Rio Tinto

West Angelas Operations

Environmental Management Program

Robe River Mining Co. Pty. Ltd.

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1 INTRODUCTION

1.1 OVERVIEW OF WEST ANGELAS

West Angelas Iron Ore Mine is located approximately 130 kilometres (km) northwest of Newman in the Pilbara region of Western Australia (Figure 1).

Robe River Mining Co. Pty. Ltd. (hereafter **Robe**), a wholly owned subsidiary of Rio Tinto, is the authorised manager of the West Angelas Iron Ore Mine on behalf of the Robe River Joint Venture Participants.

Production commenced in 2001 at Deposit A and in 2011 at Deposit E. Deposit A provides the primary ore source with Deposit E supplementing the production to maintain the current production rate. Deposit B is the next major ore source with mining scheduled to commence in 2015. Deposit A west and Deposit F have been identified as the next to be developed with mining scheduled to commence in 2016. The spatial configuration of the deposits within the context of the current mining operations is shown in Figure 2.

The integrated West Angelas Iron Ore Mining Operation (**WAO**) as implemented consists of:

- Open cut mining of iron ore from above and below the water table (**AWT** and **BWT**) by conventional drill, blast, load and haul techniques. Three deposits have been approved for mining (Deposits A, B and E). Production commenced in 2001 at Deposit A and in 2011 at Deposit E. Mining is scheduled to commence at Deposit B in 2015. Mining is scheduled to commence at Deposits A west and F from 2016.
- Ore processing in central processing facilities at a current rate of approximately 35 Million tonnes per annum (**Mtpa**).
- Surface waste dumps which will be used in progressive backfilling of the mine pits as far as practicable.
- A mine dewatering borefield which dewaters the ore bodies to allow mining BWT. Dewatering water is used on-site in the first instance to supply water for operational purposes (processing and dust suppression)
- The Turee Creek B Borefield, located approximately 30 km west of the mine site, which is used to provide potable water to the mine and camp facilities and, when required, water for processing purposes and dust suppression. The Turee Creek “B” Borefield Pipeline Corridor links the Turee Creek “B” Borefield with the West Angelas Minesite.
- An accommodation village which is located approximately 9 km west of the mine site.
- A mine access road which is approximately 35 km long and links the mine site with the Great Northern Highway. The intersection of the Great Northern Highway and the Mine Access Road is approximately 100 km northwest of Newman.
- A railway network which transports processed ore approximately 413 km to port facilities located at Cape Lambert and Dampier. The majority of the rail network is double track with spur lines to connect remote sites.

1.2 ENVIRONMENTAL APPROVALS

The West Angelas Project, which included Deposits A and B, was referred to the Environmental Protection Authority (**EPA**) under Part IV of the *Environmental Protection Act 1986* (**EP Act**) in May 1997 and was assessed at the level of Environmental Review and Management Program (**ERMP**). The ERMP was submitted to the EPA for assessment in March 1998. The EPA published its Report and Recommendations (Bulletin 924) on 30 January 1999 and the Minister for the Environment approved implementation of the West Angelas Project, subject to the conditions of Ministerial Statement 514 (**MS 514**), on 28 June 1999. Four subsequent project modifications were approved under section 45C of the EP Act.

Mining at Deposit E was granted *Not Assessed* by the Minister for the Environment on 21 June 2010. Additionally, discharge of excess dewatering water to the natural environment was granted *Not Assessed* by the Minister for the Environment on 20 December 2010.

Ministerial Statement 970 (**MS 970**), which completely supersedes MS 514, was approved on 11 June 2014. MS 970 currently provides a regulatory framework for environmental management across the entire West Angelas operations.

Robe is also committed to compliance with all relevant Federal, State and Local regulatory requirements. All relevant documentation including approvals, licences and permits will be made available to site personnel through the Health, Safety, Environment and Quality (**HSEQ**) website.

2 FRAMEWORK

2.1 PURPOSE

Condition 4 of MS 514 mandated that Robe prepare and implement an Environmental Management Program (**EMP**) which shall include a series of Environmental Management Plans. The management plans were approved by the CEO of the Department of Parks and Wildlife (**DPaW**, formerly the Department of Environmental Protection) in December 1999 and implemented from 2000.

Condition 5 of MS 970 requires the Proponent to 'implement the proposal in accordance with the *"Environmental Management Program"*, dated November 2013, or subsequent revisions approved by the CEO the Office of the Environmental Protection Authority'.

This updated EMP was prepared to address the requirements of MS 970 and supersedes all previous Environmental Management Plans.

This EMP specifically addresses:

- environmental aspects to be managed;
- environmental management objectives and targets and performance indicators;
- actions to manage environmental risks to prevent, minimise and mitigate potential environmental impacts;
- monitoring and reporting procedures; and
- details the timing and persons responsible for implementation of actions.

2.2 SCOPE

The key environmental factors considered by the EPA for the current mining operations are the:

- protection of vegetation associations having conservation value;
- protection of Declared Rare and Priority flora;
- protection of Specially Protected (Threatened) fauna;
- protection of subterranean fauna habitat;
- maintenance and restoration of original drainage patterns;
- protection of surface water and groundwater quality;
- protection of the values of Karijini National Park.

In response to these factors, the following environmental management plans have been developed:

1. Groundwater Management Plan (Section 4.1);
2. Surface Water Management Plan (Section 4.2);
3. Vegetation and Flora Management Plan (Section 4.3);
4. Fauna Management Plan (Section 4.4);

5. Dust Management Plan (Section 4.5);
6. Waste Management Plan (Section 4.6); and
7. Rail Management Plan (Section 0).

2.3 STRUCTURE

This EMP includes four key parts:

Part 1 – Introduction. This part contains an overview of the West Angelas Operations.

Part 2 – Framework. This part details the framework within which the EMP operates.

Part 3 – Implementation. This part details the processes under which the EMP is implemented.

Part 4 – Environmental Management Plans.

The environmental management plan for each environmental factor has been developed in response to the impacts identified during the environmental impact assessment process. The management plans contain the relevant environmental background, objectives, management and monitoring actions for each factor.

Each management plan is structured in a consistent format as outlined in Table 1.

Table 1 Management plan framework

Management Plan		
Description		Provides a brief description of the environmental factor.
Environmental factors to be managed		Outlines the anticipated operational issues associated with the Proposal.
Performance management	Environmental objectives	Establishes over-arching objectives for environmental management of the West Angelas Operations.
	Targets	Establishes specific targets for environmental management of the West Angelas Operations based on over-arching management objectives.
	Performance indicators	Provides details on the key indicators that will be used to determine the Proponent's achievement of the targets.
Implementation	Management actions	Provides details of actions to manage environmental risks to prevent, minimise and mitigate potential environmental impacts.
Monitoring		Provides information on monitoring activities to be performed.
Contingencies		Provides details of actions to be taken in the event that specified criteria are met or exceeded.

Some management actions are cross referenced between individual environmental management plans as they may be relevant to the management of more than one environmental aspect.

3 IMPLEMENTATION

3.1 RESPONSIBILITIES

Implementation of the EMP is the responsibility of all site personnel working for, or on behalf of, Rio Tinto. Key personnel accountable for the implementation and review of this EMP are:

- West Angelas General Manager – accountable for overall environmental performance at West Angelas Operations.
- Superintendent Environment – accountable for implementing the EMP and achieving environmental objectives.
- Site Environmental Advisor – responsible for day to day verification that the environmental performance at West Angelas Operations complies with the intent of the EMP.
- Environmental Monitoring Officer – responsible for day to day environmental monitoring and recording.
- Hydrogeology Technical Officer – responsible for day to day hydrogeological monitoring and recording.

3.2 ENVIRONMENTAL AWARENESS AND INDUCTIONS

All personnel on site are required to complete an environmental induction to ensure they are aware of their responsibilities.

The environmental induction will provide employees with an understanding of the key environmental risks on site and the environmental incident reporting process.

3.3 INCIDENTS AND CORRECTIVE ACTIONS

All environmental incidents will be recorded in the incident database in accordance with the Rio Tinto Iron Ore (WA) Non-conformance, incidents and action management work practice. Environmental incidents are classified using the Rio Tinto Iron Ore Environmental Incident Classification Guide. Incidents will be investigated and appropriate measures implemented to prevent recurrence. Where applicable, environmental incidents will be reported to the relevant government agency.

The Site Environmental Advisor is responsible for conducting regular reviews of all incidents reported within their site/division/project and/or areas of responsibility to ensure any trends are identified and to assess the effectiveness of preventative measures.

3.4 EMERGENCY RESPONSE

The West Angelas Local Emergency Management Plan outlines procedures to minimise impacts from emergency situations.

Basic emergency response training will be provided to key personnel. An emergency response team will complete regular training and assessment in emergency scenarios. Appropriate emergency response equipment will be available on-site.

3.5 AUDITING AND REPORTING OF ENVIRONMENTAL COMPLIANCE

Compliance auditing and reporting will be undertaken in accordance with the West Angelas Compliance Assessment Plan.

At a minimum, the following environmental reporting will be conducted:

Table 2 Environmental reporting commitments

Report	Reporting frequency	Relevant Agency	Relevant Legislation
Annual Environmental Report (AER)	Annually	DER	DER Licence
Annual Environment Report (AER)	Annually	DMP	*Mining Act 1978*
Annual Audit Compliance Report (AACR)	Annually	DER	DER Licence
Ministerial Statement Compliance Report	Annually	OEPA	Ministerial Statement 970
Triennial Environmental Report (TER)	Triennially	DSD	*Iron Ore (Robe River) Agreement Act 1964*
Native Vegetation Clearing Permit Annual Report.	Annually	DMP	NVCP
National Pollutant Inventory (NPI) Emissions Report.	Annually	DoE	NPI NEPM
Annual Aquifer Review (AAR).	Annually	DoW	*Rights in Water Irrigation Act 1914*
Triennial Aquifer Review (TAR).	Triennially	DoW	*Rights in Water Irrigation Act 1914*
National Greenhouse and Energy Reporting System (NGERS).	Annually	DCCEE	NGER Act 2007

3.6 DOCUMENT REVIEW

This EMP is intended to be a dynamic document that will be reviewed and updated as required throughout the duration of the West Angelas operations.

Significant changes to the EMP will be developed in consultation with relevant government agencies.

4 ENVIRONMENTAL MANAGEMENT PLANS

It is intended that the West Angelas Operations will be managed under one Environmental Management Program, comprising individual environmental management plans. Each management plan can be used on a stand-alone basis for implementation.

This Program has been developed in compliance with Condition 5 of Ministerial Statement 970.

4.1 GROUNDWATER MANAGEMENT PLAN

4.1.1 Description

- Two regional aquifer systems have been identified at West Angelas. The first is in the Jeerinah Formation in the core of the Wonna Munna anticline which is comprised of mudstones, shales and ultramafic intrusive dolerite sills. The permeability and groundwater storage is generally low in this formation, except where there are local fracture systems associated with several north-west south-east trending regional lineaments. Groundwater within the Jeerinah Formation declines steeply in a north-south direction from the central Jeerinah Plateau, where groundwater levels are relatively shallow, ranging between 10-20m below ground level, into alluvial valley systems which flank this plateau to the north and south where groundwater levels are very deep, up to 140m below ground level. The very steep water level gradients is indicative of very low permeabilities or a lack of hydraulic connection altogether between the Jeerinah plateau and the flanking valleys. However, the hydraulic isolation between the formations may also be affected by faulting.
- The Marra Mamba Iron Formation which surrounds the Jeerinah Formation hosts the majority of the mineralisation in a series of discontinuous deposits located on the north and south limbs of the regional anticline and the second aquifer system. Aquifers associated with mineralisation are very deep, porous and therefore, permeable. These aquifers have a very low hydraulic gradient from east to west, and are considered to be confined "bathtub" type aquifers, hydraulically isolated by the low permeability of the surrounding rock as a result of structural folding.
- Dewatering is required to facilitate access to below watertable ore. Water from the mine dewatering bores is used on-site to supply water for operational purposes (processing and dust control) wherever practicable. Any surplus water, exceeding operational water demand is discharged to the environment.
- The mining operations are supplied with water from the mine dewatering bores and water from the Turee Creek B Borefield, located approximately 30 kilometres west of the mine site (Figure 3).

Stygofauna

- Stygofauna tend to be highly specialised to, and obligate dwellers of, subterranean groundwater habitats. Stygofauna are known to be present in a variety of rock types including karst (limestones), fissured rock (e.g. granite) and porous rock (e.g. alluvium).
- Both dewatering of the orebody aquifers and water abstraction from the Turee Creek "B" Borefield aquifer has the potential to reduce the available habitat for stygobitic fauna.

- Subterranean fauna surveys have been undertaken over the entire West Angelas area since 1979. Baseline stygofauna surveys were conducted during 1998, prior to the commencement of dewatering. Monitoring surveys were undertaken during 2002, 2003, 2004, 2008 and 2012. Sampling of orebody aquifers has yielded no stygofauna specimens to date.
- Aquifers associated with the orebodies are generally deep, confined aquifers, hydraulically isolated by low permeability surrounding rock and are not expected to support stygal communities.
- Stygofauna have been recorded in other parts of the region, however, these records are generally associated with the saturated superficial alluvial aquifers, such as at the Turee Creek "B" Borefield.
- The risk of dewatering reducing available habitat for stygofauna is considered low due to the apparent lack of prospective habitat within the orebody aquifers. Furthermore, no stygofauna have been recorded during surveys of areas that are being, or will be, dewatered. Adjacent Jeerinah Formation aquifer systems in prospective habitats that support recorded stygofauna are not expected to be affected by drawdown due to the lack of hydraulic connection with the orebody aquifer.

It is difficult to effectively demonstrate that a significant decline in stygofauna abundance or diversity has occurred based on sampling data. Capture success is highly variable. Stygal communities also experience natural fluctuations and sampling data reflects this variability over time. A habitat monitoring program will replace the traditional stygofauna sampling approach.

4.1.2 Environmental aspects to be managed

The potential impacts of the operations on groundwater values and the causal aspects of the operations requiring management are as follows:

- **Groundwater drawdown** due to mine dewatering;
- **Reduction in groundwater quality** due to potential contamination;
- **Loss of stygofauna habitat** as a result of changes in groundwater availability;
- **Deterioration of stygofauna habitat** as a result of changes in groundwater quality, including potential contamination; and
- **Decline of phreatophytic vegetation condition** (outside natural variability) as a result of changes in groundwater availability.

Dewatering will be undertaken in accordance with the licence to abstract water, issued by the Department of Water (**DoW**) under the *Rights in Water and Irrigation Act 1914*.

4.1.3 Performance management

Environmental targets and performance indicators have been developed based on groundwater management objectives at West Angelas (Table 3).

Table 3 Groundwater management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To ensure sustainable use and protection of existing groundwater resources.	Water supply will be sourced from dewatering bores wherever practicable in preference to sourcing new water.	Development and documentation of the site water balance. Reconciliation of results from monitored groundwater abstraction against the site water balance.
	No unacceptable changes in the regional aquifer levels.	Monitoring data shows no unacceptable changes in the regional aquifer levels.
To manage groundwater abstraction in compliance with all licence requirements.	Groundwater abstraction to occur only from licenced sources in compliance with licence conditions and limits.	Reconciliation of results of monitored groundwater abstraction volumes against licence conditions and limits.
To maintain the existing quality of groundwater resources.	No contamination of groundwater.	Monitoring data shows no unacceptable changes in groundwater quality. *Also see Waste Management Plan.*
	Compliance with relevant guidelines for groundwater quality (taking into consideration natural background water quality).	Monitoring data shows no unacceptable changes in groundwater quality.
To preserve the environmental values of the dependent ecology.	No significant decline in subterranean habitat parameters (outside natural variability) as a result of groundwater drawdown.	Assessment of time series change in subterranean habitat parameters (water levels and water quality).
	No significant decline in phreatophytic vegetation condition (outside natural variability) as a result of groundwater drawdown.	Assessment of time series change in phreatophytic vegetation monitoring data. *Also see Vegetation and Flora Management Plan.*

4.1.4 Implementation

Specific actions have been identified to assist in achieving groundwater management objectives (Table 4).

Table 4 Groundwater management actions

Parameter	Action
Water abstraction	Water supply will be sourced from dewatering bores wherever practicable.
	Groundwater will only be drawn from points licenced by the DoW.
	Copies of all water licences, permits and operating strategies will be available via the Rio Tinto Iron Ore Health, Safety, Environment and Quality Management System (HSEQMS).
	The volume of groundwater abstracted will be recorded, reconciled regularly against the licence limit and will not exceed the licence limit.
Water use	A 'site water balance' will be developed and maintained to facilitate site's understanding of current and future water demands and potential effects on upstream and downstream users.
	Water from the mine dewatering bores will be used on-site wherever practicable.
Water quality	A water quality monitoring program will be established for groundwater.
	Equipment used to monitor groundwater quality will be calibrated and associated records maintained or alternatively, a NATA accredited laboratory will be engaged to conducted water quality analysis.
	Pits will be backfilled to above the natural ground water level as far as practicable to minimise the deterioration of groundwater quality.
Induction	Prior to engagement on site, all staff will be inducted on: • water conservation, • potential for spills to contaminate groundwater, • consequences of groundwater contamination, • proper storage and handling of hydrocarbons/chemicals, • spill response procedures, and • issues relevant to the protection of stygofauna, where it is related to their roles & responsibilities.
Stygofauna	Water supply will be sourced from dewatering bores wherever practicable to reduce potential for drawdown in the Jeerinah Formation.
	Where stygofauna are known to be present in an aquifer, that aquifer will be monitored for subterranean habitat parameters (water levels and water quality).

Parameter	Action
	In the event that new bores are to be installed within an aquifer that has not yet been monitored for stygofauna, a stygofauna assemblage baseline survey should be undertaken. If sampling indicates that stygofauna species of significant conservation value are present, bores will be added to the monitoring schedule for subterranean habitat parameters.
Phreatophytic vegetation	Monitoring to assess the impacts of drawdown on phreatophytic vegetation (*Eucalyptus* sp.) will be undertaken. *See Vegetation and Flora Management Plan*.

4.1.5 Monitoring program

The monitoring program for groundwater at WAO (Table 5) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 5 Groundwater monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Groundwater levels	Monthly	Abstraction volume	As per the Groundwater Abstraction Licence and Groundwater Operating Strategy	To track instantaneous and cumulative groundwater abstraction volumes and ensure compliance with licence conditions.
		Water level elevation	As per the Groundwater Operating Strategy	To track changes in groundwater levels and ensure no unacceptable changes in the regional aquifer levels as a result of groundwater abstraction.
Groundwater quality	Monthly	EC, pH, and temperature	Water quality sampling and analysis as per the Part V operating licence and Groundwater Operating Strategy	To ensure no unacceptable changes in groundwater quality.
	Quarterly	TPH, Na, K, Ca, Mg, Cl, CO_3, HCO_3, SO_4, NO_3, Metals, TSS, Total-N and Total P		
	Annually	Potability analysis	As per the Groundwater Operating Strategy	To determine water quality prior to on-site use or excess water discharge.
Stygofauna	Annually	Subterranean habitat parameters (groundwater levels and groundwater quality)	As per monitoring parameters for groundwater levels and groundwater quality	Assessment of time series change in subterranean habitat quantity and quality.
	Opportunistically	Stygofauna abundance	EPA Guidance Statement No. 54 - *Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia* (2003), Technical Appendix to Guidance Statement no. 54: *Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia* (2007)	Assessment of subterranean fauna species and abundance.
Surface water will be monitored and managed as specified in the Surface Water Management Plan.				
Phreatophytic vegetation in the Turee Creek "B" Borefield to be monitored as specified in the Vegetation and Flora Management Plan.				
Potential groundwater contamination will be monitored and managed as specified in the Waste Management Plan.				

Groundwater quality and quantity data collected throughout the monitoring program will be included in the Annual Aquifer Review

4.1.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for groundwater management are not being achieved (Table 6).

Table 6 Groundwater management contingency actions

Management objective	Trigger	Action
To ensure sustainable use and protection of existing water resources.	Groundwater levels recorded in regional aquifers below predicted natural range for successive monitoring events	1. Investigate potential causes of groundwater level variance including: i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review seasonal rainfall data and regional groundwater water levels, iii. review groundwater abstraction volumes / rates and extent of drawdown. 2. If groundwater abstraction is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess groundwater abstraction volumes / rates, cease pumping and / or utilise alternative bores) on advice on relevant stakeholders, iii. implement remedial actions as required.
To manage groundwater abstraction in compliance with all licence requirements.	Groundwater abstraction volumes exceed licence limits	1. Immediately decrease or cease groundwater abstraction. 2. Report as Environmental Incident. 3. Notify relevant stakeholders.
To maintain the existing quality of groundwater resources.	Groundwater quality indicates a substantial deviation from baseline quality for successive monitoring events	1. Investigate extent and potential causes of water quality variance including: i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review potential sources of contamination and pathways, 2. Remove identified source/s of contamination. 3. If a recovering trend is not evident following the next monitoring event; i. notify relevant stakeholders, ii. identify remedial options to maintain sufficient groundwater habitat, iii. implement remedial actions as required.

Management objective	Trigger	Action
	Groundwater quality adversely affected by a spill	1. Mitigate (initiate spill response procedures) including: i. control the spill, ii. contain the spill, iii. clean up the spill, and iv. report the spill as an Environmental Incident. 2. Investigate cause. 3. Implement remedial actions, as required. 4. Review environmental incidents relating to spills. 5. Review relevant environmental procedures (e.g. spill response procedures). 6. Review the need for personnel training (e.g. in spill response procedures).
To preserve the environmental values of the dependent ecology.	Subterranean habitat parameters (water levels and water quality) indicates a substantial change relative to baseline for successive monitoring events	1. Investigate potential causes of change to subterranean habitat parameters. 2. If a recovering trend is not evident following the next monitoring event; i. identify remedial options to maintain sufficient groundwater habitat, ii. remove potential source/s of contamination from the most likely pathway. 3. Implement remedial actions, as required.
	Significant[1] decline of phreatophytic vegetation condition relative to baseline for successive monitoring events	1. Investigate potential causes of decline including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and tree condition information to determine the presence of factors likely to cause decline in tree health – e.g. fire or flood damage, evidence of insect activity or pathogens etc., iii. review seasonal rainfall data and regional groundwater water levels, iv. review groundwater abstraction volumes / rates and extent of drawdown, v. review tree health monitoring results from regional reference sites. 2. Increase frequency of monitoring as appropriate. 3. If groundwater abstraction is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess groundwater abstraction volumes / rates, cease pumping, surface irrigation, supplementation and / or rehabilitation), iii. implement remedial actions as required.

4.2 SURFACE WATER MANAGEMENT PLAN

4.2.1 Description

- Deposits A, A west, B, E and the majority of Deposit F (pits F1 and F2) are located within the upper reaches of the Turee Creek East catchment which forms part of the regional Ashburton River Catchment (Figure 4). The upper catchment has a complex drainage pattern characterised by intermittent flow and infrequent wide-spread flooding, depending on the occurrence of high intensity rainfall events. Turee Creek East represents the most significant named watercourse in the area with a catchment area of approximately 2,050 km².
- The F3 orebody, part of Deposit F, is located in the upper reaches of the Weeli Wolli Creek catchment, part of the regional Upper Fortescue River catchment, immediately west of the regional Ashburton River catchment. The Weeli Wolli Creek catchment covers an area of approximately 3,991 km². Weeli Wolli Creek flows in a north easterly direction and merges with Marillana Creek 60 km downstream from Deposit F.
- The surface hydrology is dominated by small first-order streams and typically small sub-catchments. The hills are characterised by steep incised drainage channels. However as the channels extend out from the hillside to the very flat valley floor, they transform into shallow, poorly defined drainage lines typical of overland flow depending on the occurrence of high rainfall events. The location and extent of these shallow drainage lines on the valley floor are often hard to define.
- Ephemeral unnamed tributaries of the Turee Creek East traverse West Angelas. The northernmost of these tributaries naturally flowed across Deposit B. The southernmost of these tributaries naturally flowed along the valley floor, crossing Deposit F and Deposit E and then meandered north westerly across Deposit A. Surface water flows that are intercepted by operations have, and will continue to be diverted to maintain natural flows as far as practicable. Where it is not possible to continue flow within its natural catchment, surface water flows will be diverted to facilitate continued flow in the adjacent catchment.
- Water from the mine dewatering bores is used on-site to supply water for operational purposes (processing and dust control) wherever practicable. Any surplus water, exceeding operational water demand is discharged to the environment.

4.2.2 Environmental aspects to be managed

The potential impacts of the operations on surface water values and the causal aspects of the operations requiring management are as follows:

- **Alteration of natural surface water drainage patterns** as a result of development.
- **Decline of Mulga community health** (outside natural variability) as a result of alteration of existing surface water drainage patterns (drainage shadow).

- **Reduction in surface water quality** as a result of increased erosion and potential contamination (sediments and hydrocarbons/chemicals) from drainage management systems and surface water discharge.
- **Decline or artificial proliferation of riparian vegetation community structure,** species diversity, cover or abundance (outside natural variability) as a result of surface water discharge.

Excess water will be discharged to the environment in accordance with an environmental licence, issued by the Department of Environment Regulation (**DER**) under Part V of the *Environmental Protection Act 1986*.

4.2.3 Performance management

Environmental targets and performance indicators have been developed based on surface water management objectives at West Angelas (Table 7).

Table 7 Surface water management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To maintain the existing local hydrological regime.	No significant change in natural surface water drainage patterns (outside natural variability).	Visual inspections show no unacceptable changes in natural drainage patterns, surface water flows are maintained.
	Only water exceeding on-site requirements will be discharged to natural drainage lines.	Development and documentation of the site water balance. Reconciliation of monitored surface water discharge volumes against the site water balance.
To maintain the existing quality of surface water resources.	No contamination of surface water.	Monitoring data shows water quality meets the criteria set out in licences and relevant guidelines. *Also see Waste Management Plan.*
	Compliance with licence conditions and relevant guidelines for discharge water quality, no significant deterioration of downstream surface water quality (outside natural variability).	Monitoring data shows no unacceptable changes in surface water quality, water quality meets the criteria set out in licences and relevant guidelines.
To manage surface water discharges in compliance with all licence requirements.	Surface water discharge to occur only from licenced sources in accordance with licence conditions and limits.	Reconciliation of monitored surface water discharge volumes against licence conditions and limits.
To preserve the environmental values of the dependent ecology.	No significant decline in Mulga community health (outside natural variability) as a result of drainage shadow.	Reconciliation of Mulga monitoring data against baseline data. *Also see Vegetation and Flora Management Plan.*
	No significant decline or artificial proliferation of riparian vegetation community structure, species diversity, cover or abundance (outside natural variability) as a result of surface water discharge.	Reconciliation of riparian vegetation monitoring data against baseline data. *Also see Vegetation and Flora Management Plan.*

4.2.4 Implementation strategy

Specific actions have been identified to assist in achieving surface water management objectives (Table 8).

Table 8 Surface water management actions

Parameter	Action
Planning	Emergency response procedures will be developed for the following: • failures of large water diversion and retention structures; • unplanned discharges; and • significant hydrocarbon and/or chemical spills.
	The profile of waste dumps (e.g. height and slope angles) will be designed to ensure that they are not prone to significant erosion / sedimentation from surface water run-off.
	Mineral waste dumps located near drainage features will be monitored to assess for scouring and erosion. Rock armouring, or other stabilising material, will be utilised if necessary.
Water use	A 'site water balance' will be developed and maintained to facilitate site's understanding of current and future water demands and potential effects on upstream and downstream users.
	Water will be used on-site wherever practicable.
	Only surplus water, exceeding operational water demand will be discharged to the environment.
Water quality	A water quality monitoring program will be established to analyse TPH in surface water. *See Waste Management Plan.*
Drainage management	Culverts will be used where appropriate to minimise impacts on natural surface water drainage patterns.
	Surface water flows that are intercepted by operations will be diverted to maintain natural flows downstream as far as practicable.
	Surface water collected on-site will be managed via on-site drainage management systems.
	Surface water collected on-site will be contained in sediment traps to reduce sediment loads prior to re-use or discharge.
	Surface water collected on-site that potentially contains hydrocarbons will be directed to oily water separation facilities.
	On-site drainage management systems will be routinely inspected and maintained to ensure they remain effective.
Mulga	Additional culverts will be incorporated along the rail and access road as appropriate to minimise impacts of drainage shadow on Mulga communities adjacent to the rail line.
	Culverts will be routinely inspected and maintained to ensure they remain effective.

Parameter	Action
	Monitoring will be undertaken to assess the impacts of drainage shadow on Mulga communities adjacent to the rail line. *See Vegetation and Flora Management Plan.*
Discharge	Abstracted water will only be discharged from licenced discharge points.
	The volume of water discharged will be recorded, reconciled regularly against the licence limit and will not exceed the licenced limit.
	Copies of water licences, permits and operating strategies will be available via the Rio Tinto HSEQMS
	Erosion protection will be utilised to minimise potential erosion and scouring at the discharge point.
	Sampling will be undertaken to ensure water quality meets the criteria specified in licences and relevant guidelines (taking into consideration natural background water quality).
Riparian Vegetation	Monitoring will be undertaken to assess the impacts of discharge on riparian vegetation. *See Vegetation and Flora Management Plan.*
	Management of weeds will be undertaken. *See Vegetation and Flora Management Plan.*
Induction	Prior to engagement on site, all staff will be inducted on: • drainage management procedures, • potential for spills to contaminate surface water, • consequences of surface water contamination, • proper storage and handling of hydrocarbons/chemicals, • spill response procedures.

4.2.5 Monitoring program

The monitoring program for surface water (Table 9) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 9 Surface water monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Surface water quality	Quarterly	TPH in surface water	Water quality sampling and analysis as per the Part V operating licence	To ensure surface water quality is not compromised.
Drainage management system	Opportunistically	Surface water flows are maintained	Visual inspection	To monitor the effectiveness of the on-site drainage management systems.
	Opportunistically	Integrity of drainage management systems	Visual inspection	To monitor the integrity of the on-site drainage management systems
Discharge volume	Monthly	Discharge volume	Water quantity sampling as per the Part V operating licence	To track instantaneous and cumulative discharge volumes and ensure compliance with licence conditions.
	Quarterly	Extent of saturation	Visual inspection as per the Part V operating licence	To track extent of saturation and ensure compliance with licence conditions.
Discharge water quality	Monthly	EC, pH and temperature	Water quality sampling and analysis as per the Part V operating licence	To ensure compliance with licence conditions and ensure no unacceptable change in downstream surface water quality as a result of discharge.
	Quarterly	TPH, Na, K, Ca, Mg, Cl, CO_3, HCO_3, SO_4, NO_3, Metals and TSS		
Discharge outlet	Opportunistically	Integrity of erosion control structures and evidence of erosion	Visual inspection (as per the Part V operating licence)	To monitor the integrity of erosion control structures.
Riparian vegetation along drainage lines receiving discharge to be monitored as specified in the Vegetation and Flora Management Plan.				
Mulga adjacent to the rail to be monitored as specified in the Vegetation and Flora Management Plan.				
Weeds will be monitored and managed as specified in the Vegetation and Flora Management Plan.				
Potential surface water contamination will be managed as specified in the Waste Management Plan.				

4.2.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for surface water management are not being achieved (Table 10).

Table 10 Surface water management contingency actions

Management objective	Trigger	Action
To maintain the existing local hydrological regime	Surface water flows not maintained	1. Investigate cause. 2. Implement remedial actions (e.g. reinstate surface water flows, divert flows) as required.
	Integrity of on-site drainage management system compromised	1. Investigate cause. 2. Undertake maintenance of on-site drainage management system as required. 3. Implement remedial actions as required.
To maintain the existing quality of surface water resources.	Water quality outside criteria set in licence conditions or relevant guidelines (taking into consideration natural background water quality) for successive monitoring events	1. Immediately decrease or cease affected discharge. 2. Investigate potential causes of water quality variance including: i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review potential sources of contamination, 3. If discharge is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify alternative water management options (e.g. increase on-site use), iii. identify remedial options on advice on relevant stakeholders. iv. implement remedial actions as required.

Management objective	Trigger	Action
	Surface water quality adversely affected by a spill	1. Mitigate (initiate spill response procedures) including: i. control the spill, ii. contain the spill, iii. clean up the spill, and iv. report the spill as an Environmental Incident. 2. Investigate cause. 3. Implement remedial actions as required. 4. Review environmental incidents relating to spills. 5. Review relevant environmental procedures (e.g. spill response procedures). 6. Review the need for personnel training (e.g. in spill response procedures).
	Visible erosion or associated downstream water quality impacts occur	1. Investigate potential causes of erosion. 2. Undertake maintenance of discharge outlet as required. 3. Implement remedial actions (e.g. reassess discharge volumes / rates, increase channel stability or vegetation cover) as required.
To manage surface water discharges in compliance with all licence requirements.	Discharge volumes or extent of saturation exceed licence limits	1. Immediately decrease or cease discharge (except emergency discharge) 2. Report as Environmental Incident 3. Notify relevant stakeholders
To preserve the environmental values of the dependent ecology.	Significant[2] decline in Mulga community health (outside natural variability) for successive monitoring events	1. Investigate potential causes of degradation of vegetation condition including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and tree condition information to determine the presence of factors likely to cause degradation – e.g. fire, storm damage etc., iii. review seasonal rainfall data. 2. If drainage management is identified as cause and a recovering trend is not evident following the next monitoring event; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess drainage management systems, surface irrigation, supplementation and / or rehabilitation) on advice from relevant stakeholders, iii. implement remedial actions as required.

Management objective	Trigger	Action
	Significant[3] decline or artificial proliferation of riparian vegetation community structure, species diversity, cover or abundance (outside natural variability) for successive monitoring events	1. Investigate potential causes of decline or artificial proliferation of vegetation or degradation of vegetation condition including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and vegetation condition information to determine the presence of factors likely to cause foliage loss – e.g. fire, storm damage, insect activity, waterlogging, foliage pathogens etc., iii. review seasonal rainfall data, iv. review surface water discharge volumes / rates and extent of discharge, v. review vegetation monitoring results from regional reference sites. 2. If surface water discharge is identified as cause and a recovering trend is not evident following the next monitoring event; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess groundwater abstraction volumes / rates, reassess surface water discharge volumes / rates, surface irrigation, supplementation and / or rehabilitation) on advice from relevant stakeholders, iii. implement remedial actions as required.

4.3 VEGETATION AND FLORA MANAGEMENT PLAN

4.3.1 Description

- West Angelas is situated within the Hamersley subregion of the Pilbara (**PIL**) Bioregion as defined in the Interim Biogeographic Regionalisation of Australia (**IBRA**) Report.
- West Angelas lies entirely within the Pilbara region of the Eremaean Botanical Province as defined by Beard (1975). The vegetation of this province is typical of arid landscapes. According to Beard the predominant vegetation associations in the survey area are:
    - Low woodland; continuous Mulga *Acacia aneura* woodland communities over spinifex *Triodia basedowii* and *Triodia epactia* hummock grasslands on stony undulating plains; and
    - Low scattered tree steppe; Snappy Gum *Eucalyptus leucophloia* over spinifex *Triodia wiseana* hummock grassland on stony undulating plains.
- The Priority 1 West Angelas Cracking Clay Priority Ecological Community (**PEC**) occurs extensively within the region. The location and extent of recorded PEC's is shown on Figure 5. This community is defined as 'open tussock grasslands of *Astrebla pectinata, A. elymoides, Aristida latifolia* in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines'. The West Angelas Cracking Clays are significant because they are relatively uncommon in the region and because they are in very good condition, attributed to the absence of historic cattle grazing. Threats to this community include: clearing for mining expansion and future infrastructure development; weed invasion; and changes in fire regimes.
- Numerous additional ecosystems are deemed to be "ecosystems at risk" (Kendrick 2003) and are therefore considered locally significant. Of these, the following ecosystems are relevant to the West Angelas area:
    - Grove/intergrove mulga communities: The grove/intergrove mulga in the region is in very good condition however, this vegetation is considered to be under threat from grazing and trampling, weed ingress (particularly by Ruby Dock **Acetosa vesicaria*), and changes to hydrological regimes. Grove/intergrove Mulga communities are widely recognised as being dependent on patterns of surface water flow. The diversion of sheet flow or concentration of sheet flow to particular areas is likely to cause shadowing impacts on these mulga communities.
    - Valley floor mulga: "Valley floor mulga" is a very broad description of mulga communities (previously Acacia aneura but now including a number of species). Valley floor mulga is also recognised as being dependent on patterns of surface water flow and is considered to be under threat from the same factors listed above.

- One species of Declared Rare Flora (DRF) is known from the West Angelas area. Hamersley Lepidium, *Lepidium catapycnon* was recorded next to a creek and on slopes adjacent to the southern base of West Angelas Hill. The total population was in excess of one hundred individuals in several patches within a few hundred metres of each other, with the population extending upslope to below the low cliffs on the upper hill slope.
- Priority Flora species have been recorded during surveys at West Angelas. The location of Priority Flora is shown on Figure 6.
- West Angelas is not located within a pastoral lease and, as a result, is not actively grazed. Subsequently, the vegetation condition is generally assessed to be in very good to excellent condition. The disturbance most commonly observed was the presence of weed species. *Acetosa vesicaria*, commonly known as Ruby Dock is classified as a High Priority weed by DPaW. It is associated with disturbed areas at West Angelas and the extent of its infestation is currently considered to be low.
- The WAO will result in the clearing of native vegetation for development of mine pits, waste dumps, processing facilities, stockpiles, accommodation, roads, railway and other associated infrastructure.
- Alteration of the existing hydrological regime may also result in decline or artificial proliferation of vegetation or degradation of vegetation condition.

4.3.2 Environmental aspects to be managed

The potential impacts of the operations on vegetation and flora values and the causal aspects of the operations requiring management are as follows:

- **Clearing of vegetation** for development of mine pits, waste dumps, processing facilities, stockpiles, accommodation, roads, railway and other associated infrastructure.
- **Decline or artificial proliferation of vegetation condition** (outside natural variability) as a result of:
  - alteration of the existing hydrological regime by:
    - groundwater abstraction,
    - discharge of excess water to natural drainage lines.
  - introduction or spread of weeds by:
    - vehicle or human movement,
    - increased water availability from excess water discharge.

- dust generated by:
  - vehicle movement,
  - mining and processing,
  - wind erosion.
- increased potential risk of fire outbreak by:
  - storage and use of flammable materials,
  - provision of ignition sources (e.g. welding, grinding),
  - blasting or incorrect storage or handling of explosives required for blasting.

  Changes to the local fire regime, such as a change in the frequency and intensity of fires, may alter vegetation communities.

4.3.3 Performance management

Environmental targets and performance indicators have been developed based on vegetation and flora management objectives at West Angelas (Table 11).

Table 11 Vegetation and flora management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To minimise clearing of vegetation.	Opportunities to minimise clearing of vegetation are investigated.	Reconciliation of actual clearing against approval boundaries.
	Where clearing of vegetation is unavoidable, progressive rehabilitation will be undertaken, where possible.	Progressive rehabilitation of cleared areas is being undertaken, where possible.
To manage clearing of vegetation in compliance with all approval requirements.	Clearing of vegetation to occur only from within approval boundaries and in compliance with approval conditions.	Reconciliation of actual clearing against approval boundaries.
	Cumulative clearing totals (in hectares) within approval limits and in compliance with approval conditions.	Reconciliation of clearing (in hectares) against approval limits.
To protect conservation significant vegetation communities and species.	Avoid conservation significant vegetation communities and species.	Reconciliation of actual clearing against approval boundaries.
	No significant decline in phreatophytic vegetation condition (outside natural variability) as a result of groundwater drawdown.	Reconciliation of phreatophytic vegetation monitoring data against baseline data. *Also see Groundwater Management Plan.*
	No significant decline in Mulga community health as a result of drainage shadow.	Reconciliation of Mulga monitoring data against baseline data. *Also see Surface Water Management Plan.*
	No significant decline or artificial proliferation of riparian vegetation community structure, species diversity, cover or abundance (outside natural variability) as a result of surface water discharge.	Reconciliation of riparian vegetation monitoring data against baseline data. *Also see Surface Water Management Plan.*
To prevent the displacement of native species by weed species.	No substantial increase in the type or abundance of weeds in the area (with a particular focus on *Acetosa vesicaria*, Ruby Dock).	Reconciliation of identified weed species / abundance against baseline data.
To ensure that dust emissions do not adversely affect environmental values.	No adverse impacts on vegetation as a result of dust generated by WAO.	Ambient dust monitoring data and visual dust assessments show no unacceptable dust levels. *Also see Dust Management Plan.*
To ensure that fire does not adversely affect environmental values.	No vegetation impacted by fire as a result of activities related to WAO.	Records show no fire-related damage to vegetation.

4.3.4 Implementation strategy

Specific actions have been identified to assist in achieving vegetation and flora management objectives (Table 12).

Table 12 Vegetation and flora management actions

Parameter	Action
Planning	Emergency response procedures will be developed for the following: • outbreaks of fire.
	Opportunities to minimise the clearing of vegetation will be investigated and documented.
	Clearing will be planned such that areas of elevated conservation significance will be avoided as far as practicable.
	Clearing will be planned such that vegetated areas are retained until required ahead of mine development.
	Internal authorisations will be obtained prior to commencement of clearing.
Clearing controls	Topsoil and subsoil will be stripped prior to commencement of clearing and managed in accordance with relevant procedures.
	Clearing will only occur within approval boundaries and limits.
	Clearing will avoid areas of elevated conservation significance as far as practicable. Conservation significant areas include the following: • West Angelas Cracking Clay Priority Ecological Community (PEC), • grove / intergrove Mulga communities, and • areas supporting Rare and / or Priority Flora (particularly *Lepidium catapycnon*).
	Known locations of Declared Rare Flora, Priority 1 and Priority 2 Flora species will be mapped as an avoidance area within the proponent's internal Approvals Request System to prevent disturbance as far as practicable.
	Any proposal to disturb Declared Rare Flora will require consent from the Minister for Environment in the form of a Permit to Take.
	Vehicle access will be restricted to designated tracks and roads as far as practicable.
Rehabilitation	Where clearing of vegetation is unavoidable, areas will be progressively rehabilitated with local native vegetation where possible.
	Seeds from as many native plant species of local provenance as possible will be used for rehabilitation.
	Appropriate signage will be erected to advise that rehabilitation is in progress and access is not permitted.
	A monitoring program will be established to measure the success of rehabilitation.
	Unnecessary disturbance of rehabilitated areas will be avoided.

Parameter	Action
Phreatophytic species	A monitoring program will be undertaken to assess the impacts of drawdown on phreatophytic vegetation within the Turee Creek "B" Borefield.
Mulga	Additional culverts will be incorporated along the rail and access road as appropriate to minimise impacts of drainage shadow on Mulga communities adjacent to the rail line.
	A monitoring program will be undertaken to assess the impacts of drainage shadow on the health of Mulga communities adjacent to the rail line within the Coondewanna Flats (shown on Figure 7).
Riparian species	A monitoring program will be undertaken to assess the impacts of discharge on riparian vegetation along the discharge creekline.
Weed management	The type and abundance of weed species will be internally recorded and monitored.
	Monitoring of 'Weed Risk Areas' with high potential for weed invasion, such as along roadsides, recently cleared areas and ephemeral drainage lines will be undertaken.
	Weed management will be undertaken as part of an annual weed control program and as otherwise required. Weed management procedures include: • Mechanical (pulling out) and/or chemical (use of selective herbicides) methods to control current weed infestations; and • Spot spraying of emergent weeds to gradually deplete seed stocks and reduce or eliminate any new colonisation. Due to the presence of dormant seeds, weeds are expected to appear over a number of years irrespective of the method of control.
	Weed management will be adaptable and able to respond to changing conditions and weed infestations.
	Weed hygiene measures will be implemented. Prior to entering site, all ground engaging equipment will be inspected and cleaned of all soil, seeds and vegetative material prior to mobilisation and demobilisation to minimise the risk of introducing and spreading weeds.
Fire management	Fire restrictions will be implemented (except for fire training purposes).
	Site personnel will be required to complete basic fire-fighting training.
	Emergency response (fire fighting) procedures will be developed and implemented.
	Appropriate fire fighting equipment will be available in all buildings and vehicles to control localised outbreaks of fire.
	Regular inspection and maintenance of fire fighting equipment will be implemented to comply with relevant fire safety standards.
Induction	Prior to engagement on site, all staff will be inducted on: • conservation significant vegetation and flora locations and their importance, • the requirement to stay within approved disturbance boundaries, • identification and reporting of weeds, • procedures to minimise the introduction and spread of weeds, • fire hazard awareness and emergency response procedures.

4.3.5 Monitoring program

The monitoring program for vegetation and flora at West Angelas (Table 13) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 13 Vegetation and flora monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Clearing	Annually	Reconciliation of actual clearing against approval boundary and limits	Visual inspection	To manage clearing of vegetation in compliance with all approval requirements.
Phreatophytic species	Annually	Foliage condition, dead limbs or other damage, evidence of pests or pathogens etc. as an indicator of tree health	Tree Health Monitoring Programme	To monitor changes in phreatophytic tree health relative to baseline to determine the impact of groundwater drawdown.
Conservation significant Mulga	All transects every 3 years or at least two thirds of the transects alternate years	Mulga community health (Mulga under stress or dying)	Drainage Shadow (Mulga) Monitoring Procedure	To monitor changes to the survival and health of Mulga relative to baseline to determine the impact of drainage shadow.
Riparian vegetation	Annually	Riparian vegetation community structure, species diversity, cover and abundance	Transect surveys	To monitor changes in riparian vegetation community structure, species diversity, cover and abundance relative to baseline to determine the impact of surface water discharge.
Weeds	As required	Soil, seeds and vegetative material on equipment	Visual inspection in accordance with Equipment Hygiene Procedures	To minimise the risk of introducing and spreading weeds.
	Annually and as required	Appearance of new weed species and abundance	Visual inspection	Identification of weed risk areas.
	Ongoing	Weed species and abundance of known infestations	Visual inspection until monitoring has revealed that the infestation is no longer present.	To monitor the effectiveness of weed management and ensure known infestations are controlled or eradicated.
Weed Risk Areas	Opportunistically	Appearance of new weed infestations	Visual inspection	To monitor areas that may act as traps for seeds and provide good conditions for seed germination, and to ensure new weed infestations are controlled immediately.
Groundwater will be monitored and managed as specified in the Groundwater Management Plan.				
Surface water will be monitored and managed as specified in the Surface Water Management Plan.				
Dust will be monitored and managed as specified in the Dust Management Plan.				

4.3.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for vegetation and flora management at West Angelas are not being achieved (Table 14).

Table 14 Vegetation and flora management contingency actions

Management objective	Trigger	Action
To manage clearing of vegetation in compliance with all approval requirements.	Clearing outside approval boundary	1. Immediately cease clearing. 2. Report as Environmental Incident. 3. Initiate Incident Response Procedure, including: i. investigate cause of clearing outside approval boundary, ii. notify relevant stakeholders 4. Identify remedial actions (e.g. rehabilitation) on advice from relevant stakeholders. 5. Implement remedial action as required. 6. Review relevant environmental procedures (e.g. West Angelas Land Clearance Procedure). 7. Review the need for personnel training (e.g. in West Angelas Land Clearance Procedure).
	Area of clearing is greater than approved clearing limit	1. Immediately cease clearing. 2. Report as Environmental Incident. 3. Initiate Incident Response Procedure, including: i. investigate cause of clearing outside approved clearing limit, ii. notify relevant stakeholders 4. Identify remedial actions (e.g. rehabilitation) on advice from relevant stakeholders. 5. Implement remedial action as required. 6. Review relevant environmental procedures (e.g. West Angelas Land Clearance Procedure). 7. Review the need for personnel training (e.g. in West Angelas Land Clearance Procedure).

Management objective	Trigger	Action
To protect conservation significant vegetation communities and species.	Unauthorised disturbance to known conservation significant vegetation communities and / or species.	1. Immediately cease clearing. 2. Report as Environmental Incident. 3. Initiate Incident Response Procedure, including: i. investigate cause, ii. notify relevant stakeholders. 4. Identify remedial actions (e.g. rehabilitation) on advice from relevant stakeholders. 5. Implement remedial actions as required. 6. Review relevant environmental procedures (e.g. West Angelas Land Clearance Procedure). 7. Review the need for personnel training (e.g. in West Angelas Land Clearance Procedure).
To protect conservation significant vegetation communities and species.	New occurrence(s) of conservation significant vegetation community or species recorded.	1. Record location of species. 2. Investigate opportunities to protect new occurrence(s) of conservation significant vegetation community or species. 3. If Declared Rare Flora are found, report the occurrence(s) to the DPaW. If there is a need to disturb them, submit an application for a Licence to Take Threatened (Declared Rare) Flora, for approval by the Minister for the Environment in accordance with the *Wildlife Conservation Act 1950.*
	Significant[1] decline of phreatophytic vegetation condition (outside natural variability) for successive monitoring events	1. Investigate potential cause of decline including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and tree condition information to determine the presence of factors likely to cause decline in tree health – e.g. fire or flood damage, evidence of insect activity or pathogens etc., iii. review seasonal rainfall data and regional groundwater water levels, iv. review groundwater abstraction volumes / rates and extent of drawdown, v. review tree health monitoring results from regional reference sites. 2. Increase frequency of monitoring as appropriate. 3. If groundwater abstraction is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess groundwater abstraction volumes / rates, cease pumping, surface irrigation, supplementation and / or rehabilitation) on advice from relevant stakeholders, iii. implement remedial actions as required.

Management objective	Trigger	Action
	Significant[2] decline in Mulga community health (outside natural variability) for successive monitoring events	1. Investigate potential causes of degradation of vegetation condition including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and tree condition information to determine the presence of factors likely to cause degradation – e.g. fire, storm damage etc., iii. review seasonal rainfall data. 2. If drainage management is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess drainage management systems, surface irrigation, supplementation and / or rehabilitation) on advice from relevant stakeholders, iii. implement remedial actions as required.
	Significant[3] decline or artificial proliferation of riparian vegetation community structure, species diversity, cover or abundance (outside natural variability) for successive monitoring events	1. Investigate potential causes of decline or artificial proliferation of vegetation or degradation of vegetation condition including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and vegetation condition information to determine the presence of factors likely to cause foliage loss – e.g. fire, storm damage, insect activity, waterlogging, foliage pathogens etc., iii. review seasonal rainfall data, iv. review surface water discharge volumes / rates and extent of discharge, v. review vegetation monitoring results from regional reference sites. 2. Increase frequency of monitoring as appropriate. 3. If surface water discharge is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess groundwater abstraction volumes / rates, reassess surface water discharge volumes / rates, surface irrigation, supplementation and / or rehabilitation), on advice from relevant stakeholders, iii. implement remedial actions as required.
To prevent the displacement of native species by weed species	Introduction of new weed species and / or substantial increase in the abundance of weeds.	1. Record location and abundance. 2. Undertake weed control. 3. Review relevant procedures (e.g. vehicle hygiene procedures) and modify as required.

Management objective	Trigger	Action
To ensure that dust emissions do not adversely affect environmental values	Visual dust assessments indicate unacceptable dust levels on vegetation	1. Investigate potential cause of unacceptable dust levels on vegetation. 2. Implement additional dust control measures including, as appropriate: i. increased application of water, ii. application of dust suppressants to vehicle loads and stockpiles. 3. Moderate activities generating dust if actions listed under (2) above are inadequate to reduce dust emissions to acceptable levels. 4. Identify and implement remedial actions (e.g. rehabilitation, spray vegetation to remove dust particles) as required.
To ensure that fire does not adversely affect environmental values	Fire incident.	1. Respond to fire in accordance with Emergency Response Procedure, including as appropriate: i. immediately extinguish the fire, ii. report as an Environmental Incident. 2. Investigate cause of fire. 3. If fire was a result of operations, investigate and implement preventative measures to reduce future fire risk. 4. Implement remedial actions (e.g. rehabilitate burnt area) as required. 5. Review environmental incidents relating to fire. 6. Review relevant procedures (e.g. emergency response procedures). 7. Review the need for personnel training (e.g. in emergency response procedures).

[1] Statistical significance based on Student's paired t-test ($p<0.05$) compared to baseline and subsequent tree condition scores.

[2] Statistical significance based on Student's paired t-test ($p<0.05$) compared to baseline and subsequent Mulga health status scores.

[3] Statistical significance based on two-tailed Student's paired t-test ($p<0.05$) compared to baseline and subsequent species diversity, cover and richness.

4.4 FAUNA MANAGEMENT PLAN

4.4.1 Description

- West Angelas is acknowledged to support diverse fauna for its size due to the variety of relief and geological types which combine to provide a great diversity of habitats. Nine broad-scale habitat types have been identified across the region, largely based on vegetation structure and landform: 'footslope or plain'; 'hilltop, hillslope, ridge or cliff'; 'mixed Acacia woodland'; 'mesa top'; 'cracking clay'; 'major gorge and gully'; 'major drainage'; 'mulga woodland'; and 'cleared area'.
- One of these fauna habitats; the Cracking Clay habitat is considered to be regionally significant. Mulga woodlands also support a diverse fauna assemblage and are also considered regionally significant. The remainder of the fauna habitats represent units that are likely to be widely distributed and relatively well represented in the Hamersley subregion of the Pilbara bioregion.
- A number of species of conservation significance have either been recorded or otherwise are considered to have a moderate to high likelihood of occurrence within the area; Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) listed as 'Vulnerable' under the EPBC Act, as a Schedule 1 species under the state WC Act and as 'Vulnerable' by the DPaW; Pilbara Olive Python (XX) listed as 'Vulnerable' under the EPBC Act, as a Schedule 1 species under the state WC Act and as 'Vulnerable' by the DPaW; Fork-tailed Swift (*Apus pacificus*) listed as 'Migratory' under the EPBC Act and as a Schedule 3 species under the WC Act; Rainbow Bee-eater listed as 'Migratory' under the EPBC Act and as a Schedule 3 species under the WC Act; Pilbara Barking Gecko (*Underwoodisaurus seorsus*) listed as P1 species by the DPaW; Western Pebble-mound Mouse (*Pseudomys chapmani*) listed as P4 species by the DPaW; Ghost Bat (*Macroderma gigas*) listed as P4 species by the DPaW; Short-tailed Mouse (*Leggadina lakedownensis*) listed as P4 species by the DPaW; Australian Bustard (*Ardeotis australis*) listed as P4 species by the DPaW; and Bush Stone-curlew (*Burhinus grallarius*), listed as P4 species by the DPaW.
- Ghost Bats have been known from the area since at least 1978. Five caves have been identified as being of value to Ghost Bats: caves A1; A2; L2; and L3 near Deposit B; and a potential maternity cave AA1 near Deposit F (Figure 5).
- A number of feral species have also been recorded within the area.
- The WAO will result in the clearing and potential fragmentation/isolation of habitat for development of mine pits, waste dumps, processing facilities, stockpiles, accommodation, roads, railway and other associated infrastructure.
- The WAO will result in increased human interaction and vehicle/machinery use in the area.
- The WAO will generate domestic waste from the accommodation camp, crib rooms, and administration areas.

4.4.2 Environmental aspects to be managed

The potential impacts of the Proposal on fauna values and the causal aspects of the Proposal requiring management are as follows:

- **Habitat disturbance** through vegetation clearing.
- **Habitat disturbance** through blast vibration.
- **Direct impact to individuals** may result from human interaction and vehicle and earth movements.
- **Encouragement of feral animals** through availability of domestic waste.

The management of subterranean fauna is addressed in the Groundwater Management Plan (Section 4.1).

4.4.3 Performance management

Environmental targets and performance indicators have been developed based on the fauna management objectives for West Angelas (Table 15).

Table 15 Fauna management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To protect significant fauna habitats.	Avoid significant fauna habitats.	Reconciliation of actual clearing against approval boundaries.
	No impact to fauna habitat outside of the approved disturbance boundaries.	Reconciliation of actual clearing against approval boundaries.
To minimise impact to individual native fauna.	Minimise impact on individual native fauna by vehicle/machinery movements.	Incident Reports for native fauna collision.
Minimise the effect of feral animals on native fauna.	No substantial increase in feral animal abundance.	Number of feral animals recorded during trapping exercises.

4.4.4 Implementation strategy

Specific actions have been identified to assist in achieving fauna management objectives (Table 16).

Table 16 Fauna management actions

Parameter	Action
Protection of significant fauna habitats	Clearing will only occur within approval boundaries.
	Clearing will avoid significant fauna habitats as far as practicable.
	Sites that are utilised by Ghost Bats will be avoided as far as practicable.
	Buffers around sites that are utilised by Ghost Bats will be demarcated and maintained to a minimum of 100 metres where practicable. A 100 metre exclusion zone will be maintained for the potential ghost Bat maternity cave AA1
	Blast vibration control, including vibration risk assessment, controlled blasting and vibration monitoring will be implemented to ensure that sites that are utilised by Ghost Bats are protected.
	Appropriate signage will be put in place at sites that are utilised by Ghost Bats.
Native fauna protection	The use of barbed wire fences is prohibited, unless a statutory requirement (e.g. *Electricity (Licensing) Regulations 1991*). Where barbed wire is necessary, reflectors will be installed to deter bats.
	Pets will be prohibited on the mine site.
	Firearms use will be restricted and only after approval is received from the Registered Manager.
	Vehicles will be restricted to designated tracks and drivers will abide by the allocated speed limit except in cases of emergency.
	Known native fauna 'hot spots' will be sign posted to notify drivers
Native fauna encounter	The requirements of the Wildlife Interaction Policy will be communicated to, and implemented by, all personnel.
	Native animals encountered on-site will be given the opportunity to move on if there is no threat to personnel safety in doing so.
	Snakes will be relocated from work areas by appropriately trained snake-handlers.
	If sick or injured animals are encountered, a nominated carer will assess possible rescue and rehabilitation of the animal.
	Dead ghost bats will be lodged with the Western Australian Museum.

Parameter	Action
Feral animal control	Feral animal control measures will be implemented, including: • prohibiting the feeding of feral animals • trapping and eradication programs • effective management of domestic waste.
Induction	The induction will include relevant information on: • conservation significant fauna and their importance • conservation significant fauna habitat locations • potential for mine activities to affect fauna and fauna habitat • fauna encounter procedures • feral animal controls • safety issues concerning the Lyssavirus and bats.

4.4.5 Monitoring program

The monitoring program for fauna at West Angelas (Table 17) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 17 Fauna monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Clearing	Annually	Reconciliation of actual clearing against approval boundary	Visual inspection	To manage clearing of fauna habitat in compliance with all approval requirements.
Fauna encounter	Opportunistically	Sightings of threatened species	Visual observation in accordance with standard Rio Tinto procedures	To monitor occurrence of threatened species.
	Opportunistically	Sightings of feral species	Visual observation and trapping in accordance with standard Rio Tinto procedures	To monitor occurrence of feral species and implement management action if required
Subterranean Fauna will be monitored and managed as specified in the Groundwater Management Plan.				

4.4.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for fauna management at West Angelas are not being achieved (Table 18).

Table 18 Fauna management contingency actions

Management objective	Trigger	Action
To protect significant fauna habitats	Impact to significant fauna habitat	1. Immediately cease clearing. 2. Report as Environmental Incident. 3. Initiate Incident Response Procedure, including: i. investigate cause, ii. notify relevant stakeholders. 4. Identify remedial actions (e.g. rehabilitation, restoration of habitat) on advice from relevant stakeholders. 5. Implement remedial actions as required. 6. Review relevant environmental procedures (e.g. West Angelas Land Clearance Procedure). 7. Review the need for personnel training (e.g. West Angelas Land Clearance Procedure).
	Impact to fauna habitat outside of the approved disturbance boundaries	1. Immediately cease clearing. 2. Report as Environmental Incident. 3. Initiate Incident Response Procedure, including: i. investigate cause ii. notify relevant stakeholders 4. Identify remedial actions (e.g. rehabilitation) on advice from relevant stakeholders. 5. Implement remedial actions as required. 6. Review relevant environmental procedures (e.g. West Angelas Land Clearance Procedure). 7. Review the need for personnel training (e.g. in West Angelas Land Clearance Procedure).
To minimise impact to individual native fauna	Vehicle collision with native fauna	Measures in accordance with the Wildlife Interaction Policy will be undertaken, including: 1. Investigate cause of vehicle collision with native fauna. 2. Implement remedial actions (e.g. contacting a nominated carer to assess possible rescue and rehabilitation of the animal) as required. 3. Report as an Environmental Incident.

Management objective	Trigger	Action
	Monitoring indicates that threatened species is in decline.	1. Investigate potential cause of decline of threatened species including; i. review seasonal effects, ii. review vehicle collision records, iii. review feral animal abundance records. 2. Notify relevant stakeholders. 3. Identify remedial actions (e.g. signage, fencing, feral animal trapping or baiting program) on advice from relevant stakeholders. 4. Implement remedial actions as required.
Minimise the effect of feral animals on native fauna	Increase in feral animal abundance	1. Investigate potential cause of increase in feral animal abundance including; i. review seasonal effects, ii. review waste inventory and condition of landfill, iii. review regional feral animal records. 2. Notify relevant stakeholders. 3. Identify remedial actions (e.g. feral animal trapping or baiting program) on advice from relevant stakeholders. 4. Implement remedial actions as required.

4.5 DUST MANAGEMENT PLAN

4.5.1 Description

- The major sources resulting in visible dust emissions at West Angelas include:
  - Disturbed ground – in dry, windy conditions, particles can be lifted from disturbed areas;
  - Mining activity – blasting, loading, hauling, crushing, conveying, screening and stockpiling material; and
  - Vehicle activity – heavy mining equipment and light vehicles on unsealed surfaces.
- The likely impacts of dust generation from mining activities will mainly be related to health and safety issues. The nearest sensitive receptor is the West Angelas Village, which is approximately 7 kms from the nearest point of the mining operation.
- Dust can also smother vegetation, leading to a decline in the vegetation condition; however no dust-sensitive vegetation has been identified.
- Water for dust suppression is sourced primarily from dewatering.

4.5.2 Environmental aspects to be managed

The following aspects of the operations have been identified as potential sources of dust and require management to ensure dust emissions are minimised:

- **Physical disturbance** (removal of vegetation).
- **Ore processing** (blasting, loading, hauling, crushing, conveying, screening and stockpiling material).
- **Haulage and light traffic** on unsealed roads.

4.5.3 Performance management

Environmental targets and performance indicators have been developed based on dust management objectives at West Angelas (Table 19).

Table 19 Dust management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To manage dust in compliance with all licence requirements.	Maintain compliance with dust related licence conditions	Audit and inspection records.
To ensure that dust emissions do not adversely affect health.	No dust related complaints received.	All incidents of dust complaints will be investigated.
	No adverse impacts on health as a result of dust generated by WAO.	Ambient dust monitoring data show no unacceptable dust levels.
To ensure that dust emissions do not adversely affect environmental values.	All reasonable measures are undertaken to control dust.	Dust suppression equipment is effective.
	No adverse impacts on environmental values as a result of dust generated by WAO.	Visual dust assessments show no unacceptable dust levels.

4.5.4 Implementation strategy

Specific actions have been identified to assist in achieving dust management objectives (Table 20).

Table 20 Dust management actions

Parameter	Action
Planning	Potential sources of dust emissions will be identified. Health and environmental risks associated with these will be assessed.
	Clearing will be planned such that vegetated areas are retained until required ahead of mine development.
Minimise ground disturbance (exposure)	Clearing of vegetated areas will be staged in order to minimise the extent of exposed soil.
	Disturbed areas will be progressively rehabilitated, where possible, to reduce the extent of exposed soil.
Dust suppression	Watering from water tankers and / or other appropriate dust suppression methods will be undertaken at areas prone to dust generation, including: • access road; • haul roads; • active pit areas; • mineral waste and topsoil stockpiles, and • cleared areas, as required.
	Crushing and screening facilities will be operated with suitable dust suppression and extraction systems, screens and / or sprays.
	The train loadout facility will be fitted with water sprays to reduce dust generation.
	Regular housekeeping will be undertaken to prevent an accumulation of material in or around plant facilities that may result in dust.
	Dust suppression equipment will be maintained in an efficient operating condition.
Vehicle movements	Vehicle access will be restricted to designated tracks and roads as far as practicable.
	Vehicle speed limits will be prescribed to reduce dust lift-off from unsealed roads.
	High use roads will be sealed where practicable.
Induction	Prior to engagement on site, all staff will be inducted on: • potential for mine activities to increase dust generation, • potential effects of dust on health, safety and the environment, • dust suppression procedures.

4.5.5 Monitoring program

The monitoring program for dust at West Angelas (Table 21) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 21 Dust monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Village	15 minute intervals	PM10 dust levels, wind data	Master Monitoring Schedule	To ensure that emissions are measured and identify any dust issues.
Visible airborne dust	Opportunistically	Airborne dust	Visual observations	To determine the effectiveness of dust suppression and identify any dust issues.
Dust related complaints	Opportunistically	Dust related complaints received	Visual observations	To identify any dust issues.

4.5.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for dust management at West Angelas are not being achieved (Table 22).

Table 22 Dust management contingency actions

Management objective	Trigger	Action
To manage dust in compliance with all licence requirements.	Non-compliance with dust related licence requirement	1. Investigate potential cause of non-compliance with dust related licence requirement. 2. Report as an Environment Incident. 3. Identify remedial actions. 4. Implement remedial actions, as required.
To ensure that dust emissions do not adversely affect health.	Dust monitoring data indicates dust suppression is not effective.	1. Investigate potential cause of unacceptable dust levels. 2. Identify remedial actions. 3. Implement remedial actions, as required. 4. If trend persists, consult relevant stakeholders.
	Dust related complaint received.	1. Contact any complainants that have concerns related to dust. 2. Maintain contact until such time as the source of the incident is verified and resolved as far as practicable.
To ensure that dust emissions do not adversely affect environmental values.	Visual dust assessments indicate unacceptable dust levels on vegetation.	1. Investigate potential cause of unacceptable dust levels. 2. Investigate additional dust control measures (e.g. increased water application). 3. Implement additional dust control measures as appropriate. 4. Moderate activities generating dust if actions listed under (2) above are inadequate to reduce dust emissions to acceptable levels. 5. Identify remedial actions (e.g. rehabilitation, spray vegetation to remove dust particles). 6. Implement remedial actions, as required.

4.6 WASTE MANAGEMENT PLAN

4.6.1 Description

- Wastes will be generated by the Proposal including:
    - mineral waste;
    - inert and putrescible domestic and industrial wastes;
    - liquid wastes including ablution effluent and wash-down water;
    - hazardous waste including hydrocarbons, chemicals, used oils and greases.
- Bulk quantities of fuel required for operations will be stored in bulk fuel storage facilities on-site. Fuel storage and handling will be in accordance with Australian Standard (AS) 1940 "The storage and handling of flammable and combustible liquids" and/or the *Dangerous Goods Safety (Explosives) Regulations 2007 and their updates.*
- Waste, if inappropriately managed, has the potential to contaminate soils, groundwater and surface water and to attract feral animals.

4.6.2 Environmental aspects to be managed

The potential impacts of poor waste management practices are:

- **Inefficient use of resources** through failure to reduce, re-use, recycle or recover waste.
- **Contamination of soils, groundwater and/or surface water** through incorrect waste handling, storage and disposal.
- **Food source for feral animals** through incorrect disposal of general waste.
- **Increased potential risk of fire outbreak** through storage and use of flammable material.

The following aspects have been identified as requiring management to minimise potential contamination of the environment by hydrocarbons:

- **Fuel storage.**
- **Stationary fuel usage** (e.g. generators).

- **Refuelling** of vehicles and machinery.

4.6.3 Performance management

Environmental targets and performance indicators have been developed based on waste management objectives at West Angelas (Table 23).

Table 23 Waste management objectives, targets and performance indicators

Management objective	Target	Performance indicators
To minimise the generation of waste by reducing waste streams and increasing recycling wherever practicable.	Mineral waste used in progressive backfilling of mine pit voids as far as practicable.	Opportunities to backfill mine pit voids investigated and implemented wherever practicable.
	To implement the waste management hierarchy.	Opportunities for efficient resource use, waste minimisation and recycling investigated and implemented wherever practicable. Wastes are segregated.
To ensure that all wastes are handled, stored, treated and / or disposed of in a manner that minimises the risk to the environment.	Correct handling, storage and/or disposal of wastes. No instances of non-compliance with regulatory requirements or licence conditions.	Audit and inspection records.
To protect environmental integrity from waste and contamination.	No contamination of soils, groundwater or surface water.	No evidence of unmanaged contamination. Monitoring data shows no unacceptable changes in groundwater quality. *Also see Groundwater and Surface Water Management Plans.*

4.6.4 Implementation strategy

Specific actions have been identified to assist in achieving waste management objectives (Table 24).

Table 24 Waste management actions

Parameter	Action
Planning	Emergency response procedures will be developed for the following: • unplanned discharges; and • significant spills.
	An inventory of wastes generated, handled and disposed of on-site and off-site will be developed and maintained.
	Assessment of the environmental risks associated with wastes generated and disposed of on-site will be developed and maintained.
	On-site waste storage, treatment and disposal facilities will be inspected on a regular basis to ensure compliance.
Mineral waste	Mineral waste will be used in progressive backfilling of mine pit voids to above the natural ground water level as far as practicable.
	The design (height and slope) of mineral waste dumps will consider: • minimisation of dump height, • shaping of dumps to blend in with the surrounding natural topography, • construction to meet the requirements of the final rehabilitation design, and • drainage and erosion management features.
	Mineral waste dumps located near drainage features will be monitored to assess for scouring and erosion. Rock armouring, or other stabilising material will be utilised if necessary.
Domestic and industrial waste	Waste generation will be minimised through the adoption of the waste management hierarchy (reduce, reuse, recycle) where practicable.
	Management of domestic and industrial waste will include: • waste segregation, • burning of waste will be prohibited, and • sufficient number and appropriate placement of bins.
	The following will be disposed of at landfill facilities, which will be managed in accordance with licences and appropriate landfill guidelines: • putrescibles (food scraps); • biodegradables (e.g. paper, cardboard); • inert materials (e.g. concrete, steel, wood); and • other general rubbish (e.g. plastics).
	The landfill will be fenced and backfilled on a regular basis to prevent wind-blown litter and feral animal foraging.

Parameter	Action
Waste water	Potentially contaminated water will be excluded from natural surface water systems.
	Management measures to exclude contaminants from entering natural surface water systems include: • equipment servicing will take place in workshops wherever possible, • all mechanical equipment washdown will occur on impervious pads,
	Waste water collected on-site will be contained to allow treatment prior to re-use or discharge.
	Waste water will be directed to a sediment trap or sedimentation basin to reduce suspended solid loading.
	Where applicable, hydrocarbons will be removed from waste water via oily water separation facilities.
	Waste water treatment facilities will be routinely inspected and maintained to ensure they remain effective.
Ablution effluent	Ablution effluent will be managed via appropriately licenced wastewater treatment facilities.
	Wastewater treatment facilities will be routinely maintained.
	Effluent from the wastewater treatment plant (WWTP) will be discharged within designated irrigation area.
Hazardous waste	An inventory of hazardous materials on-site will be maintained.
	Hazardous waste materials will be segregated from the general waste stream.
	Hazardous waste materials will be collected as required by appropriately licenced controlled waste contractors for offsite disposal.
	Assessments of contractors and facilities will be undertaken to ensure that wastes sent off site for disposal or treatment are appropriately dealt with.
	Appropriate spill response equipment will be located nearby to work areas where hazardous materials are frequently used, such that it is available for immediate use.
Hydrocarbons	Hydrocarbons will be handled, stored and disposed of in accordance with all legal requirements.
	Hydrocarbon storage facilities and all associated connections will be within appropriately bunded areas.
	Hydrocarbon storage facilities and bunds will be inspected on a regular basis to identify any leaks or maintenance requirements.
	Water potentially containing hydrocarbons (exceeding licence criteria) will be contained on-site.
	Any hydrocarbon contaminated soil will be remediated and/or disposed of as appropriate.
	Hydrocarbon waste materials not suitable for onsite disposal will be collected as required by appropriately licenced controlled waste contractors for offsite disposal or recycling.
Spill response	All leaks and spills will be managed in accordance with the requirements of spill response procedures.
	Significant spills will be managed in accordance with emergency response procedures.
	Personnel that regularly work with hydrocarbons will be trained in the requirements for spill response.
	Appropriate spill response equipment will be located nearby to work areas such that it is available for immediate use.

Parameter	Action
Induction	Prior to engagement on site, all staff will be inducted on: • principles of waste minimisation, • waste management, • potential impacts associated with waste generated, • storage and handling of hydrocarbons/chemicals, and • spill response procedures.
	Personnel involved with hazardous materials handling, storage and disposal will be made aware of the associated risks to the environment and will be appropriately trained in emergency response.

4.6.5 Monitoring program

The monitoring program for waste at West Angelas (Table 25) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 25 Waste monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Waste inventory	Quarterly	Waste inventory is complete and accurate	Visual observation	To ensure all wastes have been recorded.
	Ongoing	Volume of waste	Visual observation; waste contractor inventory reports	To identify opportunities to minimise the generation of waste.
Waste dumps	Opportunistically	Design	Visual observation	To ensure that waste dumps comply with design criteria.
On-site waste facilities	Opportunistically	Design and condition of on-site waste facilities	Visual observation	To ensure effective function and condition of all on-site waste facilities.
	Opportunistically	Contents of on-site waste facilities	Visual observation	To ensure on-site waste facilities contain only wastes in the category designated for that facility.
	Opportunistically	Litter/rubbish	Visual observation	To ensure all domestic and industrial wastes are disposed of properly.
	Opportunistically	Hazardous materials segregated appropriately	Visual observation	To prevent incidents from the storage of incompatible substances e.g. fire, explosion.
WWTP discharge water quality	Ongoing	Volume of wastewater discharged	Water quality sampling and analysis as per the West Angelas Operating Licence	To track cumulative discharge volumes and ensure compliance with licence conditions.
	Quarterly	BOD, TSS, pH, Total P, Total N, *E.coli,*	Water quality sampling and analysis as per the West Angelas Operating Licence	To ensure effective function of the WWTP and ensure water quality does not exceed discharge criteria.
Contamination	Opportunistically	Spills, leaks or other evidence of unmanaged contamination	Visual observation	To identify unmanaged leaks and spills.
	Quarterly	TPH in surface water	Water quality sampling and analysis (as per the Part V operating licence)	To ensure surface water quality is not compromised.

Topic	Frequency	Parameters	Procedure	Purpose
	Quarterly	Groundwater quality – TPH, Na, K, Ca, Mg, Cl, CO_3, HCO_3, SO_4, NO_3, Metals, TSS, Total-N and Total P	Water quality sampling and analysis (as per the Part V operating licence and Groundwater Operating Strategy)	To ensure groundwater quality is not compromised.
Spill response equipment	Opportunistically	Location and and condition of spill response equipment	Visual observation	To ensure appropriate spill response equipment present, stored correctly, and in good order at all times.

4.6.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for waste management at West Angelas are not being achieved (Table 26).

Table 26 Waste management contingency actions

Management objective	Trigger	Action
To minimise the generation of waste by reducing waste streams and recycling material wherever practicable.	Volume of disposed non-recyclable wastes has exceeded the previous volume for consecutive records	1. Investigate cause of increase in volume of disposed non-recyclable wastes. 2. Review waste inventory to identify opportunities to minimise waste generation.
To ensure that all wastes are handled, stored, treated and / or disposed of in a manner that minimises the risk to the environment.	Incorrect disposal of waste	1. Report as an Environmental Incident. 2. Implement remedial actions, including correct disposal of wastes and re-informing personnel of correct disposal procedures as required. 3. Review environmental incidents relating to incorrect disposal of wastes. 4. Review relevant environmental procedures (e.g. disposal procedures). 5. Review the need for personnel training (e.g. in correct disposal procedures).
	Bins or waste facilities overflowing	1. Arrange for more frequent waste collection and / or larger receptacles. 2. Review waste inventory to identify opportunities to reduce waste generation.
	Spill	1. Mitigate (initiate spill response procedures) including: i. control the spill, ii. contain the spill, iii. clean up the spill, and iv. report the spill as an Environmental Incident. 2. Investigate cause. 3. Implement remedial actions (e.g. remove any contaminated soil for remediation or disposal) as required. 4. Review environmental incidents relating to spills. 5. Review relevant environmental procedures (e.g. spill response procedures). 6. Review the need for personnel training (e.g. in spill response procedures).

Management objective	Trigger	Action
To protect environmental integrity from waste and contamination	Natural surface water quality adversely affected by wastewater discharge	1. Immediately decrease or cease discharge (e.g. by temporary storage). 2. Report as an Environmental Incident. 3. Investigate cause. i. if cause is a is a breakdown in WWTP then initiate repairs as appropriate, ii. if cause is overloading of WWTP then initiate upgrade of plant capacity as appropriate. 4. Implement remedial actions as required.
	Groundwater or surface water quality adversely affected by a spill	1. Mitigate (initiate spill response procedures) including: i. control the spill, ii. contain the spill, iii. clean up the spill, and iv. report the spill as an Environmental Incident. 2. Investigate cause. 3. Implement remedial actions as required. 4. Review environmental incidents relating to spills. 5. Review relevant environmental procedures (e.g. spill response procedures). 6. Review the need for personnel training (e.g. in spill response procedures).

4.7 RAIL MANAGEMENT PLAN

4.7.1 Description

- The original proposed rail alignment is fully described in the Environmental Review and Management Plan (1998).
- The rail alignment in the original Proposal commenced at West Angelas and continued north-west, generally following the alignment of the existing Hamersley rail to the intersection with the Pannawonica – Cape Lambert railway. Some sections of the rail line deviated from the Hamersley rail alignment (mostly due to tenure considerations):
    - The original proposed rail alignment, from where it passed Juna Downs (Juna Downs Pass), initially followed the existing Hamersley (Marandoo) rail corridor through Karijini National Park, before it deviated around Eagle Siding. It then re-aligned with the existing Hamersley rail line before striking north from the Marandoo line east of Cockatoo Siding along the Four Corners Bore Route. The Four Corners Bore Route traversed through a Threatened Ecological Community (TEC) (*Themeda* grasslands of the Pilbara bioregion) that was identified following approval of the original Proposal. The rail then deviated northwest to meet up with the Hamersley Paraburdoo – Dampier rail line north of Possum Siding (North Possum).
- Duplication of the existing Hamersley rail from west of Rosella Siding to east of Eagle Siding was approved in February 2009 (instead of implementing the rail line as described in the original Proposal). These deviations involve:
    - Duplicating the existing rail line through Eagle Siding (rather than the construction of a new rail line across undisturbed terrain).
    - Duplicating the existing rail line from Rosella to Cockatoo (rather than constructing a new rail line between East Cockatoo and North Possum (Four Corners Bore Route) across undisturbed terrain, including the TEC, *Themeda* grasslands of the Pilbara bioregion).
    - Construction of a train refuge to the west of Rosella, parallel to the Brockman line, to allow safe and efficient utilisation of the proposed duplication through parking up of trains.
- The rail, from Juna Downs Pass to Rosella Siding, including the deviations described above, has not been implemented.
- The rail, as approved, is shown on Figure 8.

4.7.2 Environmental aspects to be managed

The potential impacts of the rail on environmental values requiring management are as follows:

- **Alteration natural surface water drainage patterns** as a result of the rail.
- **Decline of Mulga community health** (outside natural variability) as a result of alteration of existing surface water drainage patterns (drainage shadow).
- **Introduction or spread of weed species** by vehicle and human movements.
- **Contamination of soils, groundwater and/or surface** water through hydrocarbon spills and leaks.
- **Dust generation** could potentially result in the degradation of vegetation condition.

4.7.3 Performance management

Environmental targets and performance indicators have been developed based on rail management objectives at West Angelas (Table 27).

Table 27 Rail management objectives, targets and performance indicators

Management objective	Target	Performance indicators
Maintain the rail drainage system to minimise the effect on the existing local hydrological regime.	No significant change in local surface water drainage patterns (outside natural variability).	Visual inspections show no unacceptable changes in natural drainage patterns, surface water flows are maintained. *Also see Surface Water Management Plan.*
To preserve the environmental values of the dependent ecology.	No significant decline in Mulga community health (outside natural variability) as a result of drainage shadow.	Reconciliation of Mulga monitoring data against baseline data. *Also see Vegetation and Flora Management Plan.*
To prevent the displacement of native species by weed species.	No increase in the type or abundance of weeds, particularly along sections of the rail within Millstream-Chichester and Karijini National Park Corridors.	Reconciliation of identified weed species / abundance against baseline data. *Also see Vegetation and Flora Management Plan.*
Operate the railway to minimise the risk of contamination.	No contamination of soils, groundwater or surface water as a result of rail operations.	No evidence of un-managed spills or leaks (spills cleaned up on occurrence). Monitoring data shows no unacceptable changes in groundwater or surface water quality. *Also see Waste Management Plans.*

4.7.4 Implementation strategy

Specific actions have been identified to assist in achieving rail management objectives (Table 28).

Table 28 Rail management actions

Parameter	Action
Drainage management and Mulga	Culverts will be used where appropriate to minimise impacts on natural surface water flows.
	Additional culverts will be incorporated along the rail as appropriate to minimise impacts of drainage shadow on Mulga communities adjacent to the rail line.
	Culverts will be routinely inspected and maintained to ensure they remain effective.
	Monitoring will be undertaken to assess the impacts of drainage shadow on Mulga communities adjacent to the rail line. *See Vegetation and Flora Management Plan.*
Weed management	The type and abundance of weed species along the rail will be internally recorded and monitored.
	Weed management will be undertaken as part of an annual weed control program and as otherwise required. *See Vegetation and Flora Management Plan.*
	Weed management will be adaptable and able to respond to changing conditions and weed infestations.
Dust Suppression	The train loadout facility will be fitted with water sprays to reduce dust generation.
	Dust suppression equipment will be maintained in an efficient operating condition.
Hydrocarbons and spill response	All leaks and spills will be managed in accordance with spill response procedures.
	Significant spills will be managed in accordance with emergency response procedures.
	Personnel will be trained in the requirements for spill response
	Appropriate spill response equipment will be available for immediate use.
	Any hydrocarbon contaminated soil will be remediated or disposed of as appropriate.
Induction	Prior to engagement on site, all staff will be inducted on: • identification and reporting of weeds, • procedures to minimise the introduction and spread of weeds, • potential for rail activities to increase dust generation, • potential effects of dust on health, safety and the environment, • dust suppression procedures, • waste management, and • spill response procedures

4.7.5 Monitoring program

The monitoring program for the rail at West Angelas (Table 29) is designed to ensure that operations are consistent with the prescribed management actions. Monitoring will measure the success of these actions in accordance with the management objectives and targets.

Table 29 Rail monitoring program

Topic	Frequency	Parameters	Procedure	Purpose
Drainage management system	Opportunistically	Surface water flows are maintained	Visual inspection	To monitor the effectiveness of the drainage management system
	Opportunistically	Integrity of drainage management system	Visual inspection	To monitor the integrity of the drainage management system.
Conservation significant Mulga	All transects every 3 years or at least two thirds of the transects alternate years	Mulga community health (Mulga under stress or dying)	Drainage Shadow (Mulga) Monitoring Procedure	To monitor changes to the survival and health of Mulga relative to baseline to determine the impact of drainage shadow.
Weeds in the rail corridor	Annually and as required	Appearance of new weed species and abundance	Visual inspection	Identification of weed risk areas.
	Ongoing	Weed species and abundance of known infestations	Visual inspection	To monitor the effectiveness of weed management and ensure known infestations are eradicated.
Contamination	Opportunistically	Spills, leaks or other evidence of unmanaged contamination	Visual observation	To identify unmanaged leaks and spills.

Dust will be monitored and managed as specified in the Dust Management Plan.

4.7.6 Contingencies

Contingency actions have been developed to be enacted if monitoring indicates that the environmental objectives and targets for rail management at West Angelas are not being achieved (Table 30).

Table 30 Rail management contingency actions

Management objective	Trigger	Action
Maintain the rail drainage system to minimise the effect on the existing local hydrological regime.	Surface water flows not maintained	1. Investigate cause. 2. Implement remedial actions (e.g. reinstate surface water flows) as required.
	Integrity of drainage management system compromised	1. Investigate cause. 2. Undertake maintenance of on-site drainage management system as required. 3. Implement remedial actions as required.
To preserve the environmental values of the dependent ecology	Significant[2] decline in Mulga community health (outside natural variability) for successive monitoring events	1. Investigate potential causes of degradation of vegetation condition including; i. review data quality to identify any errors in data, collection or interpretation, anomalous readings etc., ii. review site and tree condition information to determine the presence of factors likely to cause degradation – e.g. fire, storm damage etc., iii. review seasonal rainfall data. 2. If drainage management is identified as cause and a recovering trend is not evident following the next monitoring; i. notify relevant stakeholders, ii. identify remedial options (e.g. reassess drainage management systems, surface irrigation, supplementation and / or rehabilitation) on advice from relevant stakeholders, iii. implement remedial actions as required.
To prevent the displacement of native species by weed species.	Introduction of new weed species and / or significant increase in the abundance of weeds.	1. Record location and abundance. 2. Undertake weed control. 3. Review relevant procedures (e.g. vehicle hygiene procedures) and modify as required.

Management objective	Trigger	Action
Operate the railway to minimise the risk of contamination.	Spill	1. Mitigate (initiate spill response procedures) including: i. control the spill, ii. contain the spill, iii. clean up the spill, and iv. report the spill as an Environmental Incident. 2. Investigate cause. 3. Implement remedial actions (e.g. remove any contaminated soil for remediation or disposal) as required. 4. Review environmental incidents relating to spills. 5. Review relevant environmental procedures (e.g. spill response procedures). 6. Review the need for personnel training (e.g. in spill response procedures).

5 ACRONYMS AND ABBREVIATION

Table 31 details the short titles and acronyms used in this document.

Table 31 Acronyms and abbreviations

Acronym / Abbreviation	Full title
ANZECC	Australia and New Zealand Conservation Council
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
BOD	Biochemical Oxygen Demand
CEO	Chief Executive Officer
DCCEE	Department of Climate Change and Energy Efficiency
DPaW	Department of Parks and Wildlife
DER	Department of Environment Regulation
DMP	Department of Mines and Petroleum
DoW	Department of Water
DRF	Declared Rare Flora
DoE	Department of Environment
EC	Electrical conductivity
EMP	Environmental Management Program
EP Act	*Environmental Protection Act 1986 (WA)*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERMP	Environmental Review and Management Plan
HSEQ	Health Safety Environment and Quality
OEPA	Office of the Environmental Protection Authority
TDS	Total dissolved solids

Acronym / Abbreviation	Full title
TPH	Total petroleum hydrocarbons
TSS	Total suspended solids

Table 32 details the water quality monitoring parameters used in this document.

Table 32 Water quality monitoring parameters

Parameter class	Ground water Parameter(s)	Surface water Parameter(s)
Biophysical	EC, pH, temperature, TSS water level elevation, abstraction volume	EC, pH, temperature, TSS discharge volume, extent of saturation
Nutrients	Total-P, Total-N	n/a
Major ions	Na, K, Ca, Mg, Cl, CO_3, HCO_3, SO_4, NO_3	Na, K, Ca, Mg, Cl, CO_3, HCO_3, SO_4, NO_3, NH_3
Metals and metalloids	Al, Bo, Fe, Cu, Zn, Ag, As, Cr, Pb, Cd, Hg, Ni, Se, Mn.	Al, Bo, Fe, Cu, Zn, Ag, As, Cr, Pb, Cd, Hg, Ni, Se, Mn.
Oils and lubricants	Total petroleum hydrocarbons (range C_6-C_{36})	Total petroleum hydrocarbons (range C_6-C_{36})

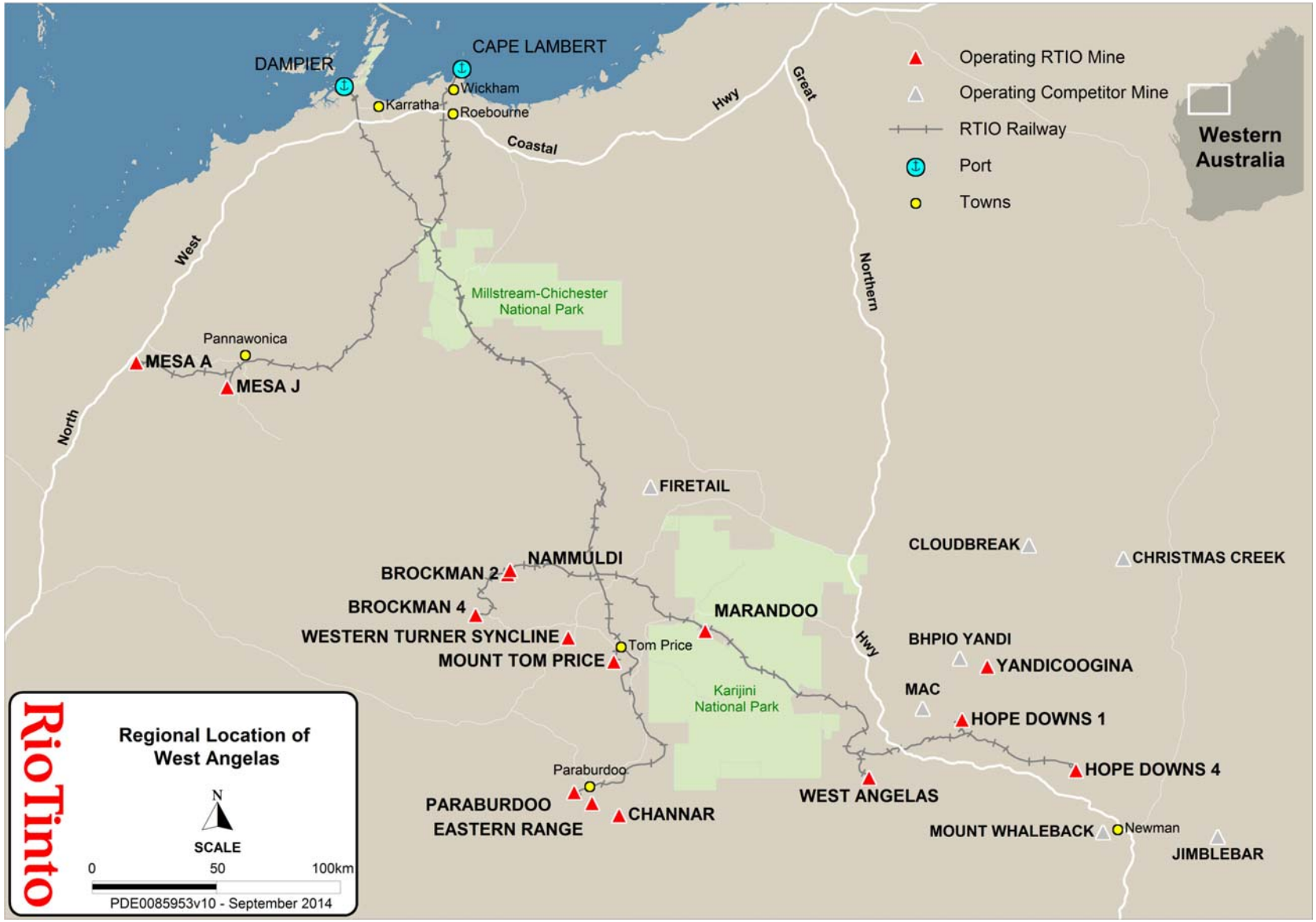

Figure 1 Regional location of West Angelas

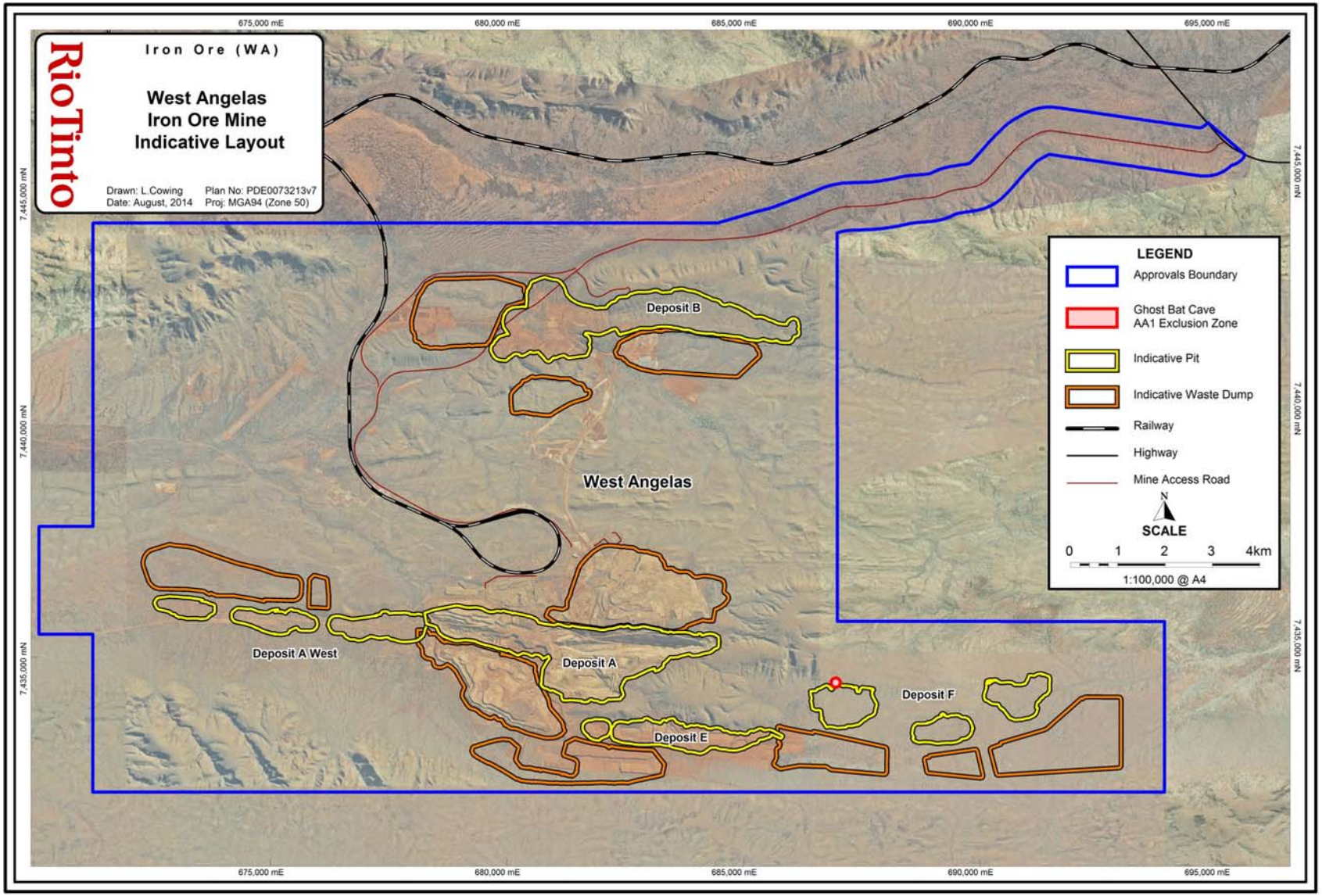

Figure 2 West Angelas Iron Ore Mine, Indicative Layout

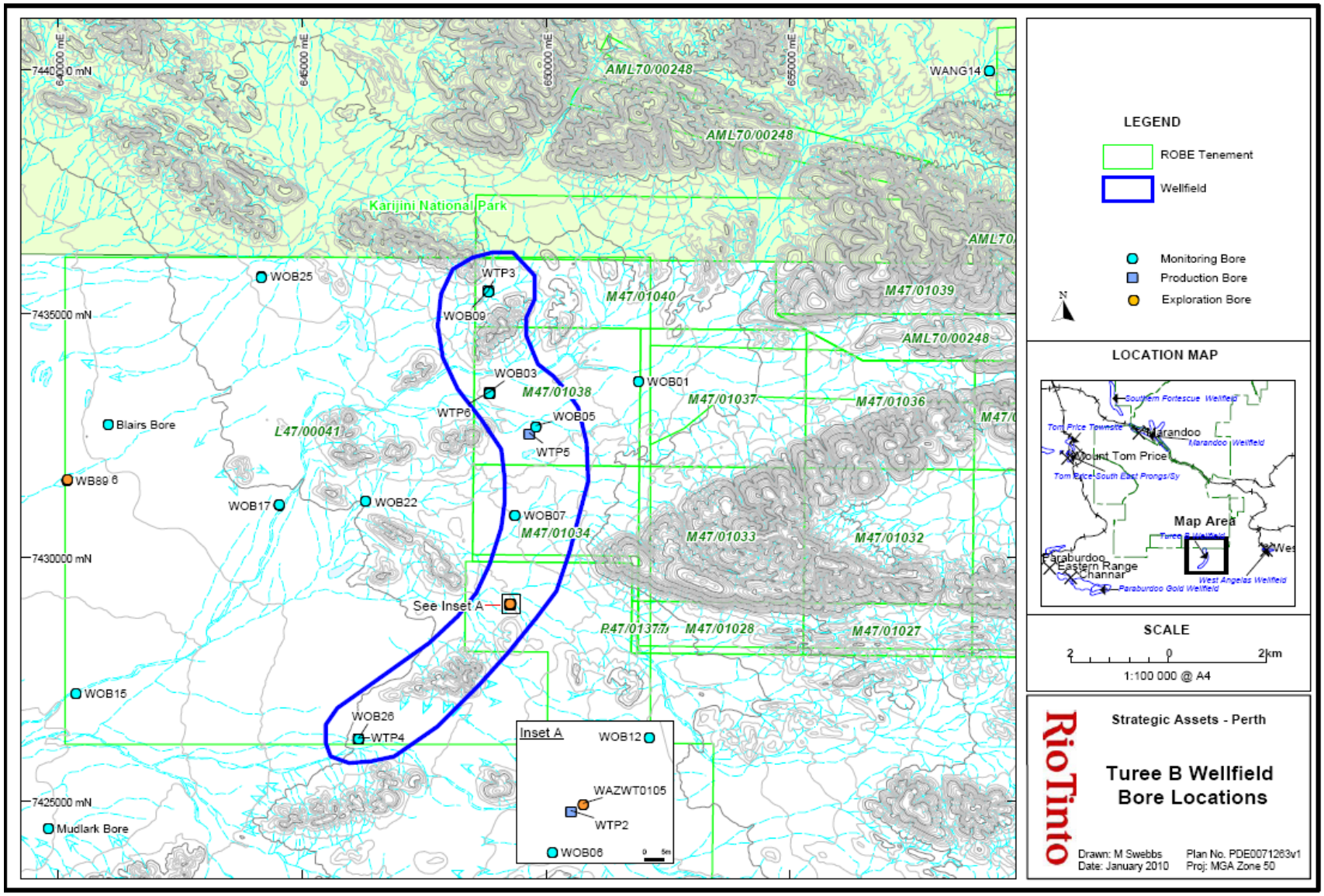

Figure 3 Turee Creek "B" Borefield, Bore Locations

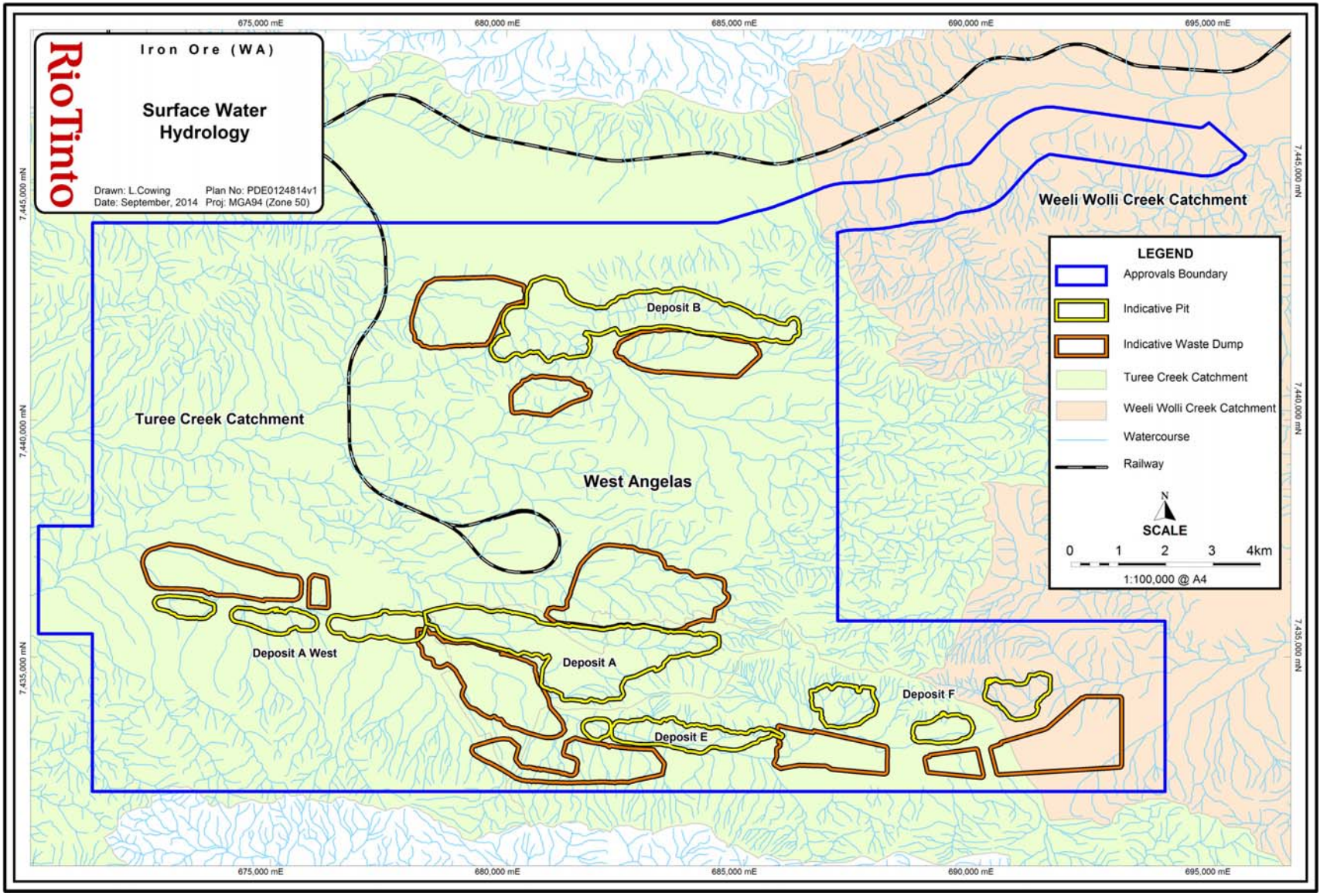

Figure 4 Surface Water Hydrology

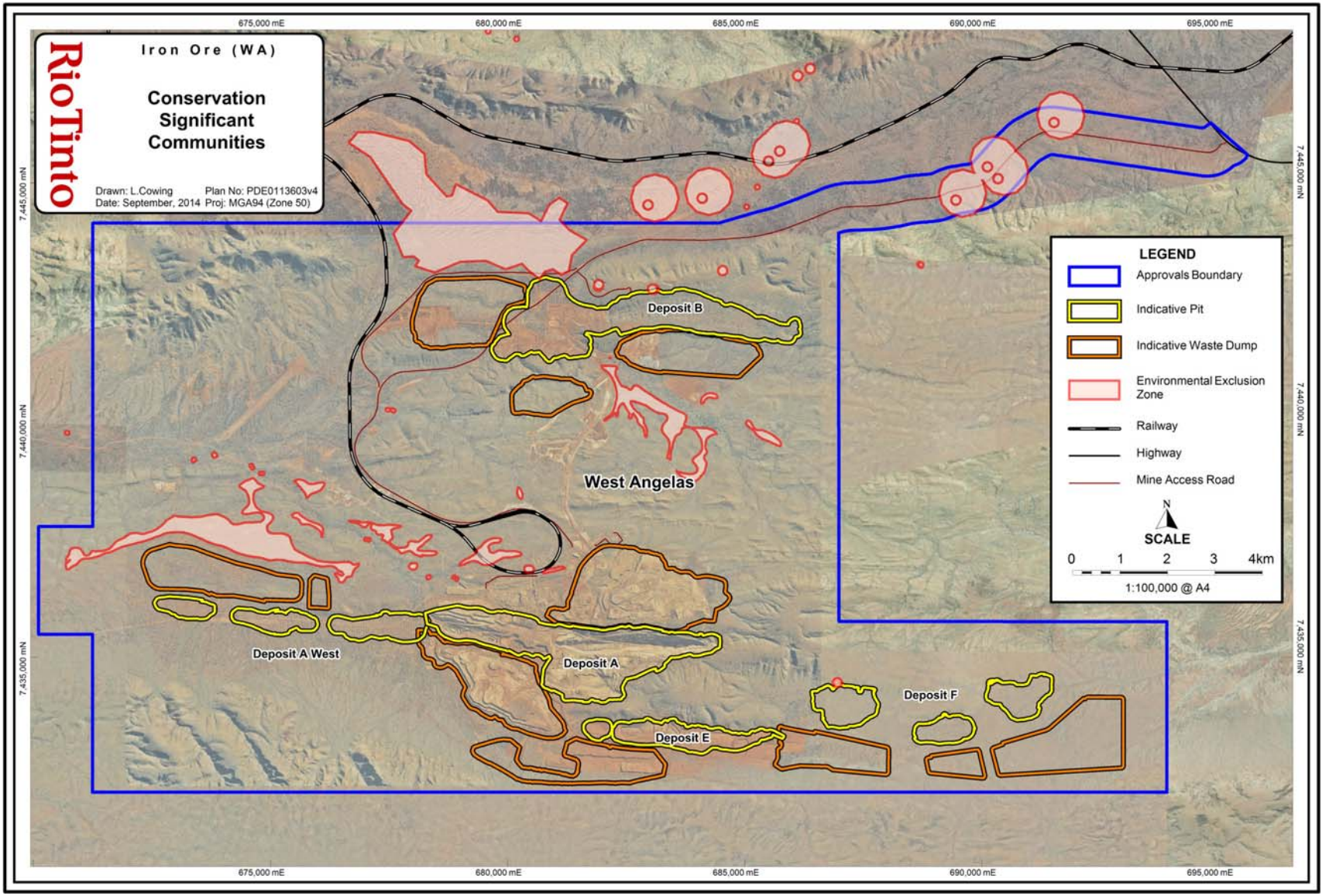

Figure 5 Location of Conservation Significant Communities and Areas

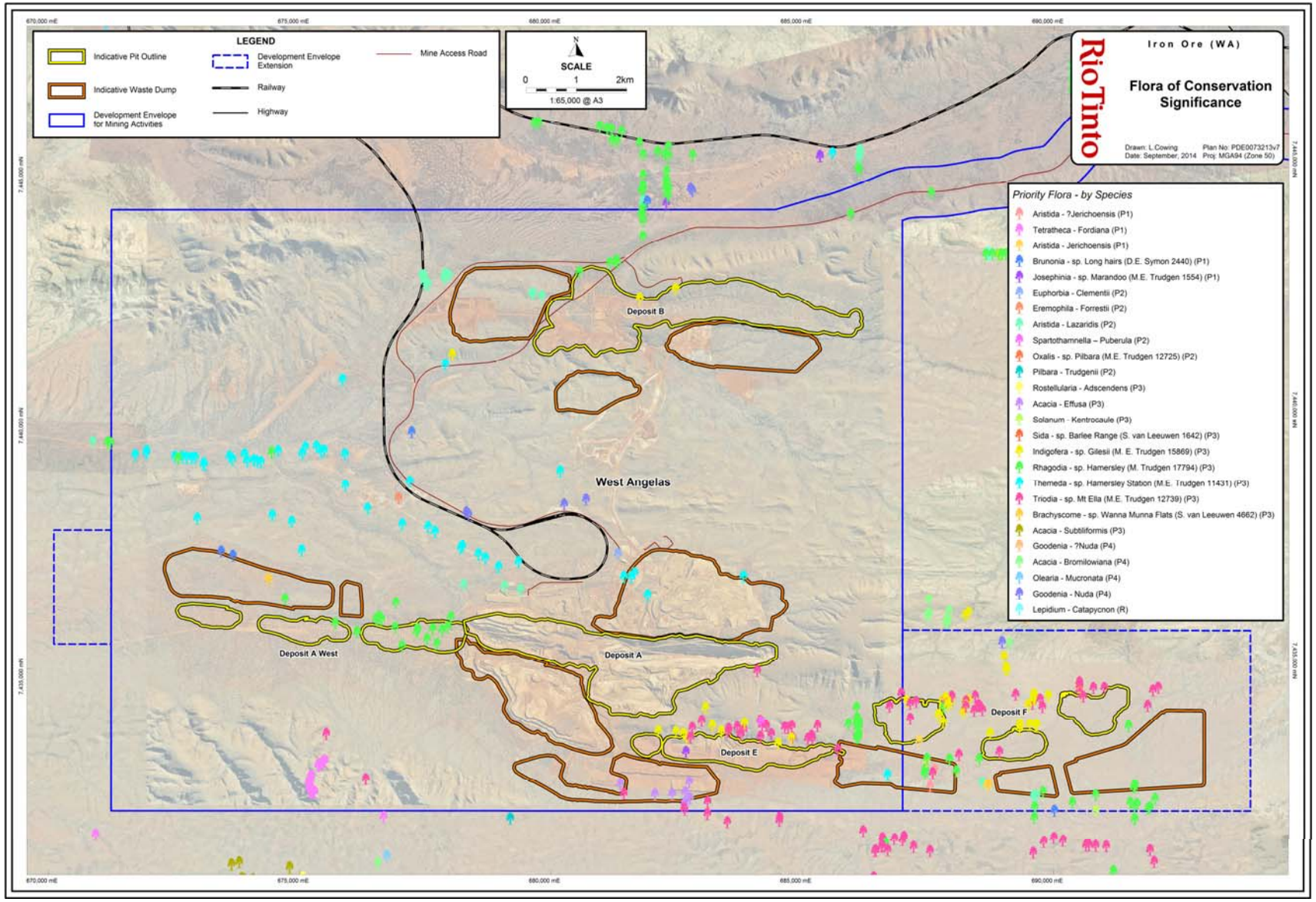

Figure 6 Flora of Conservation Significance

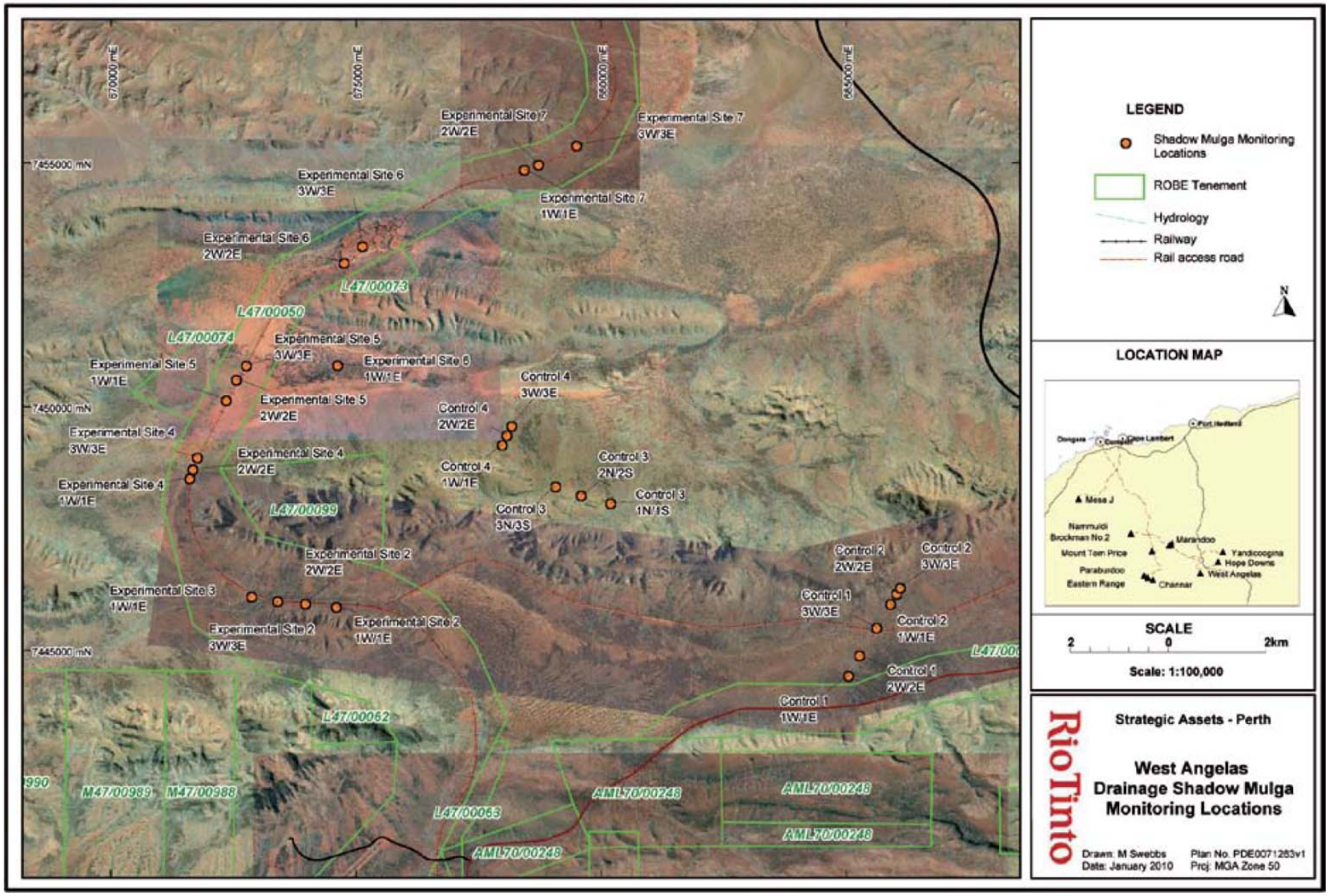

Figure 7 Drainage Shadow Mulga Monitoring Locations

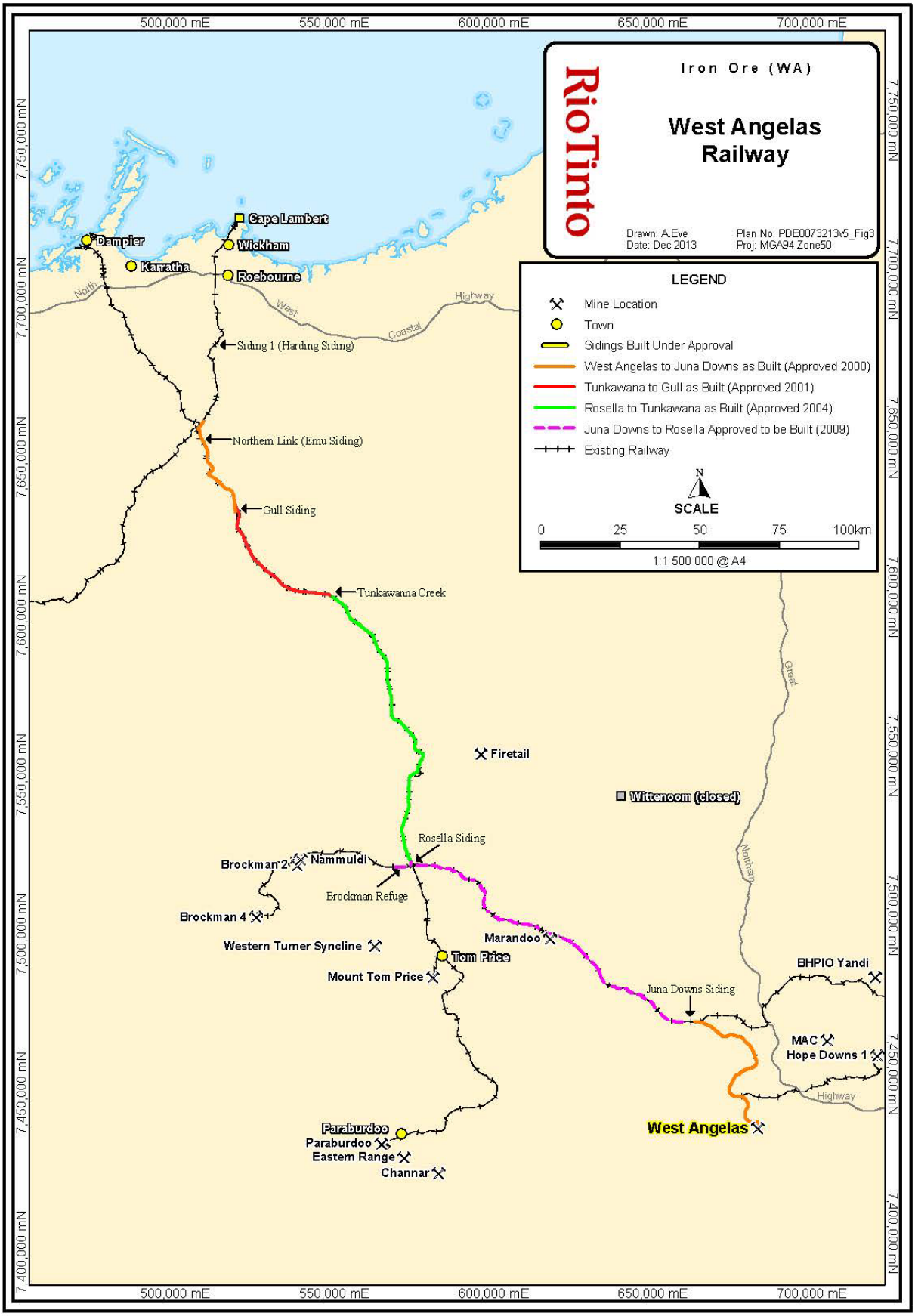

Figure 8 West Angelas Railway