Application for Licence

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

Licence Number	L4504/1981/17
Applicant	South32 Worsley Alumina Pty Ltd
ACN	008 905 155
File number	DER2017/001998-1
Premises	Worsley Alumina Refinery Gastaldo Road ALLANSON WA Legal description Lease No 3116/7574 being Wellington Locations 5314 – 5317 on Plan 220209 As defined by the coordinates in Schedule 1 of the Revised Licence
Date of report	03/03/2023
Proposed Decision	Licence granted

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1. Decision summary

This decision report documents the assessment of potential risks to the environment and public health from repurposing of existing Solar Evaporation Pond 2A (SEP2A) from a process water evaporation pond into an oxalate storage pond. As a result of this assessment, the amended Licence L4504/1981/17 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this decision 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 and overview of premises

On 28 August 2022, South32 Pty Ltd submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act).

The application includes information on the proposal to:

- reline SEP2a with a high density polyethylene (HDPE) geomembrane;
- undertake minor construction works to the embankment slopes including reducing crest height by 0.5m and regrading the 1V:2.5H barter slopes to 1V:3H (after removal of existing liner),
- replace the groundwater under drainage network;
- and the conversion of SEP2a from a process water storage and evaporation pond to an oxalate storage facility.

The SEPs were originally designed to act as a repository for the refinery's spent sulphuric and hydrochloric acid, which is generated from both cleaning and water treatment sources. The SEP2a was also intended to be used as an offline balancing pond for the storage of caustic process water during periods of high water levels in the Refinery Catchment Lake (RCL).

The previous SEP2a liner and underdrainage system were commissioned in 1989 and had reached the end of their serviceable life. An audit carried out in 2016 identified 1078 defects in the upper 10m of the batter slope, including 246 holes that had penetrated the liner and allowed seepage including a 15 m seem split, requiring the liner to be replaced. This liner failure was reported to DWER indirectly, but not in accordance with *Section 72 of the Environmental Protection Act 1986.* This is documented on DWER's Incident and Complaint Management System (ICMS) as ICMS 68306.

Following the relining of SEP2a, the intention is to convert SEP2a from a waste acid storage pond to an oxalate storage facility. Prior to assessment of this application, DWER was subsequently advised the minor works to the pond embankments and the relining of SEP2a had already been completed. This matter has been referred to DWER's Compliance and Enforcement directorate for their consideration (ICMS 68308). The Licence Holder has subsequently submitted an as constructed compliance report for these works. On this basis, the scope of the assessment of this application is now limited to conversion of SEP2a from a process water pond to an oxalate storage pond only.

The change of purpose of SEP2a relates to the primary prescribed activity of category 64: bauxite refining activities, as oxalate is generated from the refining process at a rate of approximately 75,000m3 per annum. Bauxite refining is undertaken at the premises with an

assessed maximum production capacity of 4.7 million tonnes per annum under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which is defined in licence L4504/1981/17.

Oxalate storage

During the Bayer alumina refining process, bauxite ore is broken down through mechanical grinding, heating and mixing with liquid sodium hydroxide to release alumina into solution. This process also generates sodium oxalate ("oxalate"), which forms when the sodium hydroxide bonds with organic material contained within the ore. Oxalate is relatively insoluble and reduces the uptake of alumina into solution and lowers the overall viability of the refining processes. Oxalate is periodically removed from the caustic liquor by binding it with gibbsite, washing the gibbsite and crystallising the oxalate from solution it to form an oxalate cake that can then be disposed of as a waste.

Sodium oxalate is toxic to humans and exposure through inhalation, digestion and ingestion can have potentially acute health impacts. It readily forms a white powder when exposed to the wind and it must therefore be stored within secured compounds or treated to render it innocuous. At the Worsley Alumina Refinery, oxalate is the waste oxalate cake has historically being buried in trench pits within consolidated, trafficable parts of the Bauxite Residue Disposal Areas (BRDA). SEP1, SEP3 and SEP4 are now approaching capacity and the Licence Holder is seeking to dispose of oxalate into 1 SEP2.

The storage of oxalate in the SEP's is considered a medium term option until the Licence Holder developed another more sustainable option for oxalate disposal.

Other matters considered in this assessment

The SEP2A liner is considered critical containment infrastructure and is the primary pollution control infrastructure for any process water or oxalate stored within SEP2a. A report of the as constructed composite geomembrane and Geosynthetic Clay Liner of SEP2a was provided to DWER on 12 January 2023. It includes a quality assurance testing details of the liner and subgrade soils, and some test certificates are included. DWER notes that it was constructed to meet a permeability coefficient of less than 1×10^{-9} m/s. In addition to the liner, SEP2a has also been constructed with an underdrainage system to drain seepage and upward hydrostatic pressure from shallow seasonal groundwater away from the base of the liner. The embankments contain vibrating wire piezometers (VWP) to validate the effectiveness of the underdrainage system, to measure groundwater pore pressure beneath the liner and to ensure the phreatic surface does not develop within the embankments, where embankment stability could potentially be affected if soils were allowed to become saturated.

Through the consultation process of this assessment (detailed in Section 5 of this report), the Licence Holder also sought to remove redundant conditions relating to the construction of Water Body 1; the construction works and conversion works relating to SEP 1 and SEP4 from process water storage ponds to oxalate storage ponds.

3. Location and receptors

3.1 Siting context

The Premises is located approximately 15 km northwest of Collie on the Darling Plateau, 145km south of Perth. The Premises is nearly entirely situated within the upper reaches of the Augustus River catchment, which is a tributary of the Brunswick River. Water from the Brunswick River is used for agricultural and other purposes.

The location of SEP 2A within the Premises boundary is shown in Figure 1 below.

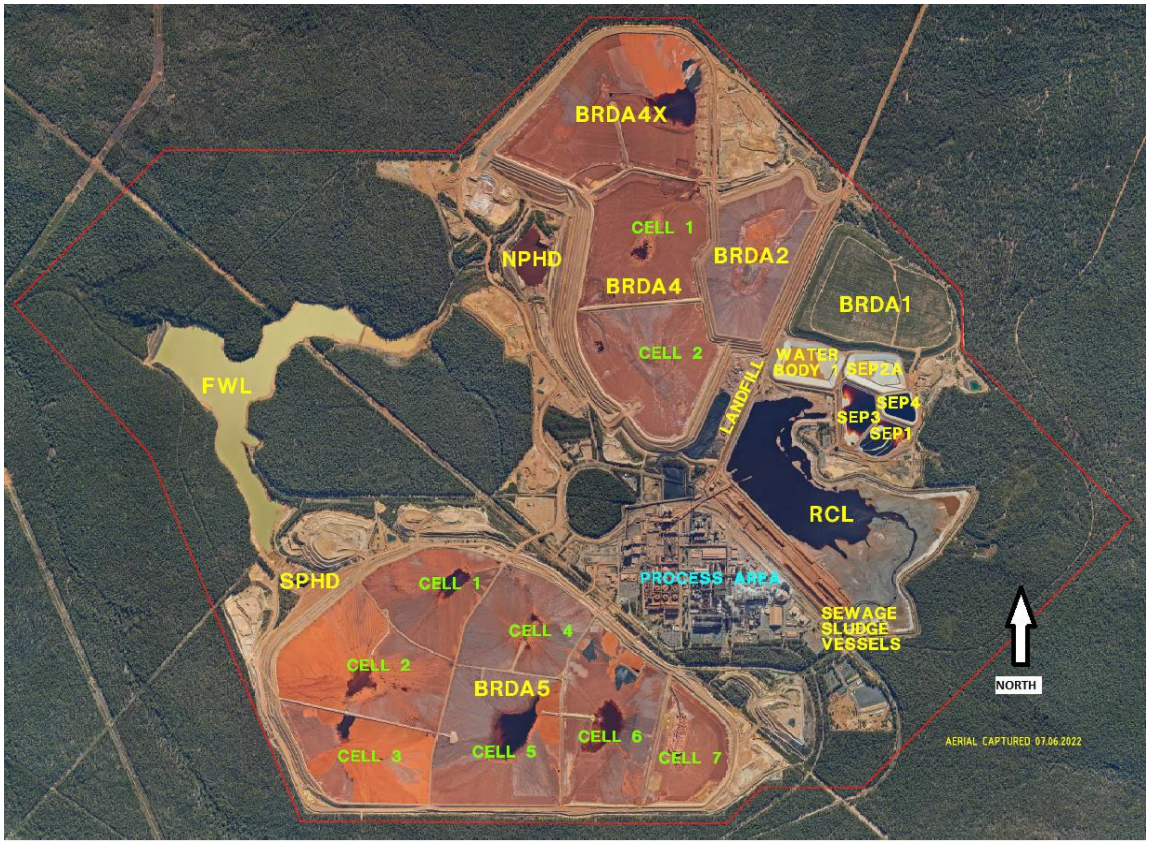

Figure 1: Location of Solar Evaporation Pond (SEP) 2A in relation to the Premises boundary (shown in red).

Source

Figure 2: SEP 2A in relation to SEPs 1-4 and Water Body 1 and the hopper used to supply oxalate to SEP 2A.

3.2 Residential and sensitive receptors

The distances to residential and sensitive receptors are detailed in Table 1.

Table 1: Receptors and distance from proposed works

Residential and sensitive premises	Distance from the proposed works
Single Rural Dwellings:	Single residential dwelling approximately 7.5 km northeast of the proposed works.
Township of Allanson	Allanson is approximately 10.5 km south of the proposed works.

3.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or emissions and discharges from the Premises. The distances to specified ecosystems are shown in Table 2. Table 2 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting.*

Table 2: Environmental values

Specified ecosystems	Distance from the proposed works
Waterways Conservation Areas	Leschenault Inlet Management Area approximately 4.5 km west
Biological component	**Distance from the proposed works**
Threatened/Priority Flora	Priority 4 species approximately 3.5 km northeast and 4 km southwest
Threatened/Priority Fauna	Priority 4 species approximately 4km east and south Vulnerable species approximately 1.2 km south Endangered species approximately 3.1 km west

3.4 Groundwater and water sources

A description of ground and surface water resources is provided in Table 3.

Table 3: Groundwater and water sources

Groundwater and water sources	Distance from the proposed works	Environmental value
Public drinking water source areas (PDWSA)	SEP2A is approximately 2.2 km west from the Harris River Dam Catchment Area (HRDCA). Ground and surface water flows from the proposed development area towards the west of the Premises, away from this receptor.	The HRDCA is a Priority 1 PDWSA, meaning that it is managed to ensure there is no degradation of the quality of the drinking water source with the objective of *risk avoidance*.
Major watercourses/waterbodies	The Premises is within the upper reaches of the Augustus River Catchment. The Freshwater Lake is approximately 4 km west of the	The Augustus River is a freshwater system with a slightly acidic pH. The upper reaches of the Brunswick River are

Groundwater and water sources	Distance from the proposed works	Environmental value
	proposed works and discharges directly into the Augustus River within the Premises boundary. The Augustus River flows into the Brunswick River approximately 2.5 km north of the Premises boundary (5 km north of the proposed works). The upper reaches of the Hamilton River run approximately 2.8 km south of the proposed works (500 m south of the Premises boundary). Ground and surface water flows from the proposed development area towards the west of the Premises, away from this receptor.	dominated by the refinery and State Forest. Downstream uses include horticulture, stock watering, recreational and domestic purposes. The Hamilton River flows south into the Wellington Dam and the Collie River.
Groundwater	Within the vicinity of SEP2A the groundwater levels range between RL 291 m along the north of the pond and RL 286 m along the south-west of the pond and the SEP 2A has a floor level of RL 289m and 286.5m at these respective locations. Current groundwater levels are about 5m below baseline at the current time.	The shallow aquifer originally fed into the upper reaches of the Augustus River. Shallow groundwater within proximity of SEP's feeds directly into the RCL which is used for site operations. In the vicinity of the SEP's, water from the fractured rock and saprolite aquifers feed into the RCL and at times of high water level in the RCL is at risk of feeding into the Freshwater Lake. The Freshwater Lake is a source for the Augustus River.
Rights in Water and Irrigation Act 1914 (RiWI Act)	The refinery operational area, including the location of SEP2A, is within two surface water catchments and the irrigation districts associated with these catchments. These areas are proclaimed under the RiWI Act as: • the Brunswick River and Tributaries • Collie River Irrigation District	The water within the Premises boundary has no environmental value for irrigation purposes. However, water from within the Premises boundary has the potential to reach the Augustus River, which has beneficial uses associate of surface water within the irrigation districts for horticulture, stock watering, recreational and domestic purposes.

4. 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.

4.1 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section **Error! Reference source not found.**. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section **Error! Reference source not found.**), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant'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 applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 4.

Licence L4504/1981/17 that accompanies this decision report authorises emissions associated with the operation of the premises.

The conditions in the issued licence, as outlined in Table 4 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

Table 4: Risk assessment of potential emissions and discharges from the premises during operation

Risk events				Risk rating [1] C = consequence L = likelihood	Reasoning	Regulatory Controls (refer to the conditions of the granted instrument)
Sources / activities	**Potential emission**	**Potential Receptors pathways and impact**	**Applicant controls**			
Operation						
Seepage from SEP2A	Slurry water: containing Al_2O_3, Na_2, CO_3, and SO_4	Receptor: underlying soil and groundwater Groundwater levels ranges from 291 m RL to 286 (minimum of 0.5 m separation from SEP2A floor level from groundwater along the south west corner of the pond). Pathway: seepage of slurry water through the floor of SEP2A into the soil profile Impact: may cause increased pH, metals and other contaminants in underlying soil and groundwater.	SEP2A engineering controls: • Permeability of less than 1 x 10 -9m/s • Floor level at between RL 289 and 286.5m • 1.5 mm thick HDPE liner • Geosynthetic Clay Liner • Underdrainage system to divert oxalate containing leachate and any rising groundwater beneath the liner to the RCL • Vibrating wire piezometers in the embankments to monitor phreatic surface and monitor effectiveness of underdrainage system	C = Slight L = Rare Low Risk	The Liner is constructed to have a permeability coefficient of less than 1 x 10m-9/s and is considered suitable to prevent seepage of oxalate and process water through the base of the liner where it may come into the soil and contaminate groundwater. Should any leachate occur the liner, a dedicated underdrainage system will function as a secondary control measure to convey contaminated leachate away from the underlying soil, where it may interact with groundwater. Oxalate solids will become consolidated within the SEP over time, further limiting movement of leachate or oxalate through the liner of SEP2A. Regular groundwater monitoring is undertaken across the Premises to detect contamination, seepage and changes in water quality in accordance with a Water Resources Management Plan required by MS719. The Delegated Officer considers these controls appropriate and has included a change to condition 1.2.4 with the purpose of further minimising the risk of contaminated water from SEP2A seeping into groundwater by . requiring the Licence Holder to demonstrate that this liner continues to meet this design specification as part of on-going operations to ensure the ongoing functionality of this infrastructure.	Licence Condition 1.2.4 has been amended to specify that the material stored in SEP2a is oxalate. Condition 1.2.4 has also been amended to require the liners of SEP1-4 be subject to periodic integrity testing.
Overtopping	Overtopping of oxalate	Receptor: localised	The minimum operational freeboard will be 300 mm	C = Slight	With the existing applicant controls in place it is expected that SEP2a will not overtop except	Condition 1.2.4 has been

Risk events				Risk rating [1] C = consequence L = likelihood	Reasoning	Regulatory Controls (refer to the conditions of the granted instrument)
Sources / activities	**Potential emission**	**Potential Receptors pathways and impact**	**Applicant controls**			
of SEP2A	from SEP2A, leading to surface runoff may cause localised contamination of soil and groundwater with increased pH, metals and other contaminants.	soil and groundwater Pathway: infiltration to groundwater Impact: over topping has the potential to cause uncontrolled discharge of oxalate and process water from SEP2a towards the RCL, Embankment stability maybe compromised, by saturation of the embankments caused by overtopping.	(contingency freeboard of 500 mm) and will also allow for a 1:100 AEP, 72 hour flood. Water Balance is actively monitored on a weekly basis and managed between the RCL and the SEP's and Water Body 1 in accordance with the *South32 WAPL Refinery Catchment Lake – Operations, Maintenance and Surveillance Manual* (WAPL, 2016) The design of SEP2A incorporates a siphon decant to allow for removal of process water back to the RCL.	L = Rare Low Risk	following extreme probability events. None-the-less SEP2a has been assessed a low hazard rated dam following embankment or structural failure. High water levels in the pond or within the embankments, or under drainage system would trigger measures to reduce water in the dam and restrict staff access to low lying areas. In the rare event that overtopping should occur, surface runoff, including run off and materials from a catastrophic dam failure, report back to the adjacent RCL The Delegated Officer considers these measures sufficient to manage the risk from overtopping	amended to specify that SEP2a maintains a total freeboard of 500mm
Pipeline failures associated with SEP2A	Slurry water: containing oxalate, increased pH and other contaminants	Receptor: localised soil and groundwater Pathway: infiltration to groundwater with increased pH, metals and other contaminants. Impact: minor localized	Daily inspection will be carried out to ensure no leaks or spills occur between SEP4 and SEP2a discharge point.	C = Slight L = Possible Low Risk	There is approximately 10m of pipeline that sits outside the SEP2a footprint, conveying oxalate from the hopper on the banks of SEP 4 to the discharge point within SEP2a. Spills or leaks that occur from pipelines within the SEP footprint area will drain into the ponds. In the event that a spill does occur outside the SEP footprint area it will be limited in duration and volume as it will be detected via daily inspections. Any slurry material discharged will be recovered and any residual seepage to soil and groundwater will occur within an area where groundwater seepage and flow is towards the Refinery Catchment Lake, a body containing caustic process water. The Delegated Officer considers daily inspections of this infrastructure acceptable for	

Risk events				Risk rating [1] C = consequence L = likelihood	Reasoning	Regulatory Controls (refer to the conditions of the granted instrument)
Sources / activities	**Potential emission**	**Potential Receptors pathways and impact**	**Applicant controls**			
					managing the risk of leaking oxalate conveyance pipeline at the current time.	
Spills from oxalate hopper area	Slurry water: containing Al_2O_3, Na_2, CO_3, and SO_4	No pathway -	The oxalate hopper area will be located on HDPE liner with a gentle incline that will drain any discharge or spill back in to SEP4 and therefore will not impact surrounding soil or groundwater	C = Slight L = Rare Low Risk	No Pathway	Not applicable
Dust lift off from tipping plate, hopper and surface of SEP2	Dust: fine particulates containing oxalate	Single rural dwelling, closest being 8.1km north-west of WB1 Nearby native vegetation Air: transport and dispersion of particulates (fugitive dust)	Oxalate is transported in a slurry form and stored submerged to prevent drying out or air lift off.	C = Slight L = Rare Low Risk	Large separation distance (8 km) for there to be minimal to no amenity impacts There is a separation distance of 50m between SEP1 and the nearest vegetation. Existing condition 1.2.6 requires oxalate to be stored wet or submerged in water. No further assessment.	.Managed via the existing condition 1.2.6 of the licence.

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

4.2 Detailed risk assessment for oxalate storage

The Delegated Officer has considered conversion of SEP2 from an acid storage pond to oxalate storage facility will not result in a material increase in emissions from the premises. The Delegated Officer has had regard to the location of the alteration within the context of the whole of premises activities, the distance sensitive receptors works within the context of the whole Premises activities, and the distance to sensitive receptors, in the decision not to apply additional regulatory controls to the storage of oxalate.

Oxalate dust is considered harmful to human health, and existing Licence Condition 1.2.6 requires the Licence holder to cover the oxalate or maintain it wet or underwater to ensure dust is not generated. The Delegated Officer considers this condition to be adequate to manage any risks posed to off-site receptors from oxalate dust due to the large separation distance. It is noted that the Licence Holder's Oxalate Management Plan (South32, 2017a), includes ambient dust monitoring near the northwestern corner of the RCL which will identify if dust emissions from a range of sources, and in particular the oxalate storage areas, pose a health and safety risk to on site receptors such as employees. The Delegated Officer has determined that the occupational exposure of site employees to oxalate dust is outside the scope of this Licence and no conditions on this ambient monitoring are included within the Licence.

The Delegated Officer has amended condition 1.2.4 to require the Licence Holder to undertake periodic integrity testing of the SEP liners to ensure that they continue to meet the required performance standard during ongoing site operations and that this is reported to DWER in a timely manner.

5. Licence Holder's comments

The Licence Holder was provided with the draft Amendment Report and draft Licence on 1 February 2023. The Licence Holder provided comments on the 22 February 2023 and a summary of these and how they have been included within the current assessment is provided within Appendix 1 to this Amendment Report.

6. Conclusion

Based on the assessment in this decision report, the delegated officer has determined that a licence will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

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

Condition	Summary of applicant's comment	Department's response
Condition 1.2.4 (Table 1.2.3) Requirement to conduct periodic integrity testing including permeability testing of the composite HDPE/ liner	Applicant provided advice about integrity testing of SEP's below stored Oxalate. Advised there is no current practical method for doing this while oxalate in currently stored within the pond. Key controls include: • routine inspection, regular monitoring of underdrainage system; • groundwater monitoring to detect changes in conductivity and pH as early indicators of seepage. • data compared to historical data for each bore • Piezometers are contained within embankments. • Trigger Action Response Plan which may lead to remediation including liner repairs, lower water levels maintained within SEP and groundwater monitoring • seepage drains toward the Refinery catchment Lake- a 9 GL dam of pH 12 process water. • Will investigate if geological surveys can be undertaken under oxalate storage dams to determine if this will be a viable measure for	The wording is changed to require the Applicant to conduct a periodic assessment of the permeability of the composite HDPE/GCL liner or PVC liners for the SEP's 1-4. The requirement to undertake a periodic integrity test of the Liner of Water Body 1 remains. In addition to the assessment, the Applicant is required to undertake remedial action or repairs as required; Condition 1.2.13(a) and 1.2.19 requiring a minimum freeboard of 500mm to be maintained and for the underdrainage system to capture is now captured under Condition 1.2.4, Table 1.2.3. Condition 1.2.13(b) also requires seepage from the underdrainage system to be captured and retained within the refinery. This is removed as it is implied within the permeability assessment requirements.
Condition 1.2.4 (Table 1.2.3)	Applicant advised that SEP has a PVC liner (not HDPE)	Update/correction to SEP 3 liner construction material made
Condition 1.2.9 Construction of Water Body 1	Removal of completed licence conditions requested. Due date: 30/09/2020 (Condition 1.2.15)	Submission of construction compliance report due date: 30 July 2020. Submission date: 9/11/2021 (DWER reference document reference numbers: A2061931 and A2061933) Associated conditions also removed: 1.2.8; 1.2.10;1.2.11; 1.2.12; and 1.2.13
Condition 1.2.14 Conversion of SEP 1 and SEP 4 to oxalate storage	Removal of old licence conditions	SEP 1: Submission of construction compliance report due date 29 October 2020 SEP 1 Submission date: 23/12/2021 (DWER document reference number: DWERDT543091)

Condition	Summary of applicant's comment	Department's response
		SEP 4: Submission of construction compliance report due date: 30 July 2023 SEP 4 Submission date: 26/11/2021 (DWER document reference number Associated Conditions also removed: 1.2.15; 1.2.16; 1.2.17; 1.2.18 and 1.2.19 Figure 2 Map of SEP4 infrastructure removed
New location of oxalate hopper	Applicant provided an updated map	Figure 1 replaced with updated hopper location map
Potential pipeline pump failures	Applicant provided information as requested and advised there is less than 10m of pipework outside the SEP footprint area. Daily inspections, CCTV is being considered to inspect for signs of clogging	Information included within risk assessment Table 3 of this report
Historical seepage	Applicant provided information regarding management of historical seepage from SEP2a	Information included within this report where relevant.
Definitions	NA	Included for PVC, GCL and HDPE