# Appendix 51 Public Drinking Water Risk Assessment

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Alcoa

# Public Drinking Water Catchment Assessment

for Environmental Review Document

November 2024

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# Public Drinking Water Catchment Assessment for Environmental Review Document

Alcoa

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WSP acknowledges that every project we work on takes place on First Peoples lands.
We recognise Aboriginal and Torres Strait Islander Peoples as the first scientists and engineers and pay our respects to Elders past and present.

# Table of contents

## List of tables



## List of figures

# 1 Introduction

Alcoa of Australia Limited (Alcoa) operates two bauxite mines, located approximately 100 km south of Perth. The Huntly Mine, established in 1972, supplies bauxite to the Pinjarra and Kwinana refineries. The Willowdale Mine, established in 1984, supplies bauxite to the Wagerup Refinery.

Alcoa's proposed Mine Development Envelope (DE) for Huntly and Willowdale are located within drinking water catchments which are classified as a Priority 1 Public Drinking Water Source Area (PDWSA) and assigned under "values directly protected under State and/or Commonwealth legislation". These PDWSAs are vulnerable to contamination from various land uses and activities.

Alcoa engaged WSP to undertake a public drinking water risk assessment (DWRA) of the proposed Huntly and Willowdale Mine DEs. This DWRA is requested in Item 14 in the Environmental Scoping Document – Bauxite mining on the Darling Range in the southwest of WA 2022 to 2026 and 2023 to 2027 (August 2024).

The purpose of this assessment is to identify potential risks to the PDWSAs from Alcoa's proposed mining activities within the Huntly and Willowdale Mine DEs, with the considerations of all significant risks associated with the proposal and any mitigation measures.

This report summarises the methodology and results of the DWRA.

## 1.1 Public drinking water source areas (PDWSA)

Public drinking water source areas (PDWSAs) are surface water catchments and groundwater areas that supply drinking water to cities, towns and communities throughout the state. These areas are designated under the Metropolitan Water Supply, Sewerage, and Drainage Act 1909 or the Country Areas Water Supply Act 1947.

There are three types of PDWSAs (Government of Western Australia, 2024):

- Underground water pollution control areas (UWPCAs) – established under the Metropolitan Water Supply, Sewerage, and Drainage Act 1909 over groundwater areas in the Perth metropolitan area.
- Catchment areas – established under the Metropolitan Water Supply, Sewerage, and Drainage Act 1909 in the Perth metropolitan area or the Country Areas Water Supply Act 1947 in the rest of the state to protect surface water sources.
- Water reserves – established under the Country Areas Water Supply Act 1947 to protect groundwater sources.

The Department of Water and Environmental Regulation (DWER) designates four different priority areas within PDWSAs to guide land use decisions. These are assigned via publicly consulted drinking water source protection reports or as a result of government approved strategic planning.

The Priority 1 (P1) areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance. P1 areas occur within PDWSAs where the existing land uses have low risks to PDWSAs. Consistent with the preventive risk-based framework of Western Australian Government, changes of land use that introduce additional risks are not recommended. P1 areas would typically include Crown land but may also include some private land (Government of Western Australia, 2024).

## 1.2 Scope

A qualitative public drinking water catchment assessment was undertaken within the Huntly and Willowdale DEs for the Proposals. The Exploration DE is not considered relevant to this assessment, as the level of impact is equal to or lesser than exploration activities within the Huntly and Willowdale DEs. The assessment considers three phases of mining activities (pre-mining, mining and rehabilitation) and the potential hazards that may impact the PDWSAs impacted by these DEs.

The PDWSAs within the Huntly Mine DE include:

1. Serpentine Dam catchment
2. Serpentine Pipehead Dam catchment
3. Conjurunup Creek Pipehead Dam catchment
4. North Dandalup Dam catchment
5. South Dandalup Dam catchment
6. South Dandalup Pipehead Dam catchment

The PDWSAs within the Willowdale Mine DE include:

1. Stirling Dam catchment

Figure 1.1 illustrates the location of the proposed Mine DEs, and the adjacent PDWSAs and reservoirs.

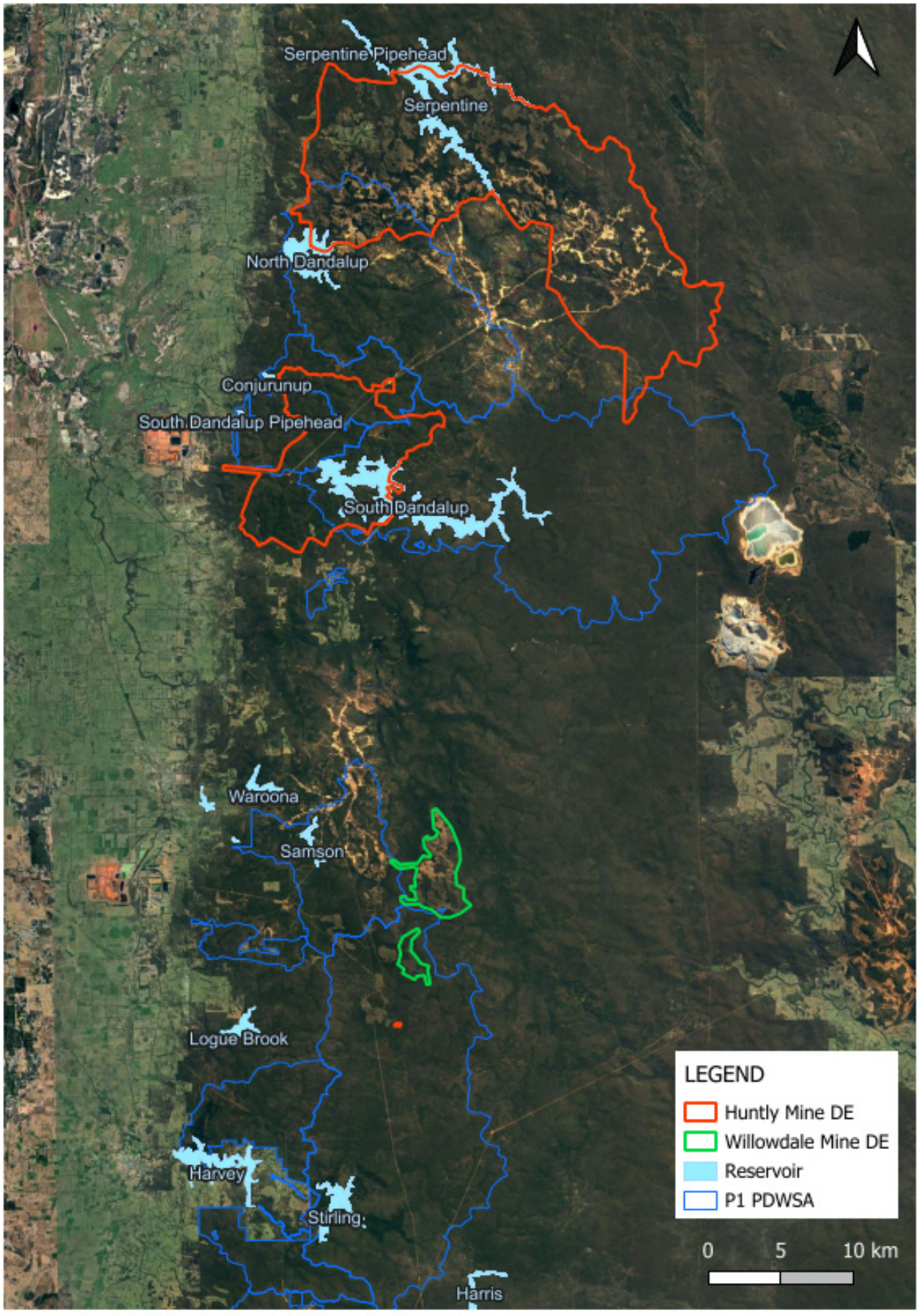


Figure 1.1 Location of proposed Mine DEs, Priority 1 PDWSAs, and adjacent reservoirs

## 1.3 Available information

No quantitative public drinking water risk assessment or modelling was undertaken within the Huntly and Willowdale DEs as part of the DWRA. Therefore, this DWRA is undertaken qualitatively by heavily utilising the findings in a previous drinking water risk assessment developed by GHD (Drinking Water Risk Assessment – Serpentine, Serpentine Pipehead, South Dandalup, and Wungong Brook Catchments, Rev1, 12 January 2022, 2022).

# 2 Risk assessment methodology

The risk assessment follows the methodology outlined in DWER's Water Quality Protection Note (WQPN) 77 – *Risk assessment process for public drinking water source areas* (2022). The note suggests the following steps in calculating the risk for the public drinking water catchment assessment:

1 Identify all the hazards (see Section 2.1)

2 Estimate the likelihood (see Section 5)

3 Estimate the consequences (see Section 5)

4 Quantify inherent and residual risk (see Section 5)

5 Develop management strategies to address risk (see Section 5).

The suggested qualitative measure of likelihood and consequences are presented in Table 2.1 and Table 2.2, respectively. The DWRA adopts the suggested consequence ratings in WQPN 77 (Department of Water and Environmental Regulation, 2022) for various potential contaminants, see Table 2.3.

Table 2.1 Qualitative measures of likelihood (Government of Western Australia, 2024)

| Likelihood | Definition |
|---|---|
| Almost certain | Is expected to occur in most circumstances |
| Likely | Will probably occur in most circumstances |
| Possible | Might or should occur at some time |
| Unlikely | Could occur at some time |
| Rare | May occur in exceptional circumstances |

Table 2.2 Qualitative measures of consequence (Government of Western Australia, 2024)

| Likelihood | Definition |
|---|---|
| Catastrophic | Major impact for large population, complete failure of system, source may require complete replacement (huge costs associated). |
| Major | Major impact for small population, system significantly compromised and abnormal operation (if at all), high level of monitoring required, significant increase in operating cost, source may require remediation (at significant cost). |
| Moderate | Minor impact for large population, significant modification to normal operation but manageable, operating cost increased, increased monitoring. |
| Minor | Minor impact for small population, some manageable operation disruption, some increase in operating cost. |
| Insignificant | Insignificant impact, little disruption to operation, low increase in operating cost. |

Table 2.3 Recommended consequence ratings for PDWSA hazards (Department of Water and Environmental Regulation, 2022)

| Hazard | Consequence | Explanation |
|---|---|---|
| Pathogens | Catastrophic | The greatest risk to drinking water consumers are pathogens, which can cause illness and, in extreme cases, death. |
| Pesticides | Major | Some are toxic or are suspected of causing cancer and affecting endocrine systems. |

| Hazard | Consequence | Explanation |
|---|---|---|
| Hydrocarbons | Major | Fuels and oils are toxic and can cause severe health issues in humans. They also can affect the water's taste and odour. |
| Nutrients | Major | Can be toxic, with infants most susceptible. High levels can cause toxic algal blooms in a water body. |
| Chemicals | Major | Heavy metals, pharmaceuticals and other chemicals can affect human health, and the taste of the water. |
| Turbidity | Major | Cloudy water impedes chlorination and makes the water look and taste unappealing. Pathogens can attach to suspended particles in cloudy water, and 'hide' from chlorination. |
| Salinity | Moderate | High salinity water is less palatable. |
| Colour | Moderate | Coloured water can cause disinfection by-products and affect the water's taste and appearance. |
| Radiological | Case by case | Radioactive compounds can cause serious health impacts. |

A risk assessment is not just about how often something happens or the chance of it occurring (likelihood), or the results if the event did happen (consequence), but a combination of the two (risk) (Government of Western Australia, 2024).

**Risk = consequence × likelihood**

The risk, which is the likelihood of identified hazards causing harm to exposed populations, including the severity of the consequences, is quantify by finding where the likelihood and consequences intersect in Table 2.4.

Table 2.4 Qualitative risk matrix (Government of Western Australia, 2024)

| Likelihood | Consequence | | | | |
|---|---|---|---|---|---|
| | Insignificant | Minor | Moderate | Major | Catastrophic |
| Almost certain | Moderate | High | Very high | Very high | Very high |
| Likely | Moderate | High | High | Very high | Very high |
| Possible | Low | Moderate | High | Very high | Very high |
| Unlikely | Low | Low | Moderate | High | Very high |
| Rare | Low | Low | Moderate | High | High |

The Australian Drinking Water Guidelines (NRMMC, 2011) emphasise that effective risk management requires identifying all potential hazards, their sources, and possible hazardous events. Therefore, all potential sources of hazards and pathways impacting relevant receptors (SPR, see Section 3) are identified for all mining activities during the pre-mining, mining, and rehabilitation phases to help assess the risk. Management strategies, such as controls and mitigation measures (Section 4), are then developed for each identified hazardous event. Details of qualitative risk assessment are presented in Section 5.

## 2.1 Identification of hazards

As suggested in WQPN 77 (2022), all potential hazards associated with the proposed mining activities within the Huntly and Willowdale Mine DEs are identified, with a summary of activities and associated hazards presented in Table 2.5.

Note forest harvesting is not included as an activity in this table as it's considered Native Vegetation Clearing as per the Pit Development activity.

Table 2.5 Summary of mining activities and associated hazards impacting the PDWSAs

| Phase of mining | Activities | Potential hazards |
|---|---|---|
| | Exploration<br>— Low impact disturbance<br>— Drilling and sampling<br>— Movement of equipment | — Hydrocarbons (oil and fuel spills).<br>— Soil erosion and increased sedimentation.<br>— Nutrient (i.e., nitrogen and phosphorus) runoff into the watercourse.<br>— Unintended vomiting and toileting in the PDWSA catchment |
| Mining | Pit development<br>— Native vegetation clearing<br>— Excavation<br>— Removal of soil and rocks | — Soil erosion and increased sedimentation.<br>— Pollutants enter water sources.<br>— Unintended vomiting and toileting in the PDWSA catchment<br>— Hydrocarbons (oil and fuel spills). |
| | Mining infrastructures<br>— Native vegetation clearing<br>— Haul roads and causeways<br>— Conveyor corridor | — Soil erosion and increased sedimentation.<br>— Heavy metal pollution. |
| | Mining facilities<br>— Machinery<br>— Storages | — Hydrocarbons (oil and fuel spills).<br>— Heavy metal pollution.<br>— Contamination from spills, leak or emission from the storage.<br>— Mobilised contaminants from previous mining activity |
| | Machinery and vehicles | — Soil erosion and increased sedimentation.<br>— Hydrocarbons (oil and fuel spills). |
| | Site safety management<br>— Firefighting system<br>— Wastewater and sewage treatment | — PFAS contaminate water sources.<br>— Pathogens contaminate water sources. |
| Rehabilitation | Decommissioning<br>— Removing any remaining infrastructure | — Soil erosion and increased sedimentation.<br>— Hydrocarbons (oil and fuel spills). |

| Phase of mining | Activities | Potential hazards |
|---|---|---|
| | Reclamation<br>— Restoring the land to its prior state and/or planned final land use | — Soil erosion and increased sedimentation.<br>— Nutrient (i.e., nitrogen and phosphorus) runoff into the watercourse. |
| | Revegetation | — Chemical (i.e., pesticides and herbicides) runoff into watercourses.<br>— Unintended vomiting and toileting in the PDWSA catchment |

# 3 Source-Pathway-Receptor summary

A desktop assessment was conducted to summarise the potential sources, pathways, and receptors (SPR), see Table 3.1. The content in Table 3.1 was populated using the information in Appendix C (Model sources, pathways and receptors) from GHD's Drinking Water Risk Assessment of Serpentine, Serpentine Pipehead, South Dandalup, and Wungong Brook Catchments (2022).

The SPR only considers hazards associated with the Proposals, meaning contaminants associated with previous mining is excluded as it should be considered in their own DWRA.

It is assumed construction activities are part of the operational phase.

The SPR considers mining activities during the pre-mining, mining, and rehabilitation phases, and the following contaminants were identified:

- Pathogenic microorganisms
- Hydrocarbons
- Suspended solids
- PFAS
- Nutrients
- Sediment, including unknown contaminants within the sediment
- Organic carbon loading
- Salinity.

This SPR informs the qualitative risk assessment in Section 5.

Table 3.1 Summary desktop impact assessment – Source-Pathway-Receptors, Informed by GHD previous work (2022)

| Hazard | Activity | Source (Potential Hazardous event) | Pathway | Receptor |
|---|---|---|---|---|
| Pathogenic microorganisms | Pre-mining | — Pre-mining stripping and timber harvesting in Reservoir Protection Zone (RPZ)<br>— Use of bushland for toileting and vomiting | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir.<br>— Transport along watercourses, discharging into reservoir.<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir. | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Mining | — Operational workforce in RPZ (mine pits and haulage) and catchment (mine pits, haulage, mine facilities).<br>— Use of bushland for toileting and vomiting<br>— Treatment of workforce sewage<br>— Irrigation of treated effluent at mine compound and facilities.<br>— Mobile ablutions facilities<br>— Pump out and transport of raw sewage for off-site disposal.<br>— Raw sewage leaks during tanker collisions. | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir.<br>— Transport along watercourses, discharging into reservoir.<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir.<br>— Irrigation of treated sewage effluent over bushland.<br>— Process upsets / failure resulting in reduced treatment efficacy / higher. | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Rehabilitation | — Rehabilitation activities within the RPZ<br>— Use of bushland for toileting and vomiting | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir.<br>— Transport along watercourses, discharging into reservoir.<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir. | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| Hydrocarbons | Pre-mining | — Exploration vehicles and equipment in the RPZ and catchment<br>— Fuel leaks during refuelling<br>— Oil leaks during vehicle/equipment maintenance<br>— Fuel or oil leaks during vehicle collisions | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |

| Hazard | Activity | Source (Potential Hazardous event) | Pathway | Receptor |
|---|---|---|---|---|
| | Mining | — Operations power supply<br>— Operational vehicles and equipment in catchment and RPZ<br>— Fuel leaks during refuelling<br>— Oil leaks during vehicle/equipment maintenance<br>— Fuel or oil leaks during vehicle collisions<br>— Fuel storage and handling at mine facilities<br>— Vehicle and equipment washdowns<br>— Wash water generation from wash bay<br>— Overflow of contaminated water storages<br>— Solid and liquid waste generation from operational activities<br>— On-site waste disposal<br>— Hazardous materials/ package chemical storage and use for vehicle and equipment maintenance | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Rehabilitation | — Rehabilitation activities within the RPZ | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| Suspended solids | Pre-mining | — Exploration workforce, vehicles and equipment in the RPZ and catchment | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Mining | — Operational vehicles and equipment in catchment and RPZ<br>— Spilling sediment from damaged equipment or dusting off the belt.<br>— Vehicle and equipment washdowns<br>— Wash water generation from wash bay<br>— Overflow of contaminated water storages or drainage controls | — Transport of sediment/ organic carbon along stream, discharging into reservoir<br>— Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Increased erosion and sediment/ organic carbon runoff from burnt areas, discharging into stream or direct to reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |

| Hazard | Activity | Source (Potential Hazardous event) | Pathway | Receptor |
|---|---|---|---|---|
| | Rehabilitation | — Bushfire due to machinery or electrical sparks<br>— Rehabilitation activities within the RPZ<br>— Vehicle and equipment washdowns<br>— Wash water generation from wash bay<br>— Overflow of rehabilitated areas | — Transport of sediment/ organic carbon along stream, discharging into reservoir<br>— Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Bushfire reduces soil cover and increases organic carbon loading<br>— Increased erosion and sediment/ organic carbon runoff from burnt areas, discharging into stream or direct to reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| PFAS | Pre-mining | — Use of aqueous film forming foam (AFFF) to respond to fire events<br>— Presence of perflouro-alkyated substances (PFAS) in AFFF | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Mining | — Use of aqueous film forming foam (AFFF) to respond to fire events<br>— Presence of perflouro-alkyated substances (PFAS) in AFFF<br>— Removal of vegetation and caprock<br>— Water use for pavement construction, dust suppression, vehicle washing and other site uses<br>— PFAS detected in existing mine water supply<br>— Operational vehicles and equipment<br>— Hazardous materials/ package chemical storage and use for vehicle and equipment maintenance | — Surface runoff from treated haul roads, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir<br>— Rising groundwater following clearing of vegetation<br>— Contaminants mobilise into groundwater and flow into streams | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Rehabilitation | — Use of aqueous film forming foam (AFFF) to respond to fire events<br>— Presence of perflouro-alkyated substances (PFAS) in AFFF<br>— Hazardous materials/ package chemical storage and use for vehicle and equipment maintenance | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| Nutrients | Pre-mining | — Pre-mining stripping and timber harvesting in RPZ<br>— Use of bushland for toileting | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir.<br>— Transport along watercourses, discharging into reservoir.<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir. | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |

| Hazard | Activity | Source (Potential Hazardous event) | Pathway | Receptor |
|---|---|---|---|---|
| | Mining | — Solid and liquid waste generation from operational activities<br>— On-site waste disposal<br>— Vehicle and equipment washdowns<br>— Wash water generation from wash bay<br>— Overflow of contaminated water ponds<br>— Use of bushland for toileting<br>— Treatment of workforce sewage<br>— Irrigation of treated effluent at mine compound and facilities.<br>— Mobile ablutions facilities<br>— Pump out and transport of raw sewage for off-site disposal.<br>— Raw sewage leaks during tanker collisions. | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Rehabilitation | — Use of fertiliser for revegetation<br>— Use of bushland for toileting | — Overland flow during heavy rainfall and wet ground conditions, discharging into stream or direct to reservoir<br>— Surface runoff from haul roads and other paved/compacted areas, discharging into stream or direct to reservoir<br>— Infiltration through soils into groundwater, subsurface flow discharging into stream or direct to reservoir<br>— Transport along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| Sediment, including unknown contaminant within the sediment | Pre-mining | — Exploration vehicles and equipment in the RPZ and catchment | — Transport of sediment/ organic carbon along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Mining | — Operational vehicles and equipment in the RPZ and catchment<br>— Haul road construction over/near waterways<br>— Disturbance to bed and banks of waterways/ reservoir<br>— Conveyor/ causeway construction over/near streams or reservoirs<br>— Equipment or dusting off the conveyor belt.<br>— Overflow of water storage or drainage controls | — Increased erosion and sediment/ organic carbon runoff from burnt areas, discharging into stream or direct to reservoir<br>— Erosion of bed and banks causing elevated sediment<br>— Transport of sediment/ organic carbon along stream, discharging into reservoir<br>— Direct discharge from conveyor/road into reservoir.<br>— Surface runoff from conveyor maintenance road, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Rehabilitation | — Rehabilitation activities within the RPZ<br>— Vehicle and equipment washdowns<br>— Wash water generation from wash bay<br>— Overflow of rehabilitated areas | — Transport of sediment/ organic carbon along stream, discharging into reservoir<br>— Direct discharge from road into reservoir.<br>— Surface runoff from road, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |

| Hazard | Activity | Source (Potential Hazardous event) | Pathway | Receptor |
|---|---|---|---|---|
| Organic carbon loading | Pre-mining | — Exploration workforce, vehicles and equipment in the RPZ and catchment<br>— Bushfire due to machinery or electrical sparks | — Bushfire reduces soil cover and increases organic carbon loading<br>— Increased erosion and sediment / organic carbon runoff from burnt areas, discharging into stream or direct to reservoir<br>— Transport of sediment / organic carbon along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
| | Mining | — Operational workforce, vehicles and equipment in the RPZ and catchment<br>— Bushfire due to machinery or electrical sparks | — Bushfire reduces soil cover and increases organic carbon loading<br>— Increased erosion and sediment / organic carbon runoff from burnt areas, discharging into stream or direct to reservoir<br>— Transport of sediment / organic carbon along stream, discharging into reservoir | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |
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| Salinity | Clearing, Mining | — Removal of vegetation and caprock<br>— Change in hydrological regime<br>— Rising groundwater mobilising salts in soils | — Rising groundwater following clearing of vegetation<br>— Salts mobilised into groundwater and flow into streams | — Huntly DE: Serpentine Dam, Serpentine Pipehead Dam, Conjurunup Creek Pipehead Dam, North Dandalup Dam, South Dandalup Dam, South Dandalup Pipehead<br>— Willowdale DE: Stirling Dam |

# 4 Mitigations measures summary

The following mitigations measures are proposed to minimise Alcoa's impact to the PDWSAs from the proposed activities within the Huntly and Willowdale DEs.

**Mitigation Measures 1 – Minimise change in water supply to PDWSAs**

The following is recommended to minimise change in water supply to the PDWSAs due to change in surface water runoff and groundwater volumes related to mining activities:

- Minimise stream crossings and impacts through crossing location selection and design.
- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values

**Mitigation Measures 2 – Minimise impact to fluvial geomorphology**

The following is recommended to minimise significant change in fluvial geomorphology due to clearing, mining and rehabilitation activities:

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining operational activities (excludes infrastructure) within 100 m buffer zone for mapped stream vegetation to encourage infiltration.
- Minimise surface hydrology changes through surface water abstraction management as per RIWI Act licences and associated operating strategies.

**Mitigation Measures 3 – Minimise increase in PDWSA salinity caused by rising groundwater levels**

The following is recommended to minimise increase in salinity concentrations in the PDWSAs caused by rising groundwater levels associated with mining activities (cleared vegetation):

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining activities within the RPZ, within 2 km of the reservoir.
- No mining operational activities (excludes infrastructure) within applied buffer zones for:
  - 200 m buffer zone from reservoir top water level (OCA1)
  - 100 m buffer zone for mapped stream vegetation to encourage infiltration.
- Minimise groundwater fluctuations to prevent salinity increase by targeting priority rehabilitation.
- Mine Design to be informed by hydrological assessments where mine usually avoids pockets of high salinity areas.
- Monitoring of salinity trends via a regional bore network and surface water stream (when flowing) monitoring.
- Minimise disturbance where possible and use existing cleared areas where practical.

**Mitigation Measures 4 – Minimise increase in sediment loads to the PDWSAs**

The following is recommended to minimise increase in sediment loads impacting the PDWSA water quality as a result of sediment laden surface water runoff during clearing, mining and rehabilitation activities:

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining activities within the RPZ, within 2 km of the reservoir.

- No mining operational activities (excludes infrastructure) within applied buffer zones for:
  - 200 m buffer zone from reservoir top water level (OCA1)
  - 100 m buffer zone for mapped stream vegetation to encourage infiltration.
- No mine pits within streams.
- Minimise stream crossings where possible.
- A 100 m buffer will be maintained between the causeway and reservoir top water level unless a WC-agreed risk assessment is in place.
- Development and implementation of Drainage Control Management Plans (DCMPs) as per Develop Water Resource Sensitive Zone Plan (AUACDS-2053-4109) for all increased risk (as per WC Working Arrangement) mining operations located within OCA1 and OCA2.
- A permit system is in place to minimise risks associated with the installation of stream crossings.
- Clearing activities within stream zones will occur during summer or autumn months, as far as practicable.
- Stream crossings will be appropriately designed to minimise impacts and potential for erosion, with suitable surface water controls.
- Adequate hydraulic drainage controls for mining areas and haul roads
- Minimise vehicle access by imposing the requirement of an authorised permit.
- Where practicable, all vehicles should use existing tracks and roads through the forest.
- Undertake rehabilitation activities in a timely and committed way to enable maximisation of progress on rehabilitation areas.
- Implement rehabilitation design to minimise potential for erosion and sediment movement.
- Develop a rehabilitation design manual, incorporating water storage controls.

**Mitigation Measures 5 – Minimise increase in sediment loads and nutrients from spontaneous bush fires**

The following is recommended to minimise increased sediment loads and nutrients affecting PDWSA water quality as a result of spontaneous bush fire ignited by mining activities:

- Establish and maintain firebreaks around mining sites to prevent the spread of bushfires.
- Ensure that adequate firefighting equipment, such as water tanks, hoses, and extinguishers, is readily available and maintained.
- Implement continuous monitoring of weather conditions and fire risk levels.
- Provide fire safety training for all personnel, including the use of firefighting equipment and emergency procedures.
- Regularly maintain and inspect mining equipment to prevent sparks and overheating, which can ignite fires.
- Manage water resources effectively to ensure there is sufficient water available for firefighting efforts.

**Mitigation Measures 6 – Minimise contamination from hydrocarbons**

The following is recommended to minimise contamination of PDWSA water quality by unintentional release of hydrocarbons from mining operations, mobilised by surface water runoff:

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining activities within the RPZ, within 2 km of the reservoir.

- No mining operational activities (excludes infrastructure) within applied buffer zones for:
  - 200 m buffer zone from reservoir top water level (OCA1)
  - 100 m buffer zone for mapped stream vegetation to encourage infiltration.
- No mine facilities, wastewater and sewage treatment plants inside the RPZ.
- Bulk fuel tankers will not cross main river channels (e.g., Serpentine River main channel and Big Brook Crossing).
- Planned maintenance of vehicles and equipment will occur within workshops, as far as practicable.
- Vehicle refuelling will occur in designated fuel bays, as far as practicable.
- Storage of all hydrocarbons and chemicals will be undertaken within appropriately sized secondary containment in accordance with the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 1997, as applicable to specific materials. Storage will consider the requirements of *WQPN 56 – Tanks for fuel and chemical storage near sensitive water resources* (Department of Water and Environmental Regulation, 2018).
- Hazardous materials and wastes will be stored at designated construction compounds or other storage facilities in accordance with the Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 1997, as applicable to specific materials. Storage will consider the requirements of *WQPN 56 – Tanks for fuel and chemical storage near sensitive water resources* (Department of Water and Environmental Regulation, 2018) and *WQPN 65-Toxic and hazardous substances* (Department of Water, 2015).
- Stormwater runoff that may contain traces of hydrocarbons must be treated via a wastewater treatment system.
- Wastewater treatment plants will have associated maintenance and monitoring.

**Mitigation Measures 7 – Minimise contamination from PFAS**

The following is recommended to minimise contamination of PDWSA water quality by unintentional release of PFAS from mining operations, mobilised by surface water and/or groundwater:

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining activities within the RPZ, within 2 km of the reservoir.
- No mining operational activities (excludes infrastructure) within applied buffer zones for:
  - 200 m buffer zone from reservoir top water level (OCA1)
  - 100 m buffer zone for mapped stream vegetation to encourage infiltration.
- No mine facilities, wastewater and sewage treatment plants inside the RPZ.
- Only PFAS-free firefighting foams will be used.
- All water supplies will be sourced from public water supply reservoirs or borefields that are tested and do not exceed PFAS limits in ADWG (2011).
- All waste will be disposed of off-site.
- PFAS-affected water will be treated at the Myara PFAS Treatment Plant or disposed of off-site at an appropriately licensed facility.
- PFAS-affected water will be stored in dedicated storage facilities.

**Mitigation Measures 8 – Minimise contamination from potential acid sulfate soils**

The following is recommended to minimise contamination of PDWSA water quality with potential acid sulfate soils (PASS) compounds as a result of soil and sediment removal at waterway crossings:

- Soil testing before soil removal
- Minimise soil removal where possible
- Residual ongoing soil and water quality testing.
- ASS desktop assessment to be undertaken prior to clearing or dewatering in potential ASS areas (swamp and stream zones) with field investigations undertaken if required (in accordance with Identification and investigation of acid sulfate soils and acidic landscapes (Department of Environmental Regulation, 2015).
- Construction will be reviewed to avoid disturbance as far as practicable where ASS is confirmed as present within the excavation or groundwater drawdown area. Where ASS disturbance is not avoidable, an ASS management plan (ASSMP) will be prepared in accordance with Treatment and management of soil and water in acid sulfate soil landscapes (Department of Environmental Regulation, 2015).

**Mitigation Measures 9 – Minimise contamination with pathogenic microorganisms**

The following is recommended to minimise contamination of PDWSA water quality with pathogenic microorganisms due to vomiting or toileting within the PDWSA catchment, mobilised either via surface water or groundwater:

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining activities within the RPZ, within 2 km of the reservoir.
- No mining operational activities (excludes infrastructure) within applied buffer zones for:
  - 200 m buffer zone from reservoir top water level (OCA1) provides potential for pathogen dilution, die-off from solar exposure and predation.
  - 100 m buffer zone for mapped stream vegetation to encourage filtration.
- No mine facilities, wastewater and sewage treatment plants inside the RPZ.
- Avoid any sewage treatment plants inside the RPZ or within stream zones.
- No composting toilets, portable toilets or portaloos.
- Demountable ablution blocks are positioned close to active mine pits, which drain to a tank which is pumped out.
- Personnel are to use designated ablution block facilities where practicable. If this is not possible, biological waste must be bagged and disposed of at a designated disposal location outside of the RPZ.
- No swimming or unauthorised immersion in drinking water reservoirs.
- Ongoing maintenance and monitoring of sewage treatment plants.
- DWER Licences for sewage treatment plants stipulates design and operational controls.
- Apply buffer of more than 50m around land irrigation area.
- No sub-surface discharge allowed.
- Minimise worker access in stream zones.
- Worker training and awareness around hygiene practises within the RPZ.
- Sewage infrastructure is not located in steep slopes or within proximity to stream zones.

**Mitigation Measures 10 – Minimise contamination of PDWSA water quality by unintentional release of fertilisers, pesticides or herbicides**

The following is recommended to minimise contamination of PDWSA water quality by unintentional release of fertiliser, pesticides or herbicides from mining operations, mobilised by surface water runoff:

- Mining Avoidance Zones (MAZs) and Limited Disturbance Areas (LDAs) avoid or minimise clearing within proximity to key water values
- No mining activities within the RPZ, within 2 km of the reservoir.
- No mining operational activities (excludes infrastructure) within applied buffer zones for:
  - 200 m buffer zone from reservoir top water level (OCA1)
  - 100 m buffer zone for mapped stream vegetation to encourage filtration.
- Buffer zone of 50 m is maintained to mapped stream vegetation zone during application of fertiliser application during rehabilitation activities.
- Applied fertiliser application per pit according to calculations for required amount.
- GIS coordinated adhered to for buffer zone maintenance via flight logs.
- Herbicide application locations recorded and submitted to Water Corporation.
- Only approved chemicals utilised within the PDWA.

# 5 Qualitative risk assessment

A qualitative risk assessment to the drinking water sources was undertaken. The qualitative risk assessment is a desktop evaluation based on a previous drinking water risk assessment (GH, 2022), and our estimated impacts from comparing the size and location of the proposed mining activities relative to the locations of the PDWSAs.

The risk assessment only considers hazards associated with the Proposals, meaning contaminants associated with previous mining is excluded as it should be considered in their own DWRA.

Table 5.1 on the next page summarises the inherent and residual risk ratings for these following 12 potential impacts:

1. Reduction in water supply to the PDWSAs due to change in surface water runoff and groundwater volumes related to mining activities.
2. Significant change in fluvial geomorphology due to clearing, mining and rehabilitation activities.
3. Increase in PDWSA salinity water quality caused by rising groundwater levels associated with mining activities (cleared vegetation).
4. Increase in sediment loads impacting the PDWSA water quality as a result of sediment laden surface water runoff during clearing, mining and rehabilitation activities.
5. Increase in sediment loads and nutrients affecting PDWSA water quality as a result of spontaneous bush fire ignited by mining activities.
6. Contamination of PDWSA water quality by unintentional release of hydrocarbons from mining operations, mobilised by surface water runoff.
7. Contamination of PDWSA water quality by unintentional release of PFAS from mining operations, mobilised by surface water and/or groundwater.
8. Contamination of PDWSA water quality with potential acid sulfate soils (PASS) compounds as a result of soil and sediment removal at waterway crossings.
9. Contamination of PDWSA water quality with pathogenic microorganisms due to vomiting or toileting within the PDWSA catchment, mobilised either via surface water or groundwater.
10. Contamination of PDWSA water quality by unintentional release of pesticides and herbicides from mining operations, mobilised by surface water runoff.

Table 5.1 Qualitative public drinking water risk assessment – Inherent and residual risk summary

| Potential Impact | # | PDWSA | Inherent risk | | | Proposed Controls | Residual risk | | | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Consequence | Likelihood | Risk Rating | | Consequence | Likelihood | Risk Rating | |
| Reduction in water supply to the PDWSAs due to change in surface water runoff and groundwater volumes related to mining activities | 1a | Serpentine Dam | Major | Unlikely | High | Mitigation measures 1 (Section 4) | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 1b | Serpentine Dam Pipehead | Major | Unlikely | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 1c | North Dandalup | Major | Unlikely | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 1d | South Dadalup | Major | Unlikely | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 1e | South Dandalup Pipehead | Major | Unlikely | High | | Minor | Unlikely | Low | Clearing proposed higher in the PDWSA catchment |
| | 1f | Conjurunup Pipehead | Major | Unlikely | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 1g | Stirling Dam | Major | Rare | High | | Minor | Rare | Low | Clearing is proposed ~20 km upstream of dam |
| Significant change in fluvial geomorphology due to clearing, mining and rehabilitation activities | 2a | Serpentine Dam | Minor | Likely | High | Mitigation measures 2 (Section 4) | Insignificant | Unlikely | Low | Clearing proposed within the RPZ |
| | 2b | Serpentine Dam Pipehead | Minor | Likely | High | | Insignificant | Unlikely | Low | Clearing proposed within the RPZ |
| | 2c | North Dandalup | Minor | Likely | High | | Insignificant | Unlikely | Low | Clearing proposed within the RPZ |
| | 2d | South Dandalup | Minor | Likely | High | | Insignificant | Unlikely | Low | Clearing proposed within the RPZ |
| | 2e | South Dandalup Pipehead | Minor | Likely | High | | Insignificant | Unlikely | Low | Clearing proposed higher in the PDWSA catchment |
| | 2f | Conjurunup Pipehead | Minor | Likely | High | | Insignificant | Unlikely | Low | Clearing proposed within the RPZ |
| | 2g | Stirling Dam | Minor | Rare | Low | | Insignificant | Rare | Low | Clearing is proposed ~20 km upstream of dam |
| Increase in PDWSA salinity water quality caused by rising groundwater levels associated with mining activities (cleared vegetation) | 3a | Serpentine Dam | Moderate | Possible | High | Mitigation 3 (Section 4) | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 3b | Serpentine Dam Pipehead | Moderate | Unlikely | Moderate | | Minor | Rare | Low | Clearing proposed within the RPZ |
| | 3c | North Dandalup | Moderate | Possible | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 3d | South Dandalup | Moderate | Unlikely | Moderate | | Minor | Rare | Low | Clearing proposed within the RPZ |
| | 3e | South Dandalup Pipehead | Minor | Unlikely | Low | | Minor | Rare | Low | Clearing proposed higher in the PDWSA catchment |
| | 3f | Conjurunup Pipehead | Moderate | Unlikely | Moderate | | Minor | Rare | Low | Clearing proposed within the RPZ |
| | 3g | Stirling Dam | Minor | Rare | Low | | Minor | Rare | Low | Clearing is proposed ~20 km upstream of dam |
| Increase in sediment loads impacting the PDWSA water quality as a result of sediment laden surface water runoff during clearing, mining and rehabilitation activities | 4a | Serpentine Dam | Major | Almost certain | Very high | Mitigation 4 (Section 4) | Moderate | Unlikely | Moderate | Clearing up to the maximum water level of the dam |
| | 4b | Serpentine Dam Pipehead | Moderate | Almost certain | Very high | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 4c | North Dandalup | Major | Almost certain | Very high | | Moderate | Unlikely | Moderate | Clearing proposed within the RPZ |
| | 4d | South Dandalup | Moderate | Almost certain | Very High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 4e | South Dandalup Pipehead | Minor | Almost certain | High | | Minor | Unlikely | Low | Clearing proposed higher in the PDWSA catchment |
| | 4f | Conjurunup Pipehead | Moderate | Almost certain | Very High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 4g | Stirling Dam | Minor | Almost certain | High | | Insignificant | Unlikely | Low | Clearing is proposed ~20 km upstream of dam |
| | 5a | Serpentine Dam | Major | Rare | High | | Minor | Rare | Low | Mining proposed within the RPZ |

| Potential Impact | # | PDWSA | Inherent risk | | | Proposed Controls | Residual risk | | | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Consequence | Likelihood | Risk Rating | | Consequence | Likelihood | Risk Rating | |
| Increase in sediment loads and nutrients affecting PDWSA water quality as a result of spontaneous bush fire ignited by mining activities | 5b | Serpentine Dam Pipehead | Major | Rare | High | Mitigation 5 (Section 4) | Minor | Rare | Low | Mining proposed within the RPZ |
| | 5c | North Dandalup | Major | Rare | High | | Minor | Rare | Low | Mining proposed within the RPZ |
| | 5d | South Dadalup | Major | Rare | High | | Minor | Rare | Low | Mining proposed within the RPZ |
| | 5e | South Dandalup Pipehead | Major | Rare | High | | Minor | Rare | Low | Mining proposed higher in the PDWSA catchment |
| | 5f | Conjurunup Pipehead | Major | Rare | High | | Minor | Rare | Low | Mining proposed within the RPZ |
| | 5g | Stirling Dam | Major | Rare | High | | Minor | Rare | Low | Mining is proposed ~20 km upstream of dam |
| Contamination of PDWSA water quality by unintentional release of hydrocarbons from mining operations, mobilised by surface water runoff | 6a | Serpentine Dam | Major | Unlikely | High | Mitigation 6 (Section 4) | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 6b | Serpentine Dam Pipehead | Major | Unlikely | High | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 6c | North Dandalup | Major | Unlikely | High | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 6d | South Dadalup | Major | Unlikely | High | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 6e | South Dandalup Pipehead | Major | Unlikely | High | | Minor | Unlikely | Low | Mining proposed higher in the PDWSA catchment |
| | 6f | Conjurunup Pipehead | Major | Unlikely | High | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 6g | Stirling Dam | Major | Unlikely | High | | Minor | Unlikely | Low | Mining is proposed ~20 km upstream of dam |
| Contamination of PDWSA water quality by unintentional release of PFAS from mining operations, mobilised by surface water and/or groundwater | 7a | Serpentine Dam | Major | Unlikely | High | Mitigation 7 (Section 4) | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 7b | Serpentine Dam Pipehead | Major | Unlikely | High | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 7c | North Dandalup | Major | Unlikely | High | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 7d | South Dadalup | Major | Unlikely | High | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 7e | South Dandalup Pipehead | Major | Unlikely | High | | Moderate | Rare | Moderate | Mining proposed higher in the PDWSA catchment |
| | 7f | Conjurunup Pipehead | Major | Unlikely | High | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 7g | Stirling Dam | Major | Unlikely | High | | Moderate | Rare | Moderate | Mining is proposed ~20 km upstream of dam |

| Potential Impact | # | PDWSA | Inherent risk | | | Proposed Controls | Residual risk | | | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Consequence | Likelihood | Risk Rating | | Consequence | Likelihood | Risk Rating | |
| Contamination of PDWSA water quality with potential acid sulfate soils (PASS) compounds as a result of soil and sediment removal at waterway crossings | 8a | Serpentine Dam | Moderate | Possible | High | Mitigation 8 (Section 4) | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 8b | Serpentine Dam Pipehead | Moderate | Possible | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 8c | North Dandalup | Moderate | Possible | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 8d | South Dadalup | Moderate | Possible | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 8e | South Dandalup Pipehead | Moderate | Possible | High | | Minor | Unlikely | Low | Clearing proposed higher in the PDWSA catchment |
| | 8f | Conjurunup Pipehead | Moderate | Possible | High | | Minor | Unlikely | Low | Clearing proposed within the RPZ |
| | 8g | Stirling Dam | Moderate | Possible | High | | Minor | Rare | Low | Clearing is proposed ~20 km upstream of dam |
| Contamination of PDWSA water quality with pathogenic microorganisms due to vomiting or toileting within the PDWSA catchment, mobilised either via surface water or groundwater | 9a | Serpentine Dam | Catastrophic | Possible | Very high | Mitigation 9 (Section 4) | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 9b | Serpentine Dam Pipehead | Catastrophic | Possible | Very high | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 9c | North Dandalup | Catastrophic | Possible | Very high | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 9d | South Dadalup | Catastrophic | Possible | Very high | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 9e | South Dandalup Pipehead | Catastrophic | Possible | Very high | | Moderate | Rare | Moderate | Mining proposed higher in the PDWSA catchment |
| | 9f | Conjurunup Pipehead | Catastrophic | Possible | Very high | | Moderate | Rare | Moderate | Mining proposed within the RPZ |
| | 9g | Stirling Dam | Catastrophic | Possible | Very high | | Moderate | Rare | Moderate | Mining is proposed ~20 km upstream of dam |
| Contamination of PDWSA water quality by unintentional release of pesticides and herbicides from mining operations, mobilised by surface water runoff | 10a | Serpentine Dam | Major | Possible | Very high | Mitigation 10 (Section 4) | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 10b | Serpentine Dam Pipehead | Major | Possible | Very high | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 10c | North Dandalup | Major | Possible | Very high | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 10d | South Dadalup | Major | Possible | Very high | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 10e | South Dandalup Pipehead | Major | Possible | Very high | | Minor | Unlikely | Low | Mining proposed higher in the PDWSA catchment |
| | 10f | Conjurunup Pipehead | Major | Possible | Very high | | Minor | Unlikely | Low | Mining proposed within the RPZ |
| | 10g | Stirling Dam | Major | Possible | Very high | | Minor | Rare | Low | Mining is proposed ~20 km upstream of dam |

# 6 Residual impacts

The final residual impacts were either Moderate or Low risks. The following potential impacts were assigned ‘moderate’ residual risk to most of the drinking water reservoirs and dams:

- Potential Impact 4: *Increase in sediment loads impacting the PDWSA water quality as a result of sediment laden surface water runoff during clearing, mining and rehabilitation activities*
- Potential Impact 7: *Contamination of PDWSA water quality by unintentional release of PFAS from mining operations, mobilised by surface water and/or groundwater*
- Potential Impact 9: *Contamination of PDWSA water quality with pathogenic microorganisms due to vomiting or toileting within the PDWSA catchment, mobilised either via surface water or groundwater*

Limitations

The qualitative risk assessment (Table 5.1) is a desktop evaluation based on previous reports and available information. The inherent and residual risks can be quantified more accurately with a comprehensive risk assessment, which would include more complete information such as the quantity of contaminants present on site, the number of point sources of contaminants, and the distance of contaminants from the offtake point, etc.

# 7 Conclusion

Alcoa's proposed Mine DEs for the Huntly and Willowdale mines are situated within Priority 1 PDWSAs, which are highly susceptible to contamination. Consequently, a public drinking water catchment assessment was conducted to identify potential risks to the PDWSAs from Alcoa's proposed mining activities within the Huntly and Willowdale Mine DEs. This assessment focused on the three phases of mining: pre-mining, mining, and rehabilitation.

First, the potential hazards that may impact the PDWSAs were identified. Then, the relationships between potential sources, pathways, and receptors (SPR) were developed. The inherent and residual risks associated with the mining activities during the three mining phases were then quantified. The outcome of the qualitative risk assessment identified one very high residual risk, three moderate residual risks, and the remaining low residual risks. According to WQPN 77 (2022), the very high residual risk will be prioritised for management and control, while moderate and low risks will be monitored to prevent escalation.

The qualitative risk assessment is a desktop evaluation based on previous reports and available information, highlighted the need for a more comprehensive risk assessment incorporating detailed data on contaminants and their sources to accurately quantify inherent and residual risks.

# 8 Limitations

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