# Gingin Minerals Sands Project Closure Plan

February 2023





# Executive Summary

This Closure Plan documents the processes and practices required to achieve satisfactory closure of the Gingin Mineral Sands Project ("the Project"). To achieve satisfactory closure Iluka aims to prevent adverse long-term environmental impacts and to restore a sustainable land use that is acceptable to regulators, post-mining land users and other local stakeholders. Iluka must also comply with all requirements of the conditions of approval, as documented in Ministerial Statement No.666, Planning Consent and Excavation Licence No. 34, Groundwater Licences 104855/2 and 104858/3 and Permit to Obstruct or Interfere 154725/2.

The Project is located approximately 3 kilometres (km) west of the township of Gingin and 80 km north of Perth at the foot slopes of the Gingin Scarp. Mining activities at the Project commenced in mid 2005 and were completed in May 2009.

The landscape is characterised by a gently sloped undulating plain. The predominant surrounding land-uses are rural. Prior to development of the Project, the site was used for livestock grazing. Surface hydrology features included a North and South stream and a small wetland depression in the central portion of the site. The site was dominated by introduced pasture with small patches of remnant eucalypt woodland and melaleuca woodland communities restricted to the streams and water catchment areas and the eastern and northern parts of the site. The fauna habitat value of the area has been heavily degraded by clearing and grazing.

The area disturbed by the Project was 280 ha. The North and South streams were diverted around each end of the site to allow mining of the stream areas. The trees from the Central wetland were removed in preparation for using this area for mining operations. During mining operations, groundwater was extracted from the superficial aquifer and the Yarragadee Aquifer. As a result of dewatering, groundwater levels in the superficial aquifer were locally drawn-down in the area of mining, with prompt recovery observed as mining ceased in each area. No decrease in groundwater levels in the Yarragadee aquifer attributable to mining activity was noted over the life of mine. Groundwater quality remained consistent with background levels over the life of mine.

The base case presented in this Closure Plan is to restore the site to pasture (for sheep and cattle grazing) with native vegetation established along the North and South streams and at the Central wetland. This is consistent with pre-mining land-uses and with the conditions of approval documents.

Alternative land-uses that could provide a local economic benefit, through the use of existing infrastructure, have been discussed with the Shire of Gingin. Any future change in land-use will be dependent on planning approvals from the Shire of Gingin, Department of Planning and Infrastructure and the Western Australian Planning Commission. Iluka would also be required to amend this plan and re-submit it for approval.

Closure objectives and completion criteria have been developed which will be used to demonstrate that the site has been satisfactorily closed. This will facilitate signoff by the EPA and return of the security bond.

The closure objectives for the Project are outlined below.

| Aspect | Objective |
|---|---|
| Safety and public health | Leave the site in a condition where the risk of adverse effects to people, livestock and other fauna, and the environment in general, has been reduced to a level acceptable to all stakeholders. |
| Visual amenity | Develop final landforms that are compatible with the surrounding rural landscape. |
| Final landform | Reinstate soil profiles that are capable of supporting the agreed final landuse. |
| Landform stability | Achieve a condition where the processes affecting the final landform stability are occurring at rates that are suitable for the chosen post mining land use. |
| Pastoral productivity | Reinstate pastoral productivity that, under normal management practices, is typical for the region. |
| Soil contamination | Achieve a condition where contaminants at the site are consistent with the final land use requirements.<br>Minimise the potential for off-site pollution. |
| Groundwater | Achieve a condition where groundwater contaminants at the site are consistent with the final land use requirements.<br>Minimise the potential for off-site pollution.<br>Ensure groundwater recovers from drawdown as a result of mining activities. |
| Surface water and drainage | Reinstate the streams and recreated wetland to a safe sustainable condition.<br>Contour the landform and install drainage structures to achieve a safe stable landform with a low risk of erosion, similar to pre-mining conditions. |
| Native vegetation | Increase the diversity of species and establish self-sustaining, resilient and stable vegetation. |

A risk assessment was conducted with the aim of identifying potential risks associated with the closure activities, along with management actions that are proposed to manage these risks. Key risks identified and their proposed management included:

- Removal and disposal of radiation density gauges – ensuring careful tracking and removal from site as soon as possible.
- Modified Co-disposal stability – ensure stability is assessed, monitored and managed to be suitable for final land use.
- Surface water management – ensure controls and appropriate designs are in place to manage surface water across the site.

Stakeholders for the Project include landowners, neighbours, people within local Shire, non-government organisations and regulators. Consultation with stakeholders will be ongoing throughout the closure process.

Key components of the closure activities to be undertaken include:

- Decommissioning of plant, infrastructure and services.
- Assessment and clean-up of any potential hydrocarbon, soil, groundwater and radiation contamination.
- Management of noise, dust and radiation issues during closure activities.
- Earthworks and reshaping to achieve a final landform that integrates into the surrounding landscape. These earthworks include filling the mine pit, re-contouring dams, and spreading overburden. The post-mining contours will be landscaped to integrate with surrounding landscape and to recreate the catchments for the North and South stream and Central wetland. The material used in the final landform will be selectively placed to achieve suitable stability and land capability.

- The North and South streams will be recreated in locations closely following the original alignments. The recreated streams will have low and high flow zones and incorporate gentle meanders consistent with the flow alignments of similar sized streams in the district. The streams will be designed to ensure the sustainability of the streams in the long-term.
- Native vegetation will be used to rehabilitate the North and South stream and the Central wetland. The total area of native vegetation rehabilitation is approximately 14.7 ha.
- Fencing will be erected along both sides of the rehabilitated length of the North, South and Central streams and around the recreated wetland (Dam 2) to provide protection to the riparian vegetation.
- Stock crossings will be installed across the North and South streams. The stock crossings will provide access across the streams and a stock watering point, whilst protecting the streams from stock impacts, such as sedimentation and nutrient enrichment. The stock crossings will be constructed to also provide an ecological functioning as riffles, whereby they create a pool upstream of the crossing, increase habitat in the river and filter and aerate the water as it passes the crossing.

A detailed monitoring program has been defined to measure progress against closure objectives and completion criteria. This includes:

- Radiation will be monitored across the entire site, on potentially contaminated plant and equipment and in groundwater. The radiation monitoring will demonstrate achievement of completion criteria related to public health and safety and protection of the environment.
- The landform contours will be monitored during reshaping to ensure they blend with the surrounding landscape and are consistent with the final landform design. Stability of the landform will be monitored with inspections of the pasture area once each year and inspections of the streams twice each year.
- Soil pH and potential contamination will be measured during rehabilitation to ensure achievement of the completion criteria.
- Groundwater levels and quality will be monitored in the Yarragadee Aquifer while extraction from the groundwater production bore continues. Groundwater levels will be measured quarterly in superficial aquifer monitoring bores until each bore is recovered to within 1 m of the adjusted pre-mining groundwater level for that bore.
- Quarterly groundwater monitoring will continue until the groundwater quality completion criterion is achieved.
- Stream flow data will be collected continuously at the downstream end of the South and North streams to demonstrate that relative stream flow is similar to pre-mining conditions. Water quality will also be analysed on a quarterly basis.
- Pastoral vegetation will be assessed annually. The agricultural productivity of the rehabilitation pasture areas will also be assessed at least once during the closure period to determine completion criteria have been met.
- Native vegetation will be monitored and will continue to ascertain completion criteria have been met,

Progress of closure activities and assessment of monitoring results and achievement of completion criteria will be reported through continuation of the Annual Environmental Report and Water Resources Review prepared and submitted to regulators on an annual basis.

Implementation of this Closure Plan will ensure that the closure objectives for the project are achieved, prevent adverse long-term environmental impacts and restore a sustainable land use that is acceptable to regulators, post-mining land users and other local stakeholders.

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# 1.0 Introduction

## 1.1 Background

Iluka Resources Limited (Iluka) commenced exploration for mineral sands in the Gingin area in 1971. Extensive drilling programs and economic assessments occurred in the 1970s and 1980s. The Gingin deposit was identified as economically viable and Iluka proceeded to acquire land title to most of the overlying properties. The following sections provide background information on the Gingin Mineral Sands Project ("the Project").

### 1.1.1 Land Tenure

The Project is located entirely within freehold land alienated from the Crown prior to 1899. The freehold title of this land includes the rights to all minerals excluding gold, silver and other precious metals. Iluka owns the majority of the property within the Project, and a landowner agreement is in place for the remaining areas.

A summary of the relevant landowners is shown in Table 1-1. The area owned by Kitson Estate is shown in Figure 1.

**Table 1-1 - Gingin Landowners**

| Landowner | Crown Grant No. | Total area (ha) |
|---|---|---|
| Iluka Resources Limited | Part Swan Locations 128, 354 & 508, Lot 2<br>Part Swan Locations 128 & 340, Lot 3<br>Part Swan Locations 128, 354, 355, 506, Lot 9 | 375 |
| Kitson Estate | Swan Location 506<br>Portion of each of Swan Locations 354 and 508, Lot 1<br>Part Swan Locations 511 & 536, Lot 7 | 51 |

### 1.1.2 Approvals Obtained

Mining Leases are not required on freehold land alienated from the Crown prior to 1899. While mining on this freehold land is not covered by the provisions of the *Mining Act 1978* (WA), the requirements of the *Environmental Protection Act 1986* (WA), *Soil and Land Conservation Act 1945* (WA), *Rights in Water and Irrigation Act 1914* (WA), *Wildlife Conservation Act 1950* (WA) and *Aboriginal Heritage Act 1972* (WA) do apply.

The Project required Planning Approval and an Excavation Licence from the Shire of Gingin, and was referred to the Environmental Protection Authority (EPA) as it was considered likely to have a significant impact on the environment. Iluka referred the proposed development to the Shire of Gingin and the EPA in December 2003.

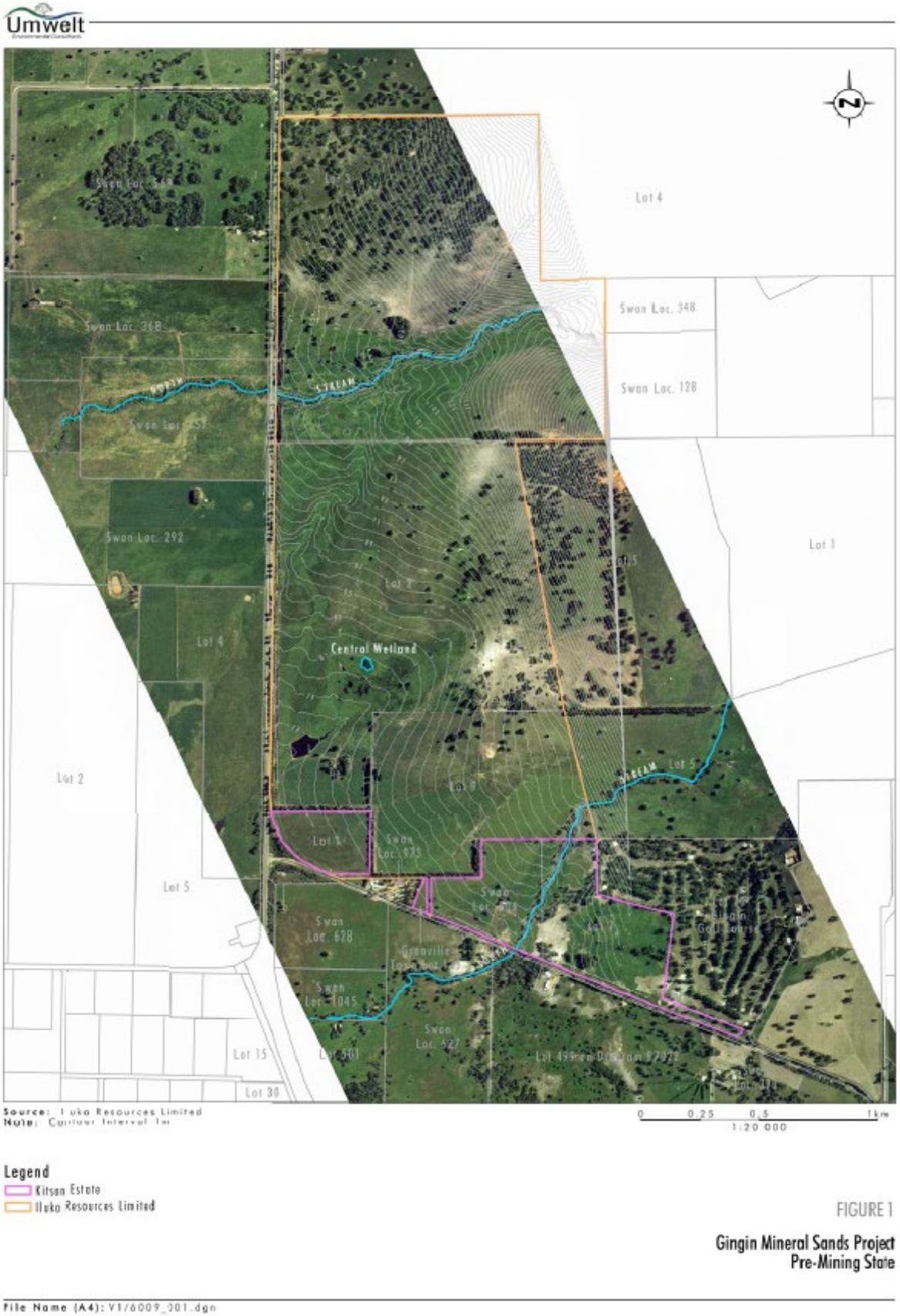



**Figure 1: Pre-Mining Aerial Photo**

The EPA set the level of assessment for the proposal as Environmental Protection Statement (EPS). This level of assessment is generally adopted for projects that are of local interest and raise a number of significant environmental impacts that can be readily managed (EPA 2002). An EPS outlining the existing environment, proposed project description, community consultation, environmental impacts and management and conceptual closure plan was prepared by Iluka and submitted to the EPA in 2004. Following assessment by the EPA, the Ministerial Statement Number 666 was issued in November 2004.

Planning Consent and an Excavation Licence were obtained from the Shire of Gingin in February 2005.

## 1.2 Preceding Documentation

This Closure Plan is preceded by the Conceptual Closure Plan and the Decommissioning and Closure Plan.

The *Conceptual Closure Plan Gingin Mineral Sands Project* (Iluka 2004a) was included as an appendix to the EPS and was the first closure plan for the Project.

*EMP-005 Decommissioning and Closure Management Plan* (Iluka 2004b) was based on the 2004 Conceptual Closure Plan. The Ministerial Approval for the Project required an Integrated Mining and Rehabilitation Plan, including a Decommissioning and Closure Plan, to be prepared to the requirements of the Minister for the Environment. The Decommissioning and Closure Management Plan was approved by the Department of Environment in 2005.

This Closure Plan expands on the concepts provided in the preceding Decommissioning and Closure Plan and includes commitments from other plans in the Integrated Mining and Rehabilitation Plan. Key commitments that are incorporated into this Closure Plan are to:

- fill the mining void and achieve final surface levels final landforms that are compatible with the surrounding rural landscape;
- return the properties to pasture, using current regional and pre-mining agricultural productivity levels as the baseline for the post rehabilitation assessment;
- reconstruct the watercourses with low and high flow channels and gentle meanders consistent with the surrounds and the pre-mining survey; and
- establish native vegetation along reconstructed watercourses.

## 1.3 Purpose of Document

The purpose of this plan is to detail the removal of equipment and infrastructure, remediation where necessary, and rehabilitation of all disturbed areas to comply with the requirements of the Ministerial Approval for the Project. As mining operations ceased in May 2009, this Closure Plan has been prepared to provide detail of the closure activities. Approval is sought for this Closure Plan to replace the previous EMP-005 Decommissioning and Closure Management Plan.

This Closure Plan documents the processes and practices required to achieve satisfactory closure of the Project. The objectives of the closure process are to prevent adverse long-term environmental impacts and to restore a sustainable land use that is acceptable to regulators, post-mining land users and other local stakeholders. This will be achieved by using safe and responsible closure practices.

This plan will be used to communicate the process for closure internally within Iluka, and externally to contractors, landholders, regulatory authorities and the public. This plan describes the regulatory and corporate requirements and the relevant guidelines and

standards pertaining to the closure, and provides details of the activities to be undertaken during closure.

## 1.4 Mining Activities

Mining activities at the Project commenced in mid-2005 and ceased in May 2009.

The ore reserve within the Gingin deposit was contained within a single northwest trending pit. The valuable heavy minerals contained in the ore are ilmenite, rutile and zircon.

The main components of the Project comprise:

- open-cut mining to a maximum depth of 28 m, with tailings backfilled into the mining void;
- an in-pit feed hopper;
- feed conveyors;
- a centrally located screen plant;
- a 250 tph concentrator;
- heavy mineral concentrate (HMC) stockpiles;
- a process water dam;
- a drop out dam;
- a raw water dam
- solar drying dams;
- site office, crib room and ablution block;
- potable water storage;
- workshop and tool shed;
- parking area;
- mine access roads; and
- earthmoving contractors' area (heavy vehicle and light vehicle parking and workshop).

Dry mining techniques were utilised with ore mined using scrapers, which then fed a mining unit at the mid-point of the ore body. In areas containing rock and difficult to access areas, a truck and shovel fleet was utilised.

The ore was fed into a drive-over hopper and then transferred via conveyor to a screening plant. The screen plant separated ore particles of less than 2 mm in size from oversize material, and the fine material was pumped to the wet concentrator. Any oversize product from the screening plant was used for construction of internal roads or placed directly back into the mined-out pits. The mining unit is pictured in Plate 1.

The mining area was dewatered via a sump located on the pit floor. A mobile diesel pump was used to pump pit water back to the process water dam for use in the production process.

The sand tailings produced from the concentrating process consisted of reject sand and water. Tailings were pumped via polyethylene pipes to the in-pit disposal area and dewatered using dewatering cyclones. The underflow from the dewatering cyclones consisted of sand at approximately 70% solids, which was pumped into the mined-out pits or to a tailings sand stockpile. The overflow was returned to the process water dam for re-use in the concentration process.

Clay tailings from the concentrator were pumped to a thickener and then pumped to solar drying dams. Clay tailings may be used as a soil conditioner in the rehabilitation process. A total of 170 ha of solar drying dams were required to contain the estimated 1.53 million tonnes of clay fines produced by the 250 tonnes per hour concentrator over the life of the Project. A total of 103 hectares of land was specifically cleared for solar drying dams. The

remainder of the drying dams were located on the mining area. Where possible, dams were used more than once to minimise the amount of clearing required.

In October 2006 Iluka implemented a new method of disposing clay fines and sand tailings. This is known as a modified co-disposal process and provided an alternative to solar drying dams. Modified co-disposal returned the wet clay, water and sand directly to the mining void. A modified co-disposal cell is pictured in Plate 2. This was a more efficient method than solar drying dams and was conducted within the existing approved areas of disturbance. Modified co-disposal allowed greater recovery of water from tailings, resulting in a reduction in groundwater use. However, the solar drying dams continued to be used when dictated by operational requirements. There is approximately 330,000$m^3$ of clay solids in the Solar Drying Dams.

Access to the mine is from an entry road off Brand Highway, just north of Dewar Road. Iluka upgraded the Brand Highway at this intersection, in consultation with Main Roads WA, to include safety slip lanes and lighting. The haulage route for heavy mineral concentrate from the site is from the entry road, on to Brand Highway, to the Iluka site at Eneabba. On average, there were up to 12 return journeys per day over the life of the project.

The total volume of heavy mineral concentrate extracted over the life of the Project is 1.4 million tonnes.

PLATE 1
**Mining Unit at Gingin Mineral Sands Project**
**View to east with natural landscape in background**

PLATE 2
**Modified co-disposal material pumped into a cell of the mining void at Gingin Mineral Sands Project**

# 2.0 Environmental Aspects

## 2.1 Pre-Mining State

The following sections describe the environment of the site prior to mining development. An aerial photograph showing the site and contours prior to commencement of mining is provided in Figure 1.

### 2.1.1 Location, Landform and Landuse

The site is located approximately 3 kilometres (km) west of the township of Gingin and 80 km north of Perth at the footslopes of the Gingin Scarp.

The landscape is characterised by a gently sloped undulating plain (Plate 3). Prior to mining, the landform was generally flat with an east to west gradient of 1:60, rising more sharply in the east of the orebody (Iluka 2004a). Pre-mining surface contours are shown on Figure 1.

The predominant surrounding landuses are rural. Prior to development of the Project, the site was used for livestock grazing.

### 2.1.2 Soils

The soils at the site are predominantly sandy and were classified by Oracle Soil and Land Pty Ltd (2002) as topsoil, subsoil or overburden depending on the particular soil characteristics and management requirements.

Topsoil covered the entire site to a depth of 150 – 200 mm. The topsoil exhibited optimal physical properties for handling and use in rehabilitation, including soil strength, gravel content and structural stability. However, the topsoil was generally acidic with pH measured in $CaCl_2$ ranging from 4.3 to 4.7. When pH is measured in $CaCl_2$ it is generally lower than pH measured in water by approximately 0.8 units; however, the pH measurement in $CaCl_2$ is less subject to seasonal variation (Department of Natural Resources and Environment 2008). It was recommended to apply lime at a rate of 1.6 t/ha to increase the pH of the topsoil and improve agricultural productivity (Oracle Soil and Land Pty Ltd 2002).

The subsoil was comprised of yellow-brown to red to pale grey sand with yellowish-brown to pale grey gravely clay as a thin lower layer. Similar to the topsoil, the subsoil materials can be handled easily during mining and rehabilitation due to the relatively sandy nature of the materials and the high gravel content in the clay. The low silt and clay content of the sandy material limits its water holding capacity; the incorporation of 10-20% fines material during rehabilitation was recommended to improve water holding capacity and cation exchange capabilities. The subsoil was slightly acidic, with pH ($CaCl_2$) of 5.4 – 5.9 (Oracle Soil and Land Pty Ltd 2002).

PLATE 3
**Undulating rural landscape to the east of Gingin Mineral Sands Project**

The overburden consisted of grey clay and grey siltstone/mottled sandstone soil materials. The grey clay underlay the drainage channels and surrounding floodplains, and was comprised of heavy-textured clay with high bulk density and moderate soil strength. The siltstone/mottled sandstone underlay the entire site and had a massive, cemented soil structure with very high bulk density and soil strength. The siltstone/mottled sandstone also had low organic matter content and high kaolinite clay fraction, resulting in a potential for slaking (collapse of soil structure in wet conditions). Both soil materials had high exchangeable sodium percentage (sodicity), and could slake and disperse if allowed to dry and re-wet. These soils are particularly sensitive to handling and changes in hydrological regime. The overburden was also generally acidic, with pH ($CaCl_2$) between 4.1 and 4.5. Consequently, the overburden should be kept separate from the topsoil and subsoil materials and handling minimised. If the overburden is used in rehabilitation, it was recommended that gypsum should be applied at a rate of 10 t/ha, and the overburden should be mixed with tailings sand and ripped prior to replacement of subsoil and topsoil (Oracle Soil and Land Pty Ltd 2002).

No actual or potential acid sulfate soils were present at the site. However, an area of acidic soils was identified approximately 150 m north to 300 m south of the North stream (Iluka 2007d). The soils in this zone had pH (KCl) between 3.7 and 4.1. The acidic soils were generally 2 – 20 m deep and included zones of topsoil, subsoil, overburden and ore material. The total volume of acidic material was approximately 270,000 $m^3$, which was 2.8 per cent of the total volume of material to be disturbed at Gingin. The recommended management of these acidic soils during rehabilitation was to replace the acidic soil in the soil profile no shallower than the position it was removed from, and treat the topsoil with lime to improve agricultural productivity (Iluka 2004a).

A pre-mining assessment of metals in the soils was also undertaken in October 2003. The results of the soil analysis were interpreted by Oracle Soil and Land Pty Ltd (2004). The pre-mining metals assessment reported naturally high concentrations of arsenic and chromium in the ore material in the central and northern part of the site, and in the overlying soil material in the northern part of the site. The concentration of arsenic was up to 25 mg/kg, and exceeded the environmental investigation level in three pre-mining samples (Oracle Soil and Land Pty Ltd 2004). The average concentration of arsenic was 6 ± 8 mg/kg (Table 2-1). The concentration of chromium (total) was up to 140 mg/kg, and exceeded the environmental investigation level in eleven pre-mining samples (Oracle Soil and Land Pty Ltd 2004). The average concentration of chromium (total) was 54 ± 40 mg/kg (Table 2-1). The elevated arsenic and chromium concentrations may be due to preferential retention of these metals from the base parent minerals and the strongly acidic nature of the soils in the northern part of the site.

The concentration of aluminium (total) was also reported as high, which may create problems of aluminium toxicity if a significant proportion of this aluminium is available to plants. The recommended concentration of soil exchangeable aluminium is 50 mg/kg. Measurements of soluble aluminium (which indicates soil exchangeable aluminium) will be carried out on the topsoil during rehabilitation.

The results of the pre-mining soil metal assessment are summarised in Table 2-1. Analytes that exceeded the guideline levels are highlighted in yellow in the table. All other analytes measured were below the environmental investigation levels, where guideline levels were available (Table 2-1).

**Table 2-1: Results from pre-mining soil assessment for metals and other analytes**

| | Concentration (mg/kg) | | | |
|---|---|---|---|---|
| **Analyte** | **Minimum** | **Maximum** | **Average (mean ± std dev)** | **Environmental Investigation Level (DEC 2006)** |
| Aluminium | 540 | 2100 | 6170 ± 4780 | N/A |
| Arsenic | <1 | 25 | 17 ± 14 | 20 |
| Boron | 1.5 | 87 | 32 ± 27 | N/A |
| Barium | 0.62 | 75 | 13 ± 17 | 400 |
| Calcium | 15.6 | 4330 | 310 ± 970 | N/A |
| Cadmium | <0.05 | 1.3 | 0.48 ± 0.39 | 3 |
| Cobalt | 2.1 | 8.3 | 3.9 ± 1.4 | 50 |
| Chromium (total) | 6.4 | 140 | 54 ± 41 | 50 |
| Copper | <0.05 | 1.8 | 0.58 ± 0.52 | 60 |
| Iron | 960 | 91000 | 32,000 ± 28,000 | N/A |
| Potassium | 13.1 | 8180 | 1070 ± 2100 | N/A |
| Magnesium | 22 | 4730 | 828 ± 1100 | N/A |
| Manganese | 1.3 | 44 | 17 ± 11 | 500 |
| Molybdenum | <0.1 | 1.3 | 0.36 ± 0.36 | 40 |
| Sodium | 25.3 | 721 | 230 ± 190 | N/A |
| Nickel | 0.87 | 50 | 8.1 ± 9.9 | 60 |
| Phosphorus | 2 | 1790 | 330 ± 470 | N/A |
| Lead | 1.7 | 14 | 6.0 ± 2.9 | 300 |
| Sulfate (total sulphur) | 11 | 1100 | 180 ± 250 | 2000 |
| Strontium | 0.3 | 97 | 18 ± 28 | N/A |
| Vanadium | 3.2 | 290 | 63 ± 64 | N/A |
| Zinc | 1 | 29 | 10 ± 9 | 200 |

### 2.1.3 Radiation

A pre-mining background radiation survey was undertaken at the site from October to December 2004, in accordance with the commitments of the EPS. This survey involved 946 measurements over the entire site. The average background radiation across the area was 0.11 ± 0.03 µGy/hour, with a range of 0.06 – 0.17 µGy/hour (Tsurikov N. 2004, memo, 23 December). This was slightly lower than the background radiation levels at Iluka's sites at Eneabba and Geraldton, which recorded average levels of 0.15 – 0.16 µGy/hr.

### 2.1.4 Surface Hydrology, Flow Rates and Water Quality

Surface hydrology features included a North and South stream and a small wetland depression in the central portion of the site (Central wetland) (locations shown in Figure 1). Photos of each of these features prior to mining are shown in Plate 4, Plate 5 and Plate 6. The Central wetland was drained by three small channels to the west, identified as CS2, CS3 and unnamed stream. The North stream and Central wetland were classed as resource enhancement category wetlands, although they were degraded, accessible to livestock and subject to weed invasion (Iluka 2004a).

PLATE 4
North stream at Gingin Mineral Sands Project prior to commencement of operations
Note the grassy banks and established trees

PLATE 5
Central wetland at Gingin Mineral Sands Project prior to commencement of operations
Note the large stand of Melaleucas and understorey of introduced grass with sedges

PLATE 6
South stream at Gingin Mineral Sands Project prior to commencement of operations
Note the natural meanders of the stream channel, with grassy banks and occasional trees

The North and South streams had broadly parabolic, well-grassed cross sections, 30 – 40 metres wide at the top of the channel and 2 – 3 metres deep. A well defined sandy low-flow channel meandered through the base of the streams, typically 1 – 3 metres wide and 0.5 – 1 metre deep. The channels from the Central wetland were considerably smaller grassed waterways. The streams were erosionally stable.

The streams all flowed east to west or southwest. All the streams were ephemeral and typically flowed in response to rain events, with baseflow in winter due to interception of the shallow groundwater table. The streams were typically dry in summer. The Central wetland was a permanent wetland.

#### 2.1.4.1 Characteristics of Streams and Catchments

The catchment area, stream length and slope and land slope for each of the streams prior to mining are provided in Table 2-2. The North stream had the largest catchment area and stream length, with the South stream relatively comparable. The central streams were all considerably shorter and drained smaller catchment areas (URS 2003a).

**Table 2-2: Pre-mining characteristics of streams and catchments (URS 2003a)**

| | North stream | CS3 | CS2 | Unnamed stream | South stream | Total |
|---|---|---|---|---|---|---|
| Catchment Area (ha) | 471 | 65 | 150 | 80 | 286 | 998 |
| Main stream length (km) | 3.3 | 0.71 | 0.96 | 1.02 | 2.36 | |
| Average main stream slope (%) | 2.8 | 1.8 | 1 | 1.5 | 2.3 | |
| Land slope (%) | 0.5-1.3 | 0.2-0.8 | 0.2-0.8 | 0.2-0.8 | 0.3-0.9 | |
| Catchment condition | Grazed open grassland with mature trees along streamlines | Grazed open grassland | Grazed open grassland | Grazed open grassland | Grazed open grassland with mature trees along streamlines | |

#### 2.1.4.2 Surface Water Flow Characteristics

Stream flow was measured from the downstream end of the North stream (NS2), central stream (CS2) and South stream (SS3) from July 2001. These monitoring locations are indicated on Figure 2. The results of the daily stream flow monitoring and monthly rainfall data are presented in Figure 3.

There was a gap in the rainfall data from September 2003 to December 2004. The stream flow monitoring results demonstrated that these streams had a rapid response to rainfall, with large flow peaks corresponding to large rain events. During winter, the streams also had a baseflow component regardless of rainfall, which was probably due to interception of the groundwater table. There was no flow from these streams during summer (typically December to March).

The pre-mining stream flow monitoring period was not long enough to capture sufficient rainfall variability to understand the long-term flow characteristics of the streams. URS undertook modelling of the stream flow characteristics using 113 years of weather data (URS 2003a). The results of the modelling are summarised in Table 2-3.


**Figure 2: Groundwater and Surface Water Monitoring Sites**

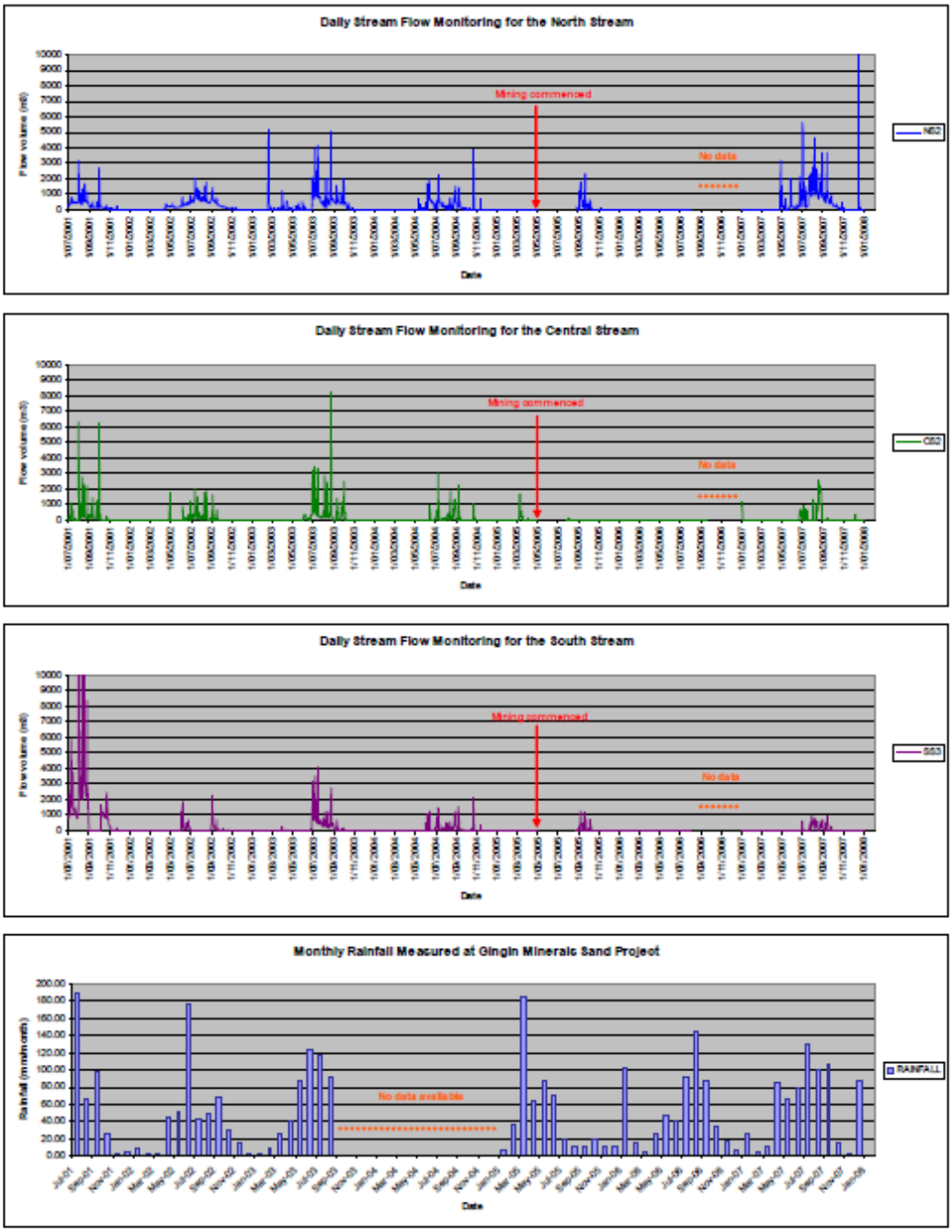



FIGURE 3

Gingin Mineral Sands Project
Results of Daily Stream Flow Monitoring at the North Stream (NS2), Central Stream (CS2) and South Stream (SS3) and Monthly Rainfall Record from 2001 to 2008

Source: Iluka Resources Limited
File Name (A4): V1/6009_006.dgn

**Figure 3: Daily Stream Monitoring and Monthly Rainfall**

**Table 2-3: Predicted runoff from streams in the pre-mining state, determined by modelling (URS 2003a)**

| | | North stream | CS3 | CS2 | Unnamed stream | South stream | Total |
|---|---|---|---|---|---|---|---|
| **Month** | **Rainfall runoff (mm)** | **Runoff (ML)** | | | | | |
| Jan | 1 | 2 | 0 | 0 | 0 | 1 | 5 |
| Feb | 1 | 4 | 0 | 1 | 0 | 2 | 9 |
| Mar | 1 | 6 | 0 | 2 | 1 | 4 | 14 |
| Apr | 2 | 6 | 0 | 2 | 1 | 4 | 15 |
| May | 10 | 42 | 6 | 15 | 8 | 29 | 101 |
| Jun | 30 | 126 | 19 | 45 | 24 | 86 | 302 |
| Jul | 44 | 181 | 28 | 65 | 34 | 124 | 434 |
| Aug | 25 | 104 | 16 | 37 | 20 | 71 | 250 |
| Sep | 8 | 31 | 4 | 11 | 6 | 21 | 76 |
| Oct | 3 | 12 | 1 | 4 | 2 | 8 | 29 |
| Nov | 1 | 3 | 0 | 1 | 0 | 2 | 7 |
| Dec | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| **Total** | **125** | **523** | **81** | **188** | **100** | **358** | **1251** |

The predicted total runoff from all streams was 1.3 GL/year at the downstream boundary of the site.

The North stream crosses Brand Highway through a culvert with a flow capacity of approximately 6 $m^3/s$, which would be sufficient for a 1 in 10 year rain event. The South stream crosses Dewar Road through a culvert with a 9 $m^3/s$ flow capacity, which is equivalent to approximately 1 in 20 year rain event (URS 2003a).

### 2.1.4.3 Surface Water Quality

Pre-mining surface water quality samples were collected two to three times per year from June 2001. Samples were collected upstream and downstream from the North and South streams and the Central wetland, at the stream monitoring locations shown on Figure 2.

The water samples were analysed for a wide range of parameters. Key results are presented in Table 2-4.

There was no significant difference between the upstream and downstream levels for any of the parameters. Many of the parameters were greater than the guideline levels before development of the Project, as shown by yellow highlighting in Table 2-4. Aluminium, nitrate and turbidity were considerably above the guidelines. Conductivity was within acceptable limits. Ammonium and filterable reactive phosphorus were high at the north stream. Nutrients (nitrate, ammonium, TKN, FRP and total phosphorus) were expected to be high due to agricultural use of the land and application of fertiliser.

**Table 2-4: Pre-mining surface water quality measurements (mean ± standard deviation)**

| | North Stream | | Central Wetland | | South Stream | | | Guideline Level |
|---|---|---|---|---|---|---|---|---|
| **Analyte** | **Upstream (NS1)** | **Downstream (NS2)** | **Upstream (CS1)** | **Downstream (CS2)** | **Upstream (SS1)** | **Upstream (SS2)** | **Downstream (SS3)** | |
| Aluminium (mg/L) | 0.3±0.2 | 0.3±0.2 | 0.06±0.03 | 0.3±0.3 | 0.3±0.2 | 0.2±0.1 | 0.3±0.1 | 0.055[1] |
| Conductivity (mS/m) | 140±80 | 150±60 | 50±20 | 60±20 | 140±30 | 70±10 | 80±10 | 300[1] |
| Nitrate (NO3) (mg/L) | 4±3 | 3±2 | 0.8 | 1.7 | 4.3 | 1.9 | 2.3 | 0.15[1] |
| Ammonium-N (NH3) (mg/L) | 0.1±0.2 | 0.1±0.2 | 0.05±0.05 | 0.05±0.02 | 0.02±0.01 | 0.02±0.01 | 0.03±0.02 | 0.08[1] |
| Total Kjeldahl Nitrogen (TKN) (mg/L) | 1.2±0.9 | 1.2±0.9 | 3.0±1.3 | 3.6±1.0 | 1.6±0.4 | 2.1±0.4 | 2.1±0.3 | N/A |
| Filterable Reactive Phosphorus (FRP) (mg/L) | 0.13±0.07 | 0.11±0.06 | 0.013±0.006 | 0.013±0.005 | 0.018±0.015 | 0.016±0.005 | 0.016±0.005 | 0.04[1] |
| Total Phosphorus (mg/L) | 0.5±0.5 | 0.4±0.6 | 0.10±0.07 | 0.2±0.2 | 0.05±0.03 | 0.06±0.02 | 0.07±0.03 | 0.065[1] |
| Total Suspended Solids (TSS) (mg/L) | 76±96 | 109±239 | 15±12 | 7±2 | 16±8 | 8±5 | 15±19 | 40[2] |
| Turbidity (NTU) | 40±32 | 47±76 | 14±13 | 36±42 | 15±12 | 14±7 | 19±13 | 20[1] |
| pH | 8.0±0.3 | 8.0±0.3 | 7.2±0.3 | 7.2±0.4 | 8.2±0.4 | 7.6±0.2 | 7.7±0.3 | 6.5-8.5 |

1 *Australian and New Zealand Guidelines for Fresh and Marine Water Quality Volume 1* (ANZECC and ARMCANZ 2000)
2 *Water Quality for Maintenance of Aquatic Ecosystems: Appropriate Indicators and Analysis*, Australia: State of the Environment Technical Paper Series (Inland Waters) (Liston and Maher 1997)

### 2.1.5 Groundwater Levels and Quality

Pre-mining water levels in bores were monitored monthly to bi-monthly between January 2001 and September 2003. This monitoring indicated that:

- groundwater levels were consistent and predominantly in the range of 75 – 85 mAHD;
- depth to groundwater in the north of the site was approximately 10 – 20 m; in the central area the groundwater was approximately 4 – 14 m deep; and in the southern end of the site the depth to groundwater was approximately 2 – 12 m deep; and
- groundwater levels fluctuated by 0.5 – 1.5 m on a seasonal basis.

Groundwater quality monitoring was conducted on a quarterly basis from July 2001 to September 2003. The results of this monitoring concluded that:

- the groundwater was predominantly brackish, with TDS of 1,200 – 5,000 mg/L;
- TDS concentrations were relatively consistent for each bore;
- fresh groundwater (less than 1,000 mg/L TDS) was present in the bores along the north-west boundary and the south-west boundary of the site;
- the groundwater was slightly acidic, with pH or 5.3 – 6.5; and
- the groundwater was of a sodium-chloride type.

Groundwater flow in the local superficial formations is predominantly in a westerly direction, with subtle variations that reflect the surface topography (URS, 2003b).

### 2.1.6 Pastoral Productivity

An agricultural assessment was undertaken by John Wise Consultancy in 2001. Soil samples were collected by auger at 25 sites across the site and analysed by a laboratory. The results of the soil analysis indicated that:

- pH was within the optimum range for pasture growth;
- electrical conductivity denoted that salt was not high;
- phosphorus was low in some areas, indicating lack of fertilizer application, and high to very high in other areas;
- potassium was low to moderate;
- phosphorus retention index was low in some areas, but high in areas with loamy soils.

Composition of pasture was assessed by recording species frequency along a one metre transect at each site. In the southern half of the site the dominant species was cape weed. There were also significant areas (up to 70%) bare ground at some sites. Other species that comprised the pasture included lotus, sub clover and ‘other grasses’. In the northern half of the site, ‘other grasses’ were dominant. Other species present included cape weed, blue lupin, sub clover and flat weed. There were also sites that had up to 60% bare ground.

The pasture yield was subjectively assessed. The agricultural productivity varied between 1 – 2 tonnes per hectare and 6 – 8 tonnes per hectare, depending on soil characteristics and management. Areas with low agricultural productivity were limited by the soil condition (poor ability to retain nutrients, water repellent surface soil and poor water holding capacity) and by inadequate management (insufficient fertilizer application, high grazing pressure, spraying of weeds that also eliminated sub clover). Areas with higher agricultural productivity were subject to lighter grazing, no weed spraying and had sufficient fertilizer application.

It was concluded that with good management the site could be rehabilitated to good grazing land with total annual dry matter pasture yields of 8 – 9 tonnes per hectare (John Wise Consultancy 2001). It was also recommended that close attention should be given to the surface drainage and selection of pasture species during rehabilitation (John Wise Consultancy 2001).

### 2.1.7 Flora

A vegetation survey was undertaken in 2004. The site was dominated by introduced pasture with small patches of remnant eucalypt woodland and melaleuca woodland communities restricted to the streams and water catchment areas and the eastern and northern parts of the site. No threatened flora species or vegetation communities were identified within the site (Mattiske Consulting Pty Ltd 2004).

The vegetation of the North stream consisted of disturbed woodland of *Melaleuca rhaphiophylla* with emergent *Corymbia calophylla* over perennial veldt grass, blue lupin, barley grass and cape weed.

The Central wetland vegetation consisted of a single stand (approx. 0.2 ha) of disturbed woodland of *Melaleuca rhaphiophylla* with emergent *Eucalyptus rudis* and *Corymbia calophylla* over perennial veldt grass, blue lupin, barley grass and cape weed.

The South stream vegetation consisted of disturbed woodland of *Eucalyptus rudis* over perennial veldt grass, blue lupin and cape weed.

Pockets of native vegetation were also present along the central eastern boundary and the northern part of the site. This vegetation comprised disturbed woodland of *Corymbia calophylla* over *Hakea prostrata*, Xanthorrhoea *preissii*, *Grevillea vestita* subsp. *vestita, Hakea prostrata, Mesomelaena pseudostygia,* perennial veldt grass, cape weed, blue lupin*,* **Ursinia anthemoides* and **Hypochaeris glabra* (smooth cats ear).

Undesirable introduced species included *Acacia pycnantha* (golden wattle), a declared plant in the Gingin area requiring management to prohibit movement and aim to eradicate infestation; and *Solanum linneanum* (apple of Sodom) and *Zantadeschia aethiopica* (arum lily), which are declared plants in the areas south of Perth.

### 2.1.8 Fauna

A fauna survey was conducted in March 2004. The habitat value of the area has been heavily degraded by clearing and grazing (Iluka 2004a). During the fauna survey, the following species were observed:

- 20 bird species – none of which were rare or priority species.
- 5 mammal species, which were *Vulpes vulpes* (red fox), *Oryctolagus cunuculus* (European rabbit), *Mus musculus* (house mouse), *Rattus norvegicus* (brown rat), and *Macropus fuliginous* (western grey kangaroo). Of these species, only the western grey kangaroo is native.
- 3 reptile species including a gwardar (western brown snake) and skinks.

The EPBC Act Protected Matters and CALM Databases indicated that the schedule 1 species *Calyptorhynchus baudinii* (Baundin's cockatoo) and *Calyptorhynchus latirostris* (Carnaby's cockatoo) may be present in the Gingin area; however, neither of these species was observed at the site.

The site had limited habitat value due to extensive clearing and use for grazing. The native habitats were isolated and degraded, and lacked understorey. Potential bird and marsupial nesting sites were occupied by feral bees. No vegetation corridors were present. Marri trees provided nectar resources but the lack of habitat limited the use of this resource.

Similarly there was a lack of habitat and native fauna in the creeks and wetland. Fauna observed in the North creek comprised two backswimmers, a diving beetle and a brown rat. No birds were observed. Filamentous algae, *Azolla* and grass were growing in the creek,

and several decomposed livestock carcasses were observed along the creekline. Deep pools are a desirable habitat for fish and amphibians. No deep pools were found in the streams (Iluka 2004a).

### 2.1.9 Aboriginal and European Heritage

Aboriginal heritage investigations were conducted in 2001 – 2002. A desktop survey of potential Aboriginal archaeological and ethnographic issues indicated that archaeological sites may be likely in the vicinity of the North and South streams. However, no Aboriginal archaeological material was located in the survey. An ethnographic survey was conducted with representatives from the Yued native title claim working party and two Aboriginal consultants from the Bibbulmun Tribal Group. No ethnographic sites were identified that would be impacted by the proposed development. Concern was raised that mining activities may impact on the drainage system, and it was requested that native vegetation be retained or salvaged where possible (Iluka 2004a).

One historic European site was known to exist within the site. This site was recorded on the Shire of Gingin's register of historic sites, and comprised the ruins of Beauly's Farmhouse. The historic ruins were relocated by Iluka to the town of Gingin, in consultation with the Shire of Gingin.

## 2.2 Post-Mining State

The post-mining state describes the environment of the site at the completion of mining and prior to closure activities. The Project ceased operations in May 2009. Figure 4 shows an aerial photograph of the site and site layout as at October 2008.

The area of disturbance of the Project is 280 ha (Domain 1 and Domain 2 in Figure 4).

### 2.2.1 Landform

The landform has been heavily altered due to the project development (Figure 4). 280 ha was disturbed by the Project.

The majority of the site has been cleared, with topsoil, subsoil and overburden stripped and stockpiled separately. Mining has progressed from the south to the north, to a maximum depth of 28 metres (see photo of mining area in Plate 7). All completed mining pits (voids) will be backfilled during closure earthworks, with material that is currently stockpiled above original ground level.

Modified co-disposal material produced through the mineral sands processing has been progressively pumped into cells in the mining pit. Solar drying dams are also located over much of the site (Plate 8). A drop-out dam, process water dam and raw water dam were constructed on the west side of the site (Figure 4, Plate 9 and Plate 10). The water dams and the majority of solar drying dams were constructed using cut-and-fill methodology.

The administration area has a bitumen entry road and ring road, with some concrete car parking facilities (see Plate 11). The product stockpile is also located near the administration area (Plate 12). Haul roads have also been constructed throughout the site.

### 2.2.2 Soils

The soils at the completion of mining include stockpiled natural soils and soil materials modified as a result of mining operations.

The stockpiled natural soils include topsoils, subsoils and overburden, which were removed prior to mining and stockpiled separately. Natural soil materials from the areas of acidic soils were stockpiled separately. In accordance with Gingin Soil Management Plan (Iluka, 2007d) acidic soil was generally replaced no shallower in the soil profile than the position it was removed from, except for acidic sand and clay tailings resulting from processing acidic ore.

When the acidic ore material from the zone near the North stream was processed, the resulting tailings were also acidic. The acidic portion of the modified co-disposal material was buried in the mine pit during mining operations.

The mining operations concentrated the mineral sands to form heavy mineral concentrate, which was removed from the site. The waste materials resulting from the processing consisted of sand and clay tailings in slurry with water. Two methods were used to dispose of this waste material. The first method involved dewatering the sand and stockpiling it separately, and pumping the clay to solar drying dams.

The second method of disposal involved modified co-disposal of the sand and clay. The sand and clay were pumped together with a flocculant directly into co-disposal cells in the mine pit.

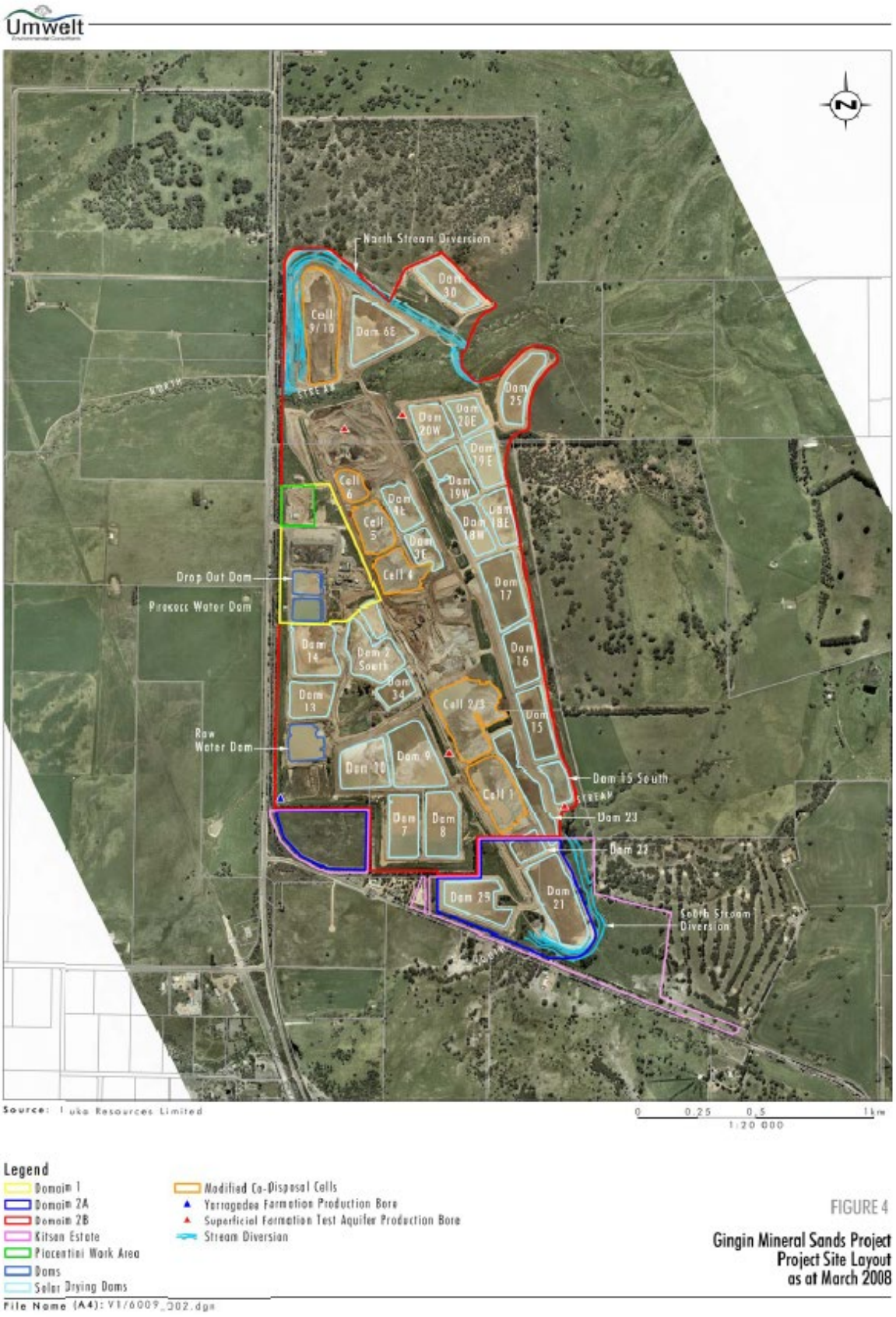



**Figure 4: Project Site Layout as at March 2008**

PLATE 7
Mining area at Gingin Mineral Sands Project
The foreground shows dewatering of modified co-disposal material

PLATE 8
Clay tailings in a Solar Drying Dam at Gingin Mineral Sands Project

PLATE 9
**Raw Water Dam at Gingin Mineral Sands Project**

PLATE 10
**Process Water Dam at Gingin Mineral Sands Project**
**Water is pumped from the Process Water Dam for use in mineral sand processing**

PLATE 11
**Administration area at Gingin Mineral Sands Project**

PLATE 12
**Heavy Mineral Concentrate product stockpile at Gingin Mineral Sands Project**

## 2.2.3 Radiation

Environmental radiation monitoring included measuring radiation levels at the site boundary once each year; analysis of dust samples collected twice each year for radioactivity; analysis of the radioactivity of groundwater samples collected once each year; and analysis of the thorium and uranium concentrations in tailings once each month. The results of the environmental radiation monitoring are reported to the Department of Mines and Petroleum annually (Iluka 2007g). A summary of each of these monitoring programs is provided in the following sections.

### 2.2.3.1 Site Boundary

Radiation surveys of the site boundaries were undertaken once each year from 2004. The results of these surveys are presented in Table 2-5.

**Table 2-5: Radiation survey results**

| Survey Date | No. of measurements | Range (µGy/hr) | Average (µGy/hr) |
|---|---|---|---|
| December 2004 | 946 | 0.06 – 0.17 | 0.11±0.03 |
| November 2005 | 111 | 0.07 – 0.25 | 0.11±0.04 |
| September 2006 | 169 | 0.05 – 0.22 | 0.11±0.03 |
| June 2007 | 185 | 0.02 – 0.13 | 0.08±0.02 |

These results indicate that the average radiation dose rate at the site boundary has not changed significantly since mining activities commenced.

### 2.2.3.2 Dust Monitoring

High volume dust samples were collected from eight sites around and near the site, twice each year. Results collected during 2008 and 2009 showed a radiation concentration of close to zero mBq/m3 for all monitoring sites, which equates to well below the dose limit of 1 mSv/yr (Iluka 2007g). From these results, it is considered that the dust generated by mining activities does not cause a radiation hazard to members of the public.

### 2.2.3.3 Groundwater Monitoring

Water samples were collected from a selection of groundwater bores and analysed for radioactivity. The results are presented in Table 2-6 below. The locations of the groundwater bores are indicated in Figure 2.

## Table 2-6: Results of Radioactivity Analysis of Groundwater 2006 - 2009

| Location in site | Bore | Date | Ra-226 (mBq/L) | Ra-228 (mBq/L) | Th-228 (mBq/L) |
|---|---|---|---|---|---|
| | GS22 (reference) | Aug-06 | 34±11 | 820±331 | <100 |
| | | Apr-07 | 123±27 | 583±280 | <100 |
| | | May-08 | 163±38 | 680±272 | 421±113 |
| | | Apr-09 | 78±22 | 304±137 | 333±118 |
| | | Average | 99.5 | 596.8 | 377 |
| Northern boundary | GS1 | Aug-06 | 4±2 | <100 | <100 |
| | | Apr-07 | <3 | 230±161 | 428±70 |
| | | May-08 | 8±5 | 277±135 | 483±114 |
| | GS2 | Aug-06 | 6±2 | <100 | <100 |
| | | Apr-07 | 3±1 | 288±90 | <100 |
| | | May-08 | 175±37 | 682±190 | <100 |
| Central eastern | GS5 | Aug-06 | 4±2 | 647±464 | <100 |
| | | Apr-07 | 24±10 | 121±113 | <100 |
| | | Apr-09 | 4±3 | 370±197 | 227±89 |
| | GS6 | Aug-06 | 14±5 | <100 | <100 |
| | | Apr-07 | 92±23 | <100 | <100 |
| | | May-08 | 117±30 | 669±231 | 763±140 |
| | | Apr-09 | 20±9 | 249±108 | <100 |
| | GS7 | May-08 | 136±30 | 535±185 | <100 |
| | | Apr-09 | 25±10 | 243±104 | <100 |
| Boundary to Kitson Estate | GS8 | Aug-06 | 43±12 | 510±388 | <100 |
| | | Apr-07 | 56±17 | 253±93 | <100 |
| | | May-08 | 138±33 | 234±127 | <100 |
| | GS9 | Aug-06 | 5415 | 498±246 | <100 |
| | | Apr-07 | 33±12 | 564±234 | <100 |
| | | May-08 | 73±21 | 502±167 | 662±156 |
| | | Apr-09 | 60±22 | 377±193 | 357±115 |
| | GS10 | Aug-06 | 36±12 | 193±78 | <100 |
| | | Apr-07 | 17±7 | 624±112 | <100 |
| | | May-08 | 55±18 | 378±149 | <100 |
| | | Apr-09 | 17±8 | 429±164 | <100 |
| | GS11 | May-08 | <100 | <100 | <100 |
| | | Apr-09 | 50±18 | 266±150 | <100 |
| South west corner | GS12 | Aug-06 | 99±24 | 556±224 | <100 |
| | | Apr-07 | 62±17 | 598±263 | <100 |
| | | May-08 | 41±15 | 420±155 | 320±90 |
| Uncleared area near Central wetland | GS13 | Aug-06 | 38±12 | <100 | <100 |
| | | Apr-07 | 9±4 | 428±148 | <100 |
| | | May-08 | 126±32 | 189±68 | <100 |
| | | Apr-09 | 93±24 | 160±82 | <100 |
| Western boundary | GS14 | Aug-06 | 82±21 | 236±135 | <100 |
| | | Apr-07 | 48±15 | 536±218 | <100 |
| | | May-08 | 39±14 | 492±233 | <100 |

| Location in site | Bore | Date | Ra-226 (mBq/L) | Ra-228 (mBq/L) | Th-228 (mBq/L) |
|---|---|---|---|---|---|
| | GS15 | Apr-09 | 10±5 | 278±153 | 322±110 |
| | GS16 | May-08 | 78±23 | <100 | <100 |
| | GS17 | Aug-06 | 1039±129 | 300±151 | <100 |
| | | Apr-07 | 22±9 | 529±243 | <100 |
| | | May-08 | 560±81 | 806±274 | 152±45 |
| South central | GS20 | Aug-06 | 115±26 | <100 | <100 |
| | | Apr-07 | 9±4 | 573±150 | <100 |
| | | May-08 | 159±37 | 727±220 | <100 |
| Kitson Estate, east of mined areas | GS21 | Aug-06 | 23±7 | <100 | <100 |
| | | Apr-07 | 4±3 | 192±121 | 403±81 |
| | | May-08 | 161±34 | <100 | <100 |
| | | Apr-09 | 85±26 | 325±168 | <100 |
| Kitson Estate | GS23 | Aug-06 | 91±22 | 465±282 | <100 |
| | | Apr-07 | 46±15 | 340±178 | <100 |
| | | May-08 | 83±22 | 177±66 | <100 |
| | | Apr-09 | 75±22 | <100 | <100 |
| | GS24 | May-08 | 49±16 | 201±123 | <100 |
| | | Apr-09 | 79±24 | 301±113 | <100 |
| | GS25 | May-08 | 194±77 | 403±178 | 617±154 |
| **Investigation Level (DOCEP and MCA 2007c)** | | | **500 Or 2 x pre-mining levels** | **200 Or 2 x pre-mining levels** | **N/A** |

The investigation levels are drawn from the Draft Radiation Safety Guidelines. However, in areas that have high naturally occurring radiation, the relevant investigation level is twice the pre-mining background radiation level. No analysis of the pre-mining groundwater radioactivity was undertaken for the Project. In this case, it is appropriate to use the background radiation level from an area not impacted by mining as a reference (DOCEP and MCA 2007c).

At the site, groundwater generally flows in a westerly direction. GS22 was selected as an appropriate reference site for groundwater radiation, as it is to the east of the site (so would not be affected by groundwater from the operations) and is the furthest groundwater monitoring bore from the site.

Results presented above average background levels at bore GS22, with consideration of standard deviation, are highlighted in blue text in the table above.

### 2.2.3.4 Tailings Monitoring

Sand tailings, clay tailings and modified co-disposal material were analysed for uranium and thorium on a monthly basis from October 2005 onwards. The average concentration of thorium in tailings was 7 ppm, and the average concentration of uranium was 1 ppm (Iluka 2007g). This results in radioactivity of the tailings of 0.04 Bq/g, which is below the threshold at which material is considered radioactive (International Atomic Energy Agency 1996).

## 2.2.4 Surface Hydrology

### 2.2.4.1 Characteristics of Streams and Catchments

Stormwater from the site was collected in the Raw Water Dam, where some sedimentation takes place before the water was pumped to the Drop Out Dam for further sedimentation. The water was finally pumped to the Process Water Dam, where it was used for mineral sands processing or discharged from the licensed discharge point. This water management system remained at the commencement of closure activities.

The North and South streams were diverted around each end of the site in accordance with the Permit to Obstruct or Interfere with stream bed and banks, to allow mining of the stream areas (Figure 4). The trees from the Central wetland were removed in preparation for using this area for mining operations. However, due to the low-lying nature of the land around the Central wetland, the area was too damp for vehicular access much of the year. The majority of the Central wetland area was not used for mining operations.

The pre and post-mining catchment and stream characteristics are outlined in Table 2-7. The post-mining characteristics are based on the stream diversion designs (URS 2003a).

The stream diversions were designed to result in small changes in catchment area and runoff for the North and South streams. The flows to and from the Central wetland were disturbed by the mining operations, as surface water from the site was collected and used in mining operations.

**Table 2-7: Pre and post-mining catchment and stream characteristics (URS 2003a)**

| | North stream | CS3 | CS2 | Unnamed stream | South stream | Total |
|---|---|---|---|---|---|---|
| Pre-Mining Catchment Area (ha) | 471 | 65 | 150 | 80 | 286 | 998 |
| Post-Mining Catchment Area (ha) | 443 | 233 (drains to raw water dam) | | | 322 | 998 |
| Pre-Mining Main Stream Length (km) | 3.3 | 0.71 | 0.96 | 1.02 | 2.36 | |
| Post-Mining Main Stream Length (km) | 4.1 | N/A | | | 3.2 | |
| Pre-Mining Average Main Stream Slope (%) | 2.8 | 1.8 | 1 | 1.5 | 2.3 | |
| Post-Mining Average main stream slope (%) | 2.3 | N/A | | | 0.8 | |
| Pre-Mining Predicted Average Annual Runoff (ML) | 523 | 81 | 188 | 100 | 358 | 1251 |
| Post-Mining Predicted Average Annual Runoff (ML) | 571 | Runoff across site, not through pre-mining streams | | | 337 | 908 |

### 2.2.4.2 Surface Water Flow Characteristics

Stream flow has been measured from the downstream end of the North stream (NS2), central stream (CS2) and South stream (SS3) from July 2001 onwards. These monitoring locations are indicated on Figure 4. The results of the daily stream flow monitoring from 2001 to 2006 are presented in Figure 3, along with monthly rainfall data. There was a gap in

the rainfall data from September 2003 to December 2004. There was also a gap in the stream flow data from September 2006 to January 2007. It is expected that there was negligible flow in the streams during this time.

Due to the generally low stream flows and high variability when the streams did flow combined with the short mine life, it is difficult to observe any changes to stream flows that may be a result of mining operations.

#### 2.2.4.3 Surface Water Quality

During mining, surface water quality samples were collected quarterly, when streams were flowing. Samples were collected upstream and downstream from the North, South streams and the Central stream, at the stream monitoring locations shown on Figure 2. The water samples were analysed for a wide range of parameters.

Surface water quality samples were also collected weekly from the Process Water Dam from 2007, to monitor water quality against the criteria for discharge from the Licensed Discharge Point. In addition, continuous loggers measured and recorded turbidity at the downstream end of the North and central streams and electrical conductivity at the downstream end of the North, Central and South streams.

Differences between chemical analysis for before and during mining were assessed by Golder Associates (2009) by calculating relative percentage difference (%RPD) based on the following equation;

$$\% \text{ RPD} = (\text{Conc. A} - \text{Conc. B}) / (\text{Conc. A} + \text{Conc. B}) * 200$$

Where Conc. A is the concentration of a given chemical analyte prior to the commencement of mining and Conc. B is the concentration of that same analyte once mining had begun. Where the result of the % RPD calculation was greater than 50%, that analyte was highlighted as having changed significantly following the commencement of mining (refer to Appendix 1).

Changes in water quality are evident at locations both upstream and downstream of the mining operation, and as such, it appears that influences off the site have contributed to surface water quality conditions.

Total suspended solids and turbidity increased significantly from the pre-mining levels at the Central wetland upstream site. This site is within the mining area; the increase in total suspended solids and turbidity is an expected effect of mining operations. Total suspended solids and turbidity increased slightly at the Central wetland downstream site. These measurements were actually taken from the Process Water Dam, as the discharge from the Licensed Discharge Point flows into the central stream. Although total suspended solids and turbidity were higher during the mining operations than pre-mining, they remained within the parameters required by the Licence for Prescribed Premises (Figure 5).

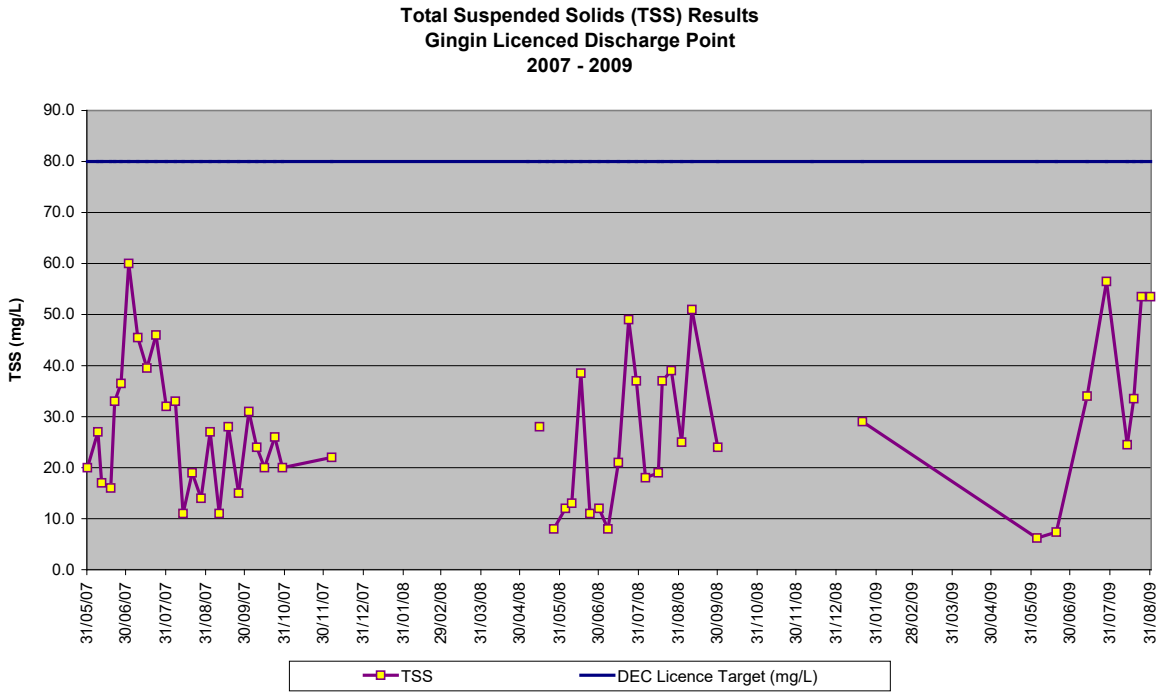



**Figure 5: Water Quality at Licensed Discharge Point, 2007 – 2009**

### 2.2.5 Groundwater Levels

During mining operations, groundwater was extracted from the superficial aquifer and the Yarragadee Aquifer. The superficial aquifer is monitored at a number of sites. The Yarragadee Aquifer is monitored in one location near the point of extraction at the groundwater production bore.

Groundwater from the superficial aquifer was dewatered to allow mining to proceed. As a result of dewatering, groundwater levels were locally drawn-down in the area of mining, with prompt recovery observed as mining ceased in each area. Long-term trends of groundwater levels in monitoring bores were assessed by URS in the Annual Aquifer Review for 2008 (URS, 2009). This report is included in Appendix 2. Groundwater bores which demonstrated an impact from groundwater drawdown included GS20, GS4, GS5, GS8 and GS9; all of which showed a recovery to pre-mining levels within a 12 to 18 month period. Overall, dewatering of the superficial aquifer has resulted in some areas of localised decline, however, the decline is less than predicted levels and has not affected off-site bores (URS, 2009).

Since 2000, water levels recorded in regional superficial aquifer groundwater bores have been decreasing by approximately 0.15 m/year (Rockwater 2008). Since mining began, the groundwater levels in the regional monitoring bores have declined by an average of 0.75m (URS, 2009).

Groundwater is extracted from the Yarragadee Aquifer from the groundwater production bore. The Yarragadee monitoring bore shows strong seasonal fluctuations in groundwater levels since 2005, with a slight overall downward trend. Other Yarragadee bores in the region demonstrate a decrease in groundwater levels of approximately 0.75 m/year since 2000, which indicates that the decreasing water levels are due to regional effects rather than mining operations (Rockwater 2008).

### 2.2.6 Groundwater Quality

Groundwater samples have been collected quarterly since January 2003 and analysed for a range of parameters. A summary of long-term groundwater quality trends, including pre-mining results is presented in 2008 Annual Aquifer Review, included in Appendix 2 (URS, 2009). Groundwater quality has not changed significantly following the onset of dewatering and mining in 2005, with generally stable concentrations of major cations and anions, and groundwater salinity.

The major findings from the 2008 Annual Aquifer Review were:

- Groundwater salinity in the superficial aquifer is generally brackish, with 2008 concentrations ranging from 200 mg/L to 5,200 mg/L TDS. All concentrations in 2008 were within background concentrations and have not changed significantly since mining commenced. Groundwater salinity in the Yarragadee bore GYP1 remained stable in 2008, ranging from 1,100 mg/L to 1,600 mg/L.
- The pH of groundwater in the Yarragadee aquifer bore was relatively stable throughout 2008, with groundwater being neutral to slightly alkaline, with an average of pH 8.0 (range 7.8 – 8.4).
- The pH of groundwater in the superficial aquifer in 2008 was generally slightly acidic, ranging from 3.1 to 7.1, with an average of 5.7. The slightly acidic groundwater in the superficial aquifer is generally within long-term averages and similar to pre-mining (2003 and 2004) values.
- Aluminium concentrations in groundwater remained relatively stable in the majority of bores throughout 2008, with the exception of bores GS2S/D, GS8S, GS13M/D, GS21S, GS22S and GYP1, which recorded fluctuating concentrations.
- Groundwater alkalinity concentrations are highly variable across the site, ranging from 5 mg/L to 190 mg/L throughout 2008.

A further review of groundwater acidity undertaken by Golders in 2009 (Appendix 1) identified that alkalinity is highly variable at the site although it can generally be considered to be at levels above 60 mg/L $CaCO_3$ equivalents. Al has been recorded at levels in excess of 1 mg/L in GYP1 and GS21S during licence related monitoring, however only limited Al results are available for bores pre-mining and therefore it cannot be determined whether Al was already elevated in these bores prior to the initiation of ground disturbance at the mine. Average pH over the licence monitoring period (2003 – 2009) for all bores is 6.35 (0.7 standard deviation) and can therefore be considered generally constant. Sulfate concentrations are more variable with average values varying up to approximately 300% (166 (324) mg/L).

It is likely that groundwater composition at the mine site reflects the composition of the soils into which the monitoring bores were constructed. A review of the bore logs for the construction of the groundwater wells did not indicate a substantial variability on soil types and thus did not provide an answer as to why some bores (e.g. GS10) have lower pH than others at the site (Golders Associates, 2009).

### 2.2.7 Flora and Fauna

The area of disturbance of the Project is 280 ha (Domain 1 and Domain 2 in Figure 4). This area has been cleared and little flora and fauna remain, with the exception of some areas of introduced pasture.

Flora outside the area of disturbance has not been disturbed. This includes a section of native vegetation to the north of the site, on Iluka land, which can be seen in Figure 4.

# 3.0 Regulatory Requirements and Commitments

Project approvals, agreements and legislation relevant to closure of the Project in are detailed below.

## 3.1 Legislation

Legislation relevant to closure of the Project is listed and detailed in Table 3-1. Details of specific approvals under the legislation are provided in the following sections.

**Table 3-1: Legislation to be considered in closure**

| Legislation | Relevance |
|---|---|
| Environmental Protection Act 1986 (WA) | Requirements are outlined in the approval granted under this Act – Ministerial Statement 666. |
| Mines Safety and Inspection Act 1994 (WA) | This Act provides a framework for the promotion and improvement of health and safety of persons at mines. The primary relevance is in management of radiation impacts on mine personnel. Radiation impacts will be managed during closure according to the *Mid-West Operations Radiation Management Plan* (Iluka 2007a). |
| Radiation Safety Act 1975 (WA)<br>Radiation Safety (General) Regulations 1983 (WA)<br>Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) | This Act relates to the keeping and use of radioactive substances and establishes the Radiological Council. The site was registered with the Radiological Council due to the presence of radiation density gauges on site. Relocation of the radiation density gauges will be managed in accordance with the requirements of legislation and the *Code of Practice for Portable Density/Moisture Gauges Containing Radioactive Sources* (ARPANSA 2004). Radiation impacts on personnel will be managed during closure according to the *Mid-West Operations Radiation Management Plan* (Iluka 2007a). |
| Soil and Land Conservation Act 1945 (WA) | This Act provides for the conservation of soil and land resources and mitigation of the effects of erosion, salinity and flooding. The Gingin Land Conservation District was established under this Act, and encompasses the Project. Closure activities will be designed and carried out to minimise soil erosion and flooding risk. |
| Rights in Water and Irrigation Act 1914 (WA) | Requirements are outlined in the approvals granted under this Act – Permit to Obstruct or Interfere and Licence to Take Water. |
| Contaminated Sites Act 2003 (WA) | This Act provides for the identification, recording, management and remediation of contaminated sites. A contaminated site is defined as '*in relation to land, water or a site, having a substance present in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value*.' At closure of the Project, it is intended that no contaminated sites will be created. |

## 3.2 Project Approvals

The following sections provide specific details of approvals for the Project relevant to closure.

### 3.2.1 Environmental Protection Act 1986, Part IV Approvals

**Ministerial Statement No. 666 (2004)**

Approval was granted for the proposal in the form of a Statement that a Proposal may be Implemented, issued by the Minister for Environment on 3 November 2004 (Ministerial Statement No. 666). The conditions relevant to closure in the Ministerial Statement No. 666 are outlined in Table 3-2.

**Table 3-2: Ministerial Statement Conditions relevant to closure**

| No. | Clause | Section of Plan if relevant to Closure |
|---|---|---|
| **6** | ***Integrated Mining and Rehabilitation Plan*** | |
| 6.1 | *Prior to ground-disturbing activity, the proponent shall develop an Integrated Mining and Rehabilitation plan to the requirements of the Minister for the Environment on advice of the Environmental Protection Authority.*<br>*The objective of this Plan is to ensure that mining impacts on the environment are minimised and the success of rehabilitation is maximised, by integrating environmental planning with the mine plan.*<br>*The Plan shall include:* | 1.2 |
| (1) | *Vegetation and Fauna Management Plan which addressed the following:* | |
| 1. | *A baseline vegetation study;* | N/A |
| 2. | *Minimisation of impacts on native vegetation;* | N/A |
| 3. | *Delineation of areas of vegetation to be retained or cleared;* | N/A |
| 4. | *Retention of topsoil for rehabilitation;* | 2.2.2 |
| 5. | *Strategy for removal and reconstruction of the north and south streams and central wetland which addresses re-establishment of soil structure, stabilisation of banks and revegetation;* | 6.2.7.1, 6.2.7.4 |
| 6. | *Fauna habitat restoration;* | 6.2.7.4 |
| 7. | *Development of specific rehabilitation performance criteria for reconstruction of the central wetland and diverted streams, and improvement of a one kilometre length of the north stream upstream of the site, including rehabilitation of these areas with more diverse native vegetation than existed pre-mining; fencing of these areas; and rehabilitation of the remaining areas to productive pasture;* | 4.5 |
| 8. | *Inspection of tailings dams for trapped animals;* | N/A |
| 9. | *Weed management;* | 6.2.7 |
| 10. | *Dieback management;* | N/A |
| 11. | *A monitoring program to determine rehabilitation success;* | 7.1 |
| 12. | *Consideration of the effect of the rehabilitation of the north and south streams on the hydrology of the site; and* | 6.2.6.3, 6.2.7.1, 6.2.7.2 |
| 13. | *Support of local land-care and water course improvement programs.* | 5.0 |
| (2) | *Soil Management Plan which addresses the following* | |
| 1. | *Delineation of highly acidic soil;* | 2.2.2 |
| 2. | *Operational handling of the soil during mining and rehabilitation;* | 2.2.2, 6.2.3.3 |

| No. | Clause | Section of Plan if relevant to Closure |
|---|---|---|
| 3. | *Treatment of the acidic soils; and* | 2.2.2, 6.2.3.3 |
| 4. | *Details of post-mining soil structure* | 2.2.2, 6.2.3.3 |
| (3) | *Stormwater and Drainage Management Plan which addressed the following:* | |
| 1. | *Erosion control measures;* | 6.2.6.3 |
| 2. | *Prevention of water contamination;* | 6.2.6.3 |
| 3. | *Monitoring of diverted/drainage water impacts on the off-site north and south streams, including a contingency plan for stabilisation of the downstream bed and banks; and* | 7.1.7.2 |
| 4. | *Mitigation measures to be taken if water quality and sedimentation levels are adversely impacting on the down-stream environment during mining;* | N/A |
| (4) | *Groundwater Management Plan to ensure that environmental and social provisions of groundwater are maintained.*<br>*This plan shall include arrangements for at least six-monthly monitoring of aquifer draw-down and recovery, and a contingency plan for replacement of landowner groundwater requirements in the case of adverse groundwater impacts; and* | 7.1.6 |
| (5) | *Decommissioning and Closure Plan for the mining areas, final voids and other mine infrastructure which includes:* | Entire Plan |
| 1. | *Removal of equipment and infrastructure;* | 6.1, 6.2 |
| 2. | *Identification and remediation of contaminated areas, and* | 6.1.3, 6.2.3 |
| 3. | *Rehabilitation of all disturbed areas to a standard suitable for the agreed new land use(s).* | Entire Plan |
| 6.2 | *The proponent shall implement the Integrated Mining and Rehabilitation Plan required by condition 6.1 until such time as the Minister for the Environment determines, on advice of the Environmental Protection Authority, that the proponent's rehabilitation responsibilities have been fulfilled.* | 10.0 |
| **7** | ***Rehabilitation Performance Bond*** | |
| 7.1 | *As security for the due and punctual observance and performance by the proponent of the requirements of condition 6.2 to be observed, conformed and complied with, the proponent shall lodge with the Chief Executive Officer of the Department of Environment on demand prior to ground-disturbing activity, an irrevocable Performance Bond as nominated and approved by the Chief Executive Office in his sole unfettered discretion to a cash value and in a form acceptable to the Chief Executive Officer ("the security") which Security at the date hereof being $2,400,000.* | 10.0 |

This Closure Plan details the closure activities to be undertaken to meet the requirements relevant to closure in Ministerial Statement 666, as indicated in Table 3-2.

### 3.2.2 Environmental Protection Act 1986, Part V Approvals

#### Licence for Prescribed Premises No. 8071/1

A Licence for Prescribed Premises was granted on 6 February 2006 for operation of the Project, in accordance with the *Environmental Protection Act 1986 (WA)* requirements for a minerals sands operation which processes more than 5000 tonnes per year. The licence expires on 5 February 2011. When the last of the heavy mineral concentrate is removed

from the site the site will no longer be a prescribed premise and the Prescribed Premises reporting requirements will not apply. The dust management and wastewater discharge point requirements in the Licence for Prescribed Premises will continue to be observed as guidelines. The dust management procedures to be implemented during closure activities are described in Section 6.3.3. The water discharge and monitoring requirements are addressed in Section 7.1.7.

The Licence for Prescribed Premises contains the following conditions that have been incorporated into closure management:

1. *The Licensee shall take all reasonable and practicable measures to ensure that no visible dust crosses the premises boundary.*
2. *(a) The Licensee shall ensure that all Wastewater* [water to be discharged to the environment] *to be discharged from the Premises is discharged from the Wastewater discharge point* [the process water dam]*.*
2. *(b) The Licensee shall, upon becoming aware that Wastewater discharged from the Wastewater discharge point has exceeded the target specified in Column 3 of Table 1* [discharge target 80 mg/L of total suspended solids at the Wastewater discharge point]*, undertake the target exceedance response required by condition 5(a), 5(b) and 5(c).*
3. *(a) The Licensee shall monitor and record the concentration of the Wastewater contaminant specified in Column 2 of Table 2, at the frequency specified in Column 3 of Table 2, for the monitoring location specified in Column 1 of Table 2* [take two samples from the process water dam prior to wastewater being discharged and analyse for total suspended solids in mg/L].
3. *(b) The licensee shall ensure that all Wastewater samples, referred to in condition 3(a), are collected, handled and preserved in accordance with Australian Standard 5667.11:1998.*
3. *(c) The Licensee shall ensure that all Wastewater samples referred to in condition 3(a), are analysed in accordance with the current "Standard Methods for Examination of Water and Wastewater", APHA-AWWA-WEF.*
3. *(d) The Licensee shall ensure that all Wastewater samples, referred to in condition 3(a), are analysed in a laboratory with NATA accreditation for the analyses specified.*
4. *The Licensee shall provide to the Director an Annual Monitoring Report by 1 October each year. This report shall contain, but not be limited to:*
    i. *the monitoring data and other collected data required by any condition of this licence, for the prescribed period; and*
    ii. *an analysis of the monitoring data collected against historical data, and targets set in this licence.*
5. *(a) The Licensee shall, within two days of becoming aware that the discharge target in Table 1 of condition 1* [condition 2] *has been exceeded when measured as specified in Table 2 of condition 2* [condition 3]*, advice the Director of this in writing.*
5. *(b) The Licensee shall ensure that the written advice required by condition 5(a) shall include the date, time and reason for the exceedance.*
5. *(c) The Licensee shall provide a full report on its investigations into any exceedances reported under condition 5(a) within seven days of becoming aware of that exceedance, and the report shall include, but not be limited to:*
    i. *The date, time and reason for the exceedance;*
    ii. *The period over which the exceedance occurred;*
    iii. *The extent of discharge over that period and potential or known environmental consequences;*
    iv. *Corrective action taken or planned to mitigate adverse environmental consequences if appropriate; and*
    v. *Corrective action taken or planned to prevent a recurrence of the exceedance, if appropriate, including a timeline for implementation.*

### 3.2.3 Local Government Authority Approvals (Shire of Gingin)

The Shire of Gingin granted Planning Consent and an Excavation Licence (Licence No. 34) on 10 February 2005. The conditions relevant to closure in the Shire of Gingin Notice of Approval of Planning Consent were:

8. *At the completion of each stage of excavation, the land shall be re-contoured and rehabilitated in accordance with the rehabilitation programme included in the Planning Application, and any revegetation shall be installed in the first winter following ground preparation.*

The conditions relevant to closure in the Shire of Gingin Excavation Licence were:

3. *The finished batter to be not less than 1 in 5 and be rounded at the floor and the crest of the extractive site, shaped to fit the existing contour.*

### 3.2.4 Licences to Take Water (Department of Water)

Two Licences to Take Water were issued by the Water and Rivers Commission on 8 February 2005 in accordance with the *Rights in Water and Irrigation Act 1914 (WA)* for taking of groundwater from the Perth Superficial aquifer (GWL 104855/2) and the Perth Yarragadee North aquifer (GWL 104858/3). These licences were reissued by Department of Water on 24 April 2008. The purposes of water use were dewatering, dust suppression and mineral ore processing. The conditions relevant to closure in the Licences to Take Water were:

3. *That should the bore be abandoned it shall be cemented off to the satisfaction of the Water and Rivers Commission within 30 days of being abandoned.* [Licence for Perth Yarragadee North aquifer only]

6. *The licensee shall comply with the operating strategy as prepared by the licensee and approved by the Department of Water on 12 January 2004, including any modifications to the strategy as approved during the term of the licence.* [Includes commitment to prepare monitoring reports, required to be submitted by 31 March each year with the reporting period being the calendar year.]

7. *The report(s) required in condition(s) 6 shall be prepared by a competent groundwater professional and comply with Statewide Policy Report No. 19 'Hydrogeological Reporting Associated with a Groundwater Well Licence'.*

8. *Results from monitoring as required in condition 6 are to be reported to the Department of Water by 31 March each year.*

11. *That the licensee record their meter readings, and volume pumped, monthly and forward the information to the Department of Water by 7 July each year.*

The letter issued with the Licences also notes that:

- *If you wish to continue taking water after this* Licence to Take Water *expires, it is your responsibility to apply to the Water and Rivers Commission for its renewal. [Duration of Licence to 24 April 2010]*

- *Should legal access to the land cease, for example you decide to sell your property, before the* Licence to Take Water *expiry date, you are required to inform the Commission using* ***Form I – Notice that Licence Holder is not or may not be Eligible to Hold a Licence*** *and return the enclosed licence within 30 days. Failure to comply is a breach of the* Rights in Water and Irrigation Act 1914.

These requirements are incorporated into the proposed production bore decommissioning methods (Section 6.2.2.1), monitoring (Section 7.1.6) and reporting (Section 9.0).

### 3.2.5 Permit to Obstruct or Interfere (Department of Water)

A Permit to Obstruct or Interfere (PMA 154725/2) was granted by the Department of Water on 11 February 2005 under the *Rights in Water and Irrigation Act 1914 (WA)* for modification of the North and South streams by diverting and altering bed and banks. The conditions relevant to closure in the Permit to Obstruct or Interfere were:

1. *The permit holder shall rehabilitate all sites affected by construction or removal activities with species that are native to the botanic region and within the same local provenance. Sites shall be planted to a similar density and diversity to local indigenous riparian zone habitats.*
2. *All material used for rehabilitation works on the river bed or banks shall be free of non-indigenous plant material.*
3. *The licensee shall not interfere with the bed of the watercourse on any location, except as approved by the Water and Rivers Commission.*
4. *That water quality be of a standard acceptable to the Water and Rivers Commission before it is allowed to re-enter a natural stream.*
5. *That licensee must maintain a flow beyond the downstream property boundary as determined from time to time by the Water and Rivers Commission.*

The letter issued with the Permit also notes that:

- *The approved modifications must be completed while the permit is current. [Duration of Permit until 1 February 2010]*

- *It is the responsibility of the permit holder to ensure the safety and adequacy of the design, method of construction and operation of the works or action the subject of the permit. The Commission recommends that people obtain an engineer's certificate.*

These requirements are incorporated into the stream reinstatement and rehabilitation of native vegetation sections (Section 6.2.7).

## 3.3 Project Agreements

### 3.3.1 Kitson Estate Landholder Agreement

A Landholder Agreement was established with the Kitson Estate, the registered owner of Lots 1, 7, 135 and Swan Location 506 located at the southern end of the site (Figure 1). The conditions relevant to closure in the Kitson Estate Landholder Agreement were:

8. *Before leaving the area the subject of this agreement the miner will fill in all excavations and leave the surface of the said property in a reasonable condition and reasonable contour including the replacement of the topsoil and grass on the portion of the said property affected by any mining operations thereunder. If so requested by the owner, the surface of the subject area will be contoured to approximate the original surface so that original drainage features will be recreated. Cased water bores developed by the miner for mining operations shall be left intact for the owner to equip and use as desired.*

Decommissioning, restoration and rehabilitation of the Kitson Estate are outlined in Section 6.2.1 and are designed to meet these requirements.

### 3.3.2 Piacentini Contract

Piacentini & Son Pty Ltd (Piacentini) was engaged as the earthmoving contractor for the Project. They own and operate the majority of the heavy vehicles on site. The general conditions in the contract between Iluka and Piacentini dictate the requirements of Piacentini at Practical Completion.

In summary, Piacentini are responsible for:

- removing all rubbish and leaving their work area in a clean and tidy condition;
- removing all plant and unused goods; and
- undertaking rehabilitation where disturbance has occurred to topsoil and vegetation.

Piacentini will be required to decommission and rehabilitate their work area within 90 days after completion of their works.

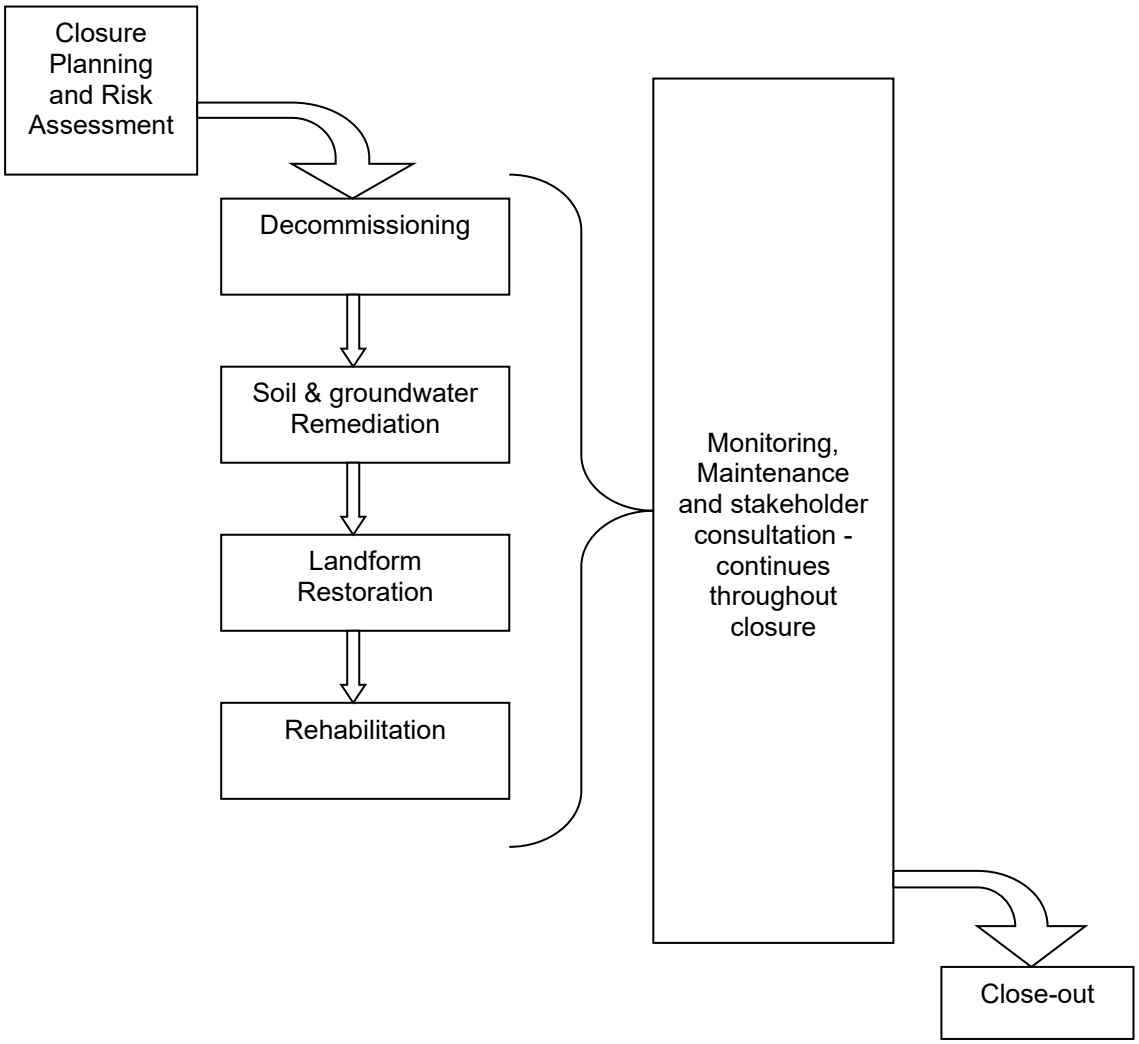
These requirements are addressed in Section 6.1.1.

# 4.0 Closure Strategy

Iluka is committed to achieving environmentally and socially acceptable closure of all operations. The desired outcome of closure is to prevent adverse long-term environmental impacts and to create self-sustaining natural ecosystems or land uses, which are acceptable to the community and other stakeholders.

## 4.1 Closure Process

The generic closure process involves a number of stages as outlined in the flowchart below. The details for each of these stages are provided in this Closure Plan.




The first step in mine closure is planning. An assessment of possible risks associated with closure activities is typically carried out. The closure objectives and completion criteria are determined, and a closure plan and cost estimate for closure is prepared. The mine area is often divided into domains for the purpose of closure planning. The domains may separate areas based on the closure activities required, risks to be managed or final landform.

The closure activities comprise decommissioning, remediation of contamination, landform restoration and rehabilitation.

Decommissioning comprises the removal of all unwanted infrastructure and services, and includes: demolition and removal or burial of all structures not required; management of hazardous materials; disposal of waste; and management of other operational infrastructure – e.g. dams (ANZMEC and MCA 2000).

Remediation is the process of removal, remediation or encapsulation of soil or groundwater contamination (ANZMEC and MCA 2000). Remediation takes place after decommissioning.

Landform restoration includes procedures for making areas safe and activities to create the post-mining landform. This includes reshaping and construction of sediment and erosion controls. Restoration takes place after decommissioning and remediation.

Rehabilitation is the process of returning the disturbed land to a stable, productive and self-sustaining condition (ANZMEC and MCA 2000). This includes replacement of subsoil, topsoil and soil improvements (addition of clay, lime, fertilizer, etc.); revegetation; and other property improvements (fences, stock crossings, etc.). Rehabilitation takes place after remediation and landform restoration.

Monitoring and maintenance of the site continues for several years after closure to demonstrate achievement of the completion criteria and ensure the site condition is stable.

Close-out is the final stage in closure of the mine. A final evaluation of the site is conducted to demonstrate that successful mine closure has been achieved, and the completion criteria have been attained. When all stakeholders are satisfied, the appropriate regulatory authorities formally sign off that closure has been achieved and the operator is absolved of all further responsibility for mining impacts.

## 4.2 Closure Risk Assessment

A closure risk assessment workshop was conducted at the start of the detailed closure planning process. Iluka and Piacentini personnel with backgrounds in operations, processing, environmental management and rehabilitation were involved in the closure risk workshop. The risk assessment workshop considered risks associated with closure-specific activities. The types of risks considered included impacts on the environment, financial and timing impacts, legal compliance, and impacts on internal and external stakeholders.

The closure activities identified as high risk and proposed management actions to reduce the consequence or likelihood of the impact are summarised in Table 4-1.

The management actions identified during the closure risk assessment workshop have been incorporated into this Closure Plan.

**Table 4-1: Closure activities identified as high risk, and proposed management actions to reduce the risk rating**

| Closure Activity | Risk | Management Action |
|---|---|---|
| Building demolition | Unsure if there is an internal or external market for assets to be sold as-is. | Buildings proposed to be relocated to another site or stored on-site at Gingin. Options to be investigated by Iluka. Assets may be sold for scrap if no market available. |
| Remove and dispose of radiation density gauges | Losing density gauges | Ensure careful tracking of density gauges. Remove them first, as soon as possible after mining operations are complete. |
| Remove sediment from base of Drop Out Dam | Volume of sediment to be removed is unknown | Iluka to determine likely volume of sediment at time of remediation. |
| Modified co-disposal material | If modified co-disposal material may be unstable, resulting in post-closure obligations for Iluka. | Stability will be suitable for proposed agricultural final landuse. |
| Raw Water Dam | The Raw Water Dam is the lowest point on the property, and overflow from the dam may impact on neighbours. | Ensure sediment and erosion controls and design for Central wetland are appropriate and sufficient to manage surface water from the site. |
| Rehabilitation | Adverse rainfall event causes erosion, loss of topsoil and delays. | Establish suitable sediment and erosion controls to manage surface water during closure. Spread topsoil immediately prior to seeding. Establish cover crop initially. |
| Corporate support | High Australian dollar reduces profit for export of mineral sands, and may contribute to attitude of wanting to reduce spending on closure. | Ensure adequate planning, justification of costs, and communication of statutory closure requirements to corporate head office. |
| Stakeholder Consultation Strategy and Social Impact Management Strategy | Reputation damage by adverse stakeholder reactions and publicity. | Social impact assessment and stakeholder consultation strategy have been developed. Close liaison with Shire of Gingin. |

## 4.3 Land Use Options

The base case for rehabilitation is to restore the area to pastoral use (sheep and cattle grazing) with native vegetation established along the North and South streams and at the Central wetland. This is consistent with pre-mining landuses and with the commitments of the Conceptual Closure Plan in the Environmental Protection Statement (Iluka 2004a).

Alternative land-uses that could provide a local economic benefit, through the use of existing infrastructure, have been discussed with the Shire of Gingin. Any future change in land-use will be dependent on planning approvals from the Shire of Gingin, Department of Planning and Infrastructure and the Western Australian Planning Commission.

## 4.4 Closure Objectives

The closure objectives for each aspect of the Gingin Project are detailed in Table 4-2. .

**Table 4-2: Closure Objectives**

| Aspect | Objective |
|---|---|
| Safety and public health | Leave the site in a condition where the risk of adverse effects to people, livestock and other fauna, and the environment in general, has been reduced to a level acceptable to all stakeholders. |
| Visual amenity | Develop final landforms that are compatible with the surrounding rural landscape. |
| Final landform | Reinstate soil profiles that are capable of supporting the agreed final landuse. |
| Landform stability | Achieve a condition where the processes affecting the final landform stability are occurring at rates that are suitable for the chosen post mining land use. |
| Pastoral productivity | Reinstate pastoral productivity that, under normal management practices, is typical for the region. |
| Soil contamination | Achieve a condition where contaminants at the site are consistent with the final land use requirements.<br>Minimise the potential for off-site pollution. |
| Groundwater | Achieve a condition where groundwater contaminants at the site are consistent with the final land use requirements.<br>Minimise the potential for off-site pollution.<br>Ensure groundwater recovers from drawdown as a result of mining activities. |
| Surface water and drainage | Reinstate the streams and recreated wetland to a safe sustainable condition.<br>Contour the landform and install drainage structures to achieve a safe stable landform with a low risk of erosion, similar to pre-mining conditions. |
| Native vegetation | Increase the diversity of species and establish self-sustaining, resilient and stable vegetation. |

## 4.5 Completion Criteria

The completion criteria detailed in Table 4-3 will be used to demonstrate that the site has been satisfactorily closed. This will facilitate signoff by the EPA and return of the security bond.

As required by the Iluka Closure Planning Procedure, the completion criteria address requirements of approval documents, stakeholder agreements and relevant policy and legislation; Iluka's corporate objective for closure; industry standards; and the environmental and social setting of the site. The completion criteria were developed in accordance with the *Mine Closure Guideline for Minerals Operations in Western Australia* (The Chamber of Minerals and Energy of Western Australia 2000). The pre-mining state and the results of monitoring during mining (described in the post-mining state (Section 2.2) were considered when developing the completion criteria.

Completion criteria will be reviewed regularly if closure activities are not substantially complete, to ensure the completion criteria remain appropriate to changing site conditions, stakeholder expectations and regulator requirements. Completion criteria may also be reviewed if alternative landuses are agreed with stakeholders.

**Table 4-3: Completion Criteria and Measurable Standards**

| Aspect | Objective | Completion Criteria | Measurable Standards required to meet Completion Criteria | Monitoring and Closure Actions to Demonstrate Achievement |
|---|---|---|---|---|
| 1. Safety and public health | Leave the site in a condition where the risk of adverse effects to people, livestock and other fauna, and the environment in general, has been reduced to a level acceptable to all stakeholders. | 1.1. All safety hazards are removed and all areas are safe for public access. | Artificial barriers and signs are removed.<br>All excavations and voids are filled in (excluding dams).<br>All drill holes and bores are securely capped, filled or otherwise made safe.<br>All rubbish is removed from site or buried deep enough to eliminate the risk of exposure.<br>Radiation density gauges are all accounted for and safely relocated. | Annual Environmental Report |
| 2. Visual amenity | Develop final landforms that are compatible with the surrounding rural landscape. | 2.1. The final landform will integrate with the surrounding landscape.<br>2.2. There is no mine void remaining post closure (excluding any dams retained). | The post-mining profile is integrated into the surrounding undisturbed landscape, continuing the gently sloped and undulating plain.<br>No slopes greater than 1:5 will remain at closure.<br>The post-mining land surface will be within +/- 1.0m of the rehabilitation design for 95% of the disturbance area. | Monitoring Program<br>Annual Environmental Report |
| 3. Final landform | Reinstate soil profiles that are capable of supporting the agreed final landuse. | 3.1. Post-mining soil profile (overburden, subsoil and topsoil) has suitable physical and chemical properties to support agricultural use.<br>3.2. Topsoil is replaced to suitable depth. | Overburden is ameliorated with sand and gypsum as required to ameliorate potential for dispersion and slaking.<br>Subsoil is ameliorated with clay and lime as required to achieve suitable moisture and nutrient retention capacity and pH ($CaCl_2$) of 4.5.<br>Lime is added to topsoil as required to achieve target pH ($CaCl_2$) of 4.5.<br>Topsoil is replaced to 100mm average depth. | Monitoring Program<br>Annual Environmental Report |

| Aspect | Objective | Completion Criteria | Measurable Standards required to meet Completion Criteria | Monitoring and Closure Actions to Demonstrate Achievement |
|---|---|---|---|---|
| 4. Landform stability | Achieve a condition where the processes affecting the final landform stability are occurring at rates that are suitable for the chosen post mining land use. | 4.1. Erosion, subsidence and swelling are occurring at rates that do not require management greater than for similar properties in the area. | Landforms are stable and resistant to erosion. The ongoing management required to maintain the landform is no greater than would be required for similar properties in the area. | Monitoring Program<br>Annual Environmental Report |
| 5. Pastoral productivity | Reinstate pastoral productivity, that under normal management practices, is typical for the region. | 5.1. Agricultural species composition and percentage cover are consistent with the intended final land use.<br>5.2. Post-mining agricultural productivity is similar to or higher than current regional or pre-mining productivity. | The proportion of each agricultural species composing the pasture is within 20 % of the target proportion for that species.<br>Average percentage cover across the pasture areas is at least 75 %.<br>Productivity of established pastures equals or exceeds pre-mining agricultural productivity of 5 tonnes per hectare total annual dry matter pasture yields, as measured in the pre-mining *Agricultural Assessment* or consistent with current regional productivity.<br>The ongoing management, required to maintain agricultural productivity, is no greater than would be required for similar properties in the area. | Monitoring Program<br>Annual Environmental Report |
| 6. Soil contamination | Achieve a condition where contaminants at the site are consistent with the final land use requirements.<br>Minimise the potential for off-site pollution. | 6.1. Soil radiation levels are at or below background radiation levels.<br>6.2. Concentrations of contaminants in the soil are at or below background levels. | Average surface radiation levels are at or below pre-mining background radiation levels of 0.11±0.03 µGy/hr.<br>Concentrations of soil contaminants at the site are at or below pre-mining levels. | Monitoring Program<br>Annual Environmental Report |

| Aspect | Objective | Completion Criteria | Measurable Standards required to meet Completion Criteria | Monitoring and Closure Actions to Demonstrate Achievement |
|---|---|---|---|---|
| 7. Groundwater | Achieve a condition where groundwater contaminants at the site are consistent with the final land use requirements.<br>Minimise the potential for off-site pollution.<br>Ensure groundwater recovers from drawdown as a result of mining activities. | 7.1. Radiation levels in the groundwater are at or below background radiation levels.<br>7.2. Concentrations of contaminants in groundwater are at or below background levels.<br>7.3. Groundwater levels in the superficial aquifer are recovered from drawdown due to mining activities and comparable with regional levels.<br>7.4. Abandoned groundwater extraction bores are decommissioned. | Average groundwater radiation levels are at or below background radiation levels.<br>The key groundwater quality parameters (total dissolved solids and pH) in the monitored superficial groundwater bores are of a standard similar to or better than pre-mining levels, taking into account external impacts such as changes to rainfall regime.<br>Groundwater levels in the superficial aquifer are within 1 m of the adjusted pre-mining groundwater level, modified proportionate with regional reductions in groundwater levels.<br>Abandoned groundwater extraction bores are cemented off to the satisfaction of the Water and Rivers Commission. | Monitoring Program<br>Annual Environmental Report<br>Water Resources Review |
| 8. Surface water and drainage | Reinstate the streams and recreated wetland to a safe sustainable condition.<br>Contour the landform and install drainage structures to achieve a safe stable landform with a low risk of erosion, similar to pre-mining conditions. | 8.1. The central wetland and streams are recreated.<br>8.2. The north and south streams are recreated generally along their original alignment.<br>8.3. The recreated streams have suitable storm flow capability and erosion resistance to provide long term stability.<br>8.4. The contours of the final landform reflect the contours and drainage of the pre-mining landform.<br>8.5. Water quality in streams is of an acceptable standard similar to or better than pre-mining levels. | Streams are recreated.<br>Central wetland is recreated as the wetland known as Dam 2<br>Location of the north and south streams is along the original alignment.<br>The streams and wetland are erosionally stable, have high and low flow zones and gentle meanders consistent with the surrounds.<br>The design of the recreated streams has been certified by an engineer to ensure storm flow capability and erosion stability is suitable for the final land use requirements and receiving environment.<br>The catchment areas and land slopes, stream lengths and slopes and proportion of average annual runoff conveyed through each stream for the recreated North and South streams is within | Monitoring Program<br>Annual Environmental Report |

| Aspect | Objective | Completion Criteria | Measurable Standards required to meet Completion Criteria | Monitoring and Closure Actions to Demonstrate Achievement |
|---|---|---|---|---|
| | | | 20 % of the pre-mining characteristics (Table 2-2).<br>The key surface water quality parameters in the North stream, South stream and Central stream are of a standard similar to or better than pre-mining levels, taking into account external impacts such as changes to rainfall regime and impacts from upstream landowners. | |
| 9. Native vegetation | Increase the diversity of species and establish self-sustaining, resilient and stable vegetation on a stable landform. | 9.1. Tree belts are established on Dewar Road and Brand Highway.<br>9.2. A diverse and stable local native vegetation community is established along the north, south and central streams and at the central wetland as illustrated in the rehabilitation plan.<br>9.3. The areas of native vegetation rehabilitation are protected from stock grazing and access. | Tree belts established on Dewar Road and Brand Highway are left intact.<br>A minimum of five local endemic understorey species plus appropriate overstorey species existing prior to mining are planted and established in areas of native vegetation rehabilitation.<br>A total of 14.7 ha is rehabilitated with native vegetation (including streams) in areas as shown on the rehabilitation plan.<br>Native vegetation in areas of rehabilitation retains diversity of initial plantings, with species richness not decreasing over a period of at least three years.<br>Ongoing management requirements for native vegetation in areas of rehabilitation are no greater than for similar properties in the area.<br>Rehabilitated streams and wetlands are fenced to prevent stock access and grazing, designed in accordance with Water Note 18 (Water and Rivers Commission 2000a).<br>At least one stock crossing is constructed at each of the north and south streams, designed in accordance with Water Notes 06 and 07 (Water and Rivers Commission 2000b and c). | Monitoring Program<br><br>Annual Environmental Report |

# 5.0 Stakeholder Consultation

The key drivers to community relations are to:

- preserve the licence to operate including access to future sites;
- build and maintain Iluka's reputation;
- meet the expectations of host communities, government, indigenous and special interest groups, employees and investors;
- contribute to sustainable development through mutually-beneficial partnerships;
- engage with stakeholders and respond to important social issues; and
- foster Iluka's corporate objectives; creating and delivering value for shareholders.

These issues are addressed in Iluka's Communication Plan, which includes the principles, goals, objectives, strategies and actions for stakeholder communications. The Communication Plan is provided in Appendix 4.

## 5.1 Communication Management

Contact details for personnel at the Gingin Mine Site have been widely circulated to key stakeholders. Iluka's Comment and Complaint procedure is used to record comments and concerns. Any public concerns or queries will continue to be responded to within 24 hours.

## 5.2 Regulatory Authorities

### 5.2.1 Local Government

The town of Gingin is within the local municipality of Gingin. Planning approval for the Project was gained from the Shire of Gingin. Iluka representatives have established a solid working relationship with shire staff. Regular briefings and presentations to full council have been and will continue to be undertaken post-mining.

Iluka has entered into a partnership with the Shire of Gingin which will see the Old Junction Hotel (near Gingin) renovated for use as a regional environment centre. Iluka will have a permanent display area which will be an avenue of updating the community on rehabilitation work.

### 5.2.2 State Government

Gingin is located in the District of Moore (Agricultural Region). No contact has been received from any member.

### 5.2.3 Government Regulatory Agencies

All properties within which the Gingin deposit occurs are freehold land alienated from the Crown prior to 1899. The land title of this land includes the rights to all minerals excluding gold, silver and other precious metals. Hence, the Project is not under the jurisdiction of the Department of Industry and Resources. Government regulatory agencies that are relevant to the Project are outlined in Table 5-1. Iluka will continue to engage with these agencies.

**Table 5-1: Government Regulatory Authorities and their roles**

| Government Regulatory Authority | Relevance |
|---|---|
| Environmental Protection Authority | Assessment of Environmental Protection Statement and approval in form of Ministerial Statement. |
| Department of Water | Granted Permit to Obstruct or Interfere with stream bed and banks (North and South stream diversions) and Licence to Take Water (groundwater production bore and dewatering superficial groundwater). |
| Department of Environment and Conservation | Issued Licence for Prescribed Premises |
| Department of Agriculture | Assessment of success of pasture rehabilitation |
| Main Roads WA | Approval of entry road from Brand Highway |
| Radiological Council | Radiation safety related to radiation density gauges and radioactive minerals |

## 5.3 Community

### 5.3.1 Non-Government Organisations

Iluka representatives have had a number of meetings with the Gingin Land Conservation District Committee (LCDC). The Gingin LCDC is reasonably active within the community and closely linked with the Friends of the Gingin Brook. In 2007, Iluka provided $10,000 towards a Gingin LCDC project which targeted stormwater runoff into the brook.

The Frogmore Progress Association represents the business operators (landowners) and residents in the Light Industrial Area (Frogmore), located on the south western corner of the Brand Highway and Gingin Brook Rd intersection. Landowners in this area have a particular interest in the impacts of Iluka's mining operation on the local groundwater. Bore monitoring in the Frogmore area has been undertaken on a regular basis.

### 5.3.2 Landholders/Neighbours

Landholders are identified as those who are directly impacted by a mining operation, including any environmental baseline, exploration and advance work programs. A landholder database has been developed and includes details of all landholders surrounding the site up to a distance of approximately 5 km.

A communication strategy is updated annually to outline key activities, responsibilities, budgets and timeframes for ensuring landowners are informed of the progress of the Gingin operations, closure and rehabilitation. Iluka maintains regular contact with neighbouring landowners through home visits, regular tours of the mine and newsletters.

## 5.4 Social Issues and Mitigation Strategies

Ongoing consultation with neighbours and community groups identified a number of concerns with the Gingin operation. Concerns that have been raised are associated with noise, dust, groundwater and impact on the environment. These key issues have been addressed and will continue to be managed and monitored during closure of the operations. A summary of the issues and mitigation strategies is provided in Table 5-2.

**Table 5-2: Key Stakeholder Issues and Mitigation Strategy**

| Type of Issue | Specific Issue | Mitigation Strategy |
|---|---|---|
| Environmental | Drawdown impacts on local groundwater | Regular groundwater level monitoring is undertaken by Iluka and results are made available to landowners. This will continue for several years after mining is completed to ensure levels recover from drawdown due to mine dewatering. |
| | Water levels in neighbours' dams | Observe water levels in dams and if water levels are decreasing due to changes in surface water management, discuss mitigation strategies with landowners. |
| | Noise | Squawkers replaced reversing beepers on all machines/vehicles to help reduce noise. Bund walls were established. Rehabilitation works are undertaken during daylight hours – times and conditions communicated with neighbours. Further management of noise is outlined in Section 7.1.11. |
| | Dust | Water carts are used to minimise dust generation.<br>Topsoil applied just before seeding.<br>Visual monitoring of dust while working.<br>Further management strategies are outlined in Section 7.1.12. |
| Economic | Local spending in the town site and use of local suppliers | Iluka to continue its efforts to buy local where possible, for as long as possible. |

Iluka has contributed to the local economy while they have been part of the Gingin community, through local spending, use of local suppliers and sponsoring local projects. At the commencement of operation, the Project was promoted as a short-term project. The four year mine life was close to the timeframe predicted; therefore there were no expectations of a long-term mining operation.

The mine's closure and plans for rehabilitation have been communicated through news articles, newsletters, face-to-face meetings and presentations to key stakeholders, and through a display and mine tours at the Annual Gingin Expo.

## 5.5 Ongoing Consultation

Maintaining a continuing and positive relationship with the local Gingin community and near neighbours is an important part of a successful mine closure, and for future success in obtaining a "social license" to operate at other sites.

Iluka will continue ongoing consultation with neighbours to update them on the progress of mine closure, and timeframes for rehabilitation. This will be through regular phone calls or face-to-face meetings.

Communication to the broader community will continue through displays at community events (like Gingin Expo), an information display in the Gingin town site about rehabilitation and closure, annual presentations to the full Gingin Shire Council, and quarterly Community Updates.

# 6.0 Mine Closure Activities

The site has been divided into two domains for the purpose of closure planning as shown in Figure 4.

## 6.1 Domain 1

Domain 1 comprises the administration and processing area, including the Iluka offices and administration area, Piacentini workshop and hardstand area, concentrator and associated infrastructure, drop out dam, process water dam and product stockpile area (Figure 4). The area of Domain 1 is 18.6 ha.

### 6.1.1 Contractor Work Area

The Piacentini work area comprises the workshop, sheds, hydrocarbon storage and refuelling area, heavy vehicle washdown facility, area for parking heavy vehicles and other ancillary facilities. The location of the Piacentini work area is shown on Figure 4.

Piacentini are required to undertake closure of their work area, including decommissioning of buildings and hydrocarbon storage and fuelling facilities, remediation of any hydrocarbon or other contamination, and rehabilitation by replacement of topsoil and seeding. Iluka is responsible for inspecting the work area and ensuring that decommissioning, remediation and rehabilitation has been undertaken to the standard required.

### 6.1.2 Decommissioning

The facilities to be decommissioned in Domain 1 include the processing plant and equipment, Iluka administration buildings, septic tanks, services such as electricity, pipelines and pumps, waste materials, and the Process Water Dam and Drop Out Dam. The warehouse, bitumen entry road and ring road will be retained post mining for future land use.

#### 6.1.2.1 Product Stockpiles

Product stockpiles will be removed at the completion of production as an operational cost. It will be approximately four to six months after completion of operations before all the product stockpile is removed from site.

#### 6.1.2.2 Mine Infrastructure

Iluka is responsible for the following mine infrastructure and services in Domain 1:

- mineral sands processing plant and equipment (flocculent and thickener tanks, feed hopper and density tanks, wet concentrator, fire water tanks, Iluka workshop, process water pumping unit, polyethylene pipes (polypipe), stockpiling infrastructure). Some of this infrastructure is pictured in Plate 13;
- Iluka administration buildings;
- septic tanks associated with the Iluka buildings; and
- services including: electrical substation and power lines, potable water pipes, telecoms (Plate 14).

The decommissioning of these items is detailed below.

**Processing Plant and Equipment**
There are a range of options for disposal of the processing plant and equipment, depending on the cost for transport and possibility of future uses within Iluka and external markets. The options for disposal of each item of the processing plant and equipment are detailed in Table 6-1. Any plant and equipment that cannot be removed by other means will be buried in the mine pit or disposed at the Shire of Gingin local landfill facility.

When the items of plant and equipment that are to be removed from site have been relocated, the concrete floor slab and foundations will be removed, pulverised and disposed of in the mine pit. Steel reinforcement will be removed and sold for scrap. The area of disturbance will be backfilled and compacted.

**Iluka Administration Buildings**
The Iluka administration buildings are relatively new transportable buildings. These will be either used by Iluka at another site or sold to an external party. The concrete pathways and footings will be removed, pulverised and disposed of in the mine pit. Steel reinforcement will be removed and sold for scrap and the disturbed area will be backfilled and compacted.

**Septic Tanks**
Three septic tanks are located at the Iluka administration area. The Shire of Gingin does not have any specific requirements regarding decommissioning of septic tanks. The septic tanks will therefore be decommissioned in accordance with the *Health (Treatment of Sewage and Disposal of Effluent and Liquid Waste) Regulations 1974 (WA)*, as follows:

1. The septic tanks will be pumped out by a liquid waste contractor approved by the Shire of Gingin, and the waste disposed to an approved site.
2. The septic tanks will be removed if practicable and re-used or broken up and buried in the mine pit or disposed at the Shire of Gingin local landfill facility. If it is not practicable to remove the septic tanks, they will be left in place and the bases broken up.

The remaining hole will be backfilled with clean fill and rehabilitated.

**Entry Road, Other Sealed Roads and Car Park Area**
As noted in Section 4.3 alternative land uses are being reviewed. It is likely that any alternative land use would be centred on Domain 1. This would make use of the heavy vehicle entry road, the sealed ring road (and area within),and existing infrastructure for electricity, potable water and telecoms, in which case this infrastructure would be retained.

**Services**
Services on site include potable water, telecoms and electricity.

Potable water is trucked in and stored in tanks, and used to supply to drink fountains, hand basins and the lunch room. Toilets and other water requirements in the administration area are supplied by bore water. The potable water supply infrastructure is coupled with the administration buildings and will be removed when the administration buildings are decommissioned.

Telecoms are supplied by a fibre optic cable located along the western side of the site. This fibre optic cable is connected to the local Gingin telecommunications network and supplies telecommunications for the entire mid-west region. This cable will be retained and protected during decommissioning and rehabilitation works.
The electricity infrastructure includes substations, overhead lines and underground cables. Electricity is supplied from the local Gingin electricity grid, with the connection near to the Piacentini work area. Iluka may install an alternative Point of Attachment to the electricity grid close to the Yarragadee groundwater bore, to enable complete decommissioning of the Piacentini work area while retaining electricity supply to the Iluka administration area and bore.

All of the electricity infrastructure will be removed and reused by Iluka or sold, unless an agreement with stakeholders requires the electricity connection to be retained. For instance, if the Yarragadee groundwater bore is retained, electricity will be required to power the groundwater pump.

**Table 6-1: Processing Plant and Equipment and Options for Disposal**

| Item of Plant or Equipment | Base Case Disposal Method | Alternative Disposal Methods |
|---|---|---|
| Flocculent and thickener tanks | Preliminary decommissioning, including remove flocculent and mineral sands material, de-oil and isolate all items of equipment, and test and treat for radiation contamination.<br>Store on site under care and maintenance until another site is identified that will use the flocculent and thickener tanks. | Sell to an external party for use in minerals processing, or demolish and sell for scrap. |
| Feed hopper and density tank | Decommission, including isolate and remove all fittings, remove mineral sands material and test and treat for radiation contamination.<br>Store on site under care and maintenance until another site is identified that will use the feed hopper and density tank. | Sell to an external party or demolish and sell for scrap. |
| Wet concentrator | Preliminary decommissioning, including dewater sumps, remove mineral sands material, de-oil and isolate all items of equipment, and test and treat for radiation contamination.<br>Store on site under care and maintenance until another site is identified that will use the concentrator. | Sell to an external party for use in minerals processing, or demolish and sell for scrap. |
| Fire water tanks | Decommission, including remove water and isolate.<br>Dismantle and relocate to another Iluka site for use at that site. | Sell to an external party for use as a water tank, or demolish and sell for scrap. |
| Iluka workshop | Decommission, including isolate and remove all equipment and fittings. Dismantle and relocate to another Iluka site for use at that site. | Sell to an external party. |
| Process water pumping units | Decommission, including isolate and remove all fittings. Dismantle and relocate to another Iluka site for use at that site. | Sell to an external party. |
| Polyethylene pipes (polypipes) | Cut into transportable lengths. Remove any materials in the polypipes, test and treat for radiation contamination.<br>Relocate to Iluka's Eneabba site for use at that site or storage. | Poor quality polypipe will be transported and shredded off site by a specialised third party to enable recycling of the pipe material. |
| Stockpiling infrastructure | Decommission, including isolate and remove all fittings, remove mineral sands material and test and treat for radiation contamination.<br>Dismantle and relocate to another Iluka site for use at that site. | Sell to an external party or demolish and sell for scrap. |

PLATE 13
Some of the mine infrastructure at Gingin Mineral Sands Project, from left to right: flocculent and thickener; feed hopper and density tanks; wet concentrator; and fire water tank

PLATE 14
Some of the infrastructure at Gingin Mineral Sands Project, including electrical substation, electrical lines and poles and polypipe


N

*Aerial photo: 2 Sept. 2018*

0 250 500 m

# GINGIN COMPLETION REPORT

## INDICATIVE FINAL LANDFORM

ILUKA

ORIG: M.Bolton DRAWN: D.G.S. SCALE: 1:16,000 (A4) DATE: Oct 2022 DWG No: 252776 ver.02

**FIGURE: 6**

### 6.1.2.3 Hazardous Materials Management

**Radiation Density Gauges**

There are six radiation density gauges at the site used to measure the density of materials in pipes. These gauges contain a radioactive source capable of in-situ measurement of the density of soils and sands, and are used during the processing of mineral sands. The gauges are only required during the operational phase.

Iluka are required by the Radiological Council to maintain records of each radiation density gauge, including the location, identification number, type of gauge and activity of the gauge (measured annually). To ensure careful management of the radiation density gauges, they will be removed from the processing equipment as soon as practicable after they are no longer required.

It is proposed to store the radiation density gauges at Iluka's site at Eneabba until a further use is identified. Prior to relocation of the radiation density gauges, the proposed storage site at Eneabba will be prepared and registered with the Radiological Council in accordance with the requirements of the *Radiation Safety Act 1975 (WA)* and the Radiation Safety (General) Regulations 1983 (WA). After removal of the radiation density gauges from the Gingin site, the Radiological Council will also be advised that the registered site at Gingin can be deleted.

The radiation density gauges will be transported to Iluka's site at Eneabba in accordance with the requirements of the Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA) and the Code of Practice for Portable Density/Moisture Gauges Containing Radioactive Sources (ARPANSA 2004). Storage of the radiation density gauges at Eneabba will be in accordance with the storage requirements of the Radiation Safety (General) Regulations 1983 (WA) and the *Code of Practice for Portable Density/Moisture Gauges Containing Radioactive Sources* (ARPANSA 2004).

**Radioactive Plant and Equipment**

The mineral sands concentrate from the Project contains the mineral monazite, which includes the naturally occurring radioactive elements thorium and uranium (Iluka 2004a). This is the primary source of radiation contamination at the site. Radiation from the monazite may contaminate plant and equipment used in mineral sands processing, especially equipment that has high contact with the mineral sands.

The Draft Radiation Safety Guidelines NORM-3.2: Monitoring NORM – Operational Monitoring Requirements (DOCEP and MCA 2007a) state that the surface of a material is contaminated if a radioactive substance is present in quantities in excess of 0.4 Bq/cm$^2$ for beta and gamma emitters and low toxicity alpha emitters, or 0.04 Bq/cm$^2$ for all other alpha emitters. The natural uranium and thorium that is the source of radiation contamination at Gingin is classed as a low toxicity alpha emitter, thus the relevant standard is 0.4 Bq/cm$^2$.

It is proposed to decontaminate any plant and equipment that has radioactive surface contamination so that it can be removed without restriction. As the site has been in operation for less than four years, the level of radioactive contamination on plant and equipment is not expected to be high. All of the plant and equipment that had high contact with the radioactive mineral sands will be screened to determine if there is any radiation contamination, in accordance with the Iluka Mid-West Operations Radiation Management Standard Job Procedures (Iluka 2008). Any materials that have radiation levels greater than 0.4 Bq/cm$^2$ will be cleaned using pressurised water, scrubbing or other suitable means in accordance with the Iluka Mid-West Operations Radiation Management Standard Job Procedures (Iluka 2008). The cleaning will be undertaken in a contained area and the waste products resulting from the cleaning, including water and sediment, will be collected in an impermeable bunded

area. The cleaned plant and equipment will be screened to determine if the radiation levels are below 0.4 Bq/cm$^2$ and if not it will be cleaned again.

Any plant and equipment that cannot be sufficiently cleaned to acceptable radiation levels will be transported to the Iluka site at Eneabba for internal reuse by Iluka or disposal with radiation-contaminated materials generated at the Eneabba site, in accordance with the requirements of the Iluka Mid-West Operations Radiation Management Standard Job Procedures (Iluka 2008) and the Radiation Safety (Transport of Radioactive Substances) Regulations 2002 (WA).

The waste products from the cleaning process will be treated according to the level of radioactive material present. This is likely to involve evaporation of the water and burial of the sediment on site. Further details of the management of radiation-contaminated sediment are included in Section 6.1.3.2.

A detailed procedure will be developed by Iluka to describe the tasks and requirements for management of potentially contaminated plant and equipment. This procedure will be submitted to the Department of Consumer and Employment Protection (DOCEP) and the Radiological Council for approval prior to decommissioning of plant and equipment.

#### 6.1.2.4 Waste Management

Any general waste remaining on site at the cessation of operations or generated during closure activities will be managed and disposed according to EMP-008 Waste Management Plan (Iluka 2007b), as detailed below.

**Inert/Putrescible Waste**

Inert wastes are non-hazardous, non-biodegradable wastes with contaminant concentrations less than the Class I landfill criteria guidelines. Putrescible waste is the component of the waste stream that is likely to become putrid and includes materials such as food wastes and office packaging waste. These wastes account for much of the general refuse generated on a daily basis in the offices and workshops.

This waste will be disposed of in the Shire of Gingin local Class I landfill facility. Specific management measures implemented for inert/putrescible waste include:

- all inert and putrescible waste is placed in bins provided at convenient locations around the project site;
- bins are emptied into general waste skip bins daily (located in a designated collection area);
- the Supervisor organises regular collection of the skip bins for disposal at the local Shire of Gingin registered landfill facility or approved alternative; and
- the Supervisor regularly inspects the site for litter and other housekeeping issues.

**Recyclable Waste**

The mining operations will result in the generation of several types of recyclable wastes including light and heavy vehicle tyres, vehicle batteries, scrap metal, paper, cardboard, glass, aluminium cans and timber pallets. The following management actions will be implemented:

- Batteries will be collected and disposed of by Piacentini.
- Light and heavy vehicle tyres will be collected in a designated area and recycled by Piacentini.
- Scrap metal will be collected in scrap metal bins.

Building and demolition waste including bricks, concrete, glass, metal and timber may be generated during the closure activities. Material will be recycled where possible, otherwise will be buried in the mine pit or disposed to the Shire of Gingin local landfill facility.

**Hydrocarbon Waste**

The majority of hydrocarbon wastes are waste oil and grease, which can generally be recycled, as well as any containers that previously held fuel, solvents, oils and other hydrocarbon products. These materials result from the use and maintenance of heavy and light vehicles, and mining machinery and facilities associated with the mining process. If hydrocarbon wastes cannot be recycled they will be disposed of in accordance with the Environmental Protection (Controlled Waste) Regulations 2004 (WA).

Specific management measures for hydrocarbon waste include:

- collection of waste oils and grease in sumps;
- ensure appropriate PPE is used when decanting oil into drums for disposal;
- waste oils and grease are to be stored in drums in a bunded area until collection;
- oily rags and used filters will be collected in a designated area and stored in drums until collection;
- empty containers from fuel, solvent, oil and other hydrocarbon products are also held in the designated collection area;
- waste hydrocarbons and associated products will be collected and disposed of in accordance with Environmental Protection (Controlled Waste) Regulations 2004 (WA);
- spill kits will be supplied in appropriate areas on site to manage any incidents; and
- any spills or potential incidents involving hydrocarbon waste are reported through Iluka's incident procedure.

### 6.1.2.5 Dams

The Drop Out Dam and Process Water Dam are in Domain 1. The Drop Out Dam is likely to have high levels of sedimentation and may contain elevated levels of contaminants such as hydrocarbons and heavy metals. The Process Water Dam is the cleanest of the three dams on site, and is the licensed discharge point from the site. The Drop Out Dam will be decommissioned, but the Process Water Dam will remain until late in the closure process to enable licensed discharges to continue as necessary.

The Drop Out Dam will be emptied, the sediment removed and buried in the mine pit and the dam walls will be pushed in to recreate the landform, and rehabilitated. Water will be pumped to solar drying dams or the Raw Water Dam to allow the sediments in the Drop Out Dam to dry. The water would most likely be evaporated from the solar drying dams as water quality may be unsuitable for discharge, e.g. high concentration of total suspended solids.

The sediments from the Drop Out Dam will be tested for contamination levels and disposed of as for contaminated soil if required (see Section 6.1.3.1).

The Process Water Dam is not expected to contain much sediment and will not need to be cleaned out. The Process Water Dam may be retained after closure as a farm dam, receiving water from the Yarragadee groundwater bore if it is retained. This option will be discussed with adjacent landowners and the Department of Water.

### 6.1.3 Soil Remediation

#### 6.1.3.1 Soil Contamination

It is standard practice that Iluka prevents soil contamination from occurring wherever possible. Where contamination is suspected or identified, investigation and remediation is commenced as soon as practical.

Hydrocarbon contamination can be caused by diesel spills from mobile equipment. No significant diesel spills occurred during mining (Walker, C. 2008, pers comm. 1 April). Iluka staff and contractors were required to report spills via the Lost Control Card system. All spills were cleaned up and the contaminated material placed in the hydrocarbon landfarm, located to the north of the Piacentini work area, where bioremediation took place.

Remediation of most hydrocarbon based soil contamination was completed during the operational life of the mine, minimising the remedial activities required upon closure. No contaminated sites have been identified at the Project; therefore, no sites have been listed on the Contaminated Sites Register.

Iluka will adopt the DEC Contaminated Site Management Series Guidelines to assess potentially contaminated land with the exception of radiation issues, which are controlled by DOCEP. Iluka's aim is to prevent or mitigate soil and groundwater contamination that may affect the local environment or restrict future land use.

Sources of contamination may include product stockpiles, processing wastes and hydrocarbon facilities. Possible types of soil contamination include heavy metals and hydrocarbons. Locations of potential soil contamination in Domain 1 include the soil underneath the product stockpiles, the sediment in the Drop Out Dam, soil surrounding vehicle washdown bays, the hydrocarbon bioremediation landfarm and other areas where hydrocarbons are handled.

Soil samples will be collected from these areas will be analysed for possible contaminants, including heavy metals and total petroleum hydrocarbons. The concentrations of contaminants will be compared with the assessment levels for soil in the Assessment Levels for Soil, Sediment and Water (DEC 2003) to determine the potential contamination of the site.

If metals are present in concentrations that exceed the health investigation levels or environmental investigation levels for soils, the concentration of contaminants will be compared to the pre-mining background contamination levels. This is particularly relevant for arsenic and chromium, which were identified at naturally high concentrations in the pre-mining background assessment.

If metals are present in concentrations that exceed the pre-mining background concentrations and the health or ecological investigation levels, the contaminated soil will be excavated and disposed of off-site in an appropriate class landfill facility. The preferred outcome is management and removal of the contamination, rather than registration of the site as a Contaminated Site.

If hydrocarbons are present in concentrations that exceed the health investigation levels or environmental investigation levels for soils, the soil will be treated by bioremediation at the hydrocarbon landfarm in accordance with the guidelines Bioremediation of Hydrocarbon Contaminated Soils in Western Australia (DEC 2004). The hydrocarbon landfarm is located near the Piacentini work area. The hydrocarbon landfarm will remain in place until all hydrocarbon contamination is biodegraded to concentrations below the assessment levels for soil in the Assessment Levels for Soil, Sediment and Water (DEC 2003). Soils will be

declared decontaminated when they meet the Ecological Investigation Levels (DEC, 2000) for total petroleum hydrocarbons (TPH) and benzene, toluene, ethyl benzene, and xylene (BTEX). The soil in the hydrocarbon landfarm will then be incorporated into the final landscape.

Following removal and treatment of any contaminated soil, the land area that had high contaminant concentrations will be assessed again to determine if there is any significant contamination remaining, and the treatment will be repeated if required.

#### 6.1.3.2 Radiation Contamination

Radiation contamination at the site may occur as a result of processing materials that contain the naturally occurring radioactive elements thorium and uranium. The radioactive elements are present in low concentrations naturally, but are concentrated in the mineral sands product. The draft guidelines for management of naturally occurring radioactive materials in mining and mineral processing, developed by the Resources Safety Division of the WA Department of Consumer and Employment Protection and the Radiation Industry Group of the Chamber of Minerals and Energy of WA, will be applied to management of radiation.

A post-mining assessment of γ-radiation (gamma radiation) will be undertaken across the entire site using an Environmental Radiation Meter type 6-80 as outlined in the Mid-West Operations Radiation Management Plan (Iluka 2007a). The post-mining radiation assessment will also focus on key areas of potential contamination (the base of the product stockpiles and the sediment in the Drop Out Dam) and potential sources of less-radioactive material (the solar drying dams, overburden, subsoil and topsoil). The results of the radiation assessment will be compared to the average pre-mining background radiation level of 0.11±0.03 µGy/hr, which is the completion criterion for surface radiation levels.

The Radiation Safety Officer will be responsible for management of radiation contamination in accordance with the Radiation Safety Guidelines NORM-4.2: Controlling NORM – Management of Radioactive Waste (DOCEP and MCA 2007b). The methods for management and treatment of radiation contamination will depend on the results of the radiation assessment and other requirements for closure of the site.

The recommended treatment for radiation contamination is to mix the contaminated material with less-radioactive soil material to reduce the overall radioactivity. This will ensure that the long term use of the site is not restricted. This may involve excavating any contaminated soil at the base of the product stockpiles and spreading and mixing it at a suitable depth in the mine pit with clay from the solar drying dams or overburden to attenuate any contamination. The intended outcome from this treatment is to reduce the soil radiation levels to a level equivalent to the pre-mining background radiation level, so that the soil does not require special treatment or placement.

If the radiation levels are still too high above the pre-mining background radiation level, the contaminated material may be buried in the mine pit at a depth sufficient to ensure that the surface radiation levels comply with the pre-mining background radiation levels. In this case the radioactive soil would be buried at a specific limited location. As no chemical or thermal treatment of the mineral occurred, the radionuclides should still be bound in the individual mineral grains; thus release of radionuclides into the groundwater would only occur at an insignificant rate (DOCEP and MCA 2007b).

Following removal and treatment of any contaminated soil, the area that had high radiation levels will be assessed again to determine if there is any significant radiation remaining, and the treatment will be repeated if required.

If the material contaminated with radiation is buried at a specific location, rather than being spread and mixed with less-radioactive material, the site will need to be registered in accordance with the *Contaminated Sites Act 2003* (WA). Registration of the site as a Contaminated Site is intended to provide an institutional control over the waste disposal area and is not relevant if the contaminated material is attenuated to levels equivalent to pre-mining background levels. The appropriate site classification depends on the radioactivity of the buried contaminated material, and is outlined in Table 6-2.

**Table 6-2: Contaminated Sites Classification according to level of radiation contamination (DOCEP and MCA 2007b)**

| Mean radiation dose to a member of the critical group of the general public (mSv/yr) | Contaminated Site Classification |
|---|---|
| 0.0 – 0.3 | Unrestricted use |
| 0.3 – 1.0 | Restricted use |
| 1.0 – 3.0 | Remediation necessary in most cases |
| > 3.0 | Remediation necessary in all cases |

As required by the Radiation Safety Guidelines, reporting and classification of a site under the *Contaminated Sites Act 2003 (WA)* will be undertaken in consultation with the DEC and Radiological Council.

## 6.1.4 Landform Restoration

### 6.1.4.1 Final Landuse and Landform

The final landform would remain generally as it is at the time of closure, as Domain 1 was not heavily disturbed by mining activities. Minor shaping will be required to ensure integration into the surrounding landscape.

The landform in Domain 1 was altered during mining operations by construction of the Process Water Dam and Raw Water Dam. Earthworks that will be undertaken to re-establish the rural landscape include pushing in the walls of the Process Water Dam and Drop Out Dam and minor reshaping of the entire Domain 1 to establish the final landform (Figure 6)

### 6.1.4.2 Stability

There are not expected to be any landform stability issues in Domain 1, as only the top layer of soil was disturbed and it will be replaced and stabilised with agricultural vegetation.

## 6.1.5 Rehabilitation

Rehabilitation in Domain 1 entails replacement of topsoil, liming if required, seeding and fertilising. Replacement of overburden and subsoil is not required as these materials were not disturbed in Domain 1. Rehabilitation activities for Domain 1 will be same as Domain 2 (Section 6.2.7).

## 6.2 Domain 2

Domain 2 comprises the majority of the site, excluding those areas which comprise Domain 1. Facilities within Domain 2 include the mining voids, Raw Water Dam, groundwater production bore, groundwater monitoring bores, mining unit, co-disposal cells, solar drying dams, and overburden, subsoil and topsoil stockpiles.

Domain 2 is divided into two sub-domains, Domain 2A and Domain 2B, due to the different land ownership of these areas. Domain 2A comprises the land owned by the Kitson Estate, which is utilised by Iluka under a landholder agreement. Domain 2B is the remainder of Domain 2. The closure and rehabilitation of Domains 2A and 2B is similar, but it is intended to return Domain 2A to the landholders as a priority in the closure process. Domains 2A and 2B are shown in Figure 4.

The area of Domain 2 is 269.4 ha, including 31.3 ha of Domain 2A.

### 6.2.1 Kitson Estate

The land owned by the Kitson Estate is referred to as Domain 2A, as shown in Figure 4.

This was the first area mined, and rehabilitation has already commenced in this area.

It was agreed with the Kitson Estate that the groundwater monitoring bores located in the land owned by the Kitson Estate should be decommissioned. The approximate location of the stock crossing was also agreed..

The decommissioning, remediation, landform restoration and rehabilitation techniques for Domain 2 described below will be applied to the land owned by the Kitson Estate as well as the remainder of Domain 2.

### 6.2.2 Decommissioning

The facilities to be decommissioned in Domain 2 include the mining unit, haul roads, the groundwater production bore, the groundwater monitoring bores, services such as electricity, pipelines and pumps, and the Raw Water Dam.

#### 6.2.2.1 Mine Infrastructure

**Mining Unit**
The mining unit is located in the mine pit, approximately 15 m below the natural ground surface. The mining unit comprises the scrubber and screening unit, which are owned by Iluka. A hopper, conveyor and screening unit owned by Piacentini were also attached to the mining unit. The plant owned by Piacentini will be removed as soon as processing is completed. The mining unit will be relocated as soon as practicable from the mine pit to a hardstand area within Domain 1. The hopper, conveyor and screening unit will then be relocated off-site by Piacentini.

The footing for the mining unit in the mine pit is a combination of bitumen and concrete base, approximately 40 m by 50 m in area. The bitumen and concrete material will be crushed and buried in the mine pit. Steel reinforcement will be removed and sold for scrap.

### Polyethylene Pipe

Polyethylene pipe (polypipe) is used to transport water, sand tails, clay tails and modified co-disposal material. There is approximately 17.8 km of polypipe on site, excluding pipe in the concentrator.

When the polypipe is no longer required, it will be cut into transportable lengths and cleaned of any materials remaining in the pipe. The polypipe that is in good condition will be relocated to Iluka's Eneabba site for use at that site or storage. Any polypipe that is in poor condition will be transported by road train to Perth, where a specialised company will shred the polypipe and recycle it to make plastic products.

### Haul Roads

Haul roads will be retained while heavy vehicles are still operating on site. Decommissioning of haul roads will involve excavating the haul roads to a depth of approximately 0.5 m, disposing of the material in the mine pit, and ripping the base of the haul road to loosen compaction of the underlying soil. Material from haul roads that remains after all voids are filled will be crushed and placed over modcod or in another position with stockpiled overburden.

### Groundwater Production Bore

The groundwater production bore is in the south west corner of the site, near the Raw Water Dam, as shown in Figure 4.

The Yarragadee Bore will be utilised during closure. The volume of water to be extracted from the Yarragadee Aquifer under the Licence to Take Water (GWL104858(3)), will be significantly less than during processing (estimated to be 10%), and is unlikely to impact on the Yarragadee Aquifer.

One of the conditions of the Licence to Take Water is that if the groundwater production bore is abandoned it should be cemented off within 30 days to the satisfaction of the Water and Rivers Commission. An alternative to decommissioning the bore is to retain the bore as an asset for future landowners.

If required, decommissioning of the groundwater production bore will be undertaken in accordance with the decommissioning guidelines in Minimum Construction Requirements for Water Bores in Australia Edition 2 (Land and Water Biodiversity Committee 2003). These guidelines require that any bore that is permanently decommissioned should be completely sealed and filled so that vertical movement of water within the bore, including within the space surrounding the casing, is prevented and the water is permanently confined to the specific zone in which it originally occurred.

Decommissioning to these requirements will be undertaken as follows:

1. Clean fill material is placed in the sections of the bore with slotted screens that intersect the groundwater aquifer. This ensures that water flow in the aquifer is not restricted.
2. Sealing material is placed in a layer 10 m thick above the clean fill, to prevent water from being transported through the bore to different aquifers of different water quality. The sealing material may be concrete or cement grout, and it is placed using a method that will avoid segregation or dilution of the sealing material and contamination of the aquifer zone. In the sealed zones, the casing is removed or slotted to allow the sealing material to fill the gap between the casing and the surrounding soil. This ensures that water cannot shortcut down the outside of the bore casing and into the aquifer.

3. Any additional sections of slotted screens will be filled with clean fill and the next 10 m layer sealed as described in 1 and 2 above.
4. Clean fill is used to fill the remainder of the bore to within 6 m of the ground surface. It is not necessary to remove or slot the casing in this section, as it is isolated from the groundwater aquifers by the stainless steel bore screens and the layers of sealing material.
5. A final layer of sealing material is placed five metres thick, ending approximately one metre below the ground surface. It is not necessary to remove or slot the casing as when the bore was constructed the casing was cement grouted. The cement grouting will prevent short-circuiting through the space between the casing and the soil into different groundwater layers. Concrete or cement grout is used as sealing material within the bore casing. This layer ensures that subsoil soakage cannot short-circuit through the bore.
6. The headworks of the bore are removed and the last layer in the top of the bore is filled with subsoil and topsoil. The soil fill is compacted and mounded to prevent ponding of surface water above the bore, and the area is rehabilitated with the rest of the site.

Complete and accurate records of the entire decommissioning procedure shall be kept for future reference and to verify that the hole was properly sealed. Details of bore cementing shall be recorded on a bore completion report. This information will be provided to the Department of Water to verify that the groundwater production bore was decommissioned satisfactorily.

In the event that Iluka sells the land where the groundwater production bore is located while the Licence to Take Water is still valid, *Form I – Notice that Licence Holder is not or may not be Eligible to Hold a Licence* will be completed and submitted to the Department of Water, with the Licence to Take Water, within 30 days of selling the land.

**Groundwater Monitoring Bores**

There are 60 groundwater monitoring bores. Some of these monitoring bores will continue to be used during closure implementation and post-closure monitoring, as detailed in Section 7.1.6 and Appendix 6.

The remainder of the groundwater monitoring bores will be decommissioned during closure implementation in accordance with the guidelines in Minimum Construction Requirements for Water Bores in Australia Edition 2 (Land and Water Biodiversity Committee 2003), as described for decommissioning of the groundwater production bore.

Most of the groundwater monitoring bores that are used for post-closure monitoring will be decommissioned at the completion of the required monitoring period

Groundwater monitoring bores may be retained as an asset for post mining land uses. This will be determined in consultation with the landowners. Retained bores will be capped and made safe[1]. .

**Services**

The only service in Domain 2 is electricity. The electricity infrastructure includes overhead power lines, underground cables and Motor Control Centres (MCCs). The MCCs are

[1] Following DWER Site Inspection on 6 August 2022, an audit was undertaken to ensure all remaining bores are capped. As of the 30th of September 2022, all of the retained bores on site have been capped.

positioned along the edge of the pit and include a transformer that converts power from the electricity distribution down to pumps in the pit.

All of the electricity infrastructure in Domain 2 will be removed and reused by Iluka or sold.

#### 6.2.2.2 Dams

The Raw Water Dam is located in Domain 2. The Raw Water Dam receives all of the stormwater runoff from the site. The runoff is retained in the Raw Water Dam to facilitate sedimentation of particulate matter, before it is pumped to the Drop Out Dam.

The Raw Water Dam is likely to contain high levels of sediments and may contain elevated levels of contaminants such as hydrocarbons and heavy metals. The sediments from the Raw Water Dam will be tested for contamination levels and disposed of as for contaminated soil if required (Section 6.2.3.2).

The Raw Water Dam is close to the location of the original Central wetland. The Raw Water Dam will be decommissioned to enable reinstatement of the Central wetland and streams.

The Raw Water Dam will be emptied, the sediment removed and buried in the mine pit and the dam walls will be pushed in to recreate the landform, then rehabilitated. There are two options for emptying the dam. The preferred option is to pump the water out into the solar drying dams and allow the sediments in the Raw Water Dam to dry. The water would most likely be evaporated from the solar drying dams as water quality may be unsuitable for discharge, e.g. high concentrations of total suspended solids. An alternative method is to use a small dredge or submersible slurry pump to remove the sediment from the Raw Water Dam while the water is still present. The sediments would be pumped in a slurry form to a containment area within the mine pit and left to dry. The remaining water in the Raw Water Dam would evaporate or be pumped to the solar drying dams.

### 6.2.3 Soil Remediation

#### 6.2.3.1 Soil Contamination

Sources of possible soil contamination in Domain 2 include hydrocarbons from mobile equipment and potential hydrocarbons and heavy metals in the raw water dam. Soil contamination in Domain 2 will be managed as per Domain 1 (Section 6.1.3.1).

#### 6.2.3.2 Radiation Contamination

There is not expected to be any radiation contamination in Domain 2, as no concentrated product was stored in or moved through this area. Some oversize ore material was used in construction of the haul roads, which may have slightly increased the surface radiation along the haul roads. A radiation assessment of the haul roads will be completed early in the closure process to confirm that radiation levels do not exceed the pre-mining background radiation levels. Radiation contamination in Domain 2 will be managed as per Domain 1 (Section 6.1.3.2).

#### 6.2.3.3 Acidic Soil

The pre-mining environment identified that the topsoil was slightly acidic, with pH ($CaCl_2$) between 4.3 and 4.7 (Section 2.1.2). Optimal growth of typical pasture crops such as wheat and oats is achieved with pH ($CaCl_2$) greater than 4.5 (Department of Agriculture 2002).

An area of acidic soils with pH (KCl) between 3.7 and 4.1 was identified in a zone near the North steam. This acidic material included topsoil, subsoil, overburden and ore material (Iluka 2007d). Apart from this zone, subsoil was within the target pH range, with values from

5.4 to 5.9 (measured in $CaCl_2$). The overburden was acidic with pH ($CaCl_2$) of 4.1 – 4.5 (Section 2.1.2).

Although the overburden is slightly acidic, it is natural acidity and is not likely to impact on the success of rehabilitation or agricultural productivity. The overburden is planned to be replaced at the same depth in the soil profile from which it originated.
The area of acidic soils was managed during operations in accordance with a Soil Management Plan (Section 2.2.2). Further management of these materials in closure is outlined below. The acidic portion of the sand tailings will be buried in the mine pit during closure or mixed with overburden. The acidic portion of the clay tailings, located in the solar drying dams, will be mixed with the soil material in the solar drying dam walls and will form part of the final landform.

In order to ensure that acidic soils were adequately managed during closure activities, Iluka engaged Golders Associates to conduct a review of acidic soils management and recommend future actions to be undertaken to minimise any impact (Golders Associates, 2009, Appendix 1). The report confirmed that all chemical analysis undertaken to date on the soils at the Gingin Mine have recorded very low sulphur content and therefore could not be interpreted to show that Acid Sulphate Soils were present. Furthermore, there was no evidence to refute the conclusion of all previous soil reports (EGi 2003, Oracle 2004 and SWC 2004) that the soils acidity is most probably due to the hydrolysis of Fe and Al bearing clays.

All data collected to date regarding the source of acidity at the site has been interpreted as non-sulfidic acidity. This acidity is retained whin the soils and is not being released to the environment as $pH_{fox}$ and $pH_{KCl}$, are similar to $pH_f$, thus indicating that the acidity is not leachable. From a risk perspective, the risk of metal mobilisation due to leaching of soils via acidic groundwater is therefore likely to be limited (Golders Associates, 2009).

Acidic regions need special management to maintain their acidic character (Golders Associates, 2009). Golders Associates do not recommend liming of soils at the mine site as the acidity recorded is not leachable and there is available alkalinity in the groundwater in quantities deemed sufficient to neutralise any potential acid generation. It is considered that liming is only required to neutralise leachable acidity and the limit rate should be modified to ensure that the pH of soils remains in the moderately acidic range in an effort to limit any change in conditions at the site from the original background levels, as the ecosystems are adapted to these conditions.

The observed tannic groundwater at the site is indicative of the soils and groundwater at Gingin containing organic acids. The period dewatering in the vicinity of the central wetland area may have resulted in groundwater level fluctuations and the exposure of the wetland sediments to air. Sediments in the central wetland area are highly likely to contain peaty organic rich soils which, upon exposure to air could oxidise leading to the release of organic acids. In order to confirm the source of the acidity in the groundwater with response to its mineral or organic origin, a test for total titratable acidity (using a suitable field kit) will be undertaken in groundwater and surface monitoring (Section 7.1.6).

### 6.2.4 Groundwater Contamination

Potential contaminants that may leach into the groundwater as a result of mining operations include radioactive elements ($Ra_{226}$, $Ra_{228}$ and $Th_{228}$); heavy metals; hydrocarbons; salinity (measured as electrical conductivity (EC)); and pH.

#### 6.2.4.1 Groundwater Acidity

Groundwater acidity at the conclusion of mining is discussed in Section 2.2.6. Although the groundwater which flows through the soil profile is of varying composition, it is generally

sufficiently alkaline to buffer the measured acidity. From a risk perspective, the probability of metal mobilisation from soils due to acidic groundwater is therefore limited (Golders Associates, 2009). To confirm that impacts remain within acceptable limits, monitoring of groundwater quality to assess acidity will be continued throughout closure, as detailed in Appendix 6

#### 6.2.4.2 Radiation Contamination

As discussed in Section 2.2.3, levels of $Ra_{226}$ in the groundwater were below investigation levels at all sites in 2007. Levels of $Ra_{228}$ were below the measured level at the reference site at all monitored sites. Hence, mining activities have not resulted in any radiation contamination in the groundwater.

#### 6.2.4.3 Hydrocarbon Contamination

The potential for groundwater contamination by hydrocarbons will be monitored by analysis of groundwater samples from a superficial aquifer monitoring bore located downstream of the hydrocarbon landfarm. Water samples will be analysed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethyl benzene, and xylene (BTEX). The monitoring results will be compared to DEC criteria for acceptable hydrocarbon concentrations in fresh water (DEC 2003).

### 6.2.5 Management of Solar Drying Dams

The Solar Drying Dams cover a large proportion of the area of disturbance in Domain 2 (Figure 4).

Solar Drying Dams 9, 10, 13, 14, 16, 17 and 18W (Figure 4) were constructed above natural ground level using overburden material, except for Dam 14 which was constructed using soil excavated from the Raw Water Dam. The remaining Solar Drying Dams on the site were constructed using cut-and-fill methodology.

Management of the Solar Drying Dams will depend on whether the dams were constructed as cut-and-fill or are above the natural ground level. In general the material in the Solar Drying Dams will be contoured in situ or relocated and form part of the final landform. However, some clay material from the Solar Drying Dams will be set aside to be mixed with the subsoil as a soil conditioner during rehabilitation, as described in Section 6.2.5. The proportion of clay to subsoil will vary between 10 and 20 per cent. Approximately 65,000 $m^3$ of clay will be required for this purpose, which equates to approximately 20 per cent of the total clay volume in the Solar Drying Dams.

Cut-and-fill dams are already at the level of the required landform. An excavator or dozer will be used to turn over the clay tailings in the cut-and-fill dams to encourage air drying. When the moisture level of the clay is suitably low, the walls of the dams will be pushed in and mixed with the clay to achieve a more natural soil consistency. The Solar Drying Dams will be reshaped to create the final landform as described in Section 6.2.5.

Dam 2 and Dam 34 are located at the original Central wetland location. During rehabilitation, Dam 2 and Dam 34 will be retained to create a wetland known as Dam 2.

The Solar Drying Dams that were constructed above natural ground level will need to be removed to achieve the required final contours. If the clay tailings in these Solar Drying Dams are relatively dry, they will be excavated and relocated. This is the preferred material to set aside for use as a soil conditioner for the subsoil. Any excess dry clay tailings will be relocated to the mine pit. However, if the moisture level of the clay tailings in Solar Drying Dams 9, 10, 16, 17 or 18W remains too high for rehandling in-situ, the western (downslope) wall will be removed and the clay tailings allowed to gradually spread downstream of the dam

in a controlled manner over previously disturbed and mined areas. This process has been successfully carried out by Iluka at Gingin when Solar Drying Dams have required removal during mining operations, with the greater surface area of clay facilitating air drying. This method is not appropriate for Solar Drying Dams 13 or 14, as they are located on the western boundary of the site, and the natural slope would cause material to spread to the west towards Brand Highway. Material from these dams will be excavated and relocated as for dry clay tailings.

The timeframe for working with the material from the Solar Drying Dams will be a balance between the cost of waiting for water from the clay tailings to evaporate (resulting in a smaller volume of drier material that is easier to handle) and the cost of handling the larger volume of wetter material. The cost of waiting will depend on how much of the closure activities can be carried out before the Solar Drying Dams are removed, as well as ongoing costs such as leases, employees, etc. The assessment of when to handle material from the Solar Drying Dams will be a judgement made during closure implementation. Solar Drying Dams that have not had fresh clay tailings added late in the mining operations will become drier earlier, so the material from these dams may be handled earlier in the closure process.

The walls of the Solar Drying Dams above natural ground level will also be removed. The walls were constructed primarily of overburden material, with soil used for Solar Drying Dam 14. The overburden and soil material in the walls of the Solar Drying Dams will be incorporated in general fill material required to reshape previously mined parts of the site.

## 6.2.6 Landform Restoration

### 6.2.6.1 Earthworks and Reshaping

This section describes earthworks and reshaping in Domain 2. Earthworks and reshaping includes activities required to develop the final landform, after decommissioning, remediation and treatment of Solar Drying Dams. Activities will include filling the mine pit (void), pushing in dam walls, and spreading overburden to achieve the approximate final landform. Treatment of overburden, replacement and treatment of subsoil, and contouring is described in Section 6.2.7.

Reshaping activities will create a post-mining profile that is integrated into the surrounding undisturbed landscape and continues the gently sloped and undulating plain. The post-mining contours will be landscaped to integrate with the surrounding landscape and to recreate the catchments for the North and South stream and Central wetland. Any high or low points will be rounded at the base and the crest and have side slopes no steeper than 1 in 5 in accordance with the requirements of the Shire of Gingin Excavation Licence.

The mine pit will be filled with soil material and some building demolition waste to ensure that no void remains at the completion of closure. A summary of the materials to be buried in the mine pit and a reconciliation of the volume of the mine pit at the cessation of operations compared to the volume of material proposed to be buried in the mine pit is provided in below. The top layer of material placed in the mine pit will consist of a thick layer of natural soil material suitable for reshaping, such as overburden and sand or clay tailings. Following placement of the final material into the mine pit, the surface of the filled mine pit will be reshaped to match the surrounding area and establish the final landform.

**Volume Reconciliation**

At the completion of mining, mine pits (voids) remain where the mining unit was located, in the last part of the southern area that was mined, and in the final central area of mining. The total difference in volume between the pre-mining profile and the profile at the cessation of

mining operations is approximately 1,046,000 $m^3$. This volume will be filled by disposal of materials into the mine pits (voids) and replacement of stockpiled soil materials.

Some materials will be buried in the mine pits (voids) remaining at the end of operations to reduce the volume of material disposed to landfill sites. The mine pits will also be backfilled with tailings, clay fines and overburden to recreate, as closely as possible, the pre-mining landform.

Materials that will be buried in the mine pits or form part of the final landform, including a reconciliation of estimated volumes, destination and summary of how they will be managed, are detailed in Table 6-3.

**Table 6-3: Estimated material handling volumes to achieve final landform**

| Material | Estimated volume ($m^3$) | Destination | Management methods |
|---|---|---|---|
| Bitumen hardstand areas from Domain 1 (remove to depth of 1 m) | 18,000 | Buried in mine pit | |
| Bitumen footing of the mining unit (assume 1 m thick) | 2,000 | Buried in mine pit | No treatment, will remain in place in mine pit |
| Concrete floor slab and foundations from mining plant and equipment, administration area and mining unit. | 825 | Buried in mine pit | Steel reinforcement removed and concrete pulverised |
| Haul roads to a depth of 0.5 m | 48,000 | Buried in mine pit | |
| Sediment from Drop Out Dam | 46,000 | Buried in mine pit | If contains high levels of contaminants, will be disposed to appropriate class landfill facility |
| Sediment from Raw Water Dam | To be estimated by Iluka during closure | Buried in mine pit | If contains high levels of contaminants, will be disposed to appropriate class landfill facility |
| Other areas of contaminated sediment | Insignificant | Buried in mine pit | If contain high levels of contaminants, will be disposed to appropriate class landfill facility |
| Radiation contaminated soil (assume base of product stockpiles is contaminated to a depth of 1 m) | 18,000 | Buried in mine pit | Will be mixed with soil that has lower radioactivity to reduce the overall radioactivity |
| SUBTOTAL (material buried in mine pit) | 132,865 | | |
| Overburden | 676,000 | Mined areas, will form part of final landform | All overburden is located in walls of Solar Drying Dams and will be spread across Domain 2. |
| Soil from Raw Water Dam in walls of Solar Drying Dam 14 | 110,000 | Mined areas, will form part of final landform | Spread across Domain 2 |
| Sand tailings | 450,000 | Mined areas, will form part of final landform | Will be mixed through overburden |

| Material | Estimated volume ($m^3$) | Destination | Management methods |
|---|---|---|---|
| Clay tailings from the Solar Drying Dams | 330,000 | Mined areas, will form part of final landform | Some clay will be set aside for improving the subsoil. The remainder will remain in situ or be spread or excavated to create the final landform. |
| Subsoil | 203,000 | Mined areas, will form part of final landform | To be spread on top of the landform in Domain 2 after reshaping |
| Topsoil | 475,257 | Entire area of disturbance | Top layer, spread on top of subsoil after contouring. Will be applied as an even layer across entire site. |
| SUBTOTAL (material to form part of final landform) | 2,244,257 | | |
| **TOTAL VOLUME** | **2,377,122** | | |
| Mine Pit Volume | 1,046,000 | | |
| % Difference from Mine Pit Volume | + 127 % (1,331,122$m^3$) | | |

The volume of material to be returned to the disturbed area is greater than the volume of material that was removed from the mined area due to expansion of the material as it is excavated and handled (swell factor).

However, the process of replacing the material in the final landform will result in some re-compaction of the material; with the final landform contours being within 1m of the rehabilitation design for 95% of the disturbance area (Figure 6).

Note that the volume of material to be placed in the mine pit comprises a relatively small proportion of the total volume of material to be returned to the area of disturbance. There will be sufficient volume in the mine pits (voids) to contain this material requiring burial in the mine pit.

#### 6.2.6.2 Stability

The material used in the final landform will generally have suitable geotechnical characteristics and be selectively placed to achieve stability suitable for the intended final landuse.

#### 6.2.6.3 Sediment and Erosion Control

Sediment and erosion controls are designed to maintain landform stability and protect natural waterways by:

- reducing the risk of erosion,
- reducing the level of sediments leaving the site, and
- separating runoff from natural areas from that generated from disturbed areas.

The primary purpose of sediment and erosion controls is the effective management of surface water flows. Different controls will be applied during closure implementation and in the final landform than were used during mining operations, as described in the following sections.

The surface water operational processes that applied during mining will continue for the first part of closure implementation.

As closure proceeds, both the Raw Water Dam and the Drop Out Dam will be emptied of sediment and water, and the dam walls pushed in to recreate the final landform. Prior to this, the surface water management structures will be modified to direct surface water from the site to the Process Water Dam. Surface water diversion structures will be designed in accordance with the Water Quality Protection Guidelines No 6: Mining and Mineral Processing – Minesite Stormwater (WRC 2000e).

The surface water runoff will be retained in the Process Water Dam to facilitate sedimentation, and will be tested prior to any discharge from the Licence Discharge Point. Water collected in the Process Water Dam may be used for dust control, watering of rehabilitated areas, and other closure requirements.

As rehabilitation proceeds, the disturbed area will be reduced and surface water can be re-directed to natural waterbodies. Towards the end of closure implementation, the Process Water Dam will be removed to create the final landform and re-establish the natural catchments. The Process Water Dam or Dam 2 may be kept as a farm dam. By this stage, the North stream, South stream and Central stream will be reinstated, the surface water diversions will be removed, and surface water will be flowing through the natural channels. There will be no requirement for discharge of water from the Licensed Discharge Point.

Further erosion and sedimentation controls to be applied during closure implementation include:
- the soil profile is ripped parallel to the contour prior to planting; and
- topsoil is spread immediately prior to seeding to limit the possibility of topsoil erosion.

**Final Landform**
Sediment and erosion controls in the final landform will include:
- creation of a final landform with gentle undulating contours that integrate with the surrounding natural landscape;
- natural catchments are recreated and drain to the South stream, North stream and Central wetland prior to leaving site;
- the reinstated South and North streams are designed and constructed to ensure storm flow capability and erosion stability is suitable for the final land use requirements and receiving environment;
- the site is revegetated, with fast-growing species planted initially to stabilise the soil;
- grass is encouraged to grow in the recreated South and North streams to stabilise the channels;
- the South,North and Central streams and recreated wetland are fenced to prevent stock access; and
- stock crossings created across the South and North streams are erosion resistant.

## 6.2.7 Rehabilitation

Rehabilitation will occur in a sequence of stages. This section describes rehabilitation for Domain 1 and 2.

### 6.2.7.1 Re-Establishment of Streams and Wetland

Landscape reshaping will recreate the catchments for the North and South streams and the recreated wetland (Dam 2). Re-establishment of the streams and wetland will take place following reshaping in the area of the stream or wetland.

Iluka has an excellent record in native vegetation rehabilitation and establishment of streams and wetlands. This is evidenced by the stability of the South stream diversion, which has been in place for three years and withstood runoff from extreme rain events associated with

Cyclone Clare in January 2006. Some photos showing stream and pasture rehabilitation by Iluka in the south west of Western Australia are provided in Plate 16. URS validated the designs of the northern and southern streams in a report completed in July 2008 (Appendix **5**). These designs will be followed in the re-creation of the streams.

**North and South Streams**

The South stream diversion has been in place since 2005. A section of the South stream diversion is shown in Plate 15. The North stream was diverted in March 2008. The stream diversions will remain in place until the pre-mining streamlines are reinstated and stabilised such that flows will not cause erosion.

The North and South streams will both be recreated in locations closely following the original alignments. The recreated streams will have low and high flow zones and incorporate gentle meanders consistent with the flow alignments of similar sized streams in the district. Erosion control measures will include grassing of the watercourse and use of geotextile matting and velocity control structures where required. The streams will be designed to ensure the sustainability of the streams in the long-term, consistent with the requirements of the Permit to Obstruct or Interfere granted by the Department of Water.

The Permit to Obstruct or Interfere with stream bed and banks requires that all materials used for rehabilitation works on the stream bed or banks will be free of non-indigenous plant material (i.e. weeds). However, this is not practical considering the surrounding landuse, which is predominantly agricultural cropping and pasture grazing. Non-native grasses are present in the surrounding areas, including upstream and downstream in the North and South streams and seeds are contained within the stripped topsoil. Non-native grasses are likely to migrate into the rehabilitated section of stream from the surrounding area over time. Management of non-native grasses with herbicides may have negative impacts on agricultural productivity of neighbours. Iluka has identified at other rehabilitation stream sites that non-native grasses are the best methodology to stabilise the stream beds. It is therefore proposed to use non-native grass (such as kikuyu) to help stabilise the stream beds. This will have water quality benefits by minimising loose sediment and controlling erosion and sediment transport downstream, and will be consistent with surrounding vegetation.

The streams will be planted with local endemic tree and shrub species in accordance with the requirements of the Permit to Obstruct or Interfere with stream bed and banks (Section 6.2.7.4). The North and South streams will be fenced from grazing stock and will each include a stock watering point and crossing (Section 6.2.7.5). This will result in a net improvement to the pre-mining condition of the streams.

**Central Wetland**

The recreated wetland (Dam 2) will be reinstated at the Central Wetland pre-mining location by shaping the post-mining contours to recreate the catchment. The recreated wetland (Dam 2) will be planted with local endemic vegetation (Section 6.2.7.4) andwill also be fenced from grazing stock (Section 6.2.7.5).

PLATE 15

**Part of the South stream diversion. Note the meandering channel with grassy banks and native saplings. Photograph taken October 2007**

#### 6.2.7.2 Establishment of Post-Mining Soil Structure

Prior to replacement of soil in an area, all facilities from the mining operations will be removed and the area will be shaped to the final landform. This will be achieved through the activities described in decommissioning, remediation and landform restoration and will culminate in spreading of overburden. The next step is treatment of the overburden and replacement of the subsoil and topsoil, including necessary soil improvements, in preparation for planting.

**Overburden**

Subject to assessment of benefits, the overburden may be treated with gypsum and sand to ameliorate potential for dispersion and slaking. The majority of the overburden is comprised of grey siltstone/mottled sandstone with high percentage of exchangeable sodium (sodicity), resulting in increased potential for dispersion of clay particles. Gypsum (hydrated calcium sulfate) will be applied to the overburden to reduce sodicity and stabilise the soil structure as required. Application of gypsum will result in calcium replacing sodium as the predominant exchangeable cation. Gypsum will be applied on top of the overburden at a rate of 10 t/ha and incorporated by ripping and mixing with dozers.

The overburden also has low organic matter content and high kaolinite proportion in the clay fraction, resulting in high potential for slaking (collapse of soil structure when saturated). The overburden will be deep ripped and mixed with tailings sand to improve the soil structure and reduce the likelihood of the collapse of soil pores when the soil is wet. After gypsum has been incorporated into the overburden, all sand tailings available (not already buried in mine pit during mining operations) will be spread on top of the overburden and incorporated by deep ripping and mixing with dozers.

After deep ripping and incorporation of sand into the overburden, the overburden will be spread into any remaining depression and contoured to achieve the required landform.

The area of disturbance in Domain 2 will then be shaped to achieve the indicative final contour plan (Figure 6).

The final landform levels will be achieved by survey control, with the specific method to be chosen during the closure implementation process. Possible methods include use of a laser or using a surveyor to peg the required levels. The shaping will be undertaken by redistribution of overburden with a dozer. The shaped landform will then be ripped on the contour to control water movement and soil erosion, reduce compaction and facilitate the infiltration of water and root penetration.

PLATE 16

Pasture and stream rehabilitation by Iluka in the Capel area, in the south west of Western Australia

**Subsoil**

The subsoil was predominantly comprised of yellow-brown to red to pale grey sand. Due to the low silt and clay content, the subsoil has limited water holding capacity. Clay from the Solar Drying Dams may be used as a soil conditioner to improve the moisture and nutrient retention capacity of the subsoil, thereby improving long term agricultural productivity.

First, the subsoil will be spread over the overburden. Approximately 203,000 $m^3$ of subsoil was stripped and stored in stockpiles. This will be spread over the area of disturbance in Domain 2. The clay will then be spread on top of the subsoil and air dried. An excavator or dozer will turn over the clay to facilitate drying. When the clay is relatively dry, the subsoil and clay will be mixed by deep ripping and mixing with dozers.

Following placement of subsoil and mixing with clay, the pH of the subsoil will be tested and may be treated with lime if considered necessary to increase the pH ($CaCl_2$) to achieve pH ($CaCl_2$) of 4.5 which is considered to be a moderately acidic range consistent with background. The rate of lime application will be calculated depending on the quality of lime to be used. Lime will be applied with a spreader and mixed in with a scarifier.

The subsoil will be shaped and ripped as necessary to maintain the required contours and reduce compaction.

**Topsoil**

The total volume of topsoil removed was 475,000 $m^3$. The topsoil will then be spread. Topsoil will only be spread prior to seeding, which is undertaken on a seasonal basis in autumn. The topsoil will be spread with a carry grader at an average depth of 170 mm. Following placement of topsoil, the pH (CaCl2) of the topsoil will be tested and the topsoil may be treated with lime to achieve a pH of 4.5. The lime will be applied using a spreader and will be mixed in with a scarifier.

### 6.2.7.3 Pasture Rehabilitation

The majority of the site will be returned to pasture for grazing sheep and cattle (Figure 7).

Iluka has extensive experience in rehabilitating pasture areas, as demonstrated in Plate 16 showing an area of pasture rehabilitated by Iluka in the south west of Western Australia. The focus of the pasture rehabilitation program will be to stabilise restored landforms with agricultural pastures.

A wheat-oats mixture will be sown initially to stabilize the soil. The exact varieties will be selected to suit the environmental conditions, in consultation with local landowners. After approximately two years, when the soil is stabilised, the rehabilitated agricultural area will be established as pasture or cropping, in accordance with the final landuse agreed with landholders. Appropriate species will be selected in consultation with local landholders and agronomists. All seed will be sourced from reputable commercial seed suppliers. Typical pasture species will include ryegrass, gland clover, biserrula and subterranean clover.

Seeding will commence immediately following placement of topsoil, in accordance with the requirements of the Shire of Gingin Notice of Approval of Planning Consent. Seeding will generally take place in the second quarter (April – June) of the year, in preparation for winter rains.

The sequence of activities is outlined below:

- topsoil scarified and seedbed prepared using a combination of secondary tillage implements (e.g. offset discs, scarifier, drag and harrows) sourced from local farmers, using best practice agricultural techniques;

- fertilizer applied. The type, rate and number of applications will be determined based on soil testing and agronomic advice;
- seed mix, consisting of wheat and oat varieties, applied; and
- roll the area to provide a firm seed bed for pasture establishment.

Where fertilisers and herbicides are used the Material Safety Data Sheets and instructions will be adhered to. Particular attention will be given to fertilisers used adjacent to the watercourses. Where necessary, the Department of Agriculture and Food and the Department of Water will be consulted regarding fertiliser usage.


N

0 250 500 m

# GINGIN

# REHABILITATION PLAN

ILUKA

ORIG: M.Bolton DRAWN: D.G.S. SCALE: 1:16,000 (A4) DATE: 5. Oct 22 DWG No: 208481 ver.05

FIGURE: 7

### 6.2.7.4 Native Vegetation Rehabilitation

Native vegetation will be used to rehabilitate the North and South stream andthe recreated wetland (Dam 2) as illustrated in Figure 7.

The total area of native vegetation rehabilitation is approximately 14.7 ha, which includes an additional section of the North stream, upstream of the area of disturbance, and within the Iluka property.

The species used in the native vegetation rehabilitation will consist of upper and middle storey species present prior to disturbance, and at least five local endemic under storey species. The species used will be chosen from the list in Table 6-4, which includes all the endemic species identified in the pre-mining flora and vegetation survey (Mattiske Consulting Pty Ltd 2004). At least three additional locally endemic understorey species will be selected for use in native vegetation rehabilitation, in consultation with the Gingin Land Conservation District Committee (LCDC) and with consideration of species present in surrounding riparian areas.

**Table 6-4: Native Vegetation Rehabilitation Species List**

| Family | Scientific Name | Common Name | Description |
|---|---|---|---|
| UPPER STOREY SPECIES | | | |
| Myrtaceae | *Corymbia calophylla* | marri | Tree to 40 m, grows beside drainage lines and wetlands |
| | *Eucalyptus rudis* | flooded gum | Tree 5 – 20 m |
| | *Eucalyptus todtiana* | coastal blackbutt | Tree 5 – 8 m, coastal sandplains |
| | *Melaleuca rhaphiophylla* | swamp paperbark | Tree 0.2 – 10 m, grows in swamps and along watercourses |
| MIDDLE STOREY SPECIES | | | |
| Papilionaceae | *Gastrolobium spinosa* | prickly poison | Shrub to 3.5 m |
| | *Jacksonia sternbergiana* | stinkwood | Weeping shrub 1.5 – 5 m, grows along rivers and creeks and near swamps |
| Proteaceae | *Banksia dallanneyi subsp. dallanneyi* | | |
| | *Banksia prionotes* | acorn banksia | Shrub to 10 m, sandplains and undulating slopes |
| | *Banksia sessilis subsp. sessilis* | | |
| | *Grevillea vestita subsp. vestita* | | Shrub 0.5 – 3 m |
| | *Hakea prostrata* | harsh hakea | Shrub 1 – 3 m, hillslopes and coastal dunes |
| Xanthorrhoeaceae | *Xanthorrhoea preissii* | grass tree | Treelike monocot to 5 m, coastal plain, near watercourses |
| UNDER STOREY SPECIES | | | |
| Cyperaceae | *Mesomelaena pseudostygia* | | Sedge 0.2 – 0.75 m |
| Phormiaceae | *Dianella revoluta* | blueberry lily | Perennial herb 0.3 – 1.5 m |

Native vegetation will be planted in a band approximately 25 m wide on either side of the North and South streams, with sedges and other vegetation tolerant of inundation planted

lower on the stream banks. A mixture of upper, middle and under storey species will be planted on top of the banks to create a natural riparian vegetation community.

Vegetation that is tolerant to water logging will be selected for the recreated wetland (Dam 2). The seedlings will be planted in clumps to mimic natural vegetation communities, with a mixture of upper, middle and lower storey species used. The wetland will be recreated with an upper storey of *Melaleuca rhaphiophylla*. A selection of understorey species will be planted based on other less degraded *Melaleuca rhaphiophylla* wetlands in the surrounding area and with advice from the Gingin LCDC.

Tree belts established on Dewar Road and the Brand Highway will remain post mining.

Native vegetation rehabilitation will be undertaken by hand-planting seedlings of the appropriate species. The seedlings will be grown from endemic seed collected from the site and surrounds. The seedlings will be approximately 11 – 16 months old when planted, depending on species type.

Native vegetation rehabilitation will generally be carried out in autumn to take advantage of winter rains for establishment of seedlings. Seedlings will be planted to achieve a similar density to local indigenous riparian zone habitats, in accordance with the requirements of the Permit to Obstruct or Interfere with stream bed and banks. Grazing stock will be excluded from areas of native vegetation rehabilitation at all times, with fences installed before stock is returned.

Return of native vegetation to the streams and improvement through fencing and other measures will encourage more native fauna to utilise the area.

The native vegetation rehabilitation will be selectively fertilised in accordance with species requirements. The rate and type of fertiliser applied will be appropriate for native vegetation and use near watercourses.

#### 6.2.7.5 Property Improvements

This section describes infrastructure that is installed or retained during closure, consistent with the final landuse. Property improvements include farm infrastructure such as fencing, stock crossings and gates.

Fencing will be erected along both sides of the rehabilitated length of the North,South and Central streams and around the recreated wetland (Dam 2) to provide protection to the riparian vegetation. The location of the fence will be determined in accordance with the guidelines in Water Note 18: Livestock Management – Fence Location and Grazing Control (WRC 2000a), installed approximately 1 – 2 m from the boundary of the native vegetation rehabilitation to allow for growth of the seedlings. Fencing will be of an appropriate design for stock control, consistent with local farm fencing practices.

Fencing will also be installed along the southern boundary of the undisturbed native vegetation in the northern section of the site. This section of native vegetation is on land owned by Iluka but was not cleared or disturbed during the mining operations. Typical rural fencing will be installed to protect the native vegetation from disturbance.

Stock crossings will be installed across the North and South streams in accordance with the commitments in the Vegetation and Fauna Management Plan EMP-001 (Iluka 2006). One stock crossing will be installed across the South stream. Two stock crossing will be installed across the North stream. The stock crossings will provide access across the streams and a stock watering point, whilst protecting the streams from stock impacts, such as sedimentation and nutrient enrichment. The stock crossings will have additional ecological benefits by

creating a pool upstream of the crossing, increasing habitat in the river and filtering and aerating the water as it passes the stock crossing.

The stock crossings will be designed in accordance with Water Note 06: Livestock Management – Construction of Livestock Crossings (WRC 2000b) and Water Note 07: Livestock Management – Watering Points and Pumps (WRC 2000c). Specific design aspects will include:

- The stock crossing will be constructed of rock with a range of diameter sizes to create a rough variable surface and limit lingering by livestock in the stream. Rock sizes will be selected to suit the flow rate through the stream. The rock will be laid below the level of the stream bed, and geotextile fabric may be used to provide erosion resistance underneath the rock layer.
- The stock crossing will be located along a straight section of the each stream, as stream flow rates generally accelerate around meanders which would increase erosion of the stock crossing.
- The stock crossing will be approximately 10 m wide to provide access for stock across the stream. The crossing will have a slope downstream of no more than 10:1 (horizontal : vertical). The slope of the upstream edge of the crossing will be no greater than 4:1.
- The rocky surface will extend across the whole width of the stream to the top of the embankments (above high water level), to ensure that the crossing is stable and resistant to scouring. The slopes of the crossing down to the stream will be no greater than 4:1 to allow access by stock.
- Both sides of the stock crossing will be fenced with appropriate fencing, selected and designed in accordance with Water Note 19: Flood Proof Fencing for Waterways (WRC 2000d) and in consultant with the landowner. The flood proof fencing will be connected to the fences along either side of the streams, to prevent stock access into the stream other than at the stock crossing. Each end of the stock crossing will also have a gate, to enable control of stock access across the crossing.

## 6.3 Implementation Issues and Management

### 6.3.1 Security

Security during closure is important for public safety as well as protection of equipment and facilities during closure implementation.

The fence and security gates surrounding the site will remain in place until the end of closure. The gates and fencing will then be removed and used by Iluka at another site.

During mining operations, the Project operates 24 hours per day, 7 days a week. However, during closure, working hours will be restricted to day shift only, Monday to Saturday.

### 6.3.2 Noise Management

Residential premises near to the Project are located at the south end of the site on Dewar Road and to the north of the site on Brand Highway. The greatest noise impacts generated by closure activities will occur when closure activities are undertaken at the most southern and northern ends of the site.

The closure activities that may result in noise impacts to neighbours include:

- decommissioning mine infrastructure, including dismantling the concentrator and mining unit and crushing concrete; and

- operation of heavy earthmoving equipment, especially at the north and south ends of the site, when contouring dams and pits; constructing stream diversions; and spreading topsoil.

Equipment used during the rehabilitation phase will vary depending on closure activities. Types of equipment could include scrapers, dozers, diggers, front-end loaders, excavators and trucks. For indicative purposes, it is anticipated there may be approximately twenty two items of equipment operating on site during closure.

Decommissioning and rehabilitation of site will be day shift only, Monday to Saturday. All activities except the removal of heavy mineral concentrate will be completed within these hours. Trucking of heavy mineral concentrate on a 24 hour basis is estimated to finish in December 2009. The continuous noise monitor will remain until the heavy mineral concentrate stockpiles are removed, and trucking at night time ceases. If the data shows noise exceedances, existing management measures will continue to be implemented.

When trucking of heavy mineral concentrate is completed, the site effectively becomes a construction site. Under Regulation 13 (Construction Sites) of the Environmental Protection (Noise) Regulations 1997, "construction site" means premises or a public place on which the sole or principal activity is the carrying out of construction work; "construction work" means "the construction, erection, installation, alteration, repair, maintenance, cleaning, painting, renewal, removal, excavation, dismantling or demolition of, or addition to, any building or structure, or any work in connection with any of these things, that is done at or adjacent to the place where the building or structure is located."

Under Regulation 13 (Construction Sites) of the Environmental Protection (Noise) Regulations 1997, Regulation 7 (Prescribed Standard for Noise Emission) does not apply to noise emitted from a construction site as a result of construction work carried out between 7 am and 7 pm on any day excepting Sundays and public holidays, provided that:

- construction work is carried out in accordance with control of environmental noise practices set out in section 6 of AS 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites;
- the equipment used is the quietest reasonably available; and
- a noise management plan in respect of the construction site is prepared, approved by the CEO and adhered to during construction.

Given the potential for noise to impact on neighbouring residents, relevant noise management strategies that were utilised during operations will continue to be applied during closure implementation. Additional noise management strategies will also be implemented to suit the specific noise impacts likely during closure. Noise management strategies will include:

- reduce working hours for closure activities to daytime only (7.00 am to 7.00 pm), Monday to Friday only;
- maintain noise bunds constructed of overburden and topsoil material at locations close to the southern neighbours for as long as possible;
- use low noise mobile equipment, including using low frequency 'squawkers' instead of high frequency reversing 'beepers';
- carry out work in accordance with the control of environmental noise practices set out in section 6 of AS 2436-1981: Guide to Noise Control on Construction, Maintenance and Demolition Sites. This standard includes engineering methods to control noise, such as substitution, modification, appropriate use and citing of equipment and regular and effective maintenance;
- all equipment will be maintained in good working order. Equipment causing excessive noise at receiving locations under certain weather conditions will be moved (to increase the distance from the source to the receiving location as per section 6.2 of AS 2436-

1981). Equipment may be stood down until conditions are favourable or substituted for quieter equipment where available. The quietest practicable equipment will be selected for use;
- where conditions are unfavourable and excessive noise is produced, the activity emitting noise will be moved, undertaken in a different manner or stopped;
- ensure all Iluka employees and contractors are aware of the requirement to manage noise impacts for neighbours;
- continue to liaise closely with all neighbours and inform them of the timetable of closure activities so that they are aware of when noise from closure activities may impact on their residence;
- if complaints are received from neighbours regarding noise levels, modify activities to reduce noise impacts on neighbours; and
- continue to use the complaints management procedure for dealing with any noise complaints received.

All Iluka employees and contractors are inducted to ensure that they are aware of their safety, environmental and social obligations. Iluka provides training to develop an understanding of risk management, safe working practices and duty of care. This message is reinforced in a variety of ways, including the implementation of reporting procedures for issues and incidents on site. These reporting procedures ensure that issues and incidents are resolved swiftly. Noise management and awareness will continue to be a specific focus in site inductions at Gingin, to ensure that all employees consider noise emissions as part of their normal daily activities.

### 6.3.3 Dust Management

The amount of dust generated during closure will depend on the activities carried out, the area of the site that is not yet rehabilitated, and wind speed and direction. The closest neighbours are at the southern and northern ends of the site, and users of Brand Highway.

The main closure activities that may generate dust are earthworks, and spreading of subsoil, topsoil and soil amendments such as lime.

Dust emissions will be managed to ensure compliance with the dust management requirements in Iluka's Licence for Prescribed Premises, which requires that all reasonable and practicable measures are taken to ensure that no visible dust crosses the boundary of the site.

Dust management strategies described in EMP-006 Dust Management Plan (Iluka 2007f) will continue to be utilised during closure implementation. Additional dust management strategies to address the specific impacts from closure activities will also be utilised. Dust management strategies include:
- water trucks are available for on site dust suppression as required;
- water is applied to roads to minimise dust generated by traffic movement;
- all site traffic is required to adhere to the site speed limit to minimise dust generated by vehicle movement;
- all unsealed roads are graded regularly and water applied during windy conditions;
- wet clay tailings will be used as a dust suppressant until the end of mining operations;
- mulch may be used as a dust suppressant where required;
- when materials are being handled, machinery will be operated to minimise drop heights and reduce dust generation;
- topsoil will only be spread immediately prior to seeding;
- pasture will be re-established as soon as practicable after completion of mining, and in any event as soon as possible after spreading of topsoil;

- site staff report any high or abnormally dusty conditions immediately to the Site Manager;
- activities will cease if they are causing high or abnormally dusty conditions (as determined by visual assessment) until measures are in place to reduce dust generation;
- ensure all Iluka employees and contractors are aware of the requirement to manage dust impacts for neighbours;
- continue to liaise closely with all neighbours and inform them of the timetable of closure activities so that they are aware of when dust from closure activities may impact on their residence; and
- continue to use the complaints management procedure for dealing with any dust complaints received.

Water from the Superficial Aquifer was utilised during mining for dust suppression. As dewatering from the Superficial Aquifer will cease at the end of mining, the Licence to Take Water (GWL104858(3)) from the Yarragadee Aquifer has been renewed and amended to include water usage for dust suppression.

### 6.3.4 Radiation Management

This section describes management of possible radiation impacts on employees and contractors. Possible radiation impacts on the environment and public health as a result of the Project are described and addressed in the decommissioning and remediation sections above.

Radiation impacts on personnel will be managed during closure according to the Mid-West Operations Radiation Management Plan (Iluka 2007a) to meet requirements of *the Mines Safety and Inspection Act 1994 (WA)* and the *Radiation Safety Act 1975 (WA)*, as outlined below.

Sources of radiation are the mineral monazite, which contains uranium and thorium and is associated with the heavy minerals mined at the site; and radiation density gauges, which are located on the side of pipes and used for measuring density of materials passing through the pipes. The primary pathway for employee and contractor exposure to radiation is through airborne dust.

Radiation exposure is managed as follows:

- Radiation density gauges are designed to minimise potential radiation exposure. The radioactive substance is located inside a lead container, which limits the potential radiation exposure to acceptable levels (Iluka 2007a).
- After the completion of mining, cleared areas are rehabilitated and revegetated as soon as possible to minimise areas of exposed soil.
- The maximum speed limit for vehicles is 60 km/hr to minimise dust generation.

Roads are regularly graded and maintained and watered when necessary to minimise dust generation.

# 7.0 Monitoring and Maintenance

## 7.1 Monitoring

Closure monitoring is intended to demonstrate progress towards and achievement of the completion criteria. Monitoring of rehabilitation vegetation will continue until positive trends emerge which indicate that no further management of vegetation (both pasture and native) and landform is required than would be necessary for similar properties in the area. The proposed timeframe for monitoring varies according to the aspect being monitored, as outlined in the Closure Monitoring Program in Appendix 6.

Further details of all closure monitoring are provided in the following sections below and in the Closure Monitoring Program in Appendix 6. The Closure Monitoring Program includes details of the proposed monitoring such as the locations of monitoring, parameters to be measured, methods and frequency of monitoring.

### 7.1.1 Radiation

The relevant completion criteria for radiation are

- 6.1 Soil radiation levels are at or below background radiation levels.
- 7.1 Radiation levels in the groundwater are at or below background radiation levels.

Measurable standards required to achieve the completion criteria for radiation are:

- Average surface radiation levels are at or below pre-mining background radiation levels of 0.11±0.03 µGy/hr.
- Radiation density gauges are all accounted for and safely relocated.
- Average groundwater radiation levels are at or below background radiation levels.

Radiation monitoring conducted during closure will include land surface radiation levels, boundary radiation survey, high volume dust monitoring, radiation assessment of plant and equipment, and groundwater radiation analysis.

A post-mining surface radiation assessment of the southern section of the site was completed in early 2008, when rehabilitation of this area commenced. The radiation levels were below the pre-mining background radiation levels; this area has achieved compliance with the surface radiation completion criteria.

A second radiation assessment will be undertaken following treatment and management of radiation contamination, other earthworks and reshaping, and placement of topsoil. This radiation assessment will be used to determine compliance with the radiation completion criterion: average surface radiation levels at or below pre-mining background radiation levels of 0.11±0.03 µGy/hr.

Land surface radiation levels will be measured prior to any topsoil application, planting or seeding activities in each rehabilitation area. Remedial earthworks will be carried out in the event that a radiation survey identifies areas that do not meet the completion criteria.

A boundary survey will be conducted biannually in existing open areas to ensure no wind blown material is entering neighbouring properties. Rehabilitated areas that have recorded satisfactory land surface radiation levels are regarded as closed, and will not be included in further boundary surveys. These rehabilitated areas will also have established ground cover and be in a stable condition, therefore would not generate dust containing radioactive material.

High volume dust monitoring was required during operations to determine radiation risk to the general public from dust generated from the operations. The 2006/07 Midwest Radiation Report presented calculated dose estimates that were 1% of the allowable limit based on the high volume dust monitoring (Iluka 2007g). As such high volume dust monitoring is considered to be no longer required and ceased in March 2009.

A radiation assessment of plant and equipment will be conducted as described in Section 6.1.2.3. All scrap metal will be screened and issued a clearance certificate for radiation prior to leaving site.

Groundwater radiation analysis will be conducted to demonstrate achievement of completion criteria. As described in Section 2.2.3.3, monitoring bore GS22 will be used as a reference site for the Gingin site. GS22 is 250m from the eastern side of the orebody and up gradient of the mine based on groundwater flow being in a generally south-westerly direction. Radionuclide monitoring in groundwater bores will continue on an annual basis to demonstrate achievement of completion criterion 6.1.

### 7.1.2 Visual Amenity

The relevant completion criteria for landform are:
- 2.1 The final landform will integrate with the surrounding landscape.
- 2.2 There is no mine void remaining post closure.

Measurable standards required to achieve the completion criteria for final landform and stability are:
- The post-mining profile is integrated into the surrounding undisturbed landscape, continuing the gently sloped and undulating plain.
- No slopes greater than 1:5 will remain at closure.
- The post-mining land surface will be within +/- 1.0m of the rehabilitation design for 95% of the disturbance area.

A survey of contours will be conducted post-mining and rehabilitation to determine compliance with the above completion criteria.

### 7.1.3 Landform Stability

The relevant completion criterion for stability is:
- 4.1 Erosion, subsidence and swelling are occurring at rates that do not require management greater than for similar properties in the area.

Measurable standards required to achieve the completion criteria for landform stability are are:
- Landforms are stable and resistant to erosion. The ongoing management required to maintain the landform is no greater than would be required for similar properties in the area.

Area inspections for erosion, slumping, sink holes, swelling or shrinkage will be conducted annually and will detect isolated movement of the landform. Inspections for erosion will continue annually until the pastoral vegetation is demonstrated to achieve the completion criteria. Investigative and remedial earthworks will be carried out in the event that movement in the landform occurs.

Analysis of area inspection results will be used to demonstrate completion criteria have been met.

### 7.1.4 Final Landform

The relevant completion criteria for final landform are:
- 3.1 Post-mining soil profile (overburden, subsoil and topsoil) has suitable physical and chemical properties to support agricultural use.
- 3.2 Topsoil is replaced to suitable depth.

Measurable standards required to achieve the completion criteria for final landform are:
- Overburden is ameliorated with sand and gypsum as required to ameliorate potential for dispersion and slaking.
- Subsoil is ameliorated with clay and lime as required to achieve suitable moisture and nutrient retention capacity and pH (CaCl2) of 4.5.
- Lime is added to topsoil as required to achieve target pH (CaCl2) of 4.5.
- Topsoil is replaced to 100 mm average depth.

Overburden, subsoil and topsoil treatment and replacement will be conducted as outlined in Section 6.2.7.2 and reported through the Annual Environmental Report as outlined in Section 9.0. The soil pH will be measured during subsoil and topsoil spreading to determine requirements for application of lime. Soil pH will be tested following lime application to determine whether the target pH level has been met.

### 7.1.5 Soil Contamination

The relevant completion criterion for soil contamination is:
- 6.2 Concentration of contaminants within the soil are at or below background levels.

The measurable standard required to achieve this criterion is
- Concentration of soil contaminants are at or below pre-mining levels.

Monitoring for soil contamination will target areas of potential contamination and the contaminants that are most likely to be present as identified in Sections 6.1.3.1 and 6.2.3.1. Soil samples will be collected from these areas and analysed for possible contaminants, including heavy metals and total petroleum hydrocarbons.

### 7.1.6 Groundwater

The completion criteria relevant to groundwater are:
- 7.1 Radiation levels in the groundwater are at or below background radiation levels (addressed in section 7.1.1).
- 7.2 Concentrations of contaminants in groundwater are at or below background levels.
- 7.3 Groundwater levels in the superficial aquifer are recovered from drawdown due to mining activities and comparable with regional levels.
- 7.4 Abandoned groundwater extraction bores are decommissioned.

Measurable standards required to achieve the completion criteria for groundwater are:
- The key groundwater quality parameters (total dissolved solids and pH) in the monitored superficial groundwater bores are of a standard similar to or better than pre-mining levels, taking into account external impacts such as changes to rainfall regime.
- Groundwater levels in the superficial aquifer are within 1 m of the adjusted pre-mining groundwater level, modified proportionate with regional reductions in groundwater levels.
- Abandoned groundwater extraction bores are cemented off to the satisfaction of the Water and Rivers Commission.

Monitoring of groundwater quality and levels will continue to demonstrate achievement of completion criteria and ensure compliance with the groundwater extraction licence. Decommissioning of bores will be demonstrated through provision of a decommissioning report to the Department of Water, as outlined in Section 9.0. Monitoring of groundwater quality and levels is described below.

#### 7.1.6.1 Yarragadee Aquifer

Quarterly monitoring of water quality in the groundwater production bore will continue until extraction from the Yarragadee Aquifer ceases in accordance with the requirements of the Licence to Take Water. Water level in the Yarragadee monitoring bore and abstraction volumes from the Yarragadee Aquifer will be recorded weekly.

#### 7.1.6.2 Superficial Aquifer

Water level and quality monitoring of superficial groundwater bores will be undertaken to demonstrate achievement of completion criteria.

Superficial aquifer groundwater levels will be measured quarterly during closure to determine if the groundwater levels meet the completion criteria. The groundwater levels measured in bores prior to mining will be adjusted proportionate with average regional fluctuations in groundwater levels, to determine the required groundwater recovery level for bores. Superficial groundwater bores recording a groundwater level within 1 m of the adjusted pre-mining groundwater level will be considered as recovered from the drawdown effect of dewatering during mining and to have satisfied completion requirements. Monitoring of each bore will continue until the bore has recovered to within 1 m of the adjusted pre-mining groundwater level for that bore and the recovered groundwater level is demonstrated to be stable. In September 2009, only five bores were recording levels at more than 1 m below adjusted pre-mining levels. Monitoring of these bores will continue post-closure until groundwater levels recover as predicted.

Water quality analysis of superficial aquifer bores has been conducted on a quarterly basis since 2001. Groundwater quality monitoring will continue to be conducted quarterly at representative groundwater bores as outlined in Appendix 6 until the average groundwater quality meets or exceeds the pre-mining groundwater quality, taking into account changes in rainfall regime and other external factors. The groundwater quality monitoring program has taken into account the Golders Associates Review (Appendix 1) to ensure potential impacts from acidic soils are monitoring and assessed. This includes a suite of laboratory and field parameters consistent with the recently released DEC guidance on sampling for ASS: “Identification and Investigation of Acid Sulphate Soils and Acidic Landscapes” (May, 2009).

#### 7.1.6.3 Potential for Hydrocarbon Contamination in Groundwater

During mining operations, hydrocarbon contaminated soil has been collected and stored in a clay lined bioremediation facility, or landfarm. This material will be remediated during rehabilitation. A superficial aquifer monitoring bore, GS24, is positioned downstream of the landfarm. To monitor groundwater quality in the vicinity of the landfarm, specifically to check impacts from hydrocarbons, quarterly water quality analysis of bore GS24 will continue until the landfarm is fully bioremediated. Parameters analysed will include total petroleum hydrocarbons (TPH) and benzene, toluene, ethyl benzene, and xylene (BTEX). The monitoring results will be compared to DEC criteria for acceptable hydrocarbon concentrations in fresh water (DEC 2003).

### 7.1.7 Surface Water

Flow characteristics of the recreated streams will be monitored with continuous stream flow measurements, as described in Section 7.1.7.2. Inspections of the streams will also be conducted twice each year for erosion and changes to flow path. Stream inspections will continue until native riparian vegetation is demonstrated to achieve the relevant completion criteria.

Completion criteria relevant to surface water are:

- 8.1 The north and south streams are recreated generally along their original alignment.
- 8.2 The recreated streams have suitable storm flow capability and erosion resistance to provide long term stability.
- 8.3 The central wetland and streams are recreated.
- 8.4 The contours of the final landform reflect the contours and drainage of the pre-mining landform.
- 8.5 Water quality in streams is of an acceptable standard similar to or better than pre-mining levels.

Measurable standards required to achieve the completion criteria for surface water are:

- Location of the north and south streams is along the original alignment.
- Central wetland is recreated as the wetland known as Dam 2.
- The streams and wetland are erosionally stable, have high and low flow zones and gentle meanders consistent with the surrounds.
- The design of the recreated streams has been certified by an engineer to ensure storm flow capability and erosion stability is suitable for the final land use requirements and receiving environment.
- The catchment areas and land slopes, stream lengths and slopes and proportion of average annual runoff conveyed through each stream for the recreated North and South streams is within 20 % of the pre-mining characteristics (Table 2-2).
- The key surface water quality parameters in the North stream, South stream and Central Stream are of a standard similar to or better than pre-mining levels, taking into account external impacts such as changes to rainfall regime and impacts from upstream landowners.

Surface water quality and flow monitoring will be conducted to demonstrate achievement of the completion criteria and ensure compliance with the Prescribed Premises Licence.

#### 7.1.7.1 Process Water Dam

The Process Water Dam will be retained as the waste water storage point to collect mine water during rehabilitation. In the event that excess stormwater is required to be released during closure, the process water dam water quality will be monitored and managed as it was during the operating period. Monitoring parameters will include total suspended solids, turbidity and pH to confirm the water quality is suitable for releasing off site. The required water quality before water can be released off site is turbidity below 80 mg/L (TSS) and pH above 5.5. Monitoring of the process water dam will continue until there is no further requirement for discharge from the licensed discharge point.

#### 7.1.7.2 Streams

Stream flow and water quality monitoring at the North, Central and South streams will continue throughout closure and for at least three years after realignment of each stream, to confirm achievement of completion criteria.

Continuous monitoring stations at the downstream ends of the North, Central and South streams measure stream flow, electrical conductivity and turbidity. This data will be downloaded monthly.

Additional water quality parameters will be measured by the analysis of quarterly water samples taken upstream and downstream of the stream realignments. Water quality sampling will continue at the same locations as during mining. The water quality parameters included in the Closure Monitoring Program are those that may be of concern as a result of mining activities (TSS, TDS, turbidity, EC, pH and Al), and have relevant guideline levels for the likely downstream water use, stock watering, and for the natural receiving environment (nutrients, Al and TSS) (Section 2.1.4).
Water quality and stream flow in the recreated streams will be analysed in the Water Resources Review and compared to pre-mining conditions to determine achievement of the completion criteria.

URS validated the designs of the northern and southern streams in a report completed in July 2008 (Appendix 5). These designs will be followed in the re-creation of the streams. The replacement of the streams will be conducted as outlined in Section 6.2.7.1 and reported through the Annual Environmental Report as outlined in Section 9.0.

Erosion of the streams will be monitored twice a year by site inspection following realignment.

#### 7.1.7.3 Rainfall

Meteorological data is continuously recorded at the site weather station and downloaded monthly. Collection of meteorological data will continue whilst surface and groundwater monitoring occurs on site. Meteorological data is used in the analysis, review and reporting of water monitoring data.

### 7.1.8 Vegetation

#### 7.1.8.1 Pasture Rehabilitation

Completion criteria relevant to pasture rehabilitation are:

- 5.1 Agricultural species composition and percentage cover are consistent with the intended final land use.
- 5.2 Post-mining agricultural productivity is similar to or higher than pre-mining productivity or current regional productivity.

Measurable standards required to achieve the completion criteria for pasture rehabilitation are:

- The proportion of each agricultural species composing the pasture is within 20 % of the target proportion for that species.
- Average percentage cover across the pasture areas is at least 75 %.
- Productivity of established pastures equals or exceeds pre-mining agricultural productivity of 5 tonnes per hectare total annual dry matter pasture yields, as measured in the pre-mining Agricultural Assessment (John Wise Consultancy 2001) or current regional productivity.
- The ongoing management, required to maintain agricultural productivity to pre-mining levels, is no greater than would be required for similar properties in the area.

Annual monitoring of the rehabilitation pasture areas will be conducted to determine pasture composition and percentage cover. Variation greater than that prescribed in the completion

criteria will be addressed by maintenance activities, including additional seeding or modification of management practices (e.g. fertiliser application or grazing activities).

Post-mining agricultural productivity will be measured during rehabilitation, as detailed in the Closure Monitoring Program. The agricultural productivity assessment will be undertaken by an independent agricultural consultant. If widescale changes in climatic conditions negatively affect regional agricultural productivity, Iluka may not be able to achieve the 2001 pre-mining productivity levels. If this is the case, Iluka will monitor regional agricultural productivity and ensure the site productivity is consistent with regional productivity levels. Variation will be addressed by maintenance activities, including additional seeding or modification of management practices (e.g. fertiliser application or grazing activities).

#### 7.1.8.2 Native Vegetation

The Completion Criteria for native vegetation are:

- 9.1 Tree belts are established along the site boundaries adjacent to Dewar Road and Brand Highway.
- 9.2 A diverse and stable native vegetation community comprising locally endemic species is established along the North and South streams, andat the recreated wetland (Dam 2).
- 9.3 The areas of native vegetation rehabilitation are protected from stock grazing and access.

Measurable standards required to achieve the completion criteria for native vegetation are:

- Tree belts established on Dewar Road and Brand Highway are left intact.
- A minimum of five local endemic understorey species plus appropriate overstorey species existing prior to mining are planted and established in areas of native vegetation rehabilitation.
- A total of 14.7 ha is rehabilitated with native vegetation (including streams) in areas as shown on the rehabilitation plan.
- Rehabilitated streams and wetlands are fenced to prevent stock access and grazing, designed in accordance with Water Note 18 (Water and Rivers Commission 2000a).
- At least one stock crossing is constructed at each of the north and south streams, designed in accordance with Water Notes 06 and 07 (Water and Rivers Commission 2000b and c).
- Native vegetation in areas of rehabilitation retains diversity of initial plantings, with species richness not decreasing over a period of at least three years.
- Ongoing management requirements for native vegetation in areas of rehabilitation are no greater than for similar properties in the area.

Re-establishment of native vegetation, fencing and stock crossings will be conducted as outlined in Sections 6.2.7.4 and 6.2.7.5 and reported through the Annual Environmental Report as outlined in Section 9.0.

Native vegetation monitoring is required to measure achievement of Completion Criteria 8.2. The native vegetation monitoring will include identification of species and measurement of diversity and vegetation condition.

Monitoring of the native vegetation will be conducted by personnel experienced in ecological assessments and identification of species from the Gingin area. Monitoring will be undertaken when the majority of the species used in rehabilitation will be flowering.

Monitoring of native vegetation will be undertaken by walking vegetation transects. Six transects will be monitored in the areas of native vegetation rehabilitation: North stream,South stream and one in the Central Stream. .One transect will also be monitored on

the South stream upstream of the site, as a reference site that will show any changes in vegetation condition as a result of external impacts (e.g. reduced rainfall). Each transect will be up to 100 m long and each end will be marked with pickets and the coordinates recorded so that the same transects are monitored each year.

Whilst walking transects, the following information will be recorded:

- Species encountered within one metre each side of the transect, and the number of times each species was recorded; and
- Vegetation condition assessment of the entire transect, in accordance with the vegetation condition scale in Table 7-1.

**Table 7-1: Vegetation Condition Rating, Adapted from Connell (1995) and Bush Forever**

| Vegetation Condition Rating | Description |
|---|---|
| Excellent (E) | Pristine or nearly so, no obvious signs of disturbance. |
| Very Good (VG) | Evidence of localised low level damage to otherwise healthy bush. Seedling recruitment and generally healthy population size (age/stage) structure apparent. Weed and grazing damage is confined (<20% of area). High likelihood that vegetation structure and species richness can be maintained. |
| Good (G) | Evidence of localised high level disturbance to otherwise low level damaged bush. Recruitment is localised and the populations of some species may be senescent. Weed and grazing damage is apparent in 20-50% of the area. Localised gall and parasitic plant damage may be apparent. Moderate likelihood that vegetation structure and species richness can be maintained. |
| Poor (P) | Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout >50% of the area. Locally some vertical strata are absent. Gall and mistletoe damage apparent. Low likelihood that vegetation structure and species richness can be maintained or re-established. |
| Very Poor (VP) | Widespread high level damage. Recruitment is disrupted and most species appear senescent. Weed and grazing damage apparent throughout the area. Widespread loss of vertical strata. Gall and mistletoe damage apparent. Little to no likelihood that vegetation structure and species richness can be re-established. |
| Completely Degraded (D) | The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. Often described as 'parkland cleared', with the flora comprising weed or crop species with isolated native trees or shrubs. |

The results from transect monitoring will be used to determine the number of species in each strata present (upper, middle and lower), whether they are native or introduced, and how many of each species are present.

The vegetation condition will also be compared to previous years to determine any changes in the condition of the native vegetation rehabilitation.

Photo monitoring to record the regeneration and condition of native vegetation will be conducted at the same locations as the native vegetation condition monitoring. Photo monitoring will also be continued at the North stream crossing at Brand Highway.

### 7.1.9 Fauna
The completion criteria for native revegetation are expected to provide improved fauna habitat. It is not considered beneficial to conduct specific fauna monitoring.

### 7.1.10 Waste
Waste generated on site will be minimal after decommissioning in 2009. There are no completion criteria related to waste. Therefore a waste data inventory will not be necessary during closure activities.

### 7.1.11 Noise
There is no completion criteria related to noise.

The prescribed standards for noise described in the Noise Management Plan (Iluka 2007e) apply to the site until the heavy mineral concentrate stockpiles are removed, and trucking at night time ceases. Trucking of heavy mineral concentrate on a 24 hour basis is estimated to finish in December 2009. The continuous noise monitor will remain until this time.

As described in Section 6.3.2, prescribed standards for noise emission will not apply to the site after all heavy mineral concentrate has been trucked. Closure activities will be conducted only between the hours of 7.00 am to 7.00 pm, Monday to Saturday. Continuous noise monitoring will not be required during closure activities.

Noise management measures will continue to be applied, as described in Section 6.3.2. In addition, noise monitoring will be conducted with a handheld meter during the closure phase in order to identify noisy activities. These excessively noisy activities will then be limited to operating when wind conditions are conducive to noise travelling away from neighbouring residences.

#### 7.1.11.1 Continuous Weather Monitoring System
Weather conditions (wind direction and speed) shall be monitored continuously to identify unsuitable weather conditions that may result in high noise levels at neighbouring residences. On completion of mining, the weather station will be dismantled and removed.

### 7.1.12 Dust
There is no completion criteria related to dust.

Dust monitoring (other than for radiation purposes) is not currently conducted on-site during operations. This is in accordance with the Dust Management Plan, as revised and approved by EPA in 2007. Initiating dust monitoring for closure activities is not considered warranted, as dust controls will be continue to be implemented during closure. Dust management will focus on complying with the standard established in the Licence for Prescribed Premises: to ensure no visible dust crosses premises boundary. Dust control methods will continue, using the same processes as during operations. These control methods are described in Section 6.3.3.

## 7.2 Rehabilitation Maintenance

Maintenance activities will be undertaken as needed to achieve compliance with completion criteria. Maintenance of the rehabilitated area will include maintenance of the landform, streams and wetland, pasture and native vegetation.

### 7.2.1 Landform

The objective of landform maintenance is to maintain stability of the landform. Maintenance activities may include:

- Repair of erosion or subsidence; and
- Modification or maintenance of sediment and erosion control structures.

Maintenance of the landform will continue as necessary until sign-off of achievement of the completion criteria.

### 7.2.2 Streams and Wetland

The maintenance objectives for the streams and wetland are to maintain structures and ensure erosional stability of the waterways. The waterways will be observed during the establishment period to ensure that the stream channels are stable and not eroding. If necessary, the stream alignment may be adjusted slightly to suit the recreated landform.

Ongoing maintenance activities may include repair of fences, gates or stock crossings; installation of erosion controls (such as geotextile lining or rock reinforcement); and mowing or re-seeding of stabilising vegetation (grass). Maintenance of the streams and wetland will continue as necessary until sign-off of achievement of the completion criteria.

### 7.2.3 Pasture

The primary aspects requiring management are: grazing, weed and pest control, and fertiliser inputs.

In the first spring after sowing, the primary objective is to develop a stable, productive soil profile by encouraging proliferation of pasture roots and soil biota. Pasture will be grazed lightly to promote a desirable balance of species and to discourage pasture weeds. Supplementary seed applications may be undertaken if appropriate.

In subsequent years, the preliminary stabilising species mix will be replaced with a pasture or cropping species mix, depending on the final landuse as agreed with the landowners. The preliminary pasture will be ploughed into the soil after summer. The species selected to establish the final landuse will then be applied using the methods described in Section 6.2.7.3.

One of the completion criteria for the pasture areas is that pasture productivity can be maintained with appropriate management, typical of the locality. Consequently, grazing intensity will be gradually increased to levels considered appropriate for the district and the seasonal conditions.

Weed control will primarily be achieved by ensuring pastures are appropriately grazed such that they out-compete pasture weeds. Pastures will be monitored for problem weeds and pests. Where warranted, weeds will be controlled via herbicide application. Similarly, where warranted, agricultural pests will be controlled by application of insecticide. Invasive or Declared Weeds such as golden wattle, apple of Sodom and arum lily will be spot sprayed with a suitable herbicide.

Weed control procedures will follow normal agricultural practices, with agronomic advice sought where necessary.

Pastures will be fertilised annually as part of an ongoing maintenance programme. The type, rate and number of fertiliser applications will be determined via soil testing and agronomic advice.

### 7.2.4 Native Vegetation

Maintenance of native vegetation areas may include activities such as planting additional seedlings, to replace any unsuccessful seedlings and ensure species diversity is maintained. Invasive or Declared Weeds, such as golden wattle, apple of Sodom and arum lily, will be hand-removed or spot sprayed with a suitable herbicide. Fences will ensure the native vegetation is protected from stock; protection from other herbivores (such as rabbits) will be utilised as necessary.

# 8.0 Review

The Closure Plan will be reviewed annually. Any significant changes will be communicated to relevant stakeholders and regulators for endorsement.

# 9.0 Reporting and Records Management

The progress of closure will be reported in the Midwest Annual Environmental Report, which is submitted to the EPA in March each year. This report will include a summary of closure activities, description of areas rehabilitated, summary and analysis of monitoring results and progress against completion criteria.

The Water Resources Review will continue to be prepared annually and submitted to neighbouring landowners by 31 March each year. The Water Resources Review includes a summary and analysis of all monitoring and management records for the local surface water and groundwater resources. The Water Resources Review will also include assessment of progress against completion criteria for surface water and groundwater.

The Annual Aquifer Review will continue to be prepared annually and submitted to the Department of Water by 31 March each year, while the Licence to Take Water remains active. The Annual Aquifer Review presents a record of groundwater extraction, including meter readings and volume pumped.

When decommissioning groundwater monitoring or extraction bores, complete and accurate records of the entire decommissioning procedure shall be kept for future reference and to verify that the bore hole was properly sealed. Details of bore cementing shall be recorded on a bore completion report. This information will be provided to the Department of Water to verify that the groundwater bores were decommissioned satisfactorily.

A radiation completion report shall be submitted to DOCEP and the Radiological Council at the completion of radiation management activities. The report will be prepared in accordance with the Iluka Mid-West Operations Radiation Management Standard Job Procedures (Iluka 2008) and will contain:

- the exact location of all radioactive waste disposal facilities and the quantity and activity of material located at each facility;
- a record of dose exposure of employees and contractors;
- a record of measurements that confirm compliance with completion criteria;
- a record of quality assurance audits and inspections;
- a record of all relevant correspondence; and
- suggested improvements for future similar activities.

Files and documents used to collate information regarding closure commitments, licences, approvals and other information concerning closure at Gingin will be catalogued and maintained in accordance with standard Iluka practices.

# 10.0 Close-Out Procedure

The Close-Out Procedure detailed below was developed with reference to the Mine Closure and Completion Handbook (Department of Industry Tourism and Resources 2006).

The Close-out Procedure is as follows:

1. Close-Out may be conducted over the whole Project at once, or discrete land parcels may be closed-out as they reach achievement of the Completion Criteria.
2. Iluka assesses the close-out area against the Completion Criteria in Section 4.5 to demonstrate that the Completion Criteria are achieved. The assessment may be undertaken or reviewed by an independent party.
3. Iluka presents the results of the Completion Criteria assessment to the regulatory authorities and land owners where relevant.
4. The regulatory authorities and/or landowner agree with the assessment of the close-out area. Any disagreement regarding achievement of Completion Criteria is resolved.
5. A process is agreed to deal with those areas of the close-out area that do not meet the Completion Criteria, or aspects of the Completion Criteria that are not met. At this stage, Iluka may need to carry out further agreed activities or maintenance to achieve the Completion Criteria. If this was the case, the close-out procedure would be recommenced at step 1 after Iluka had undertaken the required activities and maintenance and established that the close-out area had achieved the Completion Criteria.
6. The regulatory authorities sign-off on closure of the close-out area and Iluka is absolved of all further responsibility for mining impacts.
7. The close-out area is returned to the landowners, or may be sold to a third party. The landowners or third party who purchases the land accept responsibility for the rehabilitated area.

Table 10-1 outlines the authorities and the relevant close-out aspects they would be consulted for.

**Table 10-1: Regulatory authorities that may be consulted during close-out**

| Regulatory Authority | Aspect of Closure |
|---|---|
| Minister for the Environment | Primary regulatory authority. Determines if Iluka's rehabilitation requirements have been fulfilled and authorises release of the security bond. |
| Environmental Protection Authority | Provides recommendations to the Minister for the Environment. |
| Shire of Gingin | Local government authority and major stakeholder. Provision of advice to the Minister for the Environment as to whether site closure has been achieved to the standards required by the Shire of Gingin Planning Consent and further agreements between Iluka and the Shire of Gingin. |
| Department of Water | Decommissioning of groundwater production bore and groundwater monitoring bores; re-establishment of streams and wetland. |
| Department of Environment and Conservation | Dust management and water discharge from the Licensed discharge point, including related monitoring. Contaminated sites assessment if required. |
| Department of Agriculture | May be consulted by EPA in relation to achievement of required agricultural productivity. |
| Main Roads Western Australia | Entrance road from Brand Highway. |
| Radiological Council | Management of radioactive material. |

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