



Application for Licence Amendment

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

Licence Number	L6131/1990/13
Licence Holder	Pilbara Manganese Pty Ltd
ACN	074 106 577
File Number	DER2013/001337-1~6
Premises	Woodie Woodie Manganese Project Mining tenements: G45/332, G45/333, G45/334, G45/335, G45/336, G45/37-40, G46/4-5, L46/29, M45/107, M45/429-433, M45/517, M45/600-602, M45/637-641, M45/1218, M46/92-93, M46/108, M46/137, M46/150, M46/161-162, M46/383, M46/384, G45/279-284 MARBLE BAR WA 6760
Date of Report	05/09/2024
Decision	Revised licence granted

Table of Contents

Decision summary	1
Scope of assessment.....	1
Regulatory framework.....	1
Amendment summary.....	1
Reverse Osmosis Plant.....	2
Groundwater Quality from H2 bore	2
Reverse Osmosis specifications	2
WWTP Water Quality	3
Blended Predicted Product.....	4
Monitoring of nutrient loading to land.....	4
Bells West Landfill Facility.....	4
Consolidation of Licence	5
Risk assessment	6
Source-pathways and receptors.....	6
Emissions and controls.....	6
Receptors.....	7
Risk ratings.....	10
Detailed risk assessment for nutrients and RO reject effluent discharge.	13
Description on emission risk event	13
Potential impacts	13
Criteria of assessment.....	13
Assessment.....	14
Proposed controls.....	14
Consequence and likelihood of risk	15
Overall risk rating.....	15
Regulatory controls.....	15
Consultation	16
Conclusion.....	16
Summary of amendments	16
References.....	17
Table 1: Proposed throughput capacity changes.....	1
Table 2: H2 Bore Groundwater Quality Monitoring.....	2
Table 3: Reverse Osmosis Plant Design Specifications	3
Table 4:WWTP monitoring results	3

Table 5: Predicted Blended Effluent	4
Table 6: L2a and L2b Total Nitrogen and Total Phosphorous annual loads.	4
Table 7: Licences consolidated in this amendment	5
Table 8: Licence Holder controls	6
Table 9: Sensitive human and environmental receptors and distance from prescribed activity .	7
Table 10. Risk assessment of potential emissions and discharges from the Premises during operation.....	11
Table 11: Consultation	16
Table 12: Summary of licence amendments	16
Figure 1: Distance to sensitive receptors.....	9
Figure 2: Relationship between SAR and EC of irrigation water for prediction of soil structural stability. Note that 1 dS/m = 1,000 μ S/cm	14

Decision summary

Licence L6131/1990/13 is held by Pilbara Manganese Pty Ltd (licence holder) for the Woodie Woodie Mine Site (the Premises), located 400km southeast of Port Hedland in the east Pilbara region of Western Australia.

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 operation of the Premises. As a result of this assessment, Revised Licence L6131/1990/13 has been granted.

The Revised Licence issued as a result of this amendment consolidates and supersedes the existing Licence previously granted in relation to the Premises. The Revised Licence has been granted in a new format with existing conditions being transferred, but not reassessed, to the new format.

Scope of assessment

Regulatory framework

In completing the assessment documented in this Amendment Report, the department 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>.

Amendment summary

On 9 April 2024, the licence holder submitted an application to the department to amend Licence L6131/1990/13 under section 59 and 59B of the *Environmental Protection Act 1986* (EP Act). The following amendments are being sought:

- Raise the capacity on daily treated wastewater effluent to 300 m³ per day, an increase of 150 m³, to enable the treatment of reject water from the Reverse Osmosis plant. The increased volume of treat wastewater will continue to be discharged to the 3 ha irrigation field via emission point L2; and
- Amend condition 9 (previously 1.3.7) to allow for the disposal of conveyor belt waste into the Bells West Landfill Facility.

This amendment is limited only to changes to Category 54 and 89 activities from the Existing Licence. No changes to the aspects of the existing Licence relating to Category 5, 6 and 73 have been requested by the Licence Holder.

Table 1 below outlines the proposed changes to the existing Licence.

Table 1: Proposed throughput capacity changes

Category	Current production capacity	Proposed production capacity
54	150 cubic metres per day	Increase maximum daily treated wastewater effluent volume to 300 cubic metres
89	1,950 tonnes per annual period	No change in production

Reverse Osmosis Plant

The licence holder intends to install and operate a Reverse Osmosis (RO) plant to treat groundwater for potable use at Woodie Woodie. Reject water from the Reverse Osmosis plant will be discharged to the WWTP effluent holding tank, which will subsequently be discharged through licenced emission point L2 to their spray field which is 3 ha in size. Irrigation alter between L2a and L2b across the spray field and is depicted in Figure 6 of licence L6131/1990/13. The licence holder requests that the authorised treatment capacity be doubled from 150 m³/day to 300 m³/day. The expected reject water volume is 126 m³/day.

This facility will be situated within the accommodation camp, which is part of an existing fenced area. The RO plant will utilise groundwater drawn from the H2 production bore (ELWB002), transported to the plant via an overland pipeline. Within the plant, groundwater will undergo purification through membrane filtration to eliminate minerals, producing clean potable water for direct use in the camp and office facilities. The reject water from the RO process will be directed to the WWTP effluent holding tank.

Groundwater Quality from H2 bore

The quality of groundwater at the H2 bore has been regularly monitored in accordance with the Groundwater Operating Strategy for groundwater licence GWL 65080. Summarised in Table 1Table 2, the results indicate fresh groundwater (1.199 – 1.269 mS/cm), with a neutral pH (6.95 – 7.25) and slightly elevated total hardness (330 mg/L). All raw groundwater parameters comply with the Australian Drinking Water Guidelines (2011) and site target values, affirming its suitability for potable use.

Table 2: H2 Bore Groundwater Quality Monitoring

Parameter	Unit	ADWG (2011)	9/02/2022	19/01/2023	11/01/2024
Total Dissolved Solids	mg/L	<600	690	510	700
Total Hardness	mg/L	200	320	330	330
Total Alkalinity	mg/L	-	290	350	360
Sodium	mg/L	180	130	130	130
Potassium	mg/L	-	6.6	6.8	6.5
Calcium	mg/L	-	51	52	53
Magnesium	mg/L	-	46	48	47
Chloride	mg/L	250	160	160	160
Sulphate	mg/L	250	99	100	85
Bicarbonate	mg/L	-	290	350	360
Carbonate	mg/L	-	< 5	<5.0	<5.0
Nitrate	mg/L	50	1.8	0.65	1.6
Ammonia	mg/L	-	<0.005	<0.007	<0.005
Iron	mg/L	-	<0.01	<0.02	<0.02
Manganese	mg/L	0.5	<0.005	<0.01	<0.01

Water is treated via chlorination in bulk tanks and pumped to the accommodation village ensuite bathrooms, mess facilities, general-use bathrooms, garden reticulation systems, and the Woodie Woodie mine offices, which are located about 700 m southwest of the accommodation village.

Reverse Osmosis specifications

The proposed RO plant will adhere to the specifications outlined in Table 3. Based on manufacturer specifications, it is estimated that the plant will process 626 m³ of raw groundwater daily, yielding 126 m³ of reject water. This reject water will be channelled to the WWTP effluent

holding tank and subsequently discharged via license emission point L2 to the irrigation spray field.

The annual volume of permeate water produced is about 182,500 kl, based on the proposed output of 500 m³ per day, 365 days per year. This is less than the production capacity for category 85B under Schedule 1 of the *EP Regulations 1987*, and therefore is not required to be added as a new category on the licence. The treatment and disposal of the reject water will be assessed and managed under the existing category 54 (sewage facility) given the reject water will be mixed with the WWTP effluent prior to discharge and considered as one emission.

Table 3: Reverse Osmosis Plant Design Specifications

Parameter	Unit	Values
Design inflow (Raw water)	m ³ /day	626
Design product flow (Permeate)	m ³ /day	500
Permeate recovery	%	75
Freed Water Temperature		25
Raw Water pH	pH Units	8.1
Raw Water TDS	mg/l	1,088
Permeate Water TDS	mg/l	278
Permeate Water pH	pH Units	7.54
Reject water TDS	mg/l	4276.99
Reject Water pH	mg/l	8.64
Reject Water EC	µS/cm	5854
Expected Reject Water Volume	m ³ /day	126

The reject water from the RO plant is considered brine due to the high total dissolved solids (TDS) concentration. This brine water will blend with the WWTP effluent before discharge from L2, ensuring that total nitrogen and total phosphorus loadings do not surpass 480 kg/ha and 120 kg/ha per annum, as stipulated in Condition 20 of L6131/1990/13. To maintain compliance and facilitate discharge activities as per licence requirements, the licence holder proposes to amend L6131/1990/13 (Condition 9) by increasing the daily sewage discharge limit to 300 m³, an increase of 150 m³ per day. This adjustment aims to prevent non-compliance breaches and ensure adherence to L6131 stipulations.

WWTP Water Quality

The licence holder proposes to continue monitoring WWTP effluent per condition 26 of the licence. Water samples will continue to be collected and preserved following the guidelines outlined in AS/NZS 5667.1 and wastewater sampling procedures will adhere to AS/NZS 5667.10. Table 4 below indicates recent monitoring results for the WWTP.

Table 4: WWTP monitoring results

Parameter	22/23				21/22			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
pH	7.67	7.7	7.65	8.01	8.1	7.76	7.28	7.34
BOD (mg/L)	6	<5	17	N/A	<5	6	<5	7
TSS (mg/L)	<5	<5	40	<10	<5	16	<5	9
TN (mg/L)	7.2	7.4	11	11	7.2	12	8.8	9.8
TP (mg/L)	2.4	4	6	6.9	4.6	4	4.6	4.3
E.coli (10 cfu/100mL)	72000	<10	<10	N/A	<10	<10	<10	<10

Blended Predicted Product

Using the data along with the recorded raw groundwater quality from the H2 bore, the licence holder calculated the predicted water quality for the reject water, as detailed in Table 5. Additionally, Table 5 summarises the predicted water quality for the blended product. This calculation was based on the predicted reject water quality and a sample of the WWTP effluent collected on August 4, 2024.

Table 5: Predicted Blended Effluent

Ion	Unit	Reject Water (Predicted)	WWTP Effluent 4/08/2024	Blended Product Predicted
Hardness, as CaCO ₃	mg/L	1308.95	110	700.11
Calcium	mg/L	208.37	21	113.2
Magnesium	mg/L	188.32	14	99.8
Sodium	mg/L	504.33	98	298
Potassium	mg/L	25.63	9.1	17.2
Ammonium	mg/L	-	21	-
Carbonate	mg/L	93.14	<5	48.4
Bicarbonate	mg/L	1246.8	260	745.7
Sulphate	mg/L	378.27	26	199.4
Chloride	mg/L	632.69	82	353.04
Nitrate	mg/L	4.88	0.085	2.45
Phosphate	mg/L	-	6.1	-
Hydroxide	mg/L	-	<5	-
Ammonia	mg/L	0.006	21	10.67
Total Dissolved Solids	mg/L	2486.96	400	1427.18
Electrical Conductivity	uS/cm	5600	900	3213.28

Monitoring of nutrient loading to land

Wastewater is discharged to the irrigation field following treatment at the camp wastewater treatment plant. During monitoring events, treated wastewater is discharged to either the southern (L2A) or northern (L2B) area of the irrigation field. Load of Total Nitrogen (TN) and Total Phosphorus (TP) for the reporting period is reported to the Department as part of the Annual Environmental Report requirements. Annual loads are summaries in Table 6 below.

Table 6: L2a and L2b Total Nitrogen and Total Phosphorous annual loads.

Annual Period	2022/2023	2021/2022	2020/2021
Total N (480 Kg/ha/yr limit ¹)	36.6	20.9	26.9
Total P (120 kg/ha/yr limit ¹)	19.3	9.7	10.04

Note 1: Water Quality Protection Note 22, Irrigation with nutrient-rich wastewater (DoW, 2008) – Risk Category D

Bells West Landfill Facility

The licence holder intends to manage the disposal of conveyor belt waste generated on-site by utilising the existing Bells West Pit facility. Presently, this facility holds a license exclusively for Inert Waste Type 2 (Tyres), while conveyor belt waste is typically handled at the Greensnake Tyre Disposal Facility. However, the Greensnake Tyre Disposal Facility has reached full capacity and ceased operations. An amendment to the licence is sought to allow for the on-site disposal of conveyor belt waste. This proposal does not involve any additional infrastructure or

change to production capacities; instead, the licence holder intends to use the existing facilities. Operations at the Bells West Pit landfill will remain in compliance with the stipulations of L6131/1990/13.

Consolidation of Licence

As part of this amendment package the department has consolidated the licence by incorporating changes made under the Amendment Notices as summarised in Table 7.

Table 7: Licences consolidated in this amendment

Instrument	Issued	Summary of approval
L6131/1990/13	01/10/2013	Licence granted
	31/03/2017	<u>Amendment Notice 2</u> Include the Homestead In-Pit tailing storage and its groundwater monitoring bores that were approved via works approval W5821/2015/1. Additional parameters for mine dewatering discharge were added and ambient surface water quality respectively have been updated to include chloride, sulfate, sodium, potassium, cobalt, iron, nickel, selenium, mercury, chromium(VI) and total chromium to fully assess the potential impacts of discharging dewatering effluent to rivers near the mine site.
	01/11/2017	<u>Amendment Notice 3</u> <ul style="list-style-type: none"> • Change in treatment methods for the licensed WWTP; and • To allow dewatering water from Hunter pit to be discharged into Cracker Sedimentation Pond, prior to discharge to Muddauthera Creek.
	02/05/2018	<u>Amendment Notice 4</u> <ul style="list-style-type: none"> • Construction and operation of a new bioremediation area on top of the Greensnake Western Waste Dump; and Disposal of waste tyres within the Chutney/Vespa Waste Dump. • An increase to the approved throughput for Category 89 from 1,650 tonnes per annum (tpa) to 1,950 tpa.
	30/01/2019	<u>Amendment Notice 5</u> <ul style="list-style-type: none"> • Dispose waste tyres within the Paystar Waste Dump; • Dispose waste tyres within the Bells West Pit; • Extend the Greensnake Landfill footprint; • Dispose dewatering discharge from Extension Cord pit into Paystar pit; and Dispose dewatering discharge from Topvar Pit into Cracker (W1) sedimentation pond, which discharges to Muddauthera Creek.
	29/04/2016	Notice of amendment and schedule of licences with amended expiry dates
	29/07/2020	DWER initiated amendment to consolidate/ amalgamate separately issued Licence amendment notices in the main Licence.

The obligations of the licence holder have not changed in consolidating the licence. The department has not undertaken any additional risk assessment of the Premises related to previous Amendment Notices. In consolidating the licence, the CEO has:

- updated the format and appearance of the Licence;
- revised licence condition's numbers, and removed any redundant conditions and realigned condition numbers for numerical consistency; and
- corrected clerical mistakes and unintentional errors.

The full consolidation of licence conditions as they relate to this Revised Licence are detailed in the Summary of amendments.

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.

Source-pathways and receptors

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 7 below. Table 8 also details the proposed control measures the Licence Holder has proposed to assist in controlling these emissions, where necessary.

Table 8: Licence Holder controls

Emission	Sources	Potential pathways	Proposed controls
Increased volume of WWTP effluent, with potential increase in salt concentration	Irrigation of WWTP effluent blended with Reverse Osmosis plant reject water	Direct discharge to land at the irrigation spray field Infiltration Overland runoff	The irrigation of treated wastewater will continue to be managed in accordance with the Part V Licence L6131/1990/13, including: <ul style="list-style-type: none"> All irrigation generated run-off, spray drift and/or discharge occurs within the irrigation area through the licenced discharge point (L2). Effluent discharge volumes will be continuously monitored via a flow meter. Treated effluent will be evenly distributed over the irrigation area Water quality monitoring will be undertaken on a quarterly basis for the following parameters: <ul style="list-style-type: none"> pH, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Total Nitrogen, Total Phosphorus, <i>E.coli</i>. Routine inspections and observations of the irrigation area will be undertaken. The irrigation of effluent will be managed to prevent soil erosion and waterlogging. Vegetation cover over the irrigation area will be maintained. Design of the spray field- each area is fed by its own separate line, fenced off by a star picket ring lock fence with appropriate signage to keep unauthorised staff out.

Emission	Sources	Potential pathways	Proposed controls
			<ul style="list-style-type: none"> Two emission points will be rotated to ensure that water logging, water pooling or runoff does not occur.
Inert waste II	Conveyor belt	Burial of waste	<p>The Bells West Pit landfill facility will continue to be managed in accordance with the Part V Licence L6131/1990/13, including:</p> <ul style="list-style-type: none"> Tyres shall consist of batches of no more than 1,000 tyres or 40 m³ of tyre pieces, Batches will be separated from each other by at least 100 mm of soil, Conveyor belts will be batched in volumes of 40 m³ or less with batches separated by 100 mm or more of soil, The disposal site of tyres and conveyor belts will be recorded and surveyed, A minimum of 500 mm of cover material will be applied as soon as practicable after the final waste level has been achieved.

Receptors

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

Table 9 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 9: Sensitive human and environmental receptors and distance from prescribed activity

Environmental receptors	Distance from prescribed activity
Groundwater	<p>Prescribed premises is located within the Pilbara groundwater allocation plan area. Depth to groundwater was measured at monitoring bore ESWB06 which indicates water levels are approximately 89 m below ground level. Homestead Pit Monitoring bores are the closest groundwater monitoring bores to the spray field. In the 2023 reporting period monitoring bore HTPSFMB01 recorded a standing water level of 97.06 meters below ground level (mbgl) and HTPTSFMB03 reported 28.04 mbgl. Monitoring bore HTPTSFMB02 was dry for the last reporting period. Monitoring reports show that between 2017 and 2023 the SWL at HTPSFMB01 has averaged 91 mbgl. Hydraulic gradient flows south to north. TDS ~ 690 in 2022 and therefore considered fresh water.</p>
Surface Water	<p>The prescribed premises is located on the eastern margin of the Oakover Drainage Basin; the upper reaches of the Oakover River are approximately 170 km south of the prescribed premises.</p>

	<p>Tributaries to the Oakover River which intersect the prescribed premises include Muddauthera Creek, Brumby Creek and Warri Warri Creek. Surface water lines surround the spray field with the closest being 40 m from the spray field.</p>
<p>Native vegetation As per Mattiske (2014), vegetation in the vicinity of the sprayfield area is classified as: <i>Vegetation Community 5 - Scrub or Low Shrubland of Acacia ancistrocarpa, Acacia arida, Acacia acradenia, Petalostylis labicheoides, Gossypium australe, Acacia synchronicia and Acaciainaequilatera over Triodia longiceps and Triodia wiseana with patches of *Cenchrus ciliaris on flats, often associated with major watercourses.</i> The primary vegetation observed within the sprayfield is spinifex. In the licence holder's 2022 Annual Environmental Report, vegetation health within the sprayfield was reported as being in 'very poor health' to 'moderate health, with considerably physical damage or stress'. Deterioration has been noted in vegetation surrounding sprinklers.</p>	<p>Located within the sprayfield and immediately adjacent.</p>
<p>Priority Flora</p>	<p>Within the prescribed premises and within 2 km of the prescribed premises boundary including:</p> <ul style="list-style-type: none"> • <i>Goodenia pedicellata</i> – Priority 1 • <i>Lepidium amelum</i> – Priority 1 • <i>Euphorbia clementii</i> – Priority 3
<p>49 Recorded Threatened Fauna Sites</p>	<p>Within the prescribed premises and within 2 km of the prescribed premises boundary</p> <ul style="list-style-type: none"> • <i>Dasyurus hallucatus</i> (Northern quoll) – Endangered • <i>Rhinonicteris aurantia</i> (Pilbara leaf-nosed bat) – Vulnerable • <i>Pseudomys chapmani</i> (Western pebble-mound mouse) – least concern • <i>Calidris canutus</i> (Red knot) – Near threatened • <i>Liasis olivaceus barroni</i> (Pilbara Olive python) – vulnerable

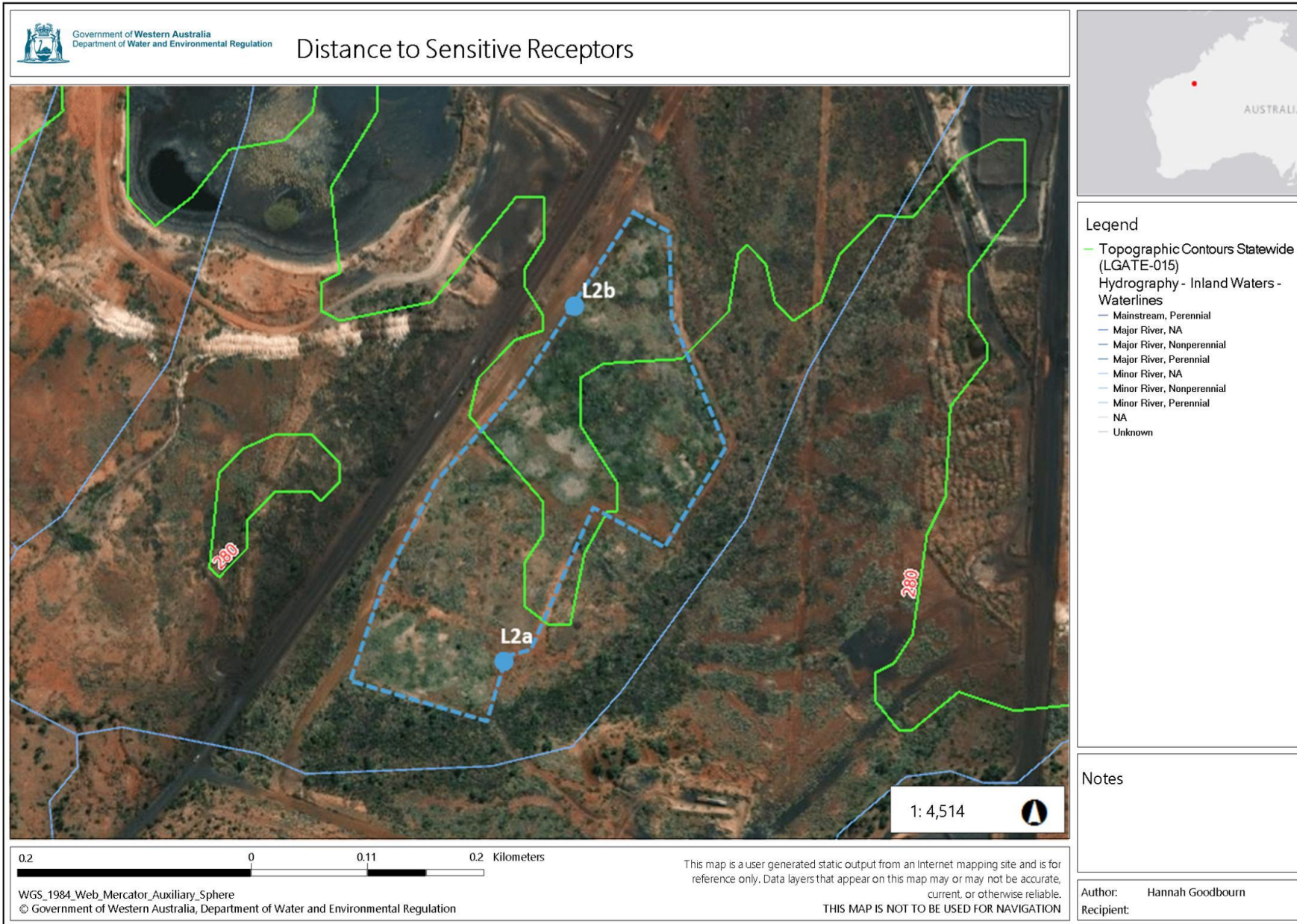


Figure 1: Distance to sensitive receptors

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 takes into account potential source-pathway and receptor linkages as identified in Section 0. 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 Emissions and controls), 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 10.

The Revised Licence L6131/1990/13 that accompanies this Amendment Report authorises emissions associated with the operation of the Premises i.e. Category 54 and 89 activities.

The conditions in the Revised Licence have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

Table 10. Risk assessment of potential emissions and discharges from the Premises during operation

Risk Event					Risk rating C = consequence L = likelihood	Applicant controls sufficient?	Conditions of licence	Justification for additional regulatory controls
Source/Activities	Potential emissions	Potential pathways and impact	Receptors	Applicant controls				
Operation								
Operation of the Reverse Osmosis Plant	Leaks/spills of pipelines and overtopping of tanks	Pathway: Direct discharge to land causing ecosystem disturbance Impacts: Degradation of the soil profile Elevated contaminants within soils causing an impact to vegetation	Soil and vegetation surrounding the plant.		C = Slight L = Unlikely Low Risk	Y	Condition 9: Management of Waste has been updated to increase capacity. Condition 14: irrigation of wastewater. <u>Condition 20: emission limits to land has been updated to include a TDS limit.</u>	
Irrigation of treated RO reject water	Increased volume of treated effluent to land with elevated TDS level	Pathway: Direct discharge to land. Spray drift or run-off during a rainfall event. Impact: Reduced vegetation health Degradation of the soil profile Elevated salinity within soils causing an impact to vegetation.	Surface water lines - Oakover Drainage Basin (Muddauthera Creek, Brumby Creek and Warri Warri Creek) Soil and vegetation within the irrigation field	Refer to Emissions and controls	C = Moderate L = Possible Medium Risk	N	Condition 26 has been updated to include TDS monitoring. <u>Condition 27: Monitoring of input or outputs has been updated to include monitoring for the volume of RO reject being blended for irrigation</u> <u>Condition 29: Vegetation monitoring within the WWTP irrigation sprayfield</u>	See Detailed risk assessment for nutrients and RO reject effluent discharge.

Risk Event					Risk rating C = consequence L = likelihood	Applicant controls sufficient?	Conditions of licence	Justification for additional regulatory controls
Source/ Activities	Potential emissions	Potential pathways and impact	Receptors	Applicant controls				
Burial of Inert Waste II	Leachate from inert landfill	Infiltration through to soil profile to groundwater	Groundwater ~89 m below ground level Oakover Drainage Basin (Muddauthera Creek, Brumby Creek and Warri Warri Creek)	Refer to Emissions and controls	C = Slight L = Unlikely Low Risk	Y	Condition 9: Management of Waste	N/A The Delegated Officer considers there is no change to risk profile, existing controls are considered sufficient to mitigate potential risks to the environment.

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

Note 2: Proposed Licence Holder's controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

Detailed risk assessment for nutrients and RO reject effluent discharge.

Description on emission risk event

Reject water from the Reverse Osmosis plant will be discharged to the WWTP effluent holding tank, this will subsequently be discharged through licenced emission point L2 spray fields. The licence holder requests that the allowance be doubled from 150 m³/day to 300 m³/day. The expected reject water volume is 126 m³/day. The proposed amendment will increase the level of salts in the blended effluent being discharged to land. Elevated salt content can impact soil structure and vegetation function. A number of ephemeral water bodies are located within the premises boundary.

Potential impacts

The discharge of Reverse Osmosis (RO) reject water containing elevated TDS can increase root zone salinity, soil structural stability and impact plant health and growth for species that cannot tolerate the increased TDS loading. The method of delivery is also a consideration, as direct discharge of effluent with elevated TDS levels to leaf tissue may result in burns, whereas this can be avoided if discharged via an irrigation system at ground level.

Impacts to soil occur particularly where irrigation water with a high Sodium Adsorption Ratio (SAR) relative to electrical conductivity (EC) is used. Over time, such water can increase the exchangeable sodium in soil, reducing permeability and increasing dispersibility. This impacts soil behaviour by hindering root penetration and air availability, leading to waterlogged, saline soils that can stunt plant growth or cause plant death.

Increased dispersibility from high SAR can also enhance soil erodibility, detaching clay platelets and potentially degrading water quality in nearby watercourses via nutrient and sediment runoff. Notably, there are no significant surface water bodies or creeks within 1km of the spray field.

Criteria of assessment

In the absence of site-specific data on the sensitivity of native vegetation species to salt concentrations in effluent, the Delegated Officer considers the *Australian Guidelines For Water Recycling And Managing Health And Environmental Risk* (EPHC 2006) provides a suitable metric for indicating whether TDS levels in effluent may present a risk of impact to vegetation when applied through an irrigation system. This guideline recommends a critical limit of 1,500 mg/L for TDS, above which operational corrective actions are recommended.

In addition, Table 4.2.5 in Volume 1 of the *Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) guidelines* (ANZECC 2000) suggest that the critical salinity threshold for olive trees in a clayey soil is about 1.7 dS/m which equates to be about 1,000 mg/L. The Departments contaminated sites experts consider olive tree's to be a suitable proxy for native vegetation.

Regarding impacts to soil structure and vegetation growth, Sodium Adsorption Ratio (SAR) serves as an indicator of water suitability for irrigation. Generally, higher SAR values indicate less suitability for irrigation, influenced by the water's electrical conductivity (EC). According to the *Australian and New Zealand Guidelines for Fresh and Marine Water Quality, Volume 3, Primary Industries* (ANZECC 2000), SAR and EC have a defined relationship that determines effluent suitability for irrigation. In some cases, a higher SAR may be manageable if the effluent also exhibits high electrical conductivity. The relationship between SAR, EC, and their impact on soil structure is illustrated in Figure 2 below.

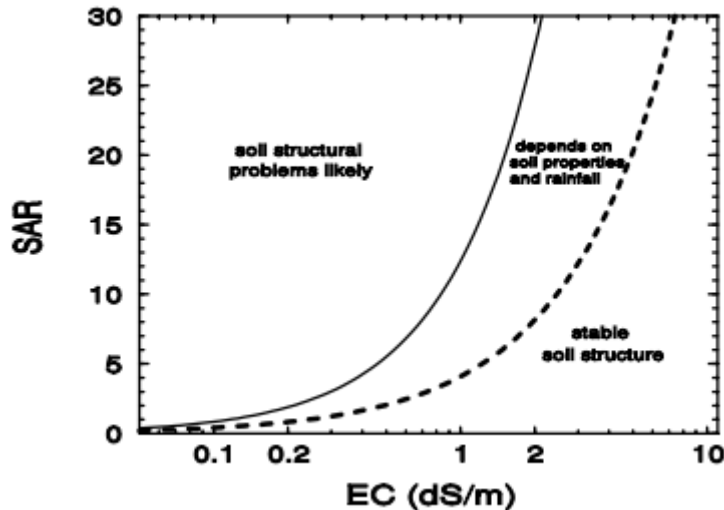


Figure 2: Relationship between SAR and EC of irrigation water for prediction of soil structural stability. Note that 1 dS/m = 1,000 μ S/cm

Assessment

The TDS concentration in the RO reject water is reported to be over 4,000 mg/L, surpassing the 1,500 mg/L critical limit for irrigated wastewater. The licence holder plans to dilute it with effluent. According to Table 5, the predicted TDS concentration of the blended discharge effluent is 1,427.18 mg/L, which is below the 1,500 mg/L limit set by the Australian Guidelines for Water Recycling and Managing Health and Environmental Risk (EPHC, 2006).

The licence holder has stated that the effluent will be discharged onto previously cleared, disturbed land with little native vegetation that is considered degraded within the sprayfield area. The licence holder's *2022 Annual Environmental Report* that there is native vegetation within the sprayfield, with the health of the vegetation ranging from "Very poor health" to "Moderate health, considerable physical damage or stress" and "deterioration in vegetation around sprinklers" had been reported in June 2023. During a monitoring period from November 2022 to June 2023, vegetation health increased in some locations and decreased in others. Photographs provided by the licence holder verify that vegetation coverage was generally diminished around some sprinkler locations with the irrigation area.

The Sodium Adsorption Ratio (SAR), which indicates water suitability for irrigation, is calculated using the following formula:

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$$

The predicted SAR of the blended effluent is 0.04 mmol/L, reflecting a low exchangeable sodium percentage in soils (DEC, 2004). Thus, negative impacts on soil and soil behaviour in the sprayfield area are considered unlikely. According to NSW 2004 guidelines, a SAR greater than 6 could increase the exchangeable sodium percentage (ESP) in soils, but this is not a concern with the current SAR value.

Proposed controls

In accordance with the Emissions and controls section of this Decision Report, the licence holder has proposed the following controls to manage effluent irrigation:

- Control of Run-off and Discharge: All run-off, spray drift, and discharge resulting from irrigation activities will be confined within the designated irrigation area, utilising the licensed discharge point (L2) for proper containment;
- Continuous Monitoring of Effluent Discharge: Effluent discharge volumes will be continuously monitored using precision flow meters to accurately track the volume of discharged effluent over time;
- Even Distribution of Treated Effluent: Treated effluent will be meticulously distributed across the entire irrigation area from emission points L2a and L2b to ensure uniform coverage;
- Quarterly Water Quality Monitoring: A rigorous schedule of quarterly water quality monitoring will be implemented. Monitoring will include pH levels, Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), Total Nitrogen, Total Phosphorus, and E. coli levels;
- Routine Inspections and Observations: Regular inspections and systematic observations of the irrigation area will be conducted to assess the effectiveness of effluent management practices, identify any operational issues, and promptly address any concerns that may arise;
- Management of Irrigation Impact: Effluent irrigation practices will be managed with a focus on preventing soil erosion and mitigating waterlogging, thereby safeguarding soil structure and maintaining optimal growing conditions for vegetation; and
- Maintenance of Vegetation Cover: Ongoing efforts will be made to sustain vegetation cover across the irrigation area.

Consequence and likelihood of risk

The discharge of irrigation using wastewater treatment plant (WWTP) effluent and reverse osmosis (RO) reject water with excessive salt loading may cause local vegetation degradation and deteriorate soil structure. Therefore, the Delegated Officer has determined that mid-level on-site impacts could occur. Consequently, the Delegated Officer assesses the consequence of excessive RO reject effluent discharge onto land as **Moderate**.

Should the RO reject water not be adequately blended and diluted prior to discharge, the Delegated Officer has determined that the risk event could occur at some time and the likelihood of the risk event is therefore **Possible**. This considers historical leaks within RO plant infrastructure (and management actions to rectify), licence holder controls, the degraded quality of vegetation within the sprayfield and the expected blended effluent quality data (including the expected TDS values).

Overall risk rating

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix contained in Guidance Statement: Risk Assessment (DER 2020) and determined that the overall rating for the risk of RO reject effluent discharge is **Medium**.

Regulatory controls

Due to the potential increase in TDS being dispensed to the irrigation field, the Delegated Officer has specified monitoring TDS in effluent discharged to land. Condition 26 will also include a limit on maximum TDS concentration of 2,000 mg/L (condition 20) to protect against native vegetation. The Delegated Officer agreed revised the TDS limit slightly higher than 1,500 mg/L following a request from the licence holder (see Table 11 below), with an additional condition for six-monthly vegetation health monitoring (condition 29) specified to ensure potential impacts to vegetation would be identified following the increased discharge volume and increase salt content up to 2,000 mg/L. The Delegated Officer notes that existing licence condition 13(e)

requires the licence holder to maintain vegetation cover within the irrigation area, so an amended condition 29 will also support reporting against condition 13. Table 13 has been updated to monitor the volume of RO plant reject water discharged to land.

Consultation

Table 11 provides a summary of the consultation undertaken by the department.

Table 11: Consultation

Consultation method	Comments received	Department response
Licence holder was provided with draft amendment on 25 July 2024	The Licence holder requests that the TDS limit of 1,500 mg/L be increased to account for the degraded state of the vegetation and the minimal impact anticipated. This adjustment will ensure that the RO plant can operate in compliance with Licence L6131 without exceeding TDS limits.	The Delegated Officer has determined revise the TDS concentration limit in blended effluent to 2,000 mg/L, however an additional requirement to monitor vegetation within the irrigation area has been specified. The revised limit is considered by the departments contaminated sites experts to still provide a level of protection against vegetation and minimise salt accumulation within the soil profile.

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.

Summary of amendments

Table 12 provides a summary of the proposed amendments and will act as record of implemented changes. All proposed changes have been incorporated into the Revised Licence as part of the amendment process.

Table 12: Summary of licence amendments

Condition no.	Proposed amendments
Numbering and layout	Licence layout and numbering updated to reflect The Departments current practice.
Condition 9, Table 4	<ul style="list-style-type: none"> Inclusion of Bells West Landfill Facility for the disposal of Conveyor Belt (Inert Waste Type 2) Wastewater treatment plant updated from 150 m³ per day to no more than 300 m³ per day.
Condition 15	Remove due to condition being outdated.
Condition 20, Table 10	Additional emission limit to land of 2,000 mg/L for TDS.
Condition 26, Table 12	Inclusion of TDS monitoring for emission points L2a or L2b
Condition 27, Table 13	Monitoring RO reject water discharged to L2.
Condition 29	Additional vegetation monitoring location within the WWTP irrigation sprayfield.
Condition 37, Table 22	1.3.14 – Construction Compliance documentation no longer required.

References

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3. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
4. Department of Water (2008), *WQPN 22, Irrigation with nutrient-rich wastewater*. Perth, Western Australia.
5. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
6. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
7. Environment Protection and Heritage Council (EPHC) 2006, *Australian Guidelines for Water Recycling: Managing Health and Environmental Risks (Phase 1)*, developed for the National Water Quality Management Strategy. Report available at: http://www.ephc.gov.au/sites/default/files/WQ_AGWR_GL_Managing_Health_Environmental_Risks_Phase1_Final_200611.pdf
8. Mattiske Consulting Pty Ltd (Mattiske), 2014, *Flora and Vegetation of the Woodie South and Max Prospects*.
9. Penn State University 2022, *Interpreting Irrigation Water Tests*. Pennsylvania, United States.