop into a kiln feed auger which transfers the vegetation slowly towards, and into the kiln. The shredder will be paced to feed the kiln at intervals, with storage between shredding and entering the kiln, to allow continuous full-time operation of the kiln.

The pyrolysis kiln will have two zones;

- a trough where combustion will occur at a temperature generally in excess of 250°C, converting the vegetation into biochar; and
- a combustion chamber, located above the trough, where combustion of gases will occur prior to discharge via a stack (generally at a temperature in excess of 600°C).

Temperature within the two zones will be monitored by temperature probes connected to a Programmable Logic Controller (PLC) which will activate alarms and shut-down in the event set high and low operating temperatures are exceeded. A chamber quench and shutdown of feed will be automatically activated in the event the temperature of the combustion chamber exceeds a nominal 900°C. The pyrolysis kiln will have a small burner which automatically switches on during start-up and in the event of low temperature within the kiln feed auger (trough) or the combustion chamber. Emissions from the burner are also discharged via the stack.

Biochar will exit the kiln via the kiln feed auger and be sprayed with water by the automated char quench. The majority of the quench water will evaporate upon contact with the char. A discharge auger will feed the cooled biochar into bulk-bags at the bagging station which will have sufficient storage capacity for 24 hours of plant operation. Alternatively the biochar may be stored in storage containers or stockpiles if bulk-bags are unavailable.

Pyrolysis of vegetation at high temperatures such as those proposed for the pyrolysis plant, can result in the production of syngas and pyrolysis oil as waste products. Pyrolysis oil is produced as an intermediary product which is then thermally decomposed, therefore does not require disposal. Syngas is generated in the trough and vented into the combustion chamber. Chevron anticipates (based on the works of Laranci 2010) that the syngas will comprise approximately 21% methane, 29% carbon monoxide, 38% carbon dioxide, 7% hydrogen and 5% nitrogen. Due to the normal operating temperature of the combustion chamber being in excess of 600°C, Chevron expects the syngas will be combusted within the combustion chamber and will not require venting. Emission testing undertaken at Energy Farmers pilot scale pyrolysis plant recorded total organic compounds (as propane) (TOC) emissions of <0.3 g/min supporting this claim.

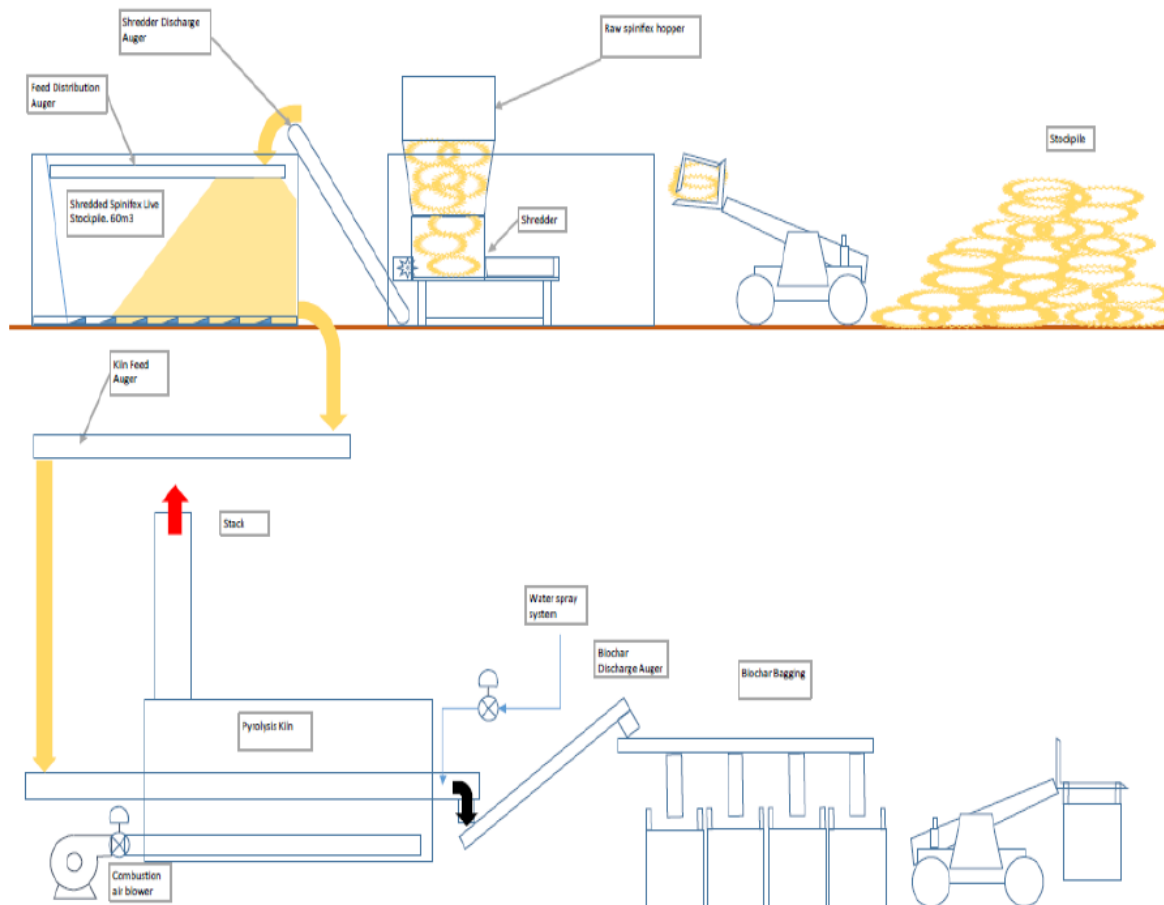


Figure 1 Process flow for the biochar facility (Chevron 2021) (combustion air blower has been removed)

4. Legislative context

4.1 Department of Mines, Industry Regulation and Safety

The Department of Mines, Industry Regulation and Safety (DMIRS) regulates onshore petroleum activities via administration of the *Petroleum and Geothermal Energy Resources Act 1967* (PGER Act), the *Petroleum and Geothermal Energy Resources (Environment) Regulations 2012* (PGER Regulations) and the *Petroleum (Submerged Lands) (Environment) Regulations 2012*. In accordance with this legislation, oil and gas operators must submit an Environment Plan (EP) to DMIRS for approval. An EP is a management document designed to demonstrate that all environmental risks and impacts associated with a petroleum activity are reduced to As Low As Reasonably Practicable, and at all times carried out in a manner consistent with the principles of ecologically sustainable development.

DMIRS approved the *Barrow Island Joint Venture Environment Plan (030240006, Revision 22.3)* on 16 September 2021. The plan is implemented by the licence holder in accordance with the above mentioned legislation, and includes the operation of the biochar facility.

5. Air quality impact assessment

The licence holder commissioned Ektimo to undertake an air quality impact assessment to determine the potential impact on air quality as a result of emissions to air from the pyrolysis plant (Ektimo 2021). Dispersion modelling was undertaken for the assessment using the CALPUFF modelling system, with recent representative meteorological data recorded on the island, to predict ground level concentrations (GLCs) for pollutants across the model domain.

The model scenario comprised a 150 kg/hr pyrolysis plant conservatively operating continuously 24 hours per day 365 days per year (actual operation may be for half the time however this is not guaranteed so full time operation was assessed) with emissions discharged from a 6.1 m high stack.

Emission rates adopted for the modelling were based on the results of two stack tests from a pilot scale pyrolysis plant in 2016. The plant was processing 100% spinifex vegetation feed, at an average spinifex feed rate of 37.5 kg/hr, at the time of testing. The recorded emission concentrations for the pilot plant were extrapolated for the proposed 150 kg/hr pyrolysis plant.

Model predictions were compared with relevant ambient air quality guideline values (AGVs) taken from the department's draft *Guideline: Air Emissions* (2019a). The AGVs specified in the draft Guideline are based on the advice from the WA Department of Health (DoH) and other published guidance or standards including the New South Wales Environmental Protection Authority (EPA) *Approved methods for the modelling and assessment of air pollutants in New South Wales* (EPA 2016) and the National Environment Protection Council (NEPC), *National Environment Protection (Ambient Air Quality) Measure 2016* (Ambient Air NEPM) and *National Environment Protection (Air Toxics) Measure 2011* (Air Toxics NEPM). The Ambient Air NEPM has been amended since the guideline was published therefore AGVs from the updated Ambient Air NEPM 2021 have been applied where appropriate (NO_x and SO₂).

A summary of the model results compared with relevant AGVs is included in Table 2. Ground level concentrations were predicted to be well within the relevant criteria pollutant and principle and individual toxic substance AGVs (<2%) at the nearest sensitive receptor and the boundary of the pyrolysis plant.

Table 2: Summary of ambient air quality model results for proposed Barrow Island pyrolysis plant (from Ektimo 2021)

Pollutant	Emission rate (g/min)	Average Period	Conc. Statistic	AGV ¹ (µg/m ³)	Max. GLC modelled at nearest sensitive receptor ² (µg/m ³)	% AGV	99.9 th percentile modelled at premises boundary (pyrolysis plant cleared area) ² (µg/m ³)	% AGV
TSP	17	24-hr	Max	82	0.7	0.8		
PM ₁₀	5.4	24-hr	Max	46	0.2	0.4		
		Annual	Ave	23	0.02	0.09		
PM _{2.5}	0.74	24-hr	Max	23	0.03	0.1		
		Annual	Ave	7	0.003	0.04		
CO	21	1-hour	Max	30,000	13	0.04		
		8-hour		10,000	2.5	0.03		
NO _x as NO ₂	3.4	1-hour	Max	150	2.1	1.4		
		Annual	Ave	28	0.01	0.04		
SO ₂	0.2	1-hour	Max	262	0.1	0.04		
		24-hr	Max	52	0.008	0.02		
Dioxin and Furans	2.3x10 ⁻⁸	1-hour	Max	2x10 ⁻⁶	1.4x10 ⁻⁸	0.7	3.4x10 ⁻⁸	1.7
Benzene	0.26	1-hour	Max	29	0.16	0.6	0.39	1.3
		Annual	Ave	9.6	0.0009	0.009	0.038	0.4
Toluene	0.010	24-hr	Max	3770	0.0004	0.000011	0.008	0.00021
		Annual	Ave	377	0.00004	0.000011	0.0015	0.0004

Note 1: Assessment criteria assume standard temperature and pressure of 25°C and 101.3kPa.

Note 2: As per the draft *Guideline: Air emissions* (DWER 2019), AGVs apply at the nearest sensitive receptor for criteria

pollutants and at the premises boundary for principle and individual toxic substances. The nearest sensitive receptor was taken to be the Western Australian Oil Base 2.5 km north northwest of the pyrolysis plant for the purposes of the assessment.

The department reviewed the applicant's air quality assessment (Ektimo 2021) and concluded that:

- the model was generally set up and configured appropriately however the modelling did not meet all requirements of the DWER *Air Quality Modelling Guidance Notes*;
- the licence holder's operations centre on Barrow Island was considered the nearest sensitive receptor for the purposes of comparing predicted GLCs with AGVs, however, as per the department's *Guideline: Risk assessments (2020)*, employees, visitors and contractors of the licence holder are excluded as sensitive receptors as other they are subject to requirements under other occupational health and safety regulations and obligations. The nearest public sensitive receptor is over 25 km away (Varanus Island Oil and gas facility);
- the meteorological input data used in the assessment were not validated and therefore not demonstrated to be suitable for use; and
- there was a discrepancy in terrain heights used for the model receptor grid and that used for the terrain height for the point source emissions which resulted in a threefold underestimation of GLCs near the source.

Despite the shortcomings in the assessment, it was considered adequate to inform the assessment of air quality impact. The pyrolysis plant emission rates are considered to be low and even with a threefold increase in GLCs, the potential for exceedance of the AGLs is still negligible, particularly given the distance to public receptors. Based on this, there is not considered to be any change in risk to air quality as a result of establishing the pyrolysis plant.

The air quality assessment did not include predicted GLCs for criteria pollutants (PM₁₀, PM_{2.5}, NO_x, CO and SO₂) at the boundary of the pyrolysis plant (not required by the draft *Guideline: Air emissions*). Given the known presence of threatened and priority fauna on Barrow Island, the Delegated Officer considered it relevant to consider GLCs for criteria pollutants at the boundary of the pyrolysis plant, to inform the assessment of risk of impact to fauna. In the absence of any specific air quality guidelines for fauna the Delegated Officer considers the AGVs an appropriate surrogate. The department's air quality experts re-ran Ektimo 2021's model, using Calpuff configuration and a consistent terrain height datum, to predict GLCs of criteria pollutants PM₁₀, PM_{2.5}, NO_x, CO and SO₂ at the pyrolysis plant boundary. All pollutants were predicted to be less than the relevant AGV (ranging between 23.5% (PM₁₀) and 0.3% (SO₂)).

6. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk assessments (DWER 2020)*.

To establish a Risk Event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

6.1 Source-pathways and receptors

6.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises operation which have been considered in this Amendment Report are detailed in Table 3 below. Table 3 also details the control measures the licence holder has proposed to assist in controlling these emissions, where necessary.

Emissions associated with establishment of the biochar facility on the premises are considered to be negligible given nature and scale of the construction activities and are therefore not included. Syngas and pyrolysis oil are also not included as emissions as they are not expected to be emitted based on the information provided by the licence holder (refer to section 3).

Table 3: Licence Holder controls

Emission	Sources	Potential pathways	Proposed controls
Fugitive dust	Transport and storage of cleared vegetation at the pyrolysis plant (predominantly spinifex)	Air/windborne pathway	Vehicles driving at the biochar location will be restricted to 10 km/hr speed limit to minimise wheel induced dust emissions.
Uncontrolled fire (vegetation loss and smoke/combustion emissions)	Ignition of vegetation stockpiles	Fire spread to surrounding vegetation	<p>Vegetation will be stockpiled in a 1,000 m² cleared area (F31A drill pad) in windrows separated from the pyrolysis plant to provide a fire break between potential ignition (plant) and a fuel source (vegetation).</p> <p>Vegetation will be stored in windrows and/or enclosed containers.</p>
Fugitive dust	Operation of the pyrolysis plant (vegetation shredding, storage of shredded vegetation and bagging)	Air/windborne pathway	<p>The vegetation shredder will be located inside an enclosed container and be fed by a partially enclosed hopper (open at the top and one side only for delivery of vegetation).</p> <p>Shredded vegetation will be transferred from the shredder into an enclosed storage container (via an enclosed auger) which is maintained under slight negative pressure to prevent dust being emitted.</p> <p>Dust from the storage container is captured by a cyclone and deposited into an enclosed auger which will transfer shredded vegetation into the pyrolysis kiln.</p> <p>The pyrolysis kiln will be located in an enclosed storage container.</p> <p>Produced char is quenched with water and transferred via an enclosed auger to a bagging area for bagging in 1 m³ bulk-bags to prevent dust being generated from the char. Storage containers and stockpiles may also be used if bulk-bags are unavailable.</p>
Combustion emissions TSP, PM ₁₀ , PM _{2.5} , CO, NO _x , SO ₂ ,	Operation of the pyrolysis plant (discharge of thermal decomposition		<p>The vegetation processed will primarily comprise cleared spinifex grassland genera such as <i>Triodia spp.</i></p> <p>The pyrolysis kiln will be located inside</p>

Emission	Sources	Potential pathways	Proposed controls
Dioxin and Furans, VOCs - Benzene, Toluene	emissions)		<p>an enclosed storage container and emissions from the kiln and burner will be discharged to air via a stack 6.1 m above the ground surface.</p> <p>The temperature zones in the pyrolysis kiln will be monitored by 8 thermocouples connected to a PLC to ensure it is operating in the optimal temperature range for pyrolysis (>250°C for the trough (kiln feed auger) and 600°C-900°C for the combustion chamber). The PLC will not start feed into the kiln until the temperature reaches 250°C and will automatically shutdown the process if temperature drops below 200°C</p> <p>An automated chamber quench and shutdown activates if a temperature of nominally >900°C is reached in the combustion chamber.</p> <p>In the event low temperatures are detected in the pyrolysis kiln (nominally 350°C in the trough or 750°C in the chamber) , a heating element (small burner) automatically switches on via the PLC.</p> <p>The kiln has been designed to draw air via natural convection which will ensure adequate combustion air flow.</p> <p>The pyrolysis kiln will operate continuously at a steady state to prevent emission spikes.</p> <p>The plant will be programmed with safety alarms to allow unmanned operation during the night including low and high temperature alarms and shut-down, zero feed shutdown based on low discharge temperature and a kiln alarm indicative of a blockage or other failure.</p> <p>The operating conditions and alarm points for the pyrolysis kiln will be reviewed during commissioning of the kiln. The normal operating temperatures and temperature for activation of the automated quench may be modified from those specified as part of commissioning and optimisation activities.</p>
Noise	Operation of the pyrolysis plant (loader operation,	Air/windborne pathway	Shredding and pyrolysis will be undertaken inside enclosed storage

Emission	Sources	Potential pathways	Proposed controls
	vegetation shredding, thermal decomposition)		containers.
Uncontrolled fire (vegetation loss and smoke/combustion emissions)	Fire ignition within the pyrolysis plant	Fire spread to surrounding vegetation	<p>The pyrolysis plant will be centrally located within a 1,000 m² cleared area to provide a fire break between potential ignition (plant) and a fuel source (cleared vegetation stockpiles and uncleared land).</p> <p>The pyrolysis kiln is located inside an enclosed storage container.</p> <p>The temperature zones in the pyrolysis kiln will be monitored. An automated chamber quench activates if a temperature >900°C is reached in the pyrolysis kiln combustion chamber.</p> <p>The pyrolysis kiln stack has a centrifugal type spark arrestor fitted to prevent fire ignition from the discharge.</p> <p>An automated char quench cools the biochar upon exiting the kiln to prevent overheating.</p>

6.1.2 Receptors

In accordance with the *Guideline: Risk assessments* (DWER 2020), the Delegated Officer has excluded employees, visitors and contractors of the licence holder from its assessment. Protection of these parties often involves different exposure risks and prevention strategies, and is provided for under other state legislation.

Table 4 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises (*Guideline: Environmental siting* (DWER 2020)).

Table 4: Sensitive human and environmental receptors and distance from prescribed activity

Human receptors	Distance from prescribed activity
Varanus Island Oil and gas facility (including workers accommodation camps)	26.5 km north-east
Residential premises (Onslow)	85 km south-west
Environmental receptors	Distance from prescribed activity
Managed Lands and Waters	The Barrow Island Oil and Gas facility is located within the Barrow Island Class A Nature Reserve (BINR). The BINR is a specified ecosystem supporting a diverse range of flora and fauna including threatened species and communities.
Threatened Ecological Communities and	The BINR is listed as a Priority Ecological

Priority Ecological Communities	Community. Smaller areas identified as Priority Ecological Communities are located on Barrow Island.
Threatened / priority flora	Three species of priority flora are located on Barrow Island.
Threatened / priority fauna (terrestrial and marine)	<p>A considerable number of threatened and priority fauna are known to occur on Barrow Island including a number species that are listed under the <i>Biodiversity Conservation Act 2016</i> (WA) (BC Act) and the Threatened (Vulnerable) Species list of the <i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cwth) (EPBC Act).</p> <p>Green and flatback turtles (both listed as vulnerable under the BC Act and EPBC Act) nest on Barrow Island. Flatback turtle rookies are recorded on the eastern coast of the island.</p>
Groundwater	<p>There is one shallow unconfined freshwater aquifer predominantly within Tertiary limestone on Barrow Island. This freshwater aquifer forms a lens of relatively fresher groundwater floating upon denser, saline ground water at depths between 9 m and 53 m. The aquifer supplies domestic water for oil and gas operations and supports subterranean.</p> <p>The groundwater system is linked to the marine ecosystem.</p>

6.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for those emission sources which are proposed to change and take into account potential source-pathway and receptor linkages as identified in Section 6.1. Where linkages are incomplete they have not been considered further in the risk assessment.

Where the licence holder has proposed mitigation measures/controls (as detailed in Section 6.1), these have been considered when determining the final risk rating. Where the Delegated Officer considers the licence holder's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the licence as regulatory controls.

Additional regulatory controls may be imposed where the licence holder's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 5.

Revised Licence L4467/1972/14 that accompanies this Amendment Report authorises emissions associated with the operation of the Premises inclusive of activities within the scope of the application i.e. storage of cleared vegetation and operation of a pyrolysis plant. The conditions in the Revised Licence have been determined in accordance with Guidance Statement: Setting Conditions (DER 2015).

The Delegated Officer has excluded construction related emissions as there is not expected to be a pathway for impacts to occur given the nature and scale of the construction activities, and the distance to the nearest sensitive human receptor (locations on the island are excluded as sensitive receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020) which establishes that employees, visitors and contractors of the licence holder are not considered sensitive receptors as protection of these parties is provided for under other state legislation). Construction will involve placement of infrastructure on the ground so will cause minimal dust

and noise emissions however there is not expected to be a pathway to the nearest receptor, the Varanus Island Oil and gas facility over 25 km from the pyrolysis plant. Noise emissions associated with operation of the pyrolysis plant are similarly not expected to be of sufficient magnitude to impact human receptors based on separation distance.

Table 5. Risk assessment of potential emissions and discharges from the Premises during operation

Risk events				Risk rating ¹ C = consequence L = likelihood	Licence Holder's controls sufficient (refer to Table 3)?	Conditions ^{2,3} of licence	Reasoning
Source/ Activities	Potential emission	Potential pathways and impact	Receptors				
Transport and storage of cleared vegetation at the pyrolysis plant (predominantly spinifex)	Fugitive dust	Air/windborne pathway causing smothering of native vegetation	Immediately surrounding vegetation within the BINR	C = Slight, minimal on site impact L = Possible, could occur at some time Low Risk	Y	NA	Given the scale of the proposed activities, and vegetation stockpiling being an activity already occurring on the island, the Delegated Officer does not reasonably foresee native vegetation in the area surrounding the pyrolysis plant being smothered by dust associated with the transport and storage of vegetation.
Ignition of vegetation stockpiles	Uncontrolled fire (vegetation loss and smoke/combustion emissions)	Fire spreads to surrounding area causing loss of biodiversity (native flora and fauna loss)	Immediately surrounding vegetation and threatened fauna within the BINR	C = Major, Short-term impact to an area of high conservation value or special significance L = Rare, may only occur in exceptional circumstances Medium Risk	N	Condition 1 and 2 Condition 3 and 4	The Delegated Officer considers the likelihood of a fire igniting within the stockpiles and spreading to surrounding vegetation to be rare, given the vegetation will primarily comprise spinifex which does not readily decompose (i.e. does not generate heat), and it will be stockpiled in a cleared area in windrows separated from the pyrolysis plant. The Delegated Officer considers the vegetation windrows should be separated from the surrounding vegetation, other stockpiles and the pyrolysis plant by a cleared buffer to mitigate the risk of fire spread in the unlikely event a fire does ignite. The Delegated Officer has therefore specified that the vegetation windrows must be separated from the pyrolysis plant, surrounding vegetation, and other stockpiles by a cleared area of at least 5 m. The Delegated Officer also included conditions restricting the amount of vegetation that can be stockpiled at the biochar facility to prevent buildup of excessively large stockpiles. The specified volume of 160,000 m ³ was determined based on the annual design capacity of the shredder, such that the stockpiled vegetation is no more than could be processed in a one year period.
Operation of the pyrolysis plant (vegetation shredding, thermal decomposition)	Noise	Air/windborne pathway causing disruption to fauna	Native fauna (including threatened fauna) within the BINR	C = Slight, minimal on site impact L = Possible, could occur at some time Low Risk	NA	NA	As the pyrolysis plant is of relatively small scale and is located in proximity to island roads and other licence holder activities which generate noise, the Delegated Officer considers there will be no increase to the risk of noise disrupting native fauna and no specific controls regarding noise emissions are required.
Operation of the pyrolysis plant (vegetation shredding, storage of shredded vegetation and bagging)	Fugitive dust	Air/windborne pathway causing smothering of native vegetation	Immediately surrounding vegetation within the BINR	C = Slight, minimal on site impact L = Possible, could occur at some time Low Risk	Y	Condition 1 and 2 Condition 3 and 4	Given vegetation shredding, and storage of shredded vegetation will occur within enclosed storage containers, and produced char will be quenched with water and bagged or stored in containers or stockpiles when exiting the plant, the Delegated Officer considers there will be minimal dust emitted from the pyrolysis plant. The delegated officer has specified containers and stockpiles must be enclosed or covered if used instead of bags to ensure minimal dust emissions. The licence holder's proposed controls relating to vegetation shredding, and quenching and bagging or container or stockpile storage of produced char, are considered critical to mitigating dust emissions therefore the Delegated Officer imposed these as controls in the licence.
Operation of the pyrolysis plant (discharge of thermal decomposition emissions)	Combustion emissions (NOx, SO2, CO, PM, VOCs – benzene and toluene, dioxins and furans) from the biochar facility	Air/windborne pathway causing health impacts to native fauna.	Native fauna (including threatened fauna) within the BINR	C = Minor, minimal offsite impacts at a local scale L = Rare, may only occur in exceptional circumstances Low Risk	N	Condition 1, 2 and 5 Condition 3 and 4 Conditions 6-9	The Delegated Officer considered the licence holder's air quality impact assessment outcomes and proposed air emission controls in determining the risk of combustion emissions from the pyrolysis plant impacting on the health of native fauna. The licence holder proposed appropriate controls to mitigate combustion emissions including: <ul style="list-style-type: none">– limiting feed to cleared native vegetation (primarily spinifex);– discharge of emissions via a 6.1m stack;– monitoring of temperature zones via a PLC to ensure the plant operates in the optimal temperature range for pyrolysis; and– alarms, shutdown and an automated quench in event of temperature exceeding the optimal range.

Risk events				Risk rating ¹ C = consequence L = likelihood	Licence Holder's controls sufficient (refer to Table 3)?	Conditions ^{2,3} of licence	Reasoning
Source/ Activities	Potential emission	Potential pathways and impact	Receptors				
							<p>As these controls are critical to mitigating the risk of combustion emissions impacting native fauna health, the Delegated Officer imposed them as conditions in the licence.</p> <p>Based on the pyrolysis plant emission rates being low, and the air quality impact assessment predicting pollutant GLCs to be well within relevant AGLs, the Delegated Officer does not reasonably foresee impact to fauna health occurring as a result of air emissions from the pyrolysis plant.</p> <p>As this assessment is based on predicted emission rates, based on stack testing of a pilot scale plant, the Delegated Officer considered it necessary to include a requirement for stack monitoring in accordance with relevant NATA requirements and internationally accepted monitoring methods, and submission of the monitoring results to the Department to confirm emissions are in line with predicted rates.</p>
Fire ignition within the pyrolysis plant	Uncontrolled fire (vegetation loss and smoke/combustion emissions)	Fire spreads to surrounding area causing loss of biodiversity (flora and fauna loss)	Immediately surrounding vegetation and threatened fauna within the BINR	<p>C = Major, Short-term impact to an area of high conservation value or special significance</p> <p>L = Rare, may only occur in exceptional circumstances</p> <p>Medium Risk</p>	Y	<p>Condition 1 and 2</p> <p>Condition 3 and 4</p>	<p>The Delegated Officer considers the licence holder has proposed appropriate controls to mitigate the risk of fire ignition within the pyrolysis plant and spread to surrounding area. These include:</p> <ul style="list-style-type: none"> - locating the plant within a suitably sized cleared area; - temperature monitoring of the kiln and quench activation in event of temperature exceeding 900°C; - a centrifugal type spark arrestor fitted to the stack; and - an automated char quench to cool the biochar. <p>The Delegated Officer specified implementation of these controls in the licence to mitigate the risk of an uncontrolled fire impacting the BINR.</p>

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk assessments* (DWER 2020).

Note 2: Proposed licence holder controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

Note 3: Conditions 3 and 4 are department imposed conditions required for compliance reporting

7. Consultation

Table 6 provides a summary of the consultation undertaken by the department.

Table 6: Consultation

Consultation method	Comments received	Department response
Local Government Authority advised of the proposal on 1 October 2021	No comments received	NA
Department of Mines, Industry Regulation and Safety (DMIRS) advised of the proposal on 1 October 2021	DMIRS replied on 14 October 2021 advising that the Barrow Island Joint Venture Environment Plan (030240006, Revision 22.3) was approved in accordance with the <i>Petroleum and Geothermal Energy Resources (Environment) Regulations 2012</i> and the <i>Petroleum (Submerged Lands) (Environment) Regulations 2012</i> by DMIRS on 16 September 2021 and that the approval includes the operation of the biochar facility on Barrow Island.	The Delegated Officer noted the comments.
Department of Biodiversity, Conservation and Attractions (DBCAs) advised of the proposal on 1 October 2021	DBCAs replied on 25 October advising that they did not have any specific comments on the application.	NA
Environs Kimberley advised of the proposal on 1 October 2021	No comments received	NA
Licence holder was provided with draft amendment on 19 May 2022	The licence holder responded to the draft documents on 13 June and 1 August 2022 with a number of requested changes and provision of requested information.	The delegated officer has addressed the response in Appendix 1

8. Decision

Based on the assessment in this amendment report the Delegated Officer has determined the proposal to establish and operate a pyrolysis plant on the premises to convert cleared vegetation to biochar for use in rehabilitation activities does not pose an unacceptable risk of impacts to receptors. Subject to the regulatory controls outlined in Table 5, the proposal is unlikely to result in a material change to the overall risk of the premise. This determination is based on the following:

- The pyrolysis plant will only process native vegetation produced from clearing activities on Barrow Island.
- Syngas and pyrolysis oil are not expected to be emitted from the pyrolysis plant.

- Air emissions from the pyrolysis plant are anticipated to be low, based on monitoring conducted on a pilot scale plant.
- Air emission modelling indicates the potential for exceedance of the AGLs at the boundary of biochar plant activities is low.

In order to minimise the potential for environmental impacts, the licence holder has proposed the following key controls which have been imposed on the licence as construction and operation conditions as they are considered critical to maintaining an acceptable level of risk:

- The pyrolysis plant and vegetation stockpiles for the plant feed will be established within an existing cleared area with separation between vegetation windrows and the plant to reduce the risk of uncontrolled fire.
- All shredding and pyrolysis will occur within enclosed sea containers.
- Temperature will be monitored within the kiln feed auger and combustion zone of the pyrolysis plant to ensure optimal combustion temperature is maintained.
- The pyrolysis plant will include a water quench which will be activated in the event of high temperatures and will also quench the produced biochar to reduce fire and dust emission risk.
- The pyrolysis plant will be constructed with a spark arrestor

Category 37: char manufacturing has been included on the licence in the Revised Licence and conditions have been included to authorise the construction and operation of the pyrolysis plant, and to authorise the discharge of emissions to air from the plant. The Delegated Officer also included a requirement to conduct one off stack monitoring of emissions from the pyrolysis plant to confirm that emissions are comparable to those considered in the assessment. Should emissions significantly differ from those assessed, the Department may review the appropriateness and adequacy of air emission controls, and following such a review, may initiate amendments to the licence under the EP Act. Conditions included in the amended licence have been determined in accordance with the *Guidance Statement: Setting Conditions* (DER 2015).

The Delegated Officer determined not to include category 61A: Solid waste facility on the Revised Licence as the category relates to reprocessing of solid waste produced on other premises. The L4467/1972/14 premises boundary encompasses the majority of Barrow Island (with some smaller areas excised for the Gorgon JV), therefore cleared vegetation feed for the plant will be sourced primarily from within the premises boundary. The Delegated Officer noted that the pyrolysis plant may receive some vegetation from locations on Barrow Island which are outside the premises boundary (such as from the Gorgon JV tenure) however considered that the storage of cleared vegetation as feed for the pyrolysis plant is considered part of category 37: char manufacturing and is therefore regulated as part of this activity.

Table 7 below provides a summary of all amendments incorporated into the Revised Licence and will act as a record of implemented changes.

Table 7: Summary of licence amendments

Condition no.	Amendments
Cover page	Categories 37 has been added to the licence with an assessed production capacity of 1,314 tonnes per year.
Condition 1 Table 1	Operational requirements added for the Pyrolysis Plant and the Cleared vegetation storage area. Location column added to the table and locations added for existing infrastructure with reference to the premises maps.
Condition 2 Table 2	New condition added to specify design and construction/installation requirements for the Pyrolysis Plant.
Conditions 3 and 4	New conditions added to specify requirement to submit an Environmental

Condition no.	Amendments
	Compliance Report for the authorised works.
Conditions 5-9	Conditions added to authorise emissions to air from the Pyrolysis Plant and require monitoring of the emission point following its installation and initial operation
Conditions 10-16	Condition numbers updated (previously numbered conditions 2-8)
Condition 13	Updated to include requirement to maintain records relating to works undertaken under the licence and the monitoring of air emissions from the pyrolysis plant.
Table 7 Definitions	Updated table number (from 1) Included definitions for AS 4323.1, m AGL, operation, STP, dry, TEQ, USEPA, and USEPA Methods 2, 5, 6C, 7E, 10, 17, 18 and 23, VOCs
Schedule 1	Figure numbers included for existing maps and Figure 5 showing the location for the Pyrolysis Plant added.

9. Conclusion

Based on the assessment in this Amendment Report, the Delegated Officer has determined that a Revised Licence will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

References

1. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2019, *Draft Guideline: Air emissions*, Perth, Western Australia.
3. Department of Water and Environmental Regulation (DWER) 2020a, *Guideline: Environmental Siting*, Perth, Western Australia.
4. DWER 2020b, *Guideline: Risk Assessments*, Perth, Western Australia.
5. Chevron 2021a, *L4467/1972/14 Amendment Application and Attachments*, Perth, Western Australia.
6. Chevron 2021b, *WA Oil L4467 – Biochar Facility Draft Licence Amendment Response to the Department of Water and Environmental Regulation*, Perth, Western Australia
7. Ektimo 2021, *Air Quality Assessment of Various Emissions to Air from a Proposed Biochar Production Plant Barrow Island, WA*, Perth, Western Australia.
8. National Environmental Protection Council 2021, *National Environment Protection (Ambient Air Quality) Measure*, Canberra, Australian Capital Territory.

Appendix 1: Summary of licence holder's comments on risk assessment and draft conditions

Condition	Summary of licence holder's comment	Department's response
Cover page	Requested Category 61A be included on the amended licence as the pyrolysis plant may receive vegetation from other areas of Barrow Island which are not part of the Barrow Island Oil and Gas Facility (i.e. from the Gorgon Gas plant tenure).	As per section 8, the Delegated Officer determined it was not necessary to include category 61A: solid waste facility as vegetation feed for the plant will primarily be sourced from within the premises boundary (although may receive some vegetation from other locations on Barrow Island such as from the Gorgon JV tenure), and the storage of cleared vegetation as feed for the pyrolysis plant is considered part of the category 37: char manufacturing activity.
Condition 1 Table 1 and Schedule 1	Requested update of some of the premises maps to remove the northern tyre storage location at WAPET landing which is not a WA Oil facility and to remove the WWTP at Production Camp as it is no longer in operation.	References to the infrastructure requested were removed from the amended licence and updates maps provided by the licence holder were included.
Condition 1 Table 1 Pyrolysis Plant	Requested the requirement for material transfers via enclosed augers to be made clearer.	Condition wording amended to ensure requirements are clear.
	Requested wording of requirement for shredded vegetation to be stored in Container 2 be amended to specify that it applies to shredded vegetation from container 1. This is to allow for vegetation which has already been mulched prior to being delivered to the pyrolysis plant to be stored in the vegetation storage area. Some vegetation may be shredded/mulched prior to being delivered to the pyrolysis plant to reduce storage and transport requirements.	The condition wording has been changed to specify that vegetation which has been shredded through Container 1 must be stored in Container 2. The vegetation storage conditions do not prevent storage of mulched vegetation.
	Requested requirement for produced char to be stored in bulka bags be broadened to include other suitable storage such as use of half heights or stockpiles as bulka bags may not always be available.	Bulka bags provide a means of completely containing the produced char to prevent dust emissions and are described as one of the licence holder's fugitive dust controls in Table 3. Containers such as half heights and stockpiles could be partially or completely open and therefore do not provide the same level of dust emission control as bulka bags. The delegated officer considered it appropriate to broaden the description of produced char storage requirements so there is some flexibility in storage which may be used but specified enclosed or covered containers and covered stockpiles to ensure there was no increase to the assessed dust risk.

Condition	Summary of licence holder's comment	Department's response
Condition 1 Table 1 and Condition 2 Table 2	Advised the pyrolysis plant would be connected to existing power supply and therefore would not require diesel generators, and that conditions and references to the diesel generators be removed from the instrument and report.	References and requirements relating to the diesel generators were removed from the instrument and this report.
Condition 1 Table 1	<p>Requested vegetation be able to be stored in enclosed containers, as mulched vegetation may be transported and stored within half-heights.</p> <p>Requested the storage volume for feed vegetation be increased from 80,000 m³ to 160,000 m³ to provide sufficient storage space for one year's feed for the plant.</p> <p>Requested the requirement to separate vegetation windrows from other vegetation windrows by 5 m be removed as there is no environmental benefit to setting a distance between storage windrows.</p>	<p>Vegetation storage requirements were amended to allow for storage in stockpiles or enclosed or covered containers.</p> <p>Vegetation storage volume was based on the annual capacity of the vegetation shredder when operating on a two week on, two week off basis as was described in the application. As the licence holder wishes to retain the ability to operate the plant full time if needed, and the assessed production capacity of the plant is based on full time operation, references to part time operation were amended to indicate this was optional and the vegetation storage volume was increased as the delegated officer did not consider the change would alter the assessed risk profile.</p> <p>As per Table 5, the requirement to separate vegetation windrows by 5 m was included by the Delegated Officer to mitigate the risk of fire spread between windrows, if a fire were to ignite in one. The requirement was therefore retained.</p>
Condition 2 Table 2 and Condition 5 Table 3	Requested the stack height be revised from 5.1 m to 6.1 m	The delegated officer amended references to the stack height as increased stack heights generally aid in plume dispersion, therefore the change is not expected to increase the assessed risk of air emission impacts. Stack height in the licence is referred to as >5 m to provide some flexibility while not increasing the risk.
Condition 3	<p>Requested a definition for constructed or installed be included in the definitions table as, <i>constructed or installed: from initial operation of the plant. The date at which normal operations commence (post construction and commissioning).</i></p> <p>Requested the timeframe for the Environmental Compliance Report (ECR) submission be increased from 28 days to 60/90 days as delays may occur due to the remote location of the premises, COVID impacts and vendor availability to provide infrastructure certification.</p>	<p>The requested definition is not suitable to include in the licence as it does not align with the department's interpretation of constructed or installed. Constructed or installed refers to all of the infrastructure specified having been constructed or installed on the premises.</p> <p>The licence does not include any reference to commissioning as any operation with feed is considered to be operation of the infrastructure, which must comply with the requirements specified in condition 1.</p> <p>It is not intended that performance testing which does not involve emissions (such as electrical testing of components) is prevented from occurring until submission of the ECR. The wording relating to commencement of the pyrolysis plant operation in condition 1 has therefore been altered from "must not be operated" to "must not commence operation" with a definition included for operation for clarity and to ensure performance testing and maintenance which does not result in emissions is able to occur prior to the ECR submission.</p>

Condition	Summary of licence holder's comment	Department's response
		<p>The timeframe for ECR submission has been amended to 60 days however the licence holder should be aware that condition 1 relating to the pyrolysis plant, only authorises operation of the plant to commence following submission of the ECR in accordance with condition 3(b). (performance testing which does not generate emissions is considered part of the construction/installation phase).</p>
Condition 4	<p>Requested clarification whether a certification report from the pyrolysis plant vendor would meet the requirements of part a of the condition.</p>	<p>The ECR must include certification whether the specified requirements of condition 2 have been met. The department does not specify what form the certification must take and it is up to the licence holder to determine what form the certification takes.</p>
Condition 6 Table 4	<p>Requested clarification whether VOC monitoring only included benzene and toluene or was for all VOCs and whether total suspended solids should be total suspended particulates as the former is usually used for water analysis.</p> <p>Requested requirements for PM₁₀ monitoring in accordance with USEPA Methods and NATA accreditation be changed to AS 3580.9.8 TEOM monitoring.</p>	<p>Total suspended solids was an error in the draft instrument and has been amended to total particulate matter in line with US EPA Method 5.</p> <p>VOC monitoring refers to VOC sampling with speciated analysis for Benzene and Toluene component as was undertaken for the sampling of the pilot plant undertaken by Ektimo, and in accordance with US Method 18 which summarises the method as "<i>the major organic components of a gas mixture are separated by gas chromatography (GC) and individually quantified</i>" by one of several listed detection principles.</p> <p>The monitoring specified in Table 4 is point in time, stack testing. AS 3580.9.8 TEOM monitoring is not suitable for this purpose as it is ambient air monitoring. The condition requires the licence holder to engage a NATA accredited stack tester to undertake monitoring of emissions from the stack in accordance with the specified methodology. The monitoring is required to verify emissions from the stack are not significantly different to modelled emissions.</p>
Amendment report - general	<p>Licence holder provided information and clarifications requested relating to temperature controls, alarms, shut-down and feed management.</p>	<p>The provided information was incorporated into the amended licence and amendment report.</p>