Hamersley Iron-Yandi Pty Limited

Yandicoogina JSW and Oxbow Project

EPBC 2011/5815 Condition 14: Threatened Species Offset Plan

MS 914 Condition 10: Residual Impact and Risk Management Measures

Hamersley Iron-Yandi Pty Limited (a member of the Rio Tinto Group)

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Rio Tinto

Disclaimer and Limitation

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EXECUTIVE SUMMARY

The Yandicoogina Junction South West and Oxbow Project was subject to both Western Australian State and Commonwealth environmental approval via Ministerial Statement 914 and EPBC Decision Notice 2011/5815, both of which were subject to a number of conditions, including offsets.

Condition 14 of EPBC 2011/5815 requires the submission of a Threatened Species Offset Plan (TSOP), which includes a contribution of no less than $3M over five years (Condition 14a), and Condition 10-1 of MS 914 requires the contribution of $3M AUD towards an offset. Both agencies agreed that the State offset requirement could be used to fund the development of the Commonwealth required TSOP.

The TSOP is required to offset significant residual impacts to two Matters of National Environmental Significance (the northern quoll and the Pilbara olive python) and biodiversity more generally by managing threatening processes. As identified in Condition 14b) EPBC 2011/5815 these threats include: introduced predators; introduced herbivores; fire; and weeds.

The Land Management Area (LMA) for the TSOP was selected based on the following: ecological resilience; ecological equivalence; regional context; additionality; tenure and land use; practicality; and stakeholder acceptance and engagement. Based on these criteria, an area of 163, 214 ha was selected which encompasses much of Yarraloola Station and a smaller area of adjoining unallocated crown land within the Hamersley subregion of the Pilbara bioregion.

Management actions have been prioritised following consultation with the Department of Parks and Wildlife and a Biodiversity Offsets Advisory Panel comprising independent experts. On their advice, this TSOP prioritises resources and expenditure towards the delivery of a landscape-scale introduced predator control program using the *Eradicat®* cat bait. This program will be supplemented by relevant actions to control introduced herbivores, fire, and weeds. These management actions, subject to approval, will be undertaken within a five year TSOP implementation period.

In 2014, approval was granted by the Department of the Environment (DotE) and the WA Office of the Environmental Protection Authority (OEPA) to commence a northern quoll *Eradicat®* cat bait uptake and survivorship study (the Survivorship Study) to identify non-target bait impacts to northern quoll. Approval was also granted to undertake reconnaissance surveys to inform the development of the TSOP Monitoring Program. Reconnaissance surveys were completed in 2014 and the Survivorship Study will commence in 2015, prior to approval of the TSOP.

Baseline surveys are also scheduled to commence in 2015, pending DotE approval of the TSOP.

Together, the Survivorship Study and baseline surveys will form Year 1 of the TSOP with other TSOP actions commencing in Year 2 subject to approval of the TSOP by the DotE and the WA OEPA.

A monitoring plan has been designed to assess the effectiveness of the management actions of the TSOP. It comprises threat and ecological monitoring, and will inform adaptive management.

Rio Tinto will report on the results of monitoring as part of its annual reporting requirements to the DotE and OEPA. Scientific publications may be prepared in collaboration with Parks and Wildlife Science and Conservation Division staff and other involved parties as appropriate.

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PART 1 - INTRODUCTION

1 BACKGROUND

The Yandicoogina Junction South West (**JSW**) and Oxbow Project (**the Project**) is located in the central Pilbara region of Western Australia, approximately 90 km north-west of Newman and 300 km south-east of Dampier. The Project is located immediately west of the existing Yandicoogina Junction Central and Junction South East operations. The proponent of the Project is Hamersley Iron-Yandi Pty Limited (**HIY**) which is a member of the Rio Tinto Group of companies.

The Project was subject to both Western Australian (**WA**) State and Commonwealth environmental assessment processes: as a Public Environmental Review (**PER**) level of assessment under the *Environmental Protection Act 1986* (**EP Act**); and as a Controlled Action: Assessment by Preliminary Documentation under the *Environment Biodiversity Conservation Act 1999* (**EPBC Act**).

The Project was approved by the WA Minister for the Environment; Water on 18 October 2012 via Ministerial Statement 914 (**MS 914**) and the Commonwealth Minister for the Environment[1] on 20 November 2012 via EPBC Decision Notice 2011/5815 (**EPBC 2011/5815**).

Both approvals were subject to a number of conditions, including offsets.

1.1 PROJECT OFFSET CONDITIONS

1.1.1 Commonwealth Offset Condition

Condition 14 of EPBC 2011/5815 requires the submission of a Threatened Species Offset Plan (**TSOP**) with Condition 14 stating the following:

"*The TSOP must include, but not necessarily be limited to:*

a) A contribution of no less than $3,000,000 (GST exclusive) to fund extend or expand a land management program within the Pilbara bioregion for a period of no less than five years;

b) Details of measures to control and/or manage, for the benefit of the northern quoll and Pilbara olive python:

- *i. introduced predators;*
- *ii. feral herbivores;*
- *iii. wild fires; and*
- *iv. invasive weeds.*

c) For each threat identified in condition 14) b), the TSOP must define:

- *i. how the control/management measures are expected to benefit the northern quoll and Pilbara olive python;*
- *ii. details of the location and area of land to be managed which must be mapped and provided to the department in a shapefiles(s);*
- *iii. details of methodology, timing, frequency and intensity (effort) of management measures;*
- *iv. responsibility for management measures; and*

[1] Then the Minister for Sustainability, Environment, Water, Population and Communities

v. details of how the management actions identified for condition 14) b) will be undertaken in a manner that is sympathetic with the conservation of other relevant threatened species listed under the EPBC Act known to occur in the area identified under 14) c) ii).

d) Details of a monitoring plan, including but not necessarily limited to:

i. methodology, timing, frequency, scope and survey effort for/of monitoring;

ii. baseline surveys of the area to be managed;

iii. monitoring during and post land management actions to determine the effectiveness of land management actions;

iv. performance indicators, which will determine the effectiveness of the land management program; and

v. measures to make the results of the monitoring made publicly available."

1.1.2 WA State Offset Condition

Condition 10-1 of MS 914 requires the contribution of $3M AUD towards a strategic regional conservation initiative for the Pilbara:

> *"In view of the significant residual impacts and risks (permanent and temporary) to native vegetation including riparian vegetation as a result of the implementation of the proposal, the proponent shall contribute three million dollars ($AUD) to a strategic regional conservation initiative for the Pilbara as determined by the Minister for Environment on advice of the Environmental Protection Authority and the DEC."*

In order to coordinate these offset efforts between State and Commonwealth requirements, the WA OEPA has indicated its support that the implementation of the TSOP will be regarded as complying with, and satisfying, the requirements of the State offset requirement. As a result, Rio Tinto (on behalf of HIY) is utilising the $3M contribution required by Condition 10-1 MS 914 and Condition 14a) to develop and implement a TSOP.

Section 2 outlines Rio Tinto's approach to managing ongoing interactions between the Commonwealth and State regarding this offset funding.

1.2 PURPOSE AND STRUCTURE OF THE TSOP

This TSOP outlines the implementation of land-based conservation strategies with the aim to improve the ecological condition of biodiversity values within a defined Land Management Area (**LMA**), for the purposes of complying with the offset conditions imposed on HIY set out above.

To ensure compliance with Condition 14 and 15 of EPBC 2011/5815 and Condition 10 of MS 914 the TSOP includes the following Parts:

Part 1: Introduction:
Background information
Rio Tinto management of TSOP offset funds
Target Matters of National Environmental Significance (**MNES**)
Land Management Area.

Part 2: Conservation Management Strategies:
Measures to benefit the northern quoll and Pilbara olive python.

Part 3: Monitoring Program.

2 OFFSET FUNDS

The TSOP is the first that requires Rio Tinto to develop and implement a direct offset in the Pilbara. Rio Tinto intends to meet this requirement through a land management program on parts of Yarraloola Station and adjoining unallocated crown land (**UCL**).

> As discussed in Section 1.1.2, Rio Tinto will utilise the $3M contribution specified under Condition 10-1 MS 914 to implement the TSOP. This will also meet the requirements of Condition 14a) of EPBC 2011/5815 which states the following: *"a contribution of no less than $3,000,000 (GST exclusive) to fund, extend or expand a land management programme within the Pilbara bioregion for a period of no less than five year."*

In lieu of a State Pilbara Strategic Conservation Initiative being developed by the WA State government, Rio Tinto is managing the Yandicoogina Expansion Projects offset funds ($3M) through a dedicated Rio Tinto Offset Bank Account (refer to Appendix 1 for OEPA endorsement).

Rio Tinto will report annually, to both the DotE and OEPA, with regards to details on the Offset Account transactions, implemented actions and biodiversity outcomes.

2.1 REVIEW AND REPORTING

Compliance against Condition 14 (EPBC 2011/5815) and Condition 10-1 (MS 914) will be reported as part of Rio Tinto's annual compliance reporting.

Additionally, in accordance with Condition 15 of EPBC 2011/5815, Rio Tinto will provide documentary evidence to DotE within 18 months of approval of the TSOP to show relevant payments for implementation of the TSOP.

The TSOP will be reviewed and revised, where appropriate, throughout the life of the TSOP, and in response to audit findings, monitoring results, and continuous improvement.

2.2 KEY STAKEHOLDERS AND ACCOUNTABILITIES

The Project's key stakeholders are identified below in Table 2-1. Rio Tinto has actively engaged with these key stakeholders during the development of the TSOP and will continue to engage through the approval stage and during implementation of the TSOP.

Rio Tinto determined that the most appropriate way to obtain expert advice and judgements relating to biodiversity offsets in the Pilbara was to assemble a Biodiversity Offset Advisory Panel (**the Advisory Panel**) with the aim of bringing together independent external biodiversity experts and Rio Tinto experts with the purpose of providing advice on issues relating to the quantification of losses, and mitigation and offset gains for biodiversity.

Table 2-1: Key Stakeholders for the TSOP

Responsible Entity	Roles	Details
Regulators		
DotE	DotE Compliance Branch. The Minister to approve the TSOP required by Condition 14 EPBC 2011/5815	Panna Pattel Post Approvals Assessment Officer Compliance and Enforcement Branch, DotE

Responsible Entity	Roles	Details
OEPA	CEO to approve use of the $3M required by Condition 10 of MS 914.	Naomi Arrowsmith Manager, Strategic Policy and Planning Division, OEPA
Project Proponent		
Hamersley Iron-Yandi Pty Limited	Prepare and implement TSOP, review monitoring and adapt management.	Rio Tinto Environment. environmentaloffset@riotinto.com
Partners of the Yarraloola Pastoral Station	Lessee of Yarraloola Pastoral Station.	Stephen Lynch. Robe River Mining Co Pty Limited, as Managing Agent for the Yarraloola Pastoral Station Partnership.
Key Stakeholders		
Department of Parks and Wildlife	Provide technical advice and implementation of bait uptake study and introduced predator control.	Keith Morris - Science and Conservation Division. Stephen Van Leeuwen – Science Partnership Manager
Biodiversity Offset Advisory Panel	Provide technical advice into the development of the TSOP (refer to Appendix 2).	Sam Luccitti. Rio Tinto Panel contact.

The Kuruma and Marthudunera People (**K&M**) and Yaburara and Mardudhunera People are the Traditional Owners of the land on which the LMA is located (refer to Figure 4-1).

Rio Tinto and K&M entered into a Claim Wide Participation Agreement in 2011, and as per this agreement, Rio Tinto will consult with K&M prior to implementation of the TSOP actions.

Rio Tinto has no agreements with the Yaburara and Mardudhunera People; however, Rio Tinto will consult with these Traditional Owners prior to implementation of the TSOP actions.

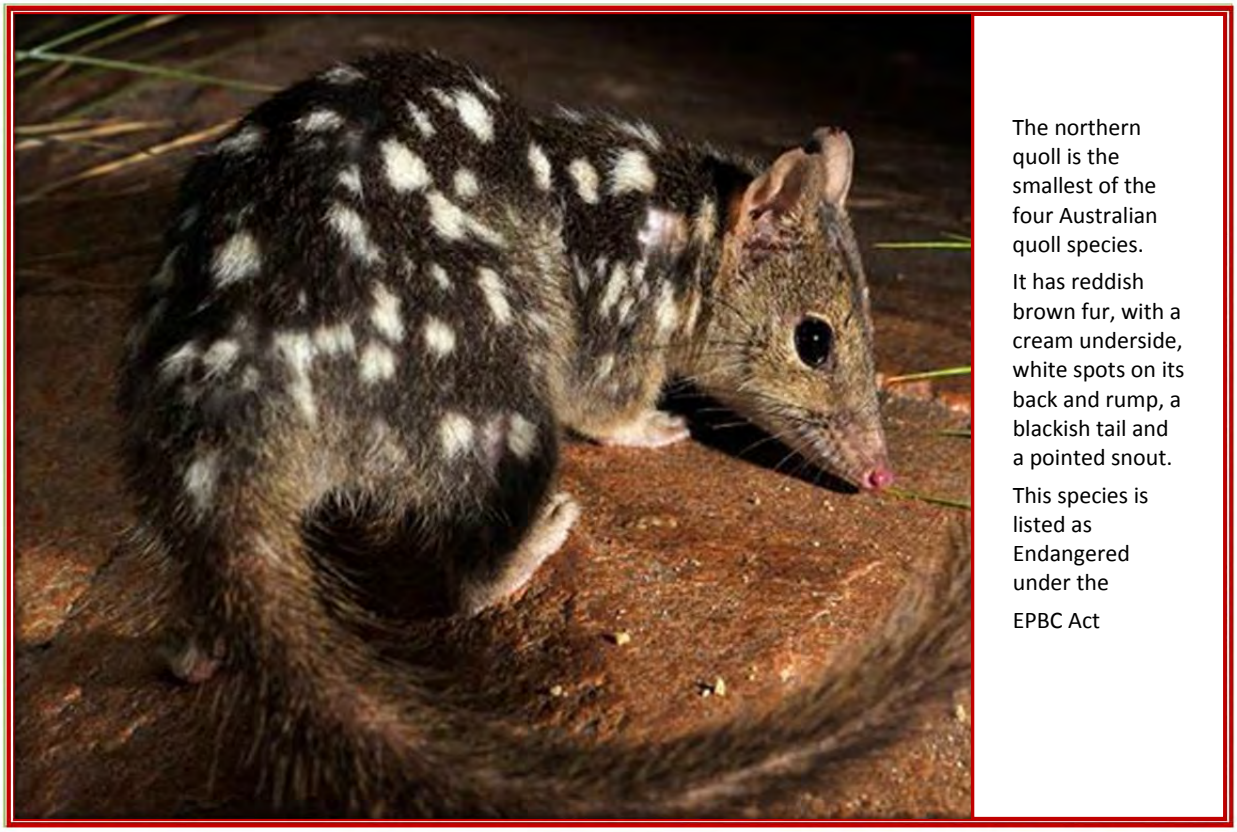
Interested and affected parties include mining tenement holders with tenure which overlaps the LMA. Relevant consultation with these parties will occur during Year 1 of the TSOP. Tenement holders are discussed further in the tenure section (Section 4.7).

3 TARGET MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

The Project is required to offset significant residual impacts on the following MNES:

- northern quoll (*Dasyurus hallucatus*); and
- olive python (Pilbara subspecies) (*Liasis olivaceus barroni*).

3.1 NORTHERN QUOLL



The northern quoll is the smallest of the four Australian quoll species.

It has reddish brown fur, with a cream underside, white spots on its back and rump, a blackish tail and a pointed snout.

This species is listed as Endangered under the

EPBC Act

The northern quoll *Dasyurus hallucatus* is a partially arboreal carnivore, preying on a varied diet of small invertebrates and vertebrates, including lizards, birds, snakes, small mammals and frogs (Oakwood 2000).

Habitat quality for the northern quoll is related to the abundance and availability of suitable denning sites (mostly rock crevices, caves, tree hollows and hollow logs); the abundance and year-round availability of prey species; the availability of adequate ground cover (to reduce predation upon it); and the abundance of potential predators (dogs and cats across most of its range, but also foxes in the periphery of its range).

It is widely distributed across northern Australia from coastal central Queensland, through the top end of the Northern Territory to the Kimberley and Pilbara, with the latter population isolated from that of the Kimberley (How *et al*. 2009). The species has declined historically across much of its range (Braithwaite and Griffiths 1994; Woinarski *et al*. 2001), but recent and more acute decline has been caused by the westward spread of Cane Toads *Rhinella marina* across Queensland and through the monsoonal tropics of the Northern Territory (Burnett 1997; Ziembicki *et al*. 2013).

The northern quoll's distribution and status in the Pilbara has been reviewed by Biota (2010) and Cook (2010) but such assessment is somewhat constrained by limited and uneven sampling. The collation and analysis of records suggests that northern quolls are widespread and patchily distributed. Where common, they are associated with land systems characterised by rugged rocky

slopes: Seventy percent (70%) of records were from the Rocklea, Macroy, Robe, Capricorn and Wona land systems; 3.6% from the River land system; and 0-3% in each of the remaining land systems.

The northern quoll is listed as Endangered under the *EPBC Act* and recognised as Schedule 1 (Fauna that is rare or is likely to become extinct) in the Wildlife Conservation (Specially Protected Fauna) Notice 2014 of the Western Australian *Wildlife Conservation Act* 1950 (**WC Act**). The National Recovery Plan for the northern quoll (Hill and Ward 2010) lists the following known threats:

- cane toads (which have caused acute decline across Queensland through the Northern Territory);
- introduced predator impacts (directly or due to depletion of shared prey species);
- inappropriate fire regimes;
- habitat degradation due to livestock or introduced stock; and
- habitat loss.

These threats were considered when developing the management strategies in this TSOP.

3.2 PILBARA OLIVE PYTHON

The Pilbara olive python is an olive brown/pale fawn python growing to at least 2.5 m.

The diet includes medium-sized mammals and medium-large sized birds.

This species is listed as Endangered under the EPBC Act

Habitat quality for the Pilbara olive python (*Liasis olivaceus barroni)* is likely to be related to the abundance and availability of suitable shelter sites (mostly rock crevices, caves and hollow logs); the abundance and year-round availability of prey species; proximity to permanent water; and the abundance of potential predators.

It is an isolated (Pilbara-endemic, or nearly so) subspecies of a species that is widespread across northern Australia. However, Rawlings *et al*. (2004) found strong genetic evidence that *barroni* represents a distinct species, increasing its importance as a Pilbara endemic. Recent genetic analysis of olive pythons from the Kimberley and Pilbara also suggest the Pilbara olive python is a distinct species (Spencer and Pearson 2014), however it continues to be treated as an endemic Pilbara

subspecies in this document consistent with its current taxonomic status in Commonwealth and Western Australian State legislation.

There has been no recent published account of the distribution of the Pilbara olive python although the Western Australian government NatureMap shows a wide distribution across the Pilbara (DPaW 2014). Smith (1981) and Pearson (1993) have provided brief overviews of its known distribution, with Pearson (1993) noting an association particularly with deep gorges and waterholes in ranges.

The Pilbara olive python is listed as Vulnerable under the EPBC Act and recognised as Schedule 1 (Fauna that is rare or is likely to become extinct) in the Wildlife Conservation (Specially Protected Fauna) Notice 2014 of the WC Act. There is no Recovery Plan for this species, however the main threats to the Pilbara olive python (adapted from TSSC 2008 and DotE 2014a) are considered to be:

- predation by introduced predators (cats and foxes), particularly of juveniles;
- reduced abundance of prey species (due to inappropriate fire regimes and/or introduced predators);
- habitat loss;
- deliberate killing due to misidentification; and
- road and rail traffic mortality.

These threats were considered when developing the management strategies in this TSOP.

4 LAND MANAGEMENT AREA

There are currently no existing programs in the Pilbara bioregion which, if extended or expanded, would deliver direct and measurable benefits to either species with necessary cost-efficiency and certainty of outcomes. As a result, it was determined that a new landscape-scale management program would be required in order to meet the requirements of Condition 14 (EPBC 2011/5815).

This TSOP focuses on the proposed management measures over the Yarraloola Land Management Area (**the LMA**) which includes much of Yarraloola Station and some adjoining unallocated crown land (**UCL**) and Reserve (stock route reserve) within the Hamersley subregion of the Pilbara bioregion (Appendix 3).

The Yarraloola Pastoral Station Partnership[2] holds the lease for Yarraloola Station which is approximately 223,871 ha in size and is located within the western Pilbara.

This Section presents an overview of the LMA in relation to its location and biophysical characteristics. Further details are provided in Appendix 4.

4.1 LOCATION

The LMA is located within the Shire of Ashburton in the Pilbara region of north west of Western Australia. The Pilbara region covers a total area of 50,789,600 ha extending from the Indian Ocean to the Northern Territory border. Figure 4-1 depicts regional location of the LMA.

The LMA itself covers an area of 163,214 ha and lies approximately 140 km south west and 60 km east of the Pilbara coastal towns of Karratha and Onslow respectively. The northern boundary of Cane River Conservation Park lies approximately 10 km to the south of the LMA (Figure 4-2).

At the local scale, the LMA lies approximately 10 km south west of Pannawonica. The North West Coastal Highway forms the western boundary while the pastoral leases of Peedamulla Station, Mardie Station, Yalleen Station and Red Hill Station border the LMA to the west, north, east and south respectively. UCL also borders the north and south of the LMA.

4.2 CLIMATE

The climate within the LMA and surrounds is classified as semi-arid. Rainfall is highly variable through all months of the year, but mostly occurs during January, February and March in association with cyclonic events. The maximum summer temperatures are high (high 30s to mid 40s degrees celcius) and the maximum winter temperatures are mild (mid 20s). Further details regarding the climate are provided in Appendix 4.

[2] The partners in Yarraloola Pastoral Station Partnership (also being members of the Robe River Joint Venture) are:

- Robe River Mining Co Pty Limited (60% Rio Tinto owned);
- Mitsui Iron Ore Development Pty Ltd;
- North Mining Limited (100% Rio Tinto owned);
- the partnership known as Cape Lambert Iron Associates (carried on between Nippon Steel & Sumitomo Metal Australia Pty Ltd, Nippon Steel & Sumikin Resources Australia Pty Ltd and Mitsui Iron Ore Development Pty Ltd); and
- the partnership known as Pannawonica Iron Associates (carried on between Nippon Steel & Sumitomo Metal Australia Pty Ltd and Nippon Steel & Sumikin Resources Australia Pty Ltd).

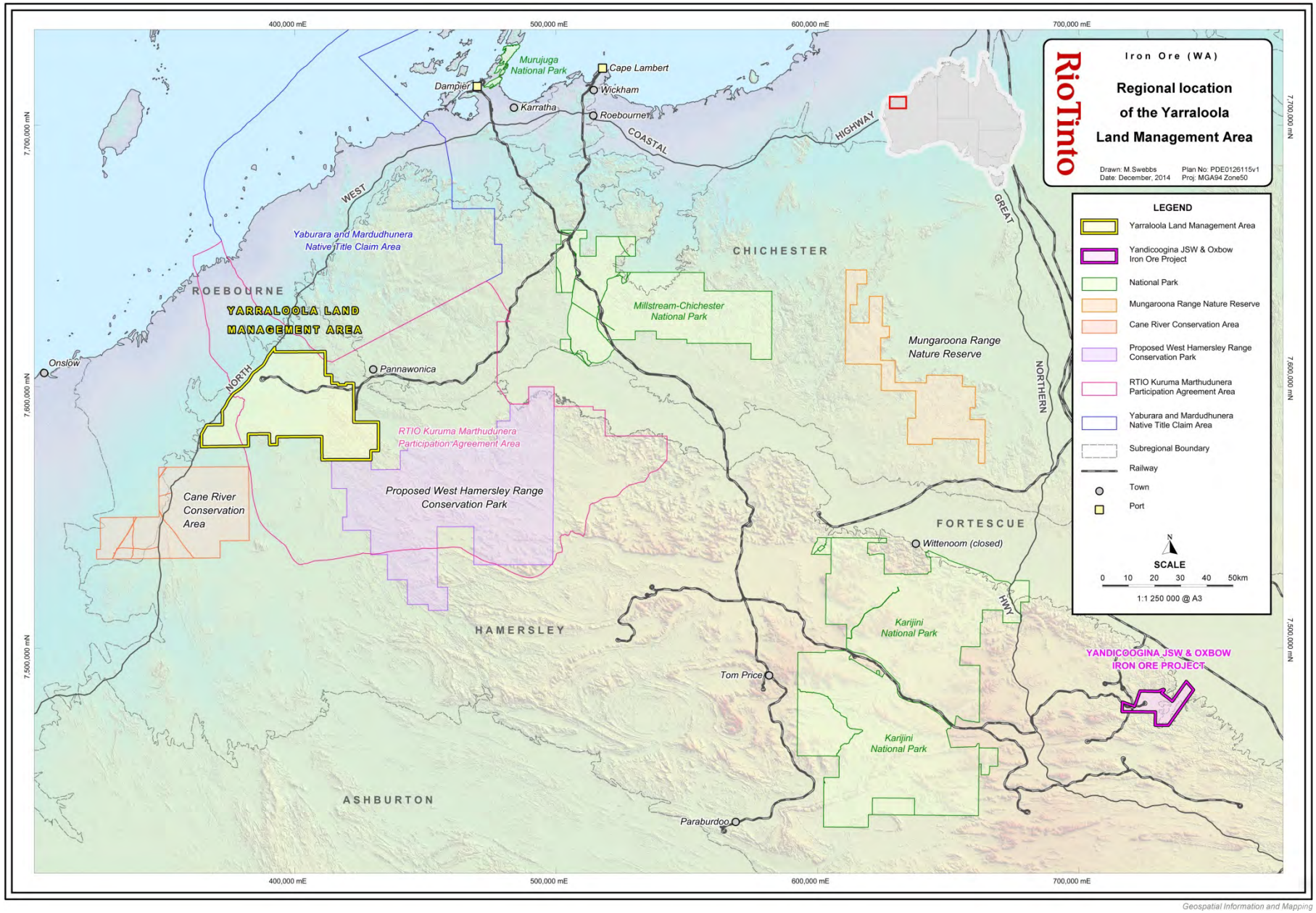


Figure 4-1: Regional location of the Yarraloola Land Management Area

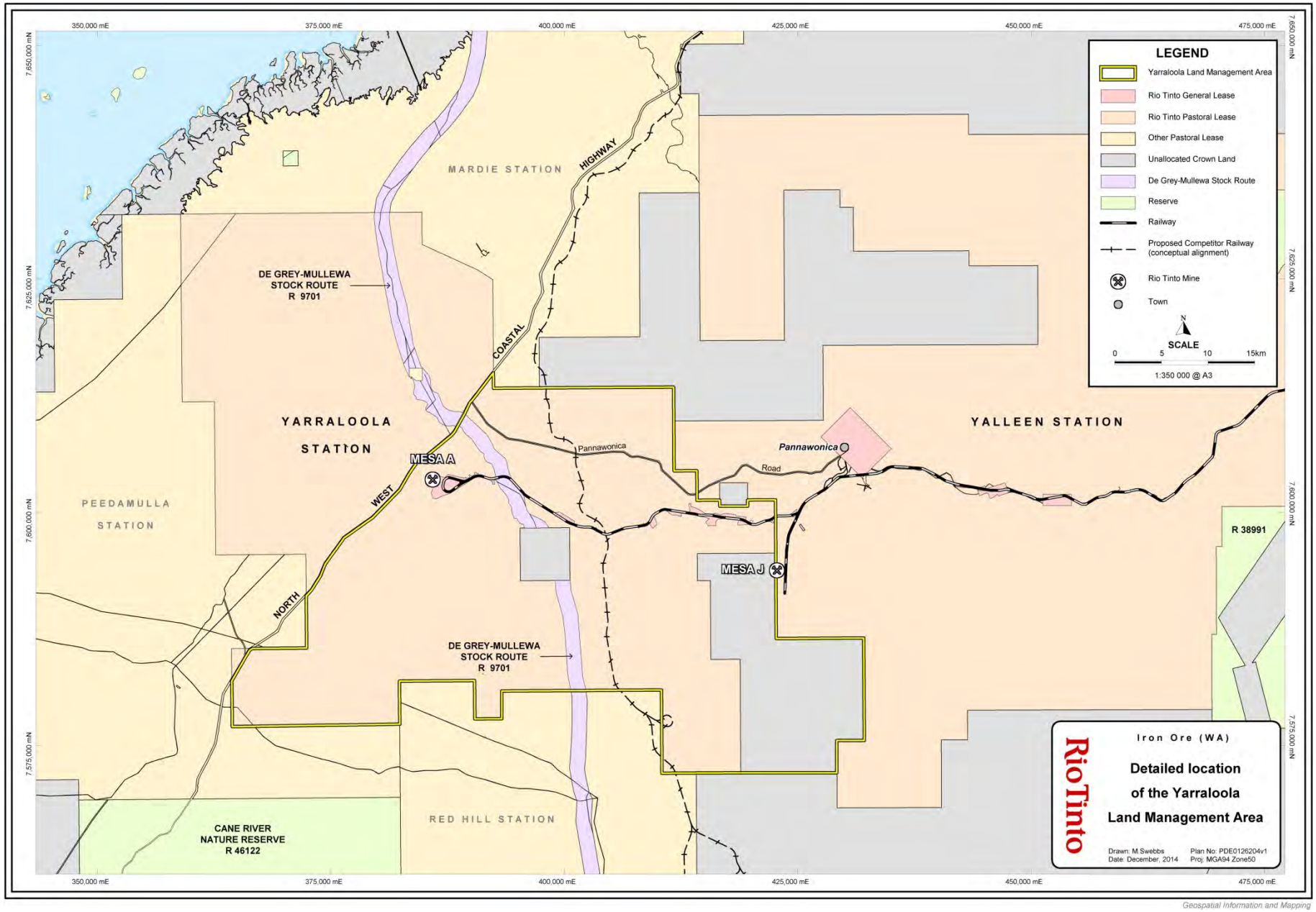


Figure 4-2: Detailed location of the Yarraloola Land Management Area

4.3 TOPOGRAPHY AND PHYSIOGNOMY

The LMA is situated within the Hamersley subregion of the Pilbara bioregion, as defined by version 7 of the Interim Biogeographic Regionalisation for Australia (**IBRA7**) (Thackway and Cresswell 1995; DSEWPaC 2012). The Hamersley subregion is defined by Kendrick (2001) as:

> *"Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorge (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and* Eucalyptus leucophloia *over* Triodia brizoides *on skeletal soils of the ranges."*

Due to its regional location at the western edge of the Hamersley subregion, the LMA covers a diverse range of landforms. The escarpment and incised plateaux uplands of the Hamersley Range dominate the east of the LMA while mesa landforms (many representing palaeodrainage of the Robe River), broad stony plains and contemporary major drainage channels and tributaries of the Robe River dominate the central and western parts. The Robe River valley traverses the northern half of the LMA with approximately 45 km of the river's lower reach contained within the LMA boundary.

The land systems occurring on the LMA were mapped by van Vreeswyk *et al*. (2004) at 1:100,000 scale (refer to Appendix 4 for illustration and details of their proportional representation within the LMA). The Stuart, Urandy and Sherlock land systems dominate the lowland plains of the western and south-eastern parts of the LMA and are interspersed with low mesas and hills of the Nanutarra and Robe land systems. To the east, the Boolgeeda, Newman and Capricorn land systems dominate the more rugged uplands. Plates 1 - 4 present landscapes typical of land systems within the LMA.

Drainage within the LMA is dominated by two major drainage systems: the Robe River and its tributaries; and the Waramboo Creek. Water flow is in a broadly southeast to northwest direction.

- The Robe River and its associated alluvial plain passes through a series of hills and mesas in the eastern portion of the LMA before flowing through a flatter colluvial plain.
- Warramboo Creek flows through the southern portion of the study area in a northerly direction before ending in a large flood out area, west of the LMA.

There are numerous pools and waterholes along the lengths of major and minor drainage lines throughout the LMA. The most significant of these are permanent pools associated with the Robe River: Yeera Bluff; Martangkuna; Japanese Pool; Robe Pool; and Wooroo Pool.

Plate 1: Looking east towards the Hamersley Range (Newman land system) scarp with broad plain of Urandy land system (left of image) and mesa hill of the Robe land system (right of image) in the mid-ground.

Plate 2: A typical mesa breakaway slope of the Robe land system within the Land Management Area.

Plate 3: Permanent/semi-permanent pools of the Robe River (River land system) (foreground) and mesa breakaway slopes of the Robe land system (background) within the Land Management Area.

Plate 4 Narrow valley (foreground) between mesas (mid-ground right and left) of the Robe land system, and valley flat (middle background) characteristic of the Urandy and Boolgeeda land systems within the southern part of the Land Management Area

4.4 VEGETATION

The LMA occurs in the northwest of the Eremaean Botanical Province as defined by Beard (Beard 1975a). Hummock grasslands with Acacia shrub steppe are the dominant vegetation types across most of the LMA however riparian woodland vegetation of River Gum (*E. camaldulensis*) and Silver Cadjeput (*Melaleuca argentea*) dominates along the Robe River. A map of vegetation complexes has been compiled for the LMA based on aerial photography interpretation and consolidation of vegetation mapping of Beard (1975a), biological consultant reports and land system mapping (refer Appendix 4).

4.5 BIOLOGICAL VALUES

A number of baseline biological surveys indicate that the LMA encompasses a range of biodiversity values protected under WA State and Commonwealth legislation and/or policies or listed under international agreements or conventions. This includes a number of recorded MNES, Priority Species, and potential habitat as summarised in Table 4-1 and illustrated in Figure 4-3.

Within the LMA, riparian vegetation and permanent pools of the Robe River have been described as sub-regionally significant (Kendrick 2001). These landscape features provide important habitat for the Pilbara olive python and northern quoll as well as a range of other common and conservation-significant taxa.

A detailed account of the biological values of the LMA is provided in Appendix 4.

Table 4-1: Summary of Conservation Significant Species recorded in the Land Management Area

Conservation Category	Species
EPBC Act/WC Act	Northern quoll (Endangered/Schedule 1) Pilbara olive python (Vulnerable/Schedule 1) Pilbara leaf-nosed bat (Vulnerable/Schedule 1)
Priority Species	*Abutilon* sp. Onslow F. Smith s.n. 10/9/61 (P 1) *Triodia* sp. Robe River M.E. Trudgen *et al*. MET 12367 (P 3) Brush-tailed mulgara (P 4) Ghost bat (P 4) Western pebble-mound mouse (P 4) Australian bustard (P 4) Bush stone-curlew (P 4) Flock bronzewing (P 4) Star finch (P4) Lined soil-crevice skink (P4) *Goodenia nuda* (P 4) *Rhynchosia bungarensis (*P 4*)*
Priority Ecological Communities listed by Parks and Wildlife	Subterranean invertebrate communities of mesas in the Robe Valley region PEC Sand sheet vegetation (Robe Valley) PEC *Triodia* sp. Robe River assemblages of mesas of the West Pilbara PEC
Invertebrate troglofauna	4 *Paradraculoides* spp.
Migratory birds	Eastern great egret Rainbow bee-eater

4.6 CURRENT ECOLOGICAL CONDITION

Overall, habitats within the LMA are largely intact with only a small fraction having been cleared in the past. Historically, vegetation clearing within the LMA has been limited to that needed for the establishment and maintenance of station tracks and other infrastructure to support extensive grazing enterprise. More recently, clearing for mineral exploration and development, most notably the Mesa A and J mines and associated rail infrastructure, has occurred in some areas.

Along the Robe River (and surrounding floodplains and tributaries which represent good to moderate pasture) there are signs of degradation as a result of overgrazing. Introduced pasture grasses and other common weed species are locally common in these areas of higher productivity. Vegetation of the slopes, breakaways, mesas and plateaus is relatively unpalatable to stock and thus unlikely to have been extensively grazed. These vegetation types are typically resilient to weed invasion unless significantly disturbed. A total of 29 introduced plant species have been recorded during past reconnaissance and systematic flora and vegetation surveys. Weed species present are largely typical of areas subject to pastoral and mining activities.

Feral and unmanaged cattle from neighbouring stations occur within the LMA and, together with managed stock, are the most significant introduced herbivore in terms of their overall abundance and distribution within the LMA. Introduced predators known to inhabit the LMA include wild dogs/dog-dingo hybrids (*Canis lupus familiaris/ C. l. dingo*) and feral cats (*Felis catus*). There is one historical record of red fox (*Vulpes vulpes*) from within the LMA.

Fire is an integral part of the landscape in which the LMA is situated. The LMA contains a relatively fine-grain mosaic of burned vegetation and spinifex-dominated vegetation complexes showing a relatively good representation of different fire ages.

Appendix 4 provides an in-depth account of the current ecological condition of the LMA including details of threatening processes such as introduced predators, introduced herbivores, wildfire and weeds.

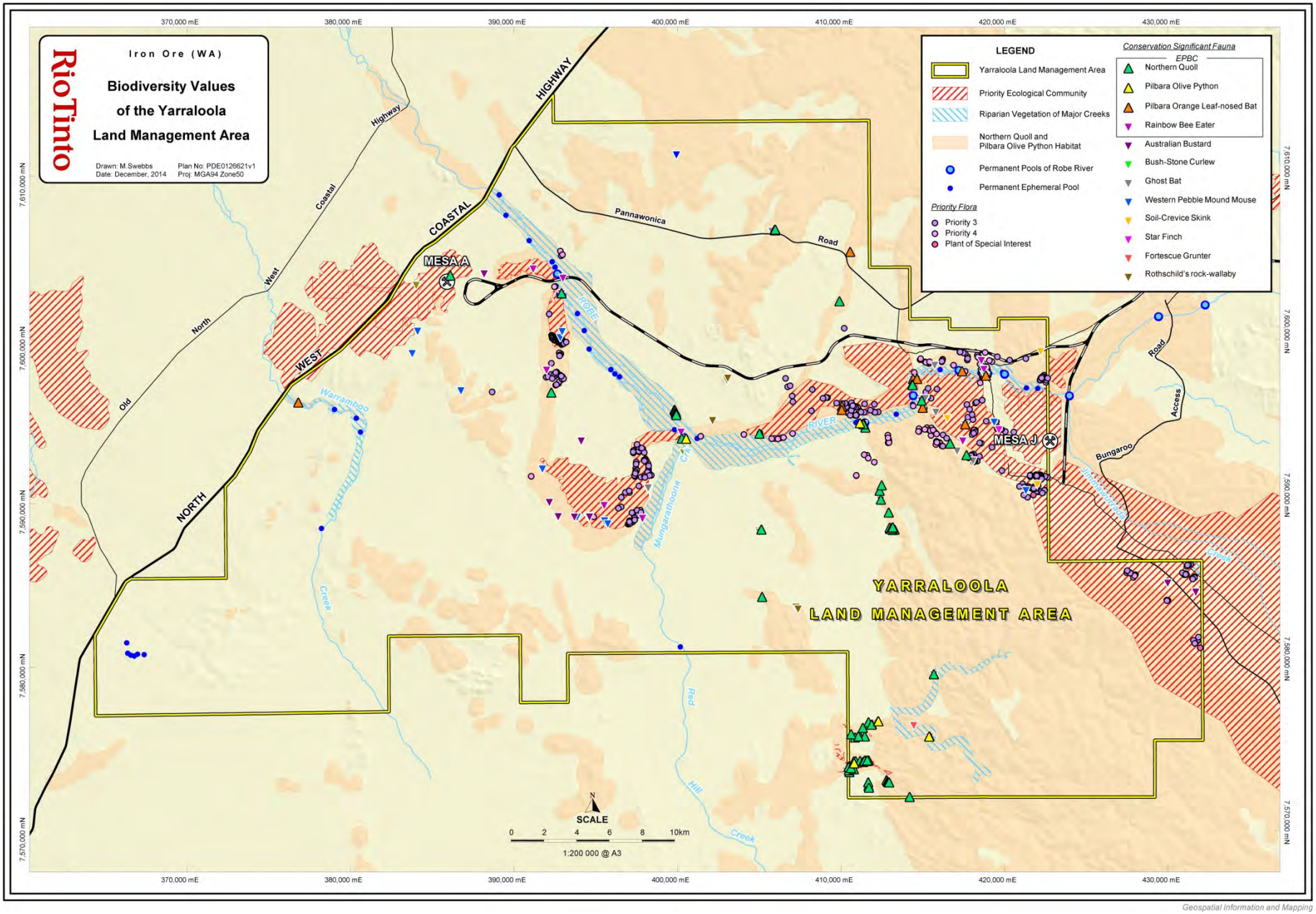


Figure 4-3: Biodiversity values recorded within the Yarraloola Land Management Area

4.7 TENURE

The LMA encompasses the south eastern portion of Yarraloola Station Pastoral Lease (L 3114 1127) with the station accounting for approximately 80 % of the total LMA (Table 4-2; Figure 4-2). The Yarraloola Pastoral Station lease is managed by Robe River Mining Co Pty Limited (a member of the Rio Tinto Group) on behalf of the Yarraloola Pastoral Station Partnership.

The LMA also encompasses 28,578 ha of adjoining UCL and overlays *Land Administrative Act 1997 (WA)* (**LAA**) Reserves 9701 and 41787 (Figure 4-2):

- Reserve 9701 is an unmanaged reserve for the purpose of the De Grey - Mullewa Stock Route, which traverses the Yarraloola Pastoral Station.
- Reserve 41787 is a repeater station site which is managed by the Australian and Overseas Telecommunication Corporation Ltd.

Historically, reserves such as the De Grey - Mullewa Stock Route supported the movement of livestock overland between grazing lands and from grazing lands to markets. These reserves are now seldom used for this purpose and are typically managed as a contiguous part of the pastoral lease through which they traverse.

Other LAA tenure within the LMA includes a general lease held by another member of the Rio Tinto group over an existing rail line and public and closed road lease areas which, when combined, account for 1.5% of the LMA (Table 4-2; Figure 4-2).

Rio Tinto will seek appropriate permission from the relevant State agencies and lease holders to undertake any activities, including biological monitoring, over LAA tenure not held by Rio Tinto.

Table 4-2: Land Administration Act 1997 tenure within the Land Management Area

LAA Lease type	Area (ha) [% of LMA]
Lease-Pastoral	128,113.20 [78.5%]
Unallocated Crown Land	28,577.72 [17.5%]
Reserve	4,038.82 [2.5%]
Lease-General	1,902.71 [1.2]
Public Road (Pannawonica Road)	569.28 [0.3]
Closed Road	11.98 [0.01]

There is currently no appropriate mechanism under the LAA or the *Mining Act 1978* WA (**Mining Act**) to provide exclusive tenure for non-government parties for the sole purpose of conservation. Mining tenements can be granted over any Crown Land not already subject to a mining tenement (excluding miscellaneous licences which can co-exist with other mining tenements), and there are overlapping tenements. As a result, and combined with little available UCL in the Pilbara, any area which is utilised for conservation purposes must co-exist with the current and future activities of the Mining Act and LAA tenement holders.

Table 4-3 and Figure 4-4 detail the underlying tenure of the LMA as of December 2014.

Table 4-3: Underlying Tenure of the Land Management Area as of December 2014

Tenement Holders	Tenements
Rio Tinto Group Tenure	
Yarraloola Pastoral Station lease 3114/1127	
Mineral Lease 248SA (Sections 100, 104 and 106) granted pursuant to the *Iron Ore (Robe River) Agreement Act* 1964 (Expiry 30 October 2033)	
Mining Act Exploration Licences 08/1148, 08/1196, 08/1467, 08/1771, 08/1772	
Mesa A rail lease K876559	
Pending Mining Act Mining Leases 08/396 and 08/397	
Pending Mining Act Miscellaneous Licence 08/00029	
Pending General Purpose Lease 0008/82 and 08/00085	
Live Prospecting Licence 08/00615	
Third Party Tenure	
AQUILA STEEL PTY LTD and WESTIRON PTY LTD	Live Exploration Licence 47/01279
AQUILA STEEL PTY LTD and AMCI (IO) PTY LTD	Pending Miscellaneous Licence 08/00075 (for the purpose of mine site accommodation facility, power, water, communications and associated infrastructure).
BUCKLAND MINERALS TRANSPORT PTY LTD	Pending Miscellaneous Licence 08/00120 (for the purpose of mine site accommodation facility, mine site admin facility, workshop and storage facility and associated infrastructure) Pending Miscellaneous Licence 08/00141 and 08/00142 (for the purpose of a bore, bore field, communications facility, meteorological station, mine site accommodation facility, mine site admin facility, pipeline, power generation, powerline, road, search for groundwater, storage or transportation facility for minerals or mineral concentrate, workshop and storage facility, an aerodrome and associated infrastructure and the taking of water) Live Miscellaneous Licence 08/00139 (for the purpose of a bore, bore field, bridge, communications facility, meteorological station, mine site accommodation facility, mine site admin facility, pipeline, power generation, powerline, road, search for groundwater, storage or transportation facility for minerals or mineral concentrate, workshop and storage facility, an aerodrome and associated infrastructure and the taking of water)
CAPE PRESTON LOGISTICS PTY LTD	Live Miscellaneous Licence 08/00100 (for the purpose of mine site accommodation facility, mine site admin facility, workshop and storage facility and associated infrastructure). Live Miscellaneous Licence 08/00101 (for the purpose of mine site accommodation facility, mine site admin facility, workshop and storage facility and associated infrastructure).
FMG PILBARA PTY LTD	Live Exploration Licence 08/01440 Live Exploration Licence 08/1439 Live Exploration Licence 08/1550 Live Exploration Licence 08/2004 Live Exploration Licence 08/2072 Live Exploration Licence 08/2137 Live Exploration Licence 08/2195 Live Exploration Licence 08/2459

Tenement Holders	Tenements
	Live Exploration Licence 08/02547 Pending Exploration Licence 08/02536 Pending Exploration Licence 08/02594 Pending Exploration Licence 08/02595
GEOLOGICAL RESOURCE SOLUTIONS PTY LTD	Pending Exploration Licence 08/2408
MAL'S RIDGE PTY LTD	Live Exploration Licence 08/01554 Live Exploration Licence 08/01900 Live Exploration Licence 08/01901
MUM RESOURCES PTY LTD	Live Exploration Licence 08/02596
PEL IRON ORE PTY LTD	Live Exploration Licence E47/01538
RED HILL IRON LIMITED	Live Exploration Licence 08/01289 Live Exploration Licence 08/01293 Live Exploration Licence 08/01294 Live Prospecting Licence 08/00623 Live Mining Lease 08/00499 Live Mining Lease 08/00500 Live Mining Lease 08/00505 Pending Mining Lease 08/00483 Pending Mining Lease 08/00501
ZANTHUS RESOURCES PTY LTD	Live Exploration Licence 08/01060 Live Exploration Licence 08/01685 Live Exploration Licence 08/01686 Live Exploration Licence 08/01826 Live Prospecting License 08/529 Live Prospecting License 08/530 Pending Mining Lease 08/00499 Pending Mining Lease 08/00500 Pending Prospecting License 08/00669

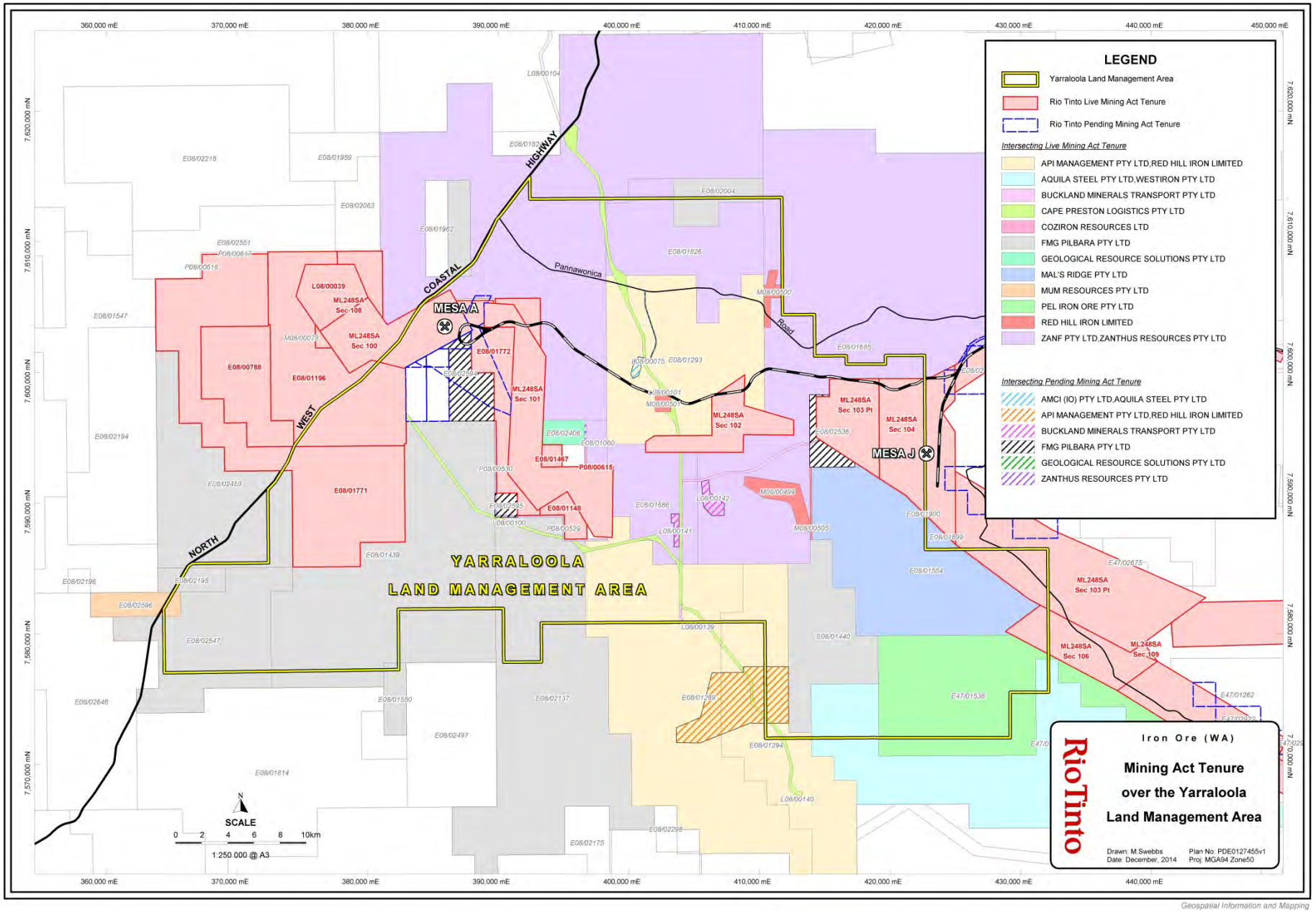


Figure 4-4: ***Mining Act 1978*** **Tenure over the Yarraloola Land Management Area**

4.8 RATIONALE FOR SELECTION OF THE LAND MANAGEMENT AREA

Given that there is no appropriate mechanism to secure land for conservation in the Pilbara and that the Rio Tinto Group owns leases for a number of pastoral stations in the Pilbara, it was determined that the greatest offset opportunity for the Yandicoogina Project lay in enhanced management of pastoral tenure.

An options analysis considered scenarios that included a number of stations with connectivity to existing or planned conservation reserves and neighbouring UCL.

The LMA was selected based on consideration of the following criteria:

Ecological resilience and the area's ability to support a viable population of northern quoll, Pilbara olive python and other biodiversity values:

- The LMA is considered large enough to enable landscape-scale control of introduced predators.
- The LMA has good connectivity with northern quoll and Pilbara olive python habitat across the regional landscape owing to the prominence of the Robe River and Hamersley Range escarpment.
- There are no significant barriers of cleared vegetation and the road and rail corridors are not considered significant barriers at meta-population level.
- The LMA is contiguous with extensive areas of UCL and with rugged rocky land systems which are unlikely to be impacted significantly by grazing or development.

Ecological equivalence with the Project Area ('like for like'):

- The LMA is known to support the northern quoll and Pilbara olive python and contains large tracts of habitats considered suitable for both species (Figure 4-3).
- The LMA and the Project Area have similar habitats and historical land uses thus the condition of northern quoll and Pilbara olive python habitat is assumed to be similar.
- The LMA is located in the same ecological sub-region (Hamersley) (Figure 4-1) and contains all land systems that occur within the Project Area as well as several additional land systems (refer Appendix 4 for land systems within the LMA).

Regional context in relation to proximity to existing and future conservation projects (conservation programs and research):

- The LMA is in close proximity to the existing Cane River Conservation Area and adjoins the proposed West Hamersley Range Conservation Park (Figure 4-1).
- It is also in proximity to the Rangelands NRM Pilbara Corridors Program.

Additionality by ensuring proposed management represents a positive departure from 'business as usual':

- TSOP management actions were assessed against the existing management regime and legal and policy requirements of land management within the LMA.

Tenure and land where current and future land use may facilitate, complement or constrain conservation management objectives:

- In WA pastoral tenure allows leaseholders to undertake conservation activities, which are not inconsistent with pastoral activities.
- Pastoral tenure for the Yarraloola pastoral station is owned by a subsidiary of Rio Tinto, enabling a greater level of access when compared with other pastoral land in the region.

Mining by considering current or known mining development within the LMA:

- Rio Tinto (on behalf of the Robe JV) currently manages a rail line and two iron ore mines (Mesa J and Mesa A) within the LMA (Figure 4-4).
- Constraints associated with future development are typical across the Hamersley sub region where iron ore mineralisation is often coincident with, or intersects, suitable habitat for both northern quoll and Pilbara olive python. A key consideration for the LMA was that the mineral resources were relatively limited and well defined in the area, with sufficient good quality habitat for both species unlikely to be impacted within the TSOP timeframe by future mining and development.

Practicality is the physical ability to implement the TSOP based on access, proximity to supporting infrastructure and human resources:

- Implementing the TSOP is considered to be practical and cost-efficient in the LMA as there are adequate roads and tracks allowing reasonable accessibility.

Stakeholder acceptance and engagement includes existing relationships with stakeholders and understanding of their requirements and expectations:

- The LMA's location within a Rio Tinto managed pastoral lease means Rio Tinto already has well-established relationships with neighbouring stations and other land managers including government and non-government agencies and organisations.

Further detail on consideration against each of the above factors and offset principals is provided in Appendix 5.

PART 2 – CONSERVATION MANAGEMENT STRATEGIES

This Part sets out the conservation management strategies and actions to benefit the biodiversity values of the LMA, in particular the northern quoll and Pilbara olive python.

Prioritising TSOP management actions within the Yarraloola Land Management Area

On the advice of the Advisory Panel this TSOP prioritises resources and expenditure towards the delivery of a landscape-scale introduced predator control program.

The introduced predator control program (both the trial northern quoll *Eradicat*® cat bait uptake and survivorship study, and the operational control program) has been designed collaboratively between Parks and Wildlife, Rio Tinto and the Advisory Panel. Parks and Wildlife has been contracted to undertake the Survivorship Study in 2015 (proposed Year 1 of the TSOP) and, given the identified synergies with similar projects already operating in the State, will also be contracted to deliver the operational broad scale baiting component (subject to approval of the TSOP) from Year 2 through to Year 5 of the TSOP.

Where possible, Rio Tinto and Parks and Wildlife will seek to optimise costs of the introduced predator control program by leveraging existing baiting operations in the region (i.e. Fortescue Marsh and Cape Range baiting programs) and Rio Tinto's existing resources in the locality. While cost-efficiencies of the program will be maximised, the effective control of introduced predators across the LMA over 5 years is expected to command a large proportion of the overall TSOP implementation budget and, consequently, a relatively small proportion of overall funds will be designated towards actions to manage wildfire, introduced herbivores and invasive weeds.

Management actions described in the subsequent sections have therefore been designed with the objective of delivering meaningful positive outcomes for the northern quoll and Pilbara olive python in a manner that is likely to produce the most benefit within the designated budget.

The Advisory Panel, Parks and Wildlife and other technical advisors support this prioritisation and resource allocation.

5 INTRODUCED PREDATOR MANAGEMENT

5.1 MANAGEMENT GOAL

When considering the optimal management actions to benefit northern quoll and Pilbara olive python within the LMA, the Advisory Panel recommended the implementation of an introduced predator control program which focuses on broad scale deployment of baits to control feral cats.

Therefore the following management goal has been set for introduced predator management:

> *To enhance northern quoll and Pilbara olive python populations (and populations of other native fauna) and their habitat through a reduction in introduced predators (principally feral cats but also foxes and wild dogs) within the LMA*

5.2 INTRODUCED PREDATORS IN THE LAND MANAGEMENT AREA

Wild dogs/dog-dingo hybrids and feral cats are known to inhabit the LMA. There is at least one historical record of red fox (*Vulpes vulpes*), though foxes are likely to occur at relatively low densities given the Pilbara lies near the northern limit of their distribution in Western Australia.

Systematic searches for spoor (track and scat) of feral cats and wild dogs were undertaken in 2014. Both feral cats and wild dogs are present within the LMA but appear to be sparsely distributed (Thomas and Rayner 2014). To date there has been no attempt to estimate the relative abundance of any introduced predator within the LMA.

5.3 EXISTING MANAGEMENT WITHIN THE LAND MANAGEMENT AREA

The Department of Agriculture and Food Western Australia (**DAFWA**) coordinate an active wild dog baiting program along the Robe River which is assumed to exert some level of control on the wild dog/dingo population inhabiting the LMA. Red fox, if present, would also be susceptible to dog baits laid by DAFWA.

The feral cat is not a "Declared" animal under the *Biosecurity and Agriculture Management Act (2007)* (**BAM**) and as such, land holders are not obliged to control this species in areas under their management. Consequently, while mine sites within and adjacent to the LMA undertake periodic cat trapping in the immediate mining areas and associated camps, there is no concerted, targeted and broad scale effort to control feral cats within the LMA.

5.4 ACTION 1 – NORTHERN QUOLL ERADICAT® CAT BAIT UPTAKE AND SURVIVORSHIP STUDY

5.4.1 Management Objective

> *To assess the field uptake of feral cat baits Eradicat® by northern quoll and its impact on their survivorship and reproduction, and to subsequently develop an effective introduced predator control strategy that will benefit the northern quoll and other threatened fauna in the LMA.*

5.4.2 Background

The *Eradicat*® feral cat bait is due for registration for operational use in WA and could be used in the Pilbara to reduce introduced predator densities and improve conservation outcomes for northern quolls and other threatened fauna such as the bilby (*Macrotis lagotis*) and brush-tailed mulgara (*Dasycercus blythi*). *Eradicat*® baits are a sausage like compound laced with the 1080 poison that

naturally occurs in the south west of Western Australia. Rhodamine B, a pink dye which remains on the lips and in the gut of poisoned individuals, is sometimes added to the baits to allow confirmation of death from 1080 poisoning.

Prior to using operationally, potential non-target bait impacts have to be identified and resolved. As a top order native predator, the northern quoll is potentially at risk of poisoning following ingestion of the *Eradicat*® baits. Based on a laboratory tested LD_{50} (lethal dose for 50% of individuals) of 7.5 mg/kg (King *et al*. 1989) for 1080, an average sized Pilbara northern quoll (380-580g) would only need to ingest one toxic cat bait (containing 4.5 mg 1080) to be at risk. The extent to which a sub-lethal dose of 1080 poison may impact northern quoll, particularly with respect to reproductive fitness, is not currently known.

A field trial using *Eradicat*® and close monitoring of northern quolls is the only certain way of assessing cat baiting risk to a free-ranging northern quoll population. To date there have been no such trials conducted in the Pilbara or elsewhere in Australia.

5.4.3 Method

The northern quoll *Eradicat*® bait uptake and survivorship study (**the Survivorship Study**) has been designed by the Parks and Wildlife Science and Conservation Division in consultation with Rio Tinto and the Advisory Panel. A detailed description of the Survivorship Study is provided in the Science Project Plan (Parks and Wildlife 2014) (Appendix 6).

The Survivorship Study will cover two sites in the western Pilbara region of WA: approximately 20,000 ha of the Yarraloola Station part of the LMA will be baited with *Eradicat*® (**Baited Site**) (Figure 5-1); and Red Hill pastoral lease (60 km south of the LMA) will be used as an unbaited control site (**Control Site**). The actual sites are proposed to be finalised in March/April 2015 taking into account accessibility and presence of adequate numbers of northern quolls.

The impact of feral cat baiting on northern quolls will be assessed by comparing survivorship before and after cat baiting at both sites (i.e. a Before After Control Impact {**BACI**} design). Survivorship of northern quolls will be assessed by two methods: a) survival of radio-collared individuals at each site; and b) detection of quolls on a camera array.

Ground and aerial radio-tracking will be undertaken in the 4-6 week period prior to cat baiting and during an 8 week period post cat baiting to determine survivorship of the radio-collared quolls. If dead quolls are detected through the mortality signal, carcasses will be retrieved where possible and autopsied to determine the cause of death. In particular, the carcasses will be examined closely for the presence of the Rhodamine B pink dye (which will be added to the *Eradicat*® baits used in the Survivorship Study). Cage trapping of northern quolls will extend after the radio-tracking component in order to assess reproduction in the northern quoll population.

Remote cameras (Reconyx Hyperfire HC900) will be used to monitor presence of quolls within the Baited Site before and after cat baiting. Where possible, individual quolls will be identified from remote camera images using their unique spot pattern (Hohnen *et al*. 2013). Remote cameras may also be used to monitor the uptake by quolls of non-toxic cat baits placed in front of cameras at the Control Site.

The Survivorship Study methodology described within the SPP was developed following reconnaissance surveys and in-depth consultation with relevant experts within DPaW and the Rio Tinto-convened Biodiversity Offsets Advisory Panel. Whilst every effort will be made to implement the cat bait uptake trial as described within the Science Project Plan (Appendix 6), changes to the project methodology may be made during the course of the study in order to adapt the project to

unforeseen and unavoidable circumstances (e.g. inability to trap and collar 20 northern quoll individuals at control and impact sites, stochastic events such as fire or flood, etc.).

5.4.4 Expected benefits to northern quoll and Pilbara olive python

Assessing the impact on quolls of baiting to control feral cats in the Pilbara is an essential component in the development of a landscape scale program to control introduced predators and reduce the extinction risk for northern quolls and other medium-sized mammals in the Pilbara. As such, the Survivorship Study is expected to provide conservation benefits above and beyond this offset project.

The Pilbara olive python is not considered at risk from *Eradicat*® as it is an ambush predator not known to consume carrion and because reptiles have been shown generally to be more tolerant to 1080 than most other animals (McIlroy *et al*. 1985). No other indigenous species were considered by Parks and Wildlife to be at significant risk from *Eradicat*® baiting, although dingo/dog hybrids will be affected.

5.4.5 Implementation and Reporting

The Survivorship Study will commence in 2015 (proposed Year 1 of the TSOP) by Parks and Wildlife Science and Conservation Division on behalf of HIY in accordance with the Science Project Plan (Appendix 6) developed specifically for the Survivorship Study.

Parks and Wildlife will prepare and provide a report to HIY detailing the outcomes of the Survivorship Study which will be made available to the DotE and OEPA as part of annual reporting on the TSOP. This report will include a definitive recommendation from Parks and Wildlife on the risk posed by the *Eradicat*® bait to northern quolls and hence the feasibility of broad scale application of the baits across the LMA as part of an ongoing operational introduced predator control program.

The results of the Survivorship Study will be made publically available through publication by Parks and Wildlife in a suitable peer-reviewed scientific journal.

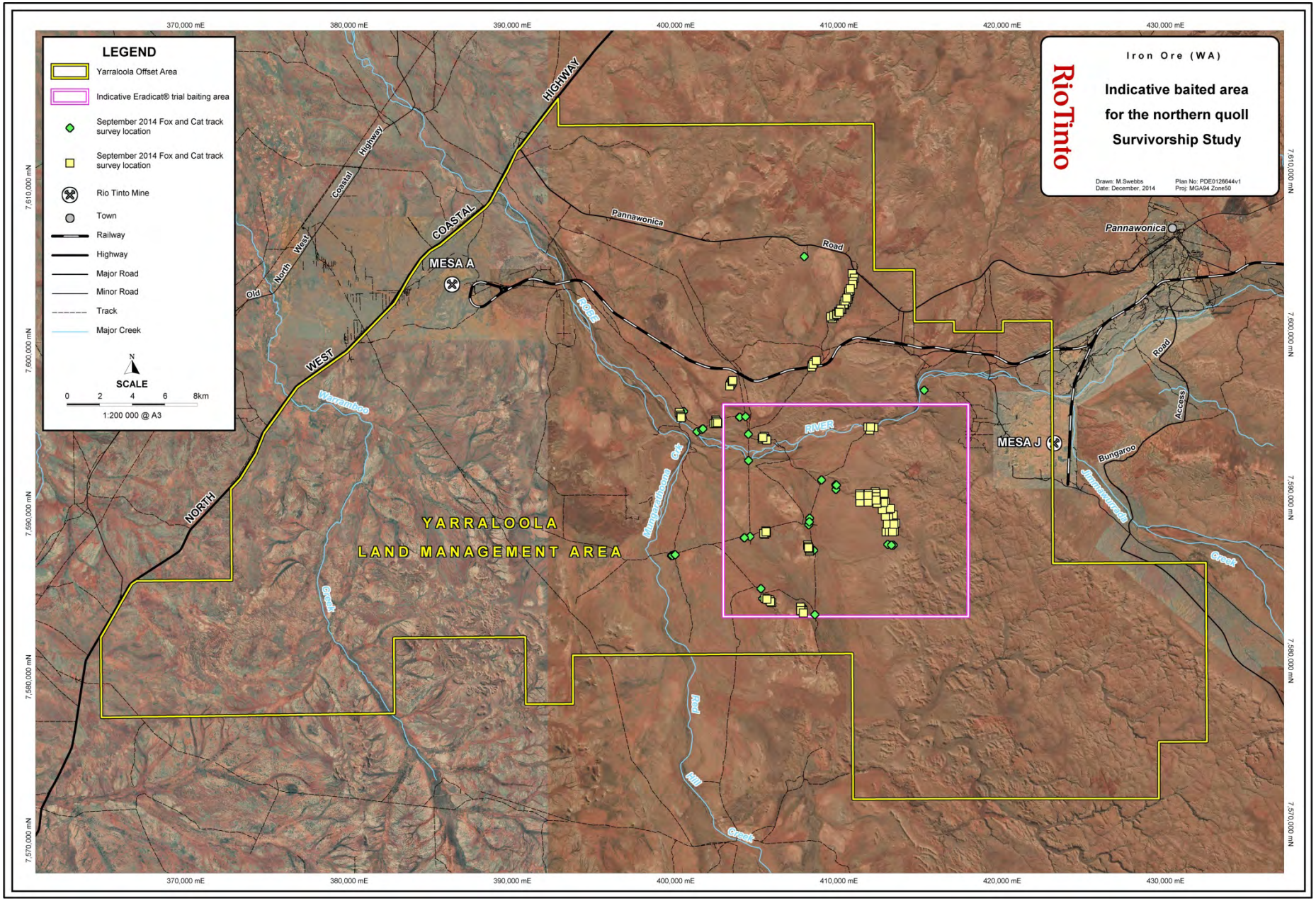


Figure 5-1: Indicative baited area for the Survivorship Study.

Responding to results of the Survivorship Study

The Survivorship Study represents the first trial of the impacts of *Eradicat*® baiting on northern quoll in the Pilbara bioregion or elsewhere across the species' range and will contribute significantly to the conservation management of northern quoll across the Pilbara bioregion.

Rio Tinto and Parks and Wildlife have collaboratively developed an introduced predator control program based on the broad scale application of *Eradicat*® baits across a large portion of the LMA (refer Section 5.5 and Appendix 7). If, as expected, the Survivorship Study indicates that standard deployment of the *Eradicat*® bait does not jeopardise northern quoll, this program will commence in Year 2, subject to approval of the TSOP by DotE and OEPA.

It is possible that the Survivorship Study will show deployment of *Eradicat*® baits using standard Parks and Wildlife baiting parameters will, or is likely, to have an unacceptable impact on northern quoll survivorship or reproduction. Such a result would initiate review and evaluation of management activities.

Rio Tinto, in conjunction with the Advisory Panel and Parks and Wildlife technical staff, have considered options for ongoing introduced predator control should the Survivorship Study demonstrate unacceptable risk to northern quoll. Key options include:

1. **Adaptation of the Parks and Wildlife standard *Eradicat* ® baiting approach** – e.g. the targeted delivery of *Eradicat*® baits to areas likely to be less frequented by northern quoll (but within introduced predator habitats), thus reducing likelihood of northern quoll encountering baits.
2. **Encapsulated *Eradicat*® Trial** – Parks and Wildlife are in the process of developing a version of the *Eradicat*® baits with the 1080 poison encapsulated rather than directly injected into the bait medium. Initial trials have shown encapsulated baits to be less effective than standard *Eradicat*® baits but encapsulated baits may present a lower risk to native fauna (due to differences in typical feeding behaviours between cats and carnivorous native mammals). As with the standard version, an encapsulated version of *Eradicat*® would need to be trialled prior to broad scale application within the LMA.
3. **Reorientation of Offset management priorities** – the relative resources and expenditure allocated to the management of wildfire, feral herbivores and weeds may be revised to account for the necessary reduction in intensity of introduced predator management.

An appropriate response to the outcomes of the Survivorship Study will be developed by Rio Tinto in collaboration with Parks and Wildlife, the Advisory Panel, DotE, and the OEPA through detailed evaluation of options.

5.5 ACTION 2 – INTRODUCED PREDATOR CONTROL PROGRAM

5.5.1 Management Objective

To improve northern quoll and Pilbara olive python habitat within the LMA through a reduction in the abundance of introduced predators.

5.5.2 Background

Baiting is recognised as the most effective method for controlling feral cats and other introduced predators over large areas on mainland Australia (Algar and Burrows 2004; Algar *et al*. 2007; DEWHA 2008a; DEWHA 2008b; Environment Australia 1999; Short *et al*. 1997), when there is limited risk posed to non-target species.

The feral cat bait *Eradicat*® (Algar and Burrows 2004; Algar *et al*. 2007) has proven to be an effective tool in reducing feral cat numbers and has been used under research permits to demonstrate baiting efficacy at a number of sites across Western Australia (including Dirk Hartog Island, Lorna Glen (Matuwa), Cape Arid National Park, Fitzgerald River National Park, and Peron Peninsula).

The Survivorship Study will commence in 2015 (proposed Year 1 of the TSOP) to assess the uptake by and impact to northern quoll under operation field conditions (see Action 1 in Section 5.4 above). If this Study demonstrates no significant detrimental impact of *Eradicat*® baiting on the northern quoll population, an operational feral cat baiting program will be implemented across the majority of the LMA. This program will be the central component of the TSOP in terms of both resources expended and the expected benefits generated for both the northern quoll and Pilbara olive python.

5.5.3 Method

The Feral Cat Baiting Program has been developed by the Parks and Wildlife Science and Conservation Division (Morris and Thomas 2014, provided in Appendix 7) in consultation with Rio Tinto and the Advisory Panel.

The program will be undertaken within the LMA by Parks and Wildlife across a baiting area of approximately 100,000 ha using a dedicated, twin-engine baiting aircraft under Parks and Wildlife's Western Shield Program Aerial Baiting Contract with baits deployed along previously designated baiting flight lines. The size and location of the baiting area will be determined once the required exclusion zones around public areas such as public roads, railways, town sites and mine sites have been taken into account. A preliminary baiting area is shown in Figure 5-2.

Baiting will be conducted in the cool and dry mid-winter (ideally the first week of July) at a time when bait uptake by feral cats is maximised due to the low abundance and activity of prey items, in particular reptiles and small mammals (Algar and Burrows 2004). Bait degradation due to rainfall, ants, and hot weather will also be significantly reduced at this time.

Prior to baiting a "1080 Baiting Application and Risk Assessment" will be completed so as to comply with the *Code of Practice for Safe Use and Management of 1080 in Western Australia* (August 2010). Engagement with local stakeholders including neighbouring pastoral lessees and the Kuruma and Marthudunera traditional owner group will also be undertaken prior to baiting.

5.5.4 Expected benefits to northern quoll and Pilbara olive python

Northern quoll and Pilbara olive python abundance is expected to increase within the LMA in response to the effective control of feral cats brought about by broad scale baiting using *Eradicat*®. Northern quolls may be expected to respond quickly to a reduction of this pressure given relatively

high fecundity and the short generation time typical of this species. By contrast, the life-history traits of Pilbara olive python suggest a much slower response is likely for this species.

In the LMA, there is likely to be significant overlap between prey items of feral cats and those of the northern quoll and Pilbara olive python. A reduction of feral cats through baiting is therefore expected to result not only in reduced predation on northern quolls and Pilbara olive pythons but also in an increase in prey availability for both species.

5.5.5 Implementation and Reporting

The Feral Cat Baiting Program will be implemented by Parks and Wildlife Science and Conservation Division on behalf of HIY. Implementation of the program will be in accordance with this TSOP and Appendix 7. The program will be subject to revision and may be updated as necessary in 2015 and beyond, following outcomes of the Survivorship Study and baseline monitoring.

Assuming a satisfactory outcome from the Survivorship Study, and approval of the TSOP by DotE and OEPA, broad scale deployment of *Eradicat*® baits across the baiting area will commence in Year 2 and continue annually for the remainder of the TSOP. The effectiveness of the Feral Cat Baiting Program will be observed through monitoring described in this TSOP and Appendix 7. Consistent with an adaptive management approach, the program is to be reviewed annually to indicate the effectiveness of the program and identify necessary changes in order to maintain or improve program effectiveness.

Parks and Wildlife will compile an annual report describing the outcomes of each annual bait deployment and associated monitoring for the preceding year. This report will be submitted to HIY each year and included in the annual reporting the following year.

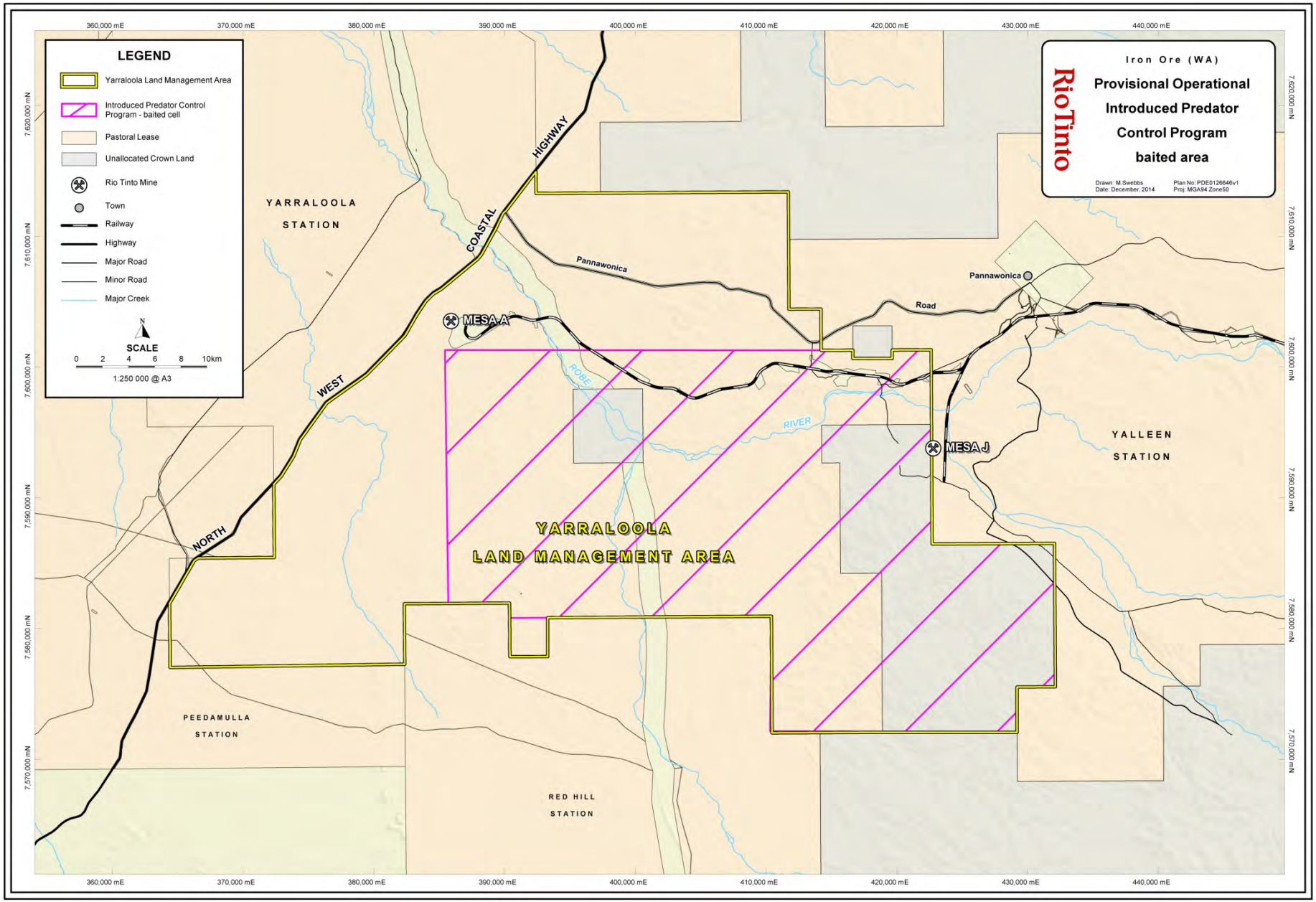


Figure 5-2: Provisional operational introduced predator control program baited area

6 INTRODUCED HERBIVORE MANAGEMENT

6.1 MANAGEMENT GOAL

To enhance northern quoll and Pilbara olive python habitat through a reduction in feral cattle within the LMA.

6.2 INTRODUCED HERBIVORES WITHIN THE LAND MANAGEMENT AREA

Feral and unmanaged cattle from neighbouring stations occur within the LMA and are the most significant introduced herbivore in terms of their overall abundance and distribution as well as their impacts on the land. Whilst there have been no systematic surveys of large introduced herbivores across the LMA, anecdotal information gathered during interviews with the Yarraloola and Yalleen Station managers, suggests camels, donkeys and horses are absent from the general Pannawonica locality including the LMA. There is one record of camel from Yarraloola Station (Parks and Wildlife 2014) however interrogation of the NatureMap database suggests this record is erroneous.

Thomas and Rayner (2014) observed cattle (*Bos taurus*) or signs of cattle throughout the central parts of the LMA. Numerous feral cattle were observed either with marked station animals, within small herds, or as individuals around water points.

6.3 EXISTING MANAGEMENT WITHIN THE LAND MANAGEMENT AREA

Robe River Mining Co Pty Limited (**RRMC**), a member of the Rio Tinto group, is responsible for the management of Yarraloola Station which includes management of the existing cattle herd and station infrastructure.

A mixture of Yarraloola Station stock, neighbouring station stock and feral cattle are mustered each year with the majority of the mustered stock from neighbouring stations. These cattle are returned to the neighbouring properties while the Yarraloola Station stock are either trucked to market or redistributed within the lease. Feral cattle are either sent to market or destroyed.

Currently, mustering takes place periodically within the pastoral lease boundary and focuses on areas of moderate to good pastoral potential within the station lease. Narrow drainage lines that dissect the large tract of UCL in the south east of the LMA and connect the UCL to Yarraloola Station are not currently a focus of mustering as they occur beyond the Yarraloola Station lease boundary. Anecdotal evidence suggests these areas provide an important refuge for significant numbers of feral cattle.

Apart from mustering described above, there are currently no regular targeted feral herbivore management activities undertaken within the area of Yarraloola Station part of the LMA.

The TSOP does not restrict existing Yarraloola Station pastoral management operations but assumes a continuation of the same or similar (low) grazing intensity from managed stock within the LMA as has been applied in recent years.

6.4 ACTION 3 - MUSTER TO REMOVE FERAL CATTLE ACROSS THE LAND MANAGEMENT AREA

6.4.1 Management Objective

Reduce the number of feral cattle and their impacts within the LMA through periodic mustering.

6.4.2 Background

Regular aerial and ground-based mustering is an effective means of removing cattle from target areas. Aerial mustering in particular can be effective in removing feral "scrub" cattle from areas difficult to reach by ground-based means such as buggies and motorcycle. Mustering efficiency is generally high (greater than 70%) when using a good helicopter mustering pilot, and when supported by ground-based crews is a cost effective way to cover large areas (particularly if rugged and inaccessible).

6.4.3 Method

Aerial mustering will be undertaken using a helicopter with an appropriately qualified and experienced pilot supported by a ground-based team using vehicles (buggy and motorcycle). Cattle will be mustered to existing paddocks and yards within Yarraloola Station or to temporary yards depending on the location and infrastructure available.

Mustering activities will be applied to the entire LMA. Areas of good or moderate pastoral potential (i.e. River, Cane, Stuart, Boolgeeda, Urandy, Sherlock, Peedamulla and Mallina land systems) will be targeted as well as areas proximal to surface water and/ or offering protection and shade (e.g. narrow drainages and gorges of Newman, Rocklea, and Nanutarra land systems).

The TSOP will expand current Yarraloola Station mustering activities to incorporate UCL in the southeast of the LMA as well as parts of Yarraloola Station that are otherwise considered uneconomical to muster. As described elsewhere, such areas include areas of core habitat for both northern quoll and Pilbara olive python, and as such are a priority for management.

Musters will be planned in consultation with station management, mustering contractors and in collaboration with neighbouring stations as appropriate.

6.4.4 Expected benefits to northern quoll and Pilbara olive python

Mustering will reduce the total number of cattle within the LMA by removing cattle belonging to neighbouring stations and feral cattle. This reduction is expected to benefit both the northern quoll and Pilbara olive python by reducing the impact of grazing within important foraging and dispersal habitat, in particular, riparian vegetation associated with the channel and permanent pools of the Robe River and other drainage lines.

6.4.5 Implementation and Reporting

Subject to approval of the TSOP, mustering is proposed for Year 1 but will be undertaken at the optimal season according to the station managers. Mustering will be repeated each year, or as necessary, with the results of monitoring used to guide the focal areas of mustering within the LMA.

RRMC, as manager of the Yarraloola Station, will maintain overall responsibility for the completion of mustering activities each year and will utilise appropriately qualified internal staff and external

contractors to undertake the work. The results of mustering will be made available to the DotE and OEPA as part of annual compliance reporting for the TSOP.

6.5 ACTION 4 - CULL OF FERAL INTRODUCED HERBIVORES

6.5.1 Management Objective

Reduce the impact of introduced herbivores on biodiversity values of the LMA through the periodic humane culling of feral introduced herbivores within the LMA.

6.5.2 Background

Aerial shooting of feral introduced herbivores from a helicopter can be a humane and extremely effective means of controlling cattle and other large introduced herbivores. The method is particularly effective when control is sought over extensive areas and inaccessible country. In the Pilbara, aerial culls are undertaken routinely by DAFWA either at the request of the Pilbara Recognised Biosecurity Group (**RBG**) or pastoral lessees to control feral donkeys, horses and, less frequently, camels and cattle.

Aerial culling is likely to be the most effective means of removing feral cattle inhabiting narrow drainage lines of rugged country that dominates the UCL in the south east of the LMA as well as from other inaccessible parts of the LMA.

6.5.3 Method

Aerial culling will involve the shooting of feral cattle (and other feral introduced herbivores if observed) from a helicopter using an appropriately qualified and experienced shooter and helicopter pilots. All relevant guidelines and procedures will be followed to ensure an effective and humane operation.

Culling operations will be targeted to areas identified during mustering as harbouring recalcitrant stock and feral cattle. The UCL in the south east of the LMA is expected to be a focal area for culling operations.

6.5.4 Expected benefits to northern quoll and Pilbara olive python

The removal of cattle will significantly reduce introduced herbivore impacts on northern quoll and Pilbara olive python habitat across the LMA. In particular, the action is expected to lead to an improvement in the condition of riparian ecosystems including permanent and ephemeral pools that provide important habitat to a range of biota including northern quoll and Pilbara olive python.

6.5.5 Implementation and Reporting

Aerial culling will be undertaken by DAFWA in consultation with the Pilbara RBG. A cull will be undertaken, subject to approval of the TSOP and if observations during mustering activities and baseline monitoring confirm it necessary. Monitoring may indicate the need for subsequent culls during the life of the TSOP.

The results of any culling undertaken will be made available to the DotE and OEPA as part of annual compliance reporting for the TSOP.

7 FIRE MANAGEMENT

7.1 MANAGEMENT GOAL

To monitor and, where necessary, manage fire in the LMA in a manner that maintains or enhances its current relatively benign impacts on northern quolls, Pilbara olive pythons and their habitats.

7.2 EXISTING MANAGEMENT WITHIN THE LAND MANAGEMENT AREA

Fire is currently managed on Yarraloola Station on an ad hoc basis in response to wildfires which represent an immediate threat to stock, pasture or station infrastructure. In such cases, back-burning against the advancing fire front is the primary means of fire control. Parts of Yarraloola Station within the LMA that are dominated by soft spinifex (e.g. Sherlock and Urandy land systems) are also likely to be burned occasionally by station staff to promote regrowth for grazing. Anecdotally, pastoralists to the east (Yalleen Station) and south (Red Hill Station) manage fire in a similar manner – i.e. burning to protect assets and to improve pasture productivity.

Fire and grazing management interact and therefore any future changes to the management of stock and other introduced herbivores across the LMA (in particular the areas covered by Yarraloola Station) may alter the fire regimes from those currently established.

Parks and Wildlife are responsible for management of fire preparedness in UCL to the east and north of the LMA although responsibility for fire suppression on these lands remains with local government (i.e. Shire of Ashburton) (DEC 2008). However, in practice, there is currently no reactive or proactive fire management by either Parks and Wildlife or the Shire of Ashburton within these areas.

Mining operations in the Robe Valley have measures in place to prevent, contain and control the outbreak of fire caused by operations, and firebreaks are maintained around key infrastructure to reduce the risk of fire impacting operations. However, the operational mine sites do not actively manage wildfire in the landscape surrounding the mines (i.e. beyond mining infrastructure).

The LMA contains several areas held by other mining organisations either under mining, exploration or other related tenure. Tenure holders are assumed to manage fire in a similar way to that described above for Rio Tinto-managed operations and infrastructure.

7.3 ACTION 5 – MONITORING OF FIRE REGIME OF LAND MANAGEMENT AREA

7.3.1 Management Objective

To monitor the frequency and extent of fire within the LMA and, if necessary, to undertake measures which reduce the risk of fire disproportionally affecting northern quoll and Pilbara olive python habitat within the LMA

7.3.2 Background

Appropriate fire regimes are critical for the successful management of vegetation communities and the habitat they provide to fauna. Inappropriate fire regimes are likely to be a significant threat to the northern quoll in the Pilbara, through consequential changes in habitat structure and composition (McKenzie *et al*. 2007). Fire may affect northern quoll through a reduction in ground cover and other shelter, hence exposing them to greater risk of predation and too-frequent burning may reduce the abundance of food if there is insufficient time to allow prey species to complete

their life cycles (Oakwood 2000; Hill and Ward 2010). There is little empirical information regarding the impacts of fire regimes on Pilbara olive python however large hot burns and/or too frequent burns may increase the likelihood of predation of juvenile pythons due to a reduction in ground cover and may impact mature pythons indirectly through a reduction in prey availability.

A recent fire history of the LMA covering the period 1999 – 2014 has been compiled using data obtained under licence from Parks and Wildlife in September 2014. These data provide an insight into the extent and frequency of fires within the LMA and demonstrate there is generally a relatively low frequency of fire (majority of vegetation unburned or burned once in the period 1999 -2014), a good spread of fire ages within vegetation complexes and within fire regime groups (refer Appendix 4) and a relatively high proportion (approximately 30%) of the LMA unburned since 1999.

Moreover, the fire history data suggest the majority of fires occur in the wet season; implicating lightning as a major cause of ignition and indicating most fires occur outside the breeding season of both northern quoll and Pilbara olive python (a time when both species may be more vulnerable to disturbance caused by fire).

Taken together these findings suggest there is likely to be little benefit to northern quolls or Pilbara olive python from changing the fire management within the LMA; rather the most cost-effective management approach is to continue monitoring and characterisation of the existing fire regime.

7.3.3 Method

Fire monitoring across the LMA will utilise a combination of desktop-based GIS analysis of remotely sensed data and field monitoring methods. These methods are described in Section 11 and Table 11-3.

Monitoring of fire-related parameters planned as part of the TSOP will build a high resolution picture of key fire history parameters across the LMA and will seek to elucidate the relative contribution of natural, accidental and prescribed ignition to the fire regime within the LMA (of critical importance in determining the required patterns of any future prescribed burning). Monitoring will facilitate the development of targeted management actions if monitoring demonstrates such actions are required.

Over time, it is anticipated that analysis of remotely sensed and ground-based monitoring data will provide a better understanding of the influence of fire on northern quoll and Pilbara olive python habitats and the populations they support.

If monitoring demonstrates a need, Rio Tinto will consult with relevant stakeholders to develop a Fire Management Plan (**FMP**) which, as far as practicable, and whilst taking into account potentially conflicting objectives of various stakeholders, will seek to apply the principles guiding Parks and Wildlife's fire planning in spinifex grasslands (Burrows and Butler 2011) and guidelines, policies and practices developed for use across the state (e.g. DEC 2008). A fire management objective expected to be shared by all stakeholders is the reduction in risk of a single wildfire affecting a large proportion of the LMA. This objective will form the core of any LMA FMP.

7.3.4 Expected benefits to northern quoll and Pilbara olive python

The fire management actions are expected to benefit northern and Pilbara olive python within the LMA by ensuring the relatively benign existing regime is maintained such that the risk of large, habitat homogenising fires occurring within the LMA remains low.

7.3.5 Implementation and Reporting

Annual monitoring of fire within the LMA will commence subject to and following approval of the TSOP.

The development and implementation of a FMP will be considered in Year 3 based on review of the following elements of the TSOP:

1. Outcomes of the Introduced Predator Control Program (Section 5).
2. Fire regime data gathered during previous monitoring (Section 11).
3. Land condition monitoring (including weed monitoring) results (Section 11).
4. Costs/benefits proposition for fire management given available resources and therefore its priority relative to other TSOP management actions.

A decision on whether the development and implementation of a LMA FMP is warranted will be made in close consultation with DotE and the OEPA and will draw on expert advice. Parks and Wildlife have previously noted the potential for active fire management to confound the results of the Survivorship Study and the introduced predator control program. Parks and Wildlife scientists will therefore be consulted prior to the imposition of fire management.

The FMP, if required, will be developed in consultation with relevant stakeholders including traditional owners, pastoral neighbours, regulatory agencies and natural resource management organisations.

The results of fire monitoring will be made available to the DotE and OEPA as part of annual compliance reporting for the TSOP. The need for development and implementation of a LMA FMP will be discussed with DotE and OEPA following the TSOP Year 2 annual reporting.

8 WEED MANAGEMENT

8.1 MANAGEMENT GOAL

To understand the diversity and distribution of weeds within the LMA and the potential implications for the management of northern quoll and Pilbara olive python habitat.

8.2 EXISTING MANAGEMENT WITHIN THE LAND MANAGEMENT AREA

Other than ad hoc surveillance for Parkinsonia (*Parkinsonia aculeata*) and Mesquite (*Prosopis* spp.) along the Robe River corridor, there are currently no weed control actions undertaken by Yarraloola Station management within the part of the station contained within the LMA.

Rio Tinto has developed a Weed Action Plan (**WAP**) covering the Mesa J, Mesa K and Pannawonica town sites and a WAP which covers all section of Rio Tinto rail including those within the LMA. Weed management under these WAPs focuses on the immediate surrounds of operational areas; and therefore little direct management extends to within the LMA.

Rio Tinto exploration tenements occur within the LMA and these are subject to the Iron Ore (WA) OCP 8: Weed Control Procedure (Rio Tinto 2013). Rio Tinto (2013) sets out weed prevention and control measures that seek to minimise the spread and establishment of weeds during exploration and other resource development activities.

Weeds such as buffel grass and birdwood grass (*Cenchrus* spp.) provide an important source of fodder for cattle within the LMA and consequently are intensively grazed. In this way, grazing by station stock, unmanaged and feral cattle potentially plays a role in limiting the cover and extent of some common weed species. A reduction in stock grazing pressure within parts of the LMA (as planned through application of management actions described in Section 5.5 above) may therefore lead to an increase in the overall biomass, foliage cover and/or extent of these weeds in some areas.

Conversely, the movement of cattle and vehicles across Yarraloola Station and other parts of the LMA represent important vectors for the spread of weeds, and, coupled with the disturbance to vegetation and soil such activities cause, may promote the establishment of novel weeds and new weed populations.

8.3 ACTION 6 – MONITORING OF WEEDS OF LAND MANAGEMENT AREA

8.3.1 Management Objective

To monitor the diversity and extent of weeds and, if necessary, undertake measures to minimise their impact on northern quoll and Pilbara olive python habitat within the LMA.

8.3.2 Background

A number of weed species are known to occur within the LMA, reflecting the historic and current land uses of the area (primarily pastoral and mining).

While baseline surveys are yet to be completed (to be undertaken Year 1 of the TSOP), a total of 29 introduced plant species have been recorded during past reconnaissance and systematic flora and vegetation surveys. Weeds commonly encountered include buffel grass (*Cenchrus ciliaris*), birdwood grass (*Cenchrus setiger*), Mexican poppy (*Argemone ochroleuca* subsp. *ochroleuca*), kapok bush (*Aerva javanica*), spiked malvastrum (*Malvastrum americanum*) and bipinnate beggartick (*Bidens bipinnata*). Kapok bush is most commonly observed on disturbed sites, particularly along infrastructure corridors such as rail lines and road and track verges. Other common weeds such as

buffel grass, birdwood grass and bipinnate beggartick are typically associated with vegetation along or adjacent to the Robe River.

The LMA is not known to contain any Weeds of National Significance (**WONS**) (as determined by Thorpe and Lynch (2000)), nor Declared Pest plants listed under the BAM (for the Shire of Ashburton).

The Advisory Panel has advised that weed control within the LMA would have little to no significant or detectable positive impact on northern quoll or Pilbara olive python over the duration of TSOP implementation. Based on this advice, and in recognition of the high priority placed on the management of introduced predators, weed management will focus on surveillance and monitoring of weeds within northern quoll and Pilbara olive python habitat of the LMA. The need for active weed control will be considered during the life of the TSOP on the basis of monitoring data.

8.3.3 Method

Weed monitoring effort will be prioritised towards northern quoll and Pilbara olive python habitat types generally understood to be at greater risk of weed invasion. Rugged rocky upland areas (e.g. Newman and Rocklea land systems) important to both species are generally considered resilient to weed invasion due to the skeletal, nutrient-poor soils and relative lack of disturbance. Conversely, riparian habitats (which are recognised as core habitat for both northern quoll and Pilbara olive python) typically support a range of weed species owing to the presence of relatively deep, nutrient rich soils, greater moisture availability and relatively higher levels of disturbance. Figure 8-1 provides an indicative outline of parts of the LMA within which weed monitoring will be prioritised.

Few of the recorded weed species are expected to adversely impact habitat quality of either northern quoll or Pilbara olive python. This may be because they do not typically inhabit the same areas as northern quoll or Pilbara olive python (e.g. Kapok bush *Aerva javanica*), occur sporadically and in small numbers, or do not significantly alter the structure of vegetation where they occur (e.g. Mexican poppy *Argemone ochroleuca*; Asthma plant *Euphorbia colona*). Therefore, weed monitoring effort will be further prioritised towards capturing abundance and distribution data on weed species that may impact the habitat quality of northern quoll and Pilbara olive python. Such species may include some exotic tussock grasses and other weeds that have the potential to significantly alter the structure and distribution of biomass within riparian habitats, or that may influence fire regimes.

Weed monitoring will be undertaken using methods described in Section 11.2.4 and Section 11.3.2 and further in Table 11-3.

The results of monitoring will be evaluated to determine whether active control is warranted in priority areas of northern quoll and Pilbara olive python habitat.

If active control is necessary, a WAP will be developed for the LMA in accordance with the Rio Tinto Weed Management Strategy. Development of the WAP will include the following activities:

- Delineation of Weed Management Areas (**WMAs**) within northern quoll and Pilbara olive python habitat based on the results of weed surveillance and monitoring.
- Assignment of management levels for weed species within each WMA based on the risk assessment procedure which takes into account the potential impact on northern quoll and Pilbara olive python habitat.
- Formulation of a management program that includes:
  - annual targets that progress towards management objectives;

- annual management and reporting actions;
- identified roles and responsibilities; and
- review and improvement procedures.

8.3.4 Expected benefits to northern quoll and Pilbara olive python

The weed management actions described will benefit the northern quoll and Pilbara olive python by minimising the degradation of important foraging habitats (e.g. riparian habitats) due to the establishment and proliferation of new or existing weeds. The weed management approach will also benefit northern quoll and Pilbara olive python by allowing the greater proportion of available resources to be invested in the control of introduced predators; currently a much greater threat to both species within the LMA than weeds.

8.3.5 Implementation and Reporting

Annual weed monitoring will commence subject to and following approval of the TSOP..

The development and implementation of a LMA WAP will be considered in Year 3 based on review of the following TSOP elements:

1. Outcomes of the Introduced Predator Control Program.
2. Weed monitoring data gathered during previous monitoring.
3. Costs/benefits proposition for weed control given available resources and therefore its priority relative to other TSOP management actions.

A decision on whether the development and implementation of a LMA WAP is warranted will be made in close consultation with DotE and OEPA and will draw on expert advice. If required, the development of the WAP will be integrated with existing weed control measures currently in place at Rio Tinto mining and exploration sites and across Rio Tinto held pastoral leases within and adjoining the LMA.

The results of weed monitoring will be made available to the DotE and OEPA as part of annual compliance reporting for the TSOP.

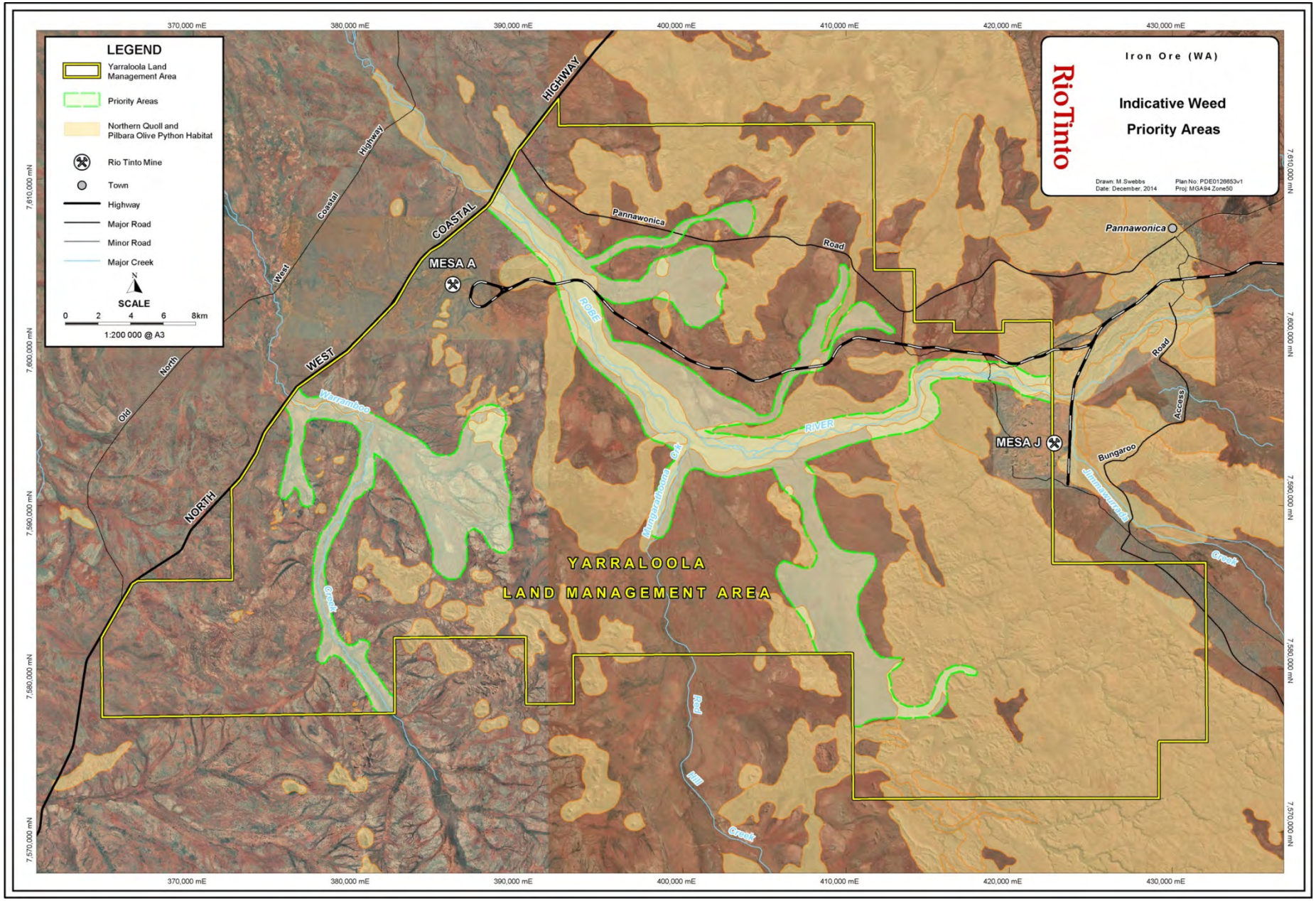


Figure 8-1: Indicative weed priority areas

9 TSOP MANAGEMENT ACTIONS

Table 9-1: Consolidated Management Actions

#	Action	Location	Methodology	Timing	Frequency	Effort/Intensity	Responsibility
1	Northern Quoll Eradicat® Cat Bait Uptake And Survivorship Study	The Baited Site (approximately 20,000 ha) on Yarraloola Station. The Control Site will include an existing Parks and Wildlife northern quoll regional monitoring site on Red Hill Station.	Radio tracking (ground and aerial) radio collared northern quolls up to 4-6 weeks before cat baiting and up to 8 weeks post cat baiting. Remote camera detection before and after cat baiting. Further details as per the Science Project Plan (see Appendix 5).	March to October	2015 (proposed Year 1)	Appendix 6 details the management effort to be applied during the delivery of the Survivorship study.	Parks and Wildlife under contract to Rio Tinto
2	Introduced Predator Control Program	Within the LMA. The baited site (~ 100,000ha) will be determined once the required exclusion zones have been taken into account. The baited site covers the majority of core northern quoll and Pilbara olive python habitat within the LMA.	Prior to baiting, a "1080 Baiting Application and Risk Assessment" will be completed, and stakeholder engagement will be undertaken. Baiting will be conducted mid-winter using standard Parks and Wildlife methods.	April to October	Annually Year 2 – Year 5.	Appendix 6 details the introduced predator control management effort to be applied within the LMA.	Parks and Wildlife under contract to Rio Tinto
3	Muster to remove feral cattle across the LMA.	LMA with focus on areas of greater pasture potential (River, Cane, Stuart, Boolgeeda, Urandy, Sherlock, Peedamulla and Mallina land systems), proximal to surface water and/ or offering protection and shade (e.g. narrow drainages and gorges of Newman, Rocklea and Nanutarra land systems).	Helicopter supported by a ground-based team using vehicles (buggy and motorcycle). Cattle will be mustered to existing paddocks and yards or to temporary yards within Yarraloola Station depending on the location and infrastructure available.	June – November (or otherwise as determined by Station manager)	Annually[3].	Each year, up to 2 days of additional mustering (i.e. additional to that required to meet Station management requirements) will occur using a helicopter and ground-based team(s) of up to 4 people.	Rio Tinto
4	Cull of feral cattle and other introduced large herbivores (horse, donkey, camel)	Aerial culling will focus on areas identified during mustering as harbouring feral herbivores. Focus areas for aerial culling will be mapped and identified in consultation with the contracted service provider.	Aerial shooting from helicopter using appropriately qualified and experienced shooter and helicopter pilot and observing all relevant guidelines and policies to ensure the humane treatment of all animals.	Following completion of mustering activities.	Annually, as required.	The required culling effort will be determined based on the results of mustering and monitoring described in Section 11.	Rio Tinto
5	Monitor the LMA fire regime	Fire monitoring will be undertaken across the entire LMA. If required, a Fire Management Plan would be developed which will define specific fire management zones in which active fire management (e.g. prescribed burning) would occur.	Fire monitoring will be undertaken using methodologies described in Section 11.2.3 and Table 11-3	Desktop monitoring – end of year Field monitoring – end of dry season	Annually	Fire monitoring effort is described in Section 11.2.3 and Table 11-3. Active fire management effort (e.g. prescribed burns, etc.) will be determined on the basis of monitoring results and consultation with all relevant stakeholders.	Rio Tinto
6	Monitor weeds within the LMA.	Weed monitoring will be undertaken across the LMA with priority monitoring areas within and adjacent to riparian vegetation. If required, a Weed Action Plan would be developed that defines Weed Management Areas which weed control actions (e.g. cultural and chemical weed control) would be prioritised.	Weed monitoring will be undertaken using methodologies described in Section 11.2.4 and Table 11-3.	End of dry season (WRPs undertaken opportunistically and therefore may occur at any time.	Annually	Weed monitoring effort is described in Section 11.2.4 and Table 11-3. Active weed management effort (e.g. cultural and chemical weed control, etc.) will be determined on the basis of monitoring results and consultation with all relevant stakeholders.	Rio Tinto

[3] Unless introduced herbivore activity monitoring across the LMA indicates a muster would not be cost-efficient

10 CONSERVATION OF OTHER EPBC ACT LISTED THREATENED SPECIES

Three species listed as threatened under the EPBC Act have been recorded within the LMA (refer Section 4.5):

- Northern quoll (Endangered)
- Pilbara olive python (Vulnerable)
- Pilbara leaf-nosed bat (Vulnerable).

The TSOP has been developed specifically to benefit northern quoll and Pilbara olive python through the management of known or purported threats to both species in the Pilbara, namely: introduced predators and large herbivores, and inappropriate fire and weeds.

This section considers the extent to which these management actions are also sympathetic with the conservation of the Pilbara leaf-nosed bat. The occurrences of Pilbara leaf-nosed bat and its habitats within the LMA are detailed in Appendix 4. There are no known Pilbara leaf-nosed bat roosts within the LMA.

Introduced herbivores and inappropriate fire and weeds may have some minor detrimental impact to Pilbara leaf-nosed bat foraging habitat, however, the main threats to this species are related to loss and disturbance of known roost sites (DotE 2014b; Woinarski *et al.* 2014).

While the TSOP focuses on managing threats to northern quoll and Pilbara olive python, in developing the management actions, consideration was also given to:

a) Minimising the likelihood that management actions would generate negative impacts on other conservation significant taxa (including the Pilbara leaf-nosed bat) known or likely to occur within the LMA.

b) Where possible, ensuring management actions enhanced conservation outcomes of other conservation significant taxa (including the Pilbara leaf-nosed bat) known or likely to occur within the LMA.

10.1 INTRODUCED PREDATOR MANAGEMENT

Actions to control introduced predators (Section 5) are unlikely to have either a strong positive or negative impact on Pilbara leaf-nosed bat individuals or their habitats as introduced predators are not recognised as a significant threat to this species. Therefore a reduction in cat, fox and dog abundance would not be expected to provide any direct benefit. Further, as an insectivore, the Pilbara leaf-nosed bat is not at risk of directly or indirectly consuming 1080 poison.

Activities necessary to implement the introduced predator control program such as aerial delivery of baits, northern quoll radio-tracking, cage trapping and remote camera trapping are unlikely to adversely impact Pilbara leaf-nosed bat. None of these activities require personnel to enter caves and as such there is little likelihood of disturbing potential roosts.

If, during implementation of the TSOP, a Pilbara leaf-nosed bat roost site is identified, measures to restrict personnel access to the area will be developed to ensure disturbance is minimised.

10.2 INTRODUCED HERBIVORE MANAGEMENT

The Robe River is assumed to provide high quality foraging habitat for the Pilbara leaf-nosed bat and may be an important corridor for movement of this species. The Robe Rive is also a focal point for grazing by managed stock and stray and feral cattle. Management actions aimed at reducing introduced herbivore abundance within the LMA (Section 6) are expected to improve riparian vegetation condition and in so doing, may be expected to improve foraging and dispersal habitat of Pilbara leaf-nosed bat.

Mustering and culling activities will be undertaken during daylight hours and are not expected to adversely impact Pilbara leaf-nosed bat individuals. If, during implementation of the TSOP, a roost site is identified, measures to restrict personnel and helicopter access to the area surrounding the roost during mustering and culling will be considered to ensure potential impacts (though unlikely) are minimised.

10.3 FIRE MANAGEMENT

Whilst inappropriate fire regimes are not listed as a significant threat to Pilbara leaf-nosed bat (DotE 2014b; Woinarski *et al*. 2014) as fire is unlikely to impact roost sites (a critical resource for Pilbara leaf-nosed bats), frequent large and hot fires may reduce the quality of foraging habitat, particularly where they impact preferred habitats such as riparian woodland.

Based on analysis of the existing fire regime within the LMA, there appears to be little need for active fire management. Consequently, annual fire monitoring is proposed for the first two years of implementation of the TSOP. Evaluation of the need for active fire management (under a FMP) will be undertaken in Year 3.

If required, a FMP will be developed and will consider the capacity for prescribed burning and other management activities to impact the temporal and spatial habitat requirements of Pilbara leaf-nosed bat. Over the longer term, any fire management described in the FMP is expected to maintain or enhance foraging habitats of the Pilbara leaf-nosed bat by reducing the risk of large, habitat homogenising fires across the LMA.

10.4 WEED MANAGEMENT

Weeds are not listed as a significant threat to Pilbara leaf-nosed bat (DotE 2014b; Woinarski *et al*. 2014) but may be expected to reduce habitat quality, particularly where they significantly alter the vegetation structure of preferred foraging habitats such as riparian zones (e.g. Mesquite and Parkinsonia infestations).

Weed surveillance and monitoring within the LMA will benefit Pilbara leaf-nosed bat by reducing the likelihood that weeds such as Mesquite and Parkinsonia become established in riparian foraging habitats (currently both Mesquite and Parkinsonia are only known from reaches of the Robe River downstream of the LMA).

If surveillance and monitoring demonstrate a need to develop and implement a Weed Action Plan for the LMA, such a plan will consider the any potential adverse impacts of weed control on conservation significant taxa including Pilbara leaf-nosed bat. It is most unlikely that mechanical and/or chemical control of weeds, as prescribed under a Weed Action Plan, would have any adverse impacts on Pilbara leaf-nosed bats.

PART 3 - MONITORING PROGRAM

11 MONITORING

The Monitoring Plan (**the Plan**) has been designed to assess the effectiveness of management measures applied within the LMA. The Plan will allow HIY to determine whether identified performance indicators of the TSOP are being met and will drive an adaptive management approach to delivery of management actions within the LMA.

The Plan comprises two aspects to capture environmental change within different components of the landscape/ ecosystems:

1. **Threat monitoring** will inform management activities in the short term, consistent with an adaptive approach to threatening process management. The timing, frequency and spatial coverage of monitoring activities will vary depending on the threat being monitored.
2. **Ecological monitoring** will track changes in key fauna populations (and/or their surrogates) and the health of ecosystems they inhabit.

Table 11-3 consolidates all monitoring commitments of the TSOP and Table 11-4 presents a high-level monitoring schedule for the 5 year TSOP period.

11.1 BASELINE SURVEYS

Baseline surveys will be undertaken in 2015 (proposed Year 1 of the TSOP) using the monitoring methodologies described in the following sections (Table 11-1). Baseline surveys are specifically designed to provide information prior to the imposition of Offset management actions. Monitoring methods will be revised as necessary based on the results of baseline surveys. However, reconnaissance surveys undertaken by Rio Tinto and Parks and Wildlife in 2013 and 2014 are expected to have reduced the likelihood that significant revisions of the monitoring approach will be required following Year 1 baseline monitoring.

Table 11-1: Year 1 baseline monitoring within the Yarraloola Land Management Area.

Purpose	Data collection method	Year 1			
		Q1	Q2	Q3	Q4
Land condition (LC)	Vegetation transects				
	Photo reference points				
Northern quoll	Cage trapping				
	Remote camera grid				
Pilbara olive python	Rothschild's rock wallaby camera traps				
Introduced herbivore activity	Aerial observations (and LC monitoring as above)				
Introduced predators*	Remote camera grid				
Fire	Analysis of fire scar spatial data				
Weeds	Weed Record Points (WRPs)	Opportunistic			

*Monitoring of introduced predators will be based on 'within-year' measures of pre and post-baiting relative abundance rather than 'between-year' changes. Therefore, baseline introduced predator monitoring is not required in Year 1 (2015). Introduced predator monitoring will commence in Year 2 and be undertaken annually thereafter (see Table 11-4).

11.2 THREAT MONITORING

11.2.1 Introduced Predators

Monitoring the abundance of feral cats is difficult because they usually occur at low densities, have large home ranges and tend to be secretive and cryptic (Long and Zielinski 2008). In situations where individual animals can be identified from photographs (e.g. through natural variations in pelage colours or markings), use of remotely deployed automatic cameras set in arrays have been used to provide more robust estimates of abundance (Bengsen *et al*. 2011). However, individual feral cats cannot always be easily distinguished.

Feral cats (and dogs and foxes) will be monitored each year before and after baiting using a standard methodology now routinely applied by Parks and Wildlife (e.g. Fortescue Marsh cat baiting), based on a grid of approximately 3 km spaced remote motion-sensitive cameras (remote cameras). One remote camera grid (7 x 7 cameras) will be established in the LMA and will be contained entirely within the operational baiting envelope. A second remote camera grid (7 x 7 cameras) will be established in a control (unbaited) site. Within each grid, presence/absence data for feral cats, dogs and foxes will be recorded before and after *Eradicat®* baiting events. Presence/absence data will be used to derive occupancy estimates for each introduced predator species.

Data from introduced predator monitoring will be used to test the hypothesis that:

- *There will be a significant reduction in the abundance of feral cats after use of Eradicat® baits in the baited area compared with the control site(s).*

Details of the approach to introduced predator monitoring are summarised in Table 11-3.

The approach to introduced predators monitoring will be reviewed and, if necessary adapted, in consultation with Parks and Wildlife and DotE following the results of the Survivorship Study. Changes to introduced predator monitoring may be necessary if results of the Survivorship Study necessitate changes to the proposed Introduced Predators Control Program (refer Section 5).

11.2.2 Introduced Herbivores

A simple method of measuring the effectiveness of introduced herbivore control within the LMA is to quantify the levels of disturbance over time (Corey *et al*. 2013). Therefore the effectiveness of introduced herbivore management actions will be determined by monitoring the following indicators of introduced herbivore activity within the LMA:

- Presence and estimated number of introduced herbivores observed.
- Presence/absence and/or frequency of dung.
- Presence/absence and/or frequency of tracks.
- Utilisation of palatable plant species.

As well as demonstrating the effectiveness of introduced herbivore management actions, this information will provide context to the results of ecological monitoring described in Section 11.3.

All indicators of introduced herbivore activity will be monitored at point-intercept transect sites while a subset of indicators (i.e. visual estimate of number of cattle sighted, estimated pasture utilisation, presence/absence of scats/tracks) will be captured at photo reference points.

Mustering flights will be used to gather information on the abundance and distribution of introduced herbivores opportunistically across the LMA. An estimate of the number and location of any introduced herbivores not captured during mustering (and culling) will be recorded.

Table 11-3 summarises the methods as well as the timing, frequency, scope and survey effort of introduced herbivore monitoring across the LMA.

11.2.3 Fire

Fire monitoring will be undertaken across the LMA using a combination of desk-top based remote sensing and GIS-based techniques together with field data collection methods.

Desk-top monitoring will include analysis of fire scar data derived from Landsat and/or Moderate Resolution Imaging Spectroradiometer (**MODIS**) imagery. Such data will be used to enhance the existing fire history dataset compiled for the LMA in 2014. Field-based monitoring will validate remotely sensed data, characterise fuel loads within vegetation complexes and track compositional and structural changes in vegetation in response to fire. Vegetation transects and photo reference points will be the primary means by which field-based fire parameters will be measured across the LMA.

All fire-related monitoring methods are summarised in Table 11-3.

11.2.4 Weeds

Weed monitoring will be undertaken across the LMA in order to track changes in the richness and extent of exotic plant species. Monitoring effort will be focused within habitats important for Pilbara olive python and northern quoll and known to be susceptible to weed establishment (e.g. riparian habitats). Weeds will be monitored as a component of the suite of land condition parameters assessed using the land condition monitoring methods described in Section 11.3.2. Photo reference points and point-intercept transects will be the primary methods used to monitor changes in weed diversity and cover/abundance over time.

Weed Record Points (**WRP**) will be completed opportunistically as a means of recording new weeds or new occurrences of weed species across the LMA. WRPs will consist of a 5 x 5 m quadrat within which the cover of all weed species will be recorded.

11.3 ECOLOGICAL MONITORING

Ecological monitoring will track trends in the condition of ecosystems (identified as vegetation complexes) within the LMA over time as well as provide specific information on the response of key species' populations to the implementation of the TSOP.

The methods used are quantitative and repeatable and, as far as practicable, will be deployed with sufficient effort to generate statistically robust outputs. Supporting data (e.g. meteorological parameters) will be recorded to assist the interpretation of observed changes.

Ecological monitoring will begin in 2015 (proposed Year 1 of the TSOP) as a baseline against which subsequent monitoring will be compared.

Monitoring will take place during all years of the TSOP (though not all monitoring activities will take place every year) and will conclude in Year 5.

11.3.1 Survivorship Study

Northern quoll monitoring is a significant component of the Survivorship Study. Monitoring will be based on cage trapping and VHF radio-tracking of northern quoll individuals at both Baited and Control sites before and after the deployment of *Eradicat®* baits (BACI experimental design). The monitoring methodology is described in detail in the Parks and Wildlife Science Project Plan (Appendix 6).

11.3.2 Land Condition

Land condition monitoring will be undertaken within the range of vegetation complexes mapped within the LMA. Sampling will include areas of habitats and vegetation units expected to respond strongly to changes associated with introduced herbivore management as well as areas expected to remain more stable over the management period of 5 years. Land condition is not expected to change measurably as a result of introduced predator control.

During 2015 (proposed Year 1) up to 3 sites will be established within each of the seven vegetation complexes mapped across the LMA. Replication will seek to account for finer-scale heterogeneity within each vegetation complex. The intensity and spatial distribution of land condition sites will be reviewed following completion of baseline surveys.

Land condition monitoring will be undertaken using two assessment methodologies: photo reference points (**PRP**); and vegetation transects. These have been designed hierarchically to collect land condition parameters in increasingly quantitative and systematic fashion and can either be undertaken independently (in the case of photo reference points) as a rapid assessment tool or nested to create a comprehensive land condition site (i.e. combined photo reference point and transect).

Site context data will be collected at all land condition monitoring sites. Parameters to be recorded will include:

- Site ID;
- date and time;
- hand-held GPS location (point location for PRP; start and end points of transects);
- observers (persons completing site survey);
- aspect and slope;
- landform pattern and element;
- distance from permanent water;
- soil colour and texture;
- fire (visual estimate of fire age, intensity and extent); and
- grazing impacts (visual estimate of number of cattle sighted, pasture utilisation, presence/absence of tracks and dung).

a) Photo Reference Points

PRPs will be used to capture a qualitatively visual record of changes in vegetation and habitat condition within the LMA. These will be established and permanently marked either as a stand-alone

PRP monitoring site or combined with transect monitoring as part of a comprehensive land condition site monitoring.

The location of each PRP will be marked using a galvanised steel fence-dropper and recorded using GPS. The date, time, observer and image numbers of each photograph will be recorded on a purposely designed field data sheet and later entered into the Rio Tinto GIS database.

PRPs are expected to provide a record of:

- Changes in vegetation structure (e.g. presence/absence of canopy species, shrubs, fringing aquatic macrophytes, tussock and hummock grasses) and biomass.
- Changes in presence/extent of surface water and general water status of vegetation (e.g. green growth/senescing/dead).
- Recent disturbance (e.g. fire, weed infestation, grazing and/or trampling by introduced herbivores, land clearing, erosion).

At each PRP a minimum of 5 images will be taken in the following directions:

- Downslope;
- Upslope;
- Across slope – right;
- Across slope – left; and
- Directly down (when facing downslope).

b) Point-intercept Vegetation Transects

Point-intercept vegetation transects will be established in each vegetation complex across the LMA as a means of quantitatively but rapidly assessing condition across the LMA. A subset of transects will be coincident with northern quoll/Rothschild rock-wallaby monitoring locations.

The precise configuration of point-intercept transects (length, number of point-intercepts, etc.) will be confirmed in 2015 prior to commencement of baseline surveys. Provisionally, a 50 m transect will be surveyed along which 100 points will be sampled (i.e. one point at each 50 cm increment proposed to be sampled along the transect). The species, growth form (Hnatiuk *et al*. 2009) and height of each vascular plant within the ground, mid and upper layer that intercepts each point will be recorded. The ground cover (litter, bare ground, coarse woody debris, biological soil crusts etc.) intercepting each point will also be recorded. Intercepts will be detected using a laser beam and densitometer mounted on a staff as per the AUSPLOT survey protocol (White *et al*. 2012).

Each transect will be established within a homogenous and representative area of a single vegetation complex with care taken not to cross any obvious ecotones. The start and end point of each transect will be marked using a galvanised steel fence-dropper and recorded using differential GPS. A PRP will be established at the start of each transect to provide a qualitative visual record of changes in condition.

Data generated by the point-intercept vegetation transects will be used to rapidly and quantitatively track changes in land condition parameters such as:

- Proportional cover of bare ground, biological soil crusts, leaf-litter and woody debris.
- Proportional cover of native and exotic perennial ground cover.

- Native and exotic shrub and canopy cover.

Data concerning exotic species gathered during transect monitoring will satisfy the requirements of invasive weed monitoring. Grazing activity and fire monitoring parameters will also be captured at each point-intercept vegetation transect.

Table 11-3 summarises each land condition monitoring method and the proposed timing, frequency and survey effort.

11.3.3 Northern Quoll

The northern quoll population within the LMA will be monitored to assess changes in relative abundance and spatial distribution/habitat usage of individuals during the course of the TSOP implementation. Northern quoll monitoring will be undertaken using two complementary methods:

- Cage trapping; and
- Remote camera trapping.

Cage trap monitoring will follow the methods of Dunlop *et al*. (2014) developed for the Parks and Wildlife Pilbara regional northern quoll monitoring program. This methodology employs small Sheffield type cage traps arranged in a transect formation within suitable northern quoll habitat.

Cage trap monitoring sites will be established at locations (provisionally 7 sites in total) within baited areas within the LMA in areas of suitable habitat identified on the basis of reconnaissance field surveys completed in 2013, 2014 and scheduled for 2015. Control sites (provisionally 3 sites in total) will be established outside the LMA (i.e. in unbaited treatments) also in suitable habitat identified following field reconnaissance.

Cage trap sites will be monitored once annually at approximately the same time each year (provisionally between July and September). A baseline monitoring phase will be completed in 2015 (proposed Year 1 of the TSOP) with the same sites then revisited each round of monitoring for the TSOP duration.

In addition to the cage trapping sites established specifically for the TSOP, northern quoll data from regional quoll monitoring sites managed by Parks and Wildlife (Dunlop *et al*. 2014) will be used as reference sites to aid in the interpretation of trends observed at impact and control sites.

Data from cage trap monitoring will be used to test the hypothesis that:

- *Land management actions (principally feral cat and other introduced predator control) within the LMA will result in an increase in the abundance of northern quolls within the LMA when compared with the control site and baseline (pre-baiting) values.*

A variety of physical parameters will be recorded from each trapped northern quoll individual including: sex, weight, age, pes (hindfoot), head length, pouch /testes development, number and size of pouch young, tail diameter and tissue sample. This information may be used to make inferences and test hypotheses relating to northern quoll survivorship and breeding demographics within the LMA and control sites and will contribute data to the overall regional northern quoll monitoring program being undertaken by Parks and Wildlife.

In addition to cage trap monitoring, northern quolls will be monitored at both the LMA and control sites using a closely spaced grid of remote cameras nested within the more widely spaced introduced predator monitoring camera grid.

Provisionally remote cameras will be spaced 1 km apart (c.f. 3 km for introduced predators) with 16 lured cameras used to cover an area of 900 ha.

Data obtained from the northern quoll remote camera grid monitoring will be used to test the hypothesis:

- *Land management actions (principally feral cat and other introduced predator control) within the LMA will result in an increase in the occurrence of northern quolls within lowland habitats of the LMA when compared with the control site and baseline (pre-baiting) values.*

Habitat biophysical attributes, photo points and indicators of recent disturbance history (e.g. recent fire, livestock impacts, etc.) will be recorded at all monitoring sites (i.e. cage trap sites and remote camera grids) as per Dunlop *et al*. (2014). This information will provide context to any observed changes in northern quoll abundance and habitat usage as well as contribute to the objectives of the regional northern quoll monitoring program.

Cage trapping and remote camera grids are expected to return records of a variety of non-target vertebrate species. As a minimum, non-target fauna will be identified to the lowest taxonomic group possible (it is often difficult to confidently identify some small mammal species and reptiles from remote camera images) and the location recorded. Other information (sex, age weight, etc.) may be recorded depending on resources available and the conservation status of the taxon in question.

Table 11-3 describes the methods in detail as well as the indicators of success, timing, frequency and accountability of the monitoring

11.3.4 Pilbara Olive Python

Monitoring of Pilbara olive python populations is inherently difficult because: their habitat requirements and usage is generally poorly understood; both juveniles and mature individuals exhibit cryptic behaviour within those habitats; and their population size is likely to be low. These difficulties are compounded by the safety and logistical difficulties of surveying a nocturnal species in the typically inhospitable and remote terrain of the Pilbara.

Techniques such as spot-lighting, road traverses ('road-running') and scat searches are commonly used in fauna inventory surveys and targeted surveys to return presence/absence information about snakes for environmental impact assessment, however, such techniques generally return very low 'capture' rates and are therefore unlikely to be cost-efficient or to yield statistically robust results when used in a monitoring context. To date there is no recognised broad scale technique that is capable of effectively monitoring Pilbara olive python abundance directly.

In recognition of the constraints to 'direct' monitoring, the TSOP monitoring program will monitor indicators of Pilbara olive python habitat quality rather than directly monitor Pilbara olive python abundance to determine the effectiveness of land management actions. Appropriate habitat quality indicators for Pilbara olive python within the LMA were identified during a workshop convened by Rio Tinto and attended by the Advisory Panel and subject experts from the Parks and Wildlife Science and Conservation Division. The indicators of Pilbara olive python habitat quality agreed during the workshop included:

- Relative abundance of Pilbara olive python prey species:
  - Northern quoll; and
  - Rothschild's rock wallaby.

- Condition of ground vegetation and especially fringing and emergent vegetation beside permanent and semi-permanent water bodies.

Female Pilbara olive pythons need larger sized prey to attain sexual maturity and to breed. Therefore the abundance of large prey items such as northern quoll and Rothschild's rock wallaby may be an appropriate indicator of Pilbara olive python habitat quality. Monitoring of northern quoll and Rothschild's rock-wallaby is tractable and much more likely to yield statistically robust information compared with direct monitoring of Pilbara olive pythons

Methods used to monitor northern quoll are summarised in section 11.3.3 and Table 11-3 and described by Morris and Thomas (2014). Monitoring of Rothschild's rock wallaby will use remote cameras at sites known to support this species. Remote camera captures of Rothschild's rock wallaby will be processed to yield a 'minimum number known to be alive' (**MNKTBA**) metric which can be compared over time to determine the trend in relative abundance in response to TSOP management actions.

Riparian vegetation, in particular permanent pools and associated fringing and emergent aquatic macrophytes, are important shelter and foraging habitats for juvenile pythons and important foraging habitat for adult pythons. The condition of riparian habitat will be monitored using a combination of photo reference points and point-intercept transects (see Section 11.3.2).

Monitoring described above will be undertaken within the LMA as well as within identified control sites outside the LMA. The relative change in monitored parameters (northern quoll relative abundance, Rothschild's rock wallaby MKTBA, and riparian vegetation habitat condition) among years will be compared between the LMA and control sites to determine the effectiveness of land management on Pilbara olive python habitat quality

Data from monitoring for Pilbara olive python will be used to test the prediction that:

- Land management actions (principally feral cat and other introduced predator control) within the LMA will result in a relative increase in the abundance of northern quolls within the LMA when compared with the control site and baseline (pre-baiting) values.
- Land management actions (principally feral cat and other introduced predator control) within the LMA will result in a relative increase in the abundance of Rothschild's rock wallaby within the LMA when compared with the control site and baseline (pre-baiting) values.
- Land management within the LMA will result in a relative improvement in riparian vegetation condition within the LMA when compared with control site and baseline values.

Opportunistic records of Pilbara olive pythons within the LMA and control sites will be collated and will support systematic monitoring described above. Other monitoring techniques such as radio-tracking of individual pythons may be considered during the TSOP to answer basic questions concerning the species' biology and ecology (e.g. habitat preferences, survivorship over time, etc.).

Table 11-3 describes the methods in detail as well as the indicators of success, timing, frequency and accountability of the monitoring.

11.4 MONITORING OF CLIMATIC VARIABLES

Rainfall, temperature and humidity data will be sourced from Rio Tinto-operated weather stations located at Mesa A mine (within the LMA), Mesa J mine (immediately east of the LMA) and in the Bungaroo Valley (approximately 13 km south east of the LMA). Yarraloola Station rainfall gauges will also provide local rainfall information.

Historic and ongoing climate data will be sourced from Bureau of Meteorology-managed weather stations surrounding the LMA. These weather stations may include: Yarraloola (BoM Station No. 005032); Yalleen (BoM Station No. 005029); Pannawonica (BoM Station No. 005069); Robe (BoM Station No. 005070); and Red Hill (BoM Station No. 005022).

11.5 PERFORMANCE INDICATORS TO DETERMINE MANAGEMENT EFFECTIVENESS

Performance indicators which will be used to determine the effectiveness of TSOP management actions are described in Table 11-2 below.

The sustained reduction in feral cat occupancy will be the key determinant of the effectiveness of introduced predator control within the LMA. The effectiveness of introduced herbivore management will be determined based on the reduction in feral cattle activity and increase in land condition within the LMA over the duration of the TSOP. The effectiveness of fire and weed management within the LMA will be determined based on the degree to which historic and baseline fire and weed conditions are maintained (and where possible, improved).

Table 11-2: Performance indicators to determine the effectiveness of land management actions undertaken within the Yarraloola Land Management Area

	Management Action	Performance Indicator
1	Northern Quoll *Eradicat*® Cat Bait Uptake And Survivorship Study	Completion of the Survivorship Study
		Risk to northern quoll posed by standard application of *Eradicat*® bait understood and used to define approach to broad-scale baiting of the LMA.
		Eradicat® is approved for broad scale use within the LMA
2	Introduced Predator Control Program	Feral cat baits delivered at the optimal time to maximise likelihood that feral cats will consume baits.
		Completion of introduced predator, northern quoll and Pilbara olive python monitoring.
		Significant and sustained reduction in feral cat occupancy (relative abundance) post-baiting within the baited cell relative to that of the unbaited control site.
3	Muster to remove feral cattle across the LMA.	Aerial muster completed annually across all areas of the LMA known or expected to support unmanaged and feral herbivores.
		A decreasing trend in feral herbivore activity relative to baseline values is observed over time during mustering flights within the LMA.
		An increasing trend in land condition is observed over time at sites located within areas of moderate to good pastoral potential.
4	Cull of feral cattle and other introduced large herbivores (horse, donkey, camel)	Aerial and/or ground-based cull completed within the LMA by qualified personnel.
		A decreasing trend in feral herbivore activity relative to baseline values is observed over time at monitoring sites located within areas of moderate to good pastoral potential.
		An increasing trend in land condition is observed over time at sites located within areas of moderate to good pastoral potential.

	Management Action	Performance Indicator
5	Monitor the LMA fire regime	Annual data analysis is completed each year and fire parameters do not show a substantial departure from historic/baseline values.
		A review of fire monitoring data is undertaken in Year 3 using Year 1 and Year 2 data to determine the need for a FMP.
6	Monitor weeds within the LMA.	Annual monitoring and data analysis is completed each year and cover/abundance of priority weed species does not substantially increase relative to baseline values such that northern quoll and Pilbara olive python habitat is threatened.
		WRPs are completed each year and new weed species or new weed occurrences that may impact northern quoll and Pilbara olive python habitat are identified.
		A review of weed monitoring data is undertaken in Year 3 using Year 1 and Year 2 data to determine the need for a WAP.

11.6 DATA MANAGEMENT AND ANALYSIS

Rio Tinto maintains a GIS database which houses all biological data generated by biological surveys and monitoring undertaken by the company. The maintenance of this database is supported by a series of Data Standards which guide the collection and correct storage of a range of biological data including those generated from desktop and field reconnaissance surveys, targeted threatened flora and fauna survey, systematic flora, vegetation and fauna surveys and biological monitoring programs.

All biotic and abiotic data captured during monitoring within the LMA will be geographically referenced (to the relevant monitoring site/location) and stored in the Rio Tinto GIS database. Specific datasets (e.g. vegetation structural and composition attributes, remote camera images) may additionally be stored in other stand-alone databases to facilitate data analysis, interpretation and reporting.

Threat and Ecological monitoring data will be analysed using a suite of visual and statistical techniques in order to describe and report on the effectiveness of management actions implemented as part of the TSOP. The precise techniques used will be determined following completion of the baseline monitoring phase in Year 1 of the TSOP.

Northern quoll monitoring during the TSOP implementation will follow the methodology described by Dunlop *et al*. (2014) and as such will contribute data to the Parks and Wildlife Pilbara northern quoll project. Complimentarily, data from the regional sites established as part of the Pilbara northern quoll project will support the analysis and interpretation of the results of TSOP northern quoll monitoring.

11.7 REPORTING AND REVIEW

On the advice of the Advisory Panel this TSOP prioritises resources and expenditure towards the delivery of a landscape-scale introduced predator control program. This prioritisation is reflected in the TSOP monitoring program. The monitoring program will therefore be reviewed and, if necessary, adapted, if the results of the Survivorship Study necessitate a substantive change in the approach to the introduced predator control program.

Rio Tinto will report on the results of monitoring as part of its annual compliance reporting requirements to the DotE and OEPA. The monitoring results will be available to the public once submitted to DotE and OEPA.

Species records collected during monitoring will be reported to Parks and Wildlife in compliance with flora and fauna collection licenses and permits and will become publically available via the NatureMap database administered by Parks and Wildlife.

Scientific publications will be prepared from time to time in collaboration with Parks and Wildlife Science and Conservation Division staff and other involved parties as appropriate.

The monitoring program will be reviewed annually and updated to reflect any changes in the management actions, monitoring methodologies or parameters monitored. Recalibration of the monitoring program described here is expected to be required during the life of the TSOP (with any such recalibration not being so extreme that it then renders that baseline no longer useful as a 'Before' component of the on-going monitoring plan).

Table 11-3: Consolidated Monitoring Actions

Purpose	Measured and derived monitoring parameters	Description	Timing	Frequency	Provisional scope and survey effort
Remote Camera Grid					
Introduced Predators[4]	Presence/absence of introduced predators at remote camera sites. Frequency of introduced predators at remote camera sites Occupancy of introduced feral cats, wild dogs, dog/dingo hybrids and foxes.	Grid of remote cameras (each with olfactory and visual lure) covering an area of approximately 32,000 ha. Cameras spaced ~2-3 km apart to provide for independence of cat records. One monitoring grid will be established within the Yarraloola LMA and a second within the unbaited control area.	Pre and post deployment of *Eradicat®* baits	Annual (beginning Year 2)	Each remote camera grid (baited and control sites) will contain 49 cameras operated over a period of approximately 20 days before and after bait deployment within the LMA. This equates to 1,960 remote camera nights annually over an approximate area of 32,000 ha of the baited LMA and control site.
Northern quoll Pilbara olive python	Habitat variables (as per Dunlop *et al*. 2014) Northern quoll presence/absence Northern quoll occupancy	Remote cameras nested within the introduced predator monitoring grid following Morris and Thomas (2014).	Before and after baiting (in concert with introduced predator monitoring	Annual (in concert with operation of introduced predator remote camera monitoring)	16 cameras, spaced 1 km apart and operated over a period of approximately 20 days before and after bait deployment within the LMA. This equates to 320 remote camera nights annually over an approximate area of 900 ha of the baited LMA and control site
Point-intercept vegetation transect					
Introduced herbivore activity Land Condition	**Community composition and structure:** • Native/exotic canopy and mid-storey cover • Native/exotic ground stratum cover by growth form • Proportional cover of increaser and decreaser species. **Habitat and ecosystem function parameters:** • Leaf litter cover • Bare ground cover • Coarse woody debris cover • Rock cover **Disturbance parameters** • Frequency (no. of point intercepts) of cattle dung • Frequency (no. of point intercepts) of cattle tracks • No. plant point-intercepts grazed and extent of utilization	Permanently marked transect. Records of plant species and growth form as well as ground cover (litter, rock, bare ground, etc.) directly intercepting points at pre-determined intervals along transect. Plant utilisation by grazers estimated by comparison with standard photographs. Point-intercepts of dung, tracks and grazed vegetation will be recorded at each point along the transect. Where a grazed plant intercepts a point, the percentage utilization will be scored	End dry season.	Annual	Up to 3 transects in each vegetation complex of the LMA. One point-intercept transect will be established at each northern quoll monitoring site. Transects will be of uniform length with point-intercepts recorded at regular intervals along each transect. Transects will be positioned in areas representative of each vegetation complex.

[4] The approach to introduced predators monitoring will be reviewed and, if necessary adapted, in consultation with Parks and Wildlife and DotE following the results of the Survivorship Study. Changes to introduced predator monitoring may be necessary if results of the Survivorship Study necessitate changes to the proposed Introduced Predators Control Program (refer Section 5).

Purpose	Measured and derived monitoring parameters	Description	Timing	Frequency	Provisional scope and survey effort
Photo reference points					
Introduced herbivore activity Wildfire and Land Condition Pilbara Olive Python	**Community composition and structure:** • Presence/absence of vegetation strata • Presence/absence and relative cover of growth forms • Relative cover of conspicuous weed species • Riparian vegetation structure and composition **Moisture conditions:** • Presence/absence and relative extent of surface water of permanent or ephemeral pools • Vegetation greenness/vigour • Site surface water status **Biomass:** • Visual estimate of fuel load **Disturbance parameters:** • Visual estimate (score) of fire age, extent and intensity • Visual record of active erosion • Visual assessment of grazing impacts (no. of introduced herbivore individuals observed, presence/absence of tracks, presence/absence of dung, visual estimate of grass utilisation)	5 images will be taken at each photo reference point using a digital camera. One image will be taken at each of the following directions • Downslope • Upslope • Across slope – right • Across slope – left • Directly down (when facing downslope) Visual estimate of fire age, extent and intensity. Fuel load estimate following FESA Visual Fuel Load Guide for the Pilbara Region (FESA 2009) Grass utilisation by grazers estimated by comparison with standard photographs.	End of dry season	Annual	Up to 3 PRPs will be established in each vegetation complex of the LMA. Photo reference points established at major permanent pools of the Robe River (subject to Traditional Owner approval) including: Yeera Bluff, Martangkuna, Japanese Pool, Robe Pool, Wooroo Pool and one unnamed pool. One PRP will be established at each northern quoll monitoring site. Five images will be recorded at each PRP. Control sites established at permanent pools on the Robe River outside the LMA. Pools may include (subject to Traditional Owner approval): Pannawonica Hill Pool, Yarramudda and Medawandy.
Observation from mustering aircraft					
Introduced herbivore activity	Estimate of no. of introduced herbivore individuals Distribution of introduced herbivores within the LMA	Estimates of the number of cattle in the LMA observed during mustering flights will be recorded at the completion of each mustering flight. An indicative location of any observed un-mustered introduced herbivores will be recorded after each mustering flight	Dry season	When mustering occurs	As dictated by mustering requirements.
Analysis of fire scar spatial data					
Fire	Location and extent of unplanned burns Burn patch size Proportion of LMA burnt Total area and proportion of seral states Distribution of seral states Season of burn	Interrogation of available remotely sensed (Landsat/MODIS/AVHRR) spatial fire scar data	End of each calendar year	Annual	Analysis of spatial data across the entire LMA
Weed Record Points (WRPs)					
Weeds	Weed cover/abundance Weed species richness Total cover of each stratum of vegetation.	A temporary 5 x 5 m square quadrat within which the cover abundance of each weed species present is visually estimated and recorded. Total cover of vegetation in each stratum also recorded. Quadrat corners recorded using a hand-held GPS.	Opportunistic throughout the year (but mostly coincident with land condition monitoring).	Opportunistic	Opportunistic therefore scope and survey effort will vary among years.

Purpose	Measured and derived monitoring parameters	Description	Timing	Frequency	Provisional scope and survey effort
Cage trapping					
Northern quoll Pilbara olive python	Northern quoll relative abundance Morphometrics and reproductive status: • body weight • pes (hindfoot) • head length • age class • sex • reproductive condition.	Cage trap monitoring will follow Dunlop *et al*. (2014).	Dry season (provisionally July – September)	Annual	LMA: up to 7 sites of 50 cage traps (two transects of 25 traps) open for 4 nights equates to 1,400 trap nights annually within the LMA. Control area(s): 3 sites of 50 cage traps (two transects of 25 traps) open for 4 nights equates to 600 trap nights annually within control site(s).
Rothschild's rock-wallaby remote camera trapping					
Pilbara olive python	Rothschild's rock-wallaby relative abundance (expressed as minimum number known to be alive)	Synchronised photos at set intervals before and after sunrise/sunset from remote cameras deployed at known resting and sunning spots.	Dry season (provisionally July – September)	Annual	Several cameras at each northern quoll cage trap monitoring site (or other sites as determined by Parks and Wildlife Research Scientist) in the LMA and control site(s). All remote cameras synchronized to record an image every 10 minutes with at least 10 image events before and after sunset and sunrise.

Table 11-4: Monitoring Schedule

Purpose	Data collection method	Year 1				Year 2				Year 3				Year 4				Year 5			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Land condition (LC)	Vegetation transects																				
	Photo reference point																				
Northern quoll	Cage trapping																				
	Remote camera grid																				
Pilbara olive python	Northern quoll cage trapping																				
	Rothschild's rock wallaby camera traps																				
	Permanent pool photo reference points																				
Introduced herbivore activity	Vegetation transects																				
	Photo reference points																				
	Aerial observations																				
Introduced predators	Remote camera grid operation																				
Fire	Analysis of fire scar spatial data																				
	Photo reference point																				
Weeds	Weed Record Points (WRPs)	Opportunistic																			
	Vegetation transect																				
	Photo reference points																				

12 RISKS AND UNCERTAINTIES

This TSOP has been designed using the best available information and in collaboration and consultation with prominent national and Western Australian conservation science experts. Nevertheless, there are a number of risks and uncertainties inherent to the Pilbara bioregion generally, the LMA specifically, and to the suite of management and monitoring methodologies proposed.

The key risks and uncertainties associated with the TSOP are discussed below. Where possible, measures have been included in the TSOP to mitigate these risks and uncertainties. Such measures are also outlined.

12.1 LAND TENURE

Security of land tenure is an inherent risk across the Pilbara generally. The lack of secure tenure presents a risk in terms of offset management, as areas of core habitat for important species such as the northern quoll and Pilbara olive python may coincide with economic iron ore reserves.

The LMA contains known recoverable iron ore resources held by Rio Tinto Group companies as well as several 3rd party mining proponents and the offset program cannot restrict the development of these resources or the exploration and evaluation of potential future resources. The scale and timing of such development activities within the LMA is not necessarily predictable, but any such evaluation and development activity will affect only a very small proportion of the LMA over the timeframe of the TSOP.

The choice of a LMA attempts to minimise the overall impact of future mineral exploration and development within the LMA. The primary action to mitigate this risk was the selection of an LMA that contains a large area of known and potential northern quoll and Pilbara olive python habitat relative to the area of habitat impacted by the Yandicoogina Project. The LMA covers more than 163,000 ha and contains approximately 66,000 ha of known or potential northern quoll and Pilbara olive python habitat (based on interpretation of land system mapping). By contrast, an estimated 2,200 ha of potential habitat may be impacted by the Project.

The location of the LMA also attempts to account for the likely spatial and temporal arrangement of future mining-related developments as well as other relevant biological and landscape factors (see Section 4.8).

12.2 ONGOING PASTORAL MANAGEMENT

Most (c. 80%) of the LMA is situated within Yarraloola Station. The TSOP outlines provisions for the management of feral herbivores within the LMA, including the area of Yarraloola Station, and assumes a continuation of the same or similar (low) grazing intensity from managed stock within the LMA as has been applied in recent years. Future grazing intensity within the LMA is, however, uncertain as managed stock numbers may increase or decrease over the life of the TSOP based on pastoral management objectives.

Station infrastructure within the LMA, most notably functioning artificial watering points, will be retained for the duration of the TSOP to support existing pastoral production. As is presently the case, such infrastructure will likely continue to support the presence of feral cattle over the TSOP timeframe. This has been taken in to account when designing actions to manage feral cattle (i.e. annual mustering and periodic culling) within the LMA.

12.3 EFFICACY OF MANAGEMENT ACTIONS

Although there is now well-established evidence (including from the Pilbara region) that predator baiting, using the protocols proposed in this TSOP, results in substantial reduction in feral predator numbers, there is less direct empirical data that such actions will benefit northern quolls and Pilbara olive pythons. Therefore there is some uncertainty as to whether the delivery of the management actions will result in a significant benefit to either species. Indeed, it is possible that the predator control action may have a detrimental impact on the northern quoll. This risk is explicitly considered in this TSOP through the implementation of a carefully designed Survivorship Study undertaken in collaboration with Parks and Wildlife Science and Conservation Division. This Survivorship Study will occur before any broader-scale implementation of the predator control program, and results of the trial will determine whether that implementation proceeds, needs to be modified, or will be abandoned.

Uncertainty about the extent of benefit of imposed management actions has been mitigated as far as possible by basing the design of actions upon best available information from the literature and expert opinion gathered through the Advisory Panel and in collaboration with Parks and Wildlife Science and Conservation Division. The uncertainty is further mitigated by embedding the management actions within a BACI experimental design and substantial ongoing monitoring which will maximise the potential for demonstrating a benefit to northern quolls and Pilbara olive pythons and for informing similar activities in the future.

12.4 EFFICACY OF MONITORING

Northern quoll and Pilbara olive python populations are difficult to monitor because individuals can be highly cryptic (for the Pilbara olive python), occur at very low densities even within suitable habitat (for both species), and/or because population size can vary widely (for northern quoll in response to climatic variation and the die-off of most males post breeding). As such, there is a risk that benefits generated by management actions within the LMA may not be statistically demonstrable in the time-frame of the TSOP. A relatively 'slow' life history for the Pilbara olive python may also make it difficult to demonstrate population increase over the time period of the TSOP.

For Pilbara olive python, this risk of failing to detect change in population size is mitigated by monitoring a range of indicators of Pilbara olive python habitat quality (see Section 11.3.4) rather than attempting to directly monitor individuals.

For northern quoll, the risk is mitigated by: the completion of targeted surveys prior to the TSOP implementation (i.e. 2013 and 2014) to identify areas likely to support reliable numbers of individuals; by the inclusion of nearby existing regional northern quoll monitoring sites as control sites; and by ensuring monitoring is undertaken at the same time(s) each year.

The expert opinion of the Advisory Panel, Parks and Wildlife scientists and Rio Tinto staff has been employed to devise a pragmatic monitoring program that strikes a balance between logistical and budgetary constraints and statistical rigour so as to maximise the likelihood of drawing robust conclusions from TSOP implementation.

12.5 EXTERNAL (STOCHASTIC) FACTORS

There is a risk that uncontrollable stochastic factors will mask, erode or negate the impact of some of the management activities on northern quolls and Pilbara olive pythons. The potential external factors of most significance comprise prolonged drought conditions (i.e. several years of below

average rainfall) and extensive wildfire (precipitated by one or more years of above average rainfall) occurring within the TSOP implementation period.

This risk is mitigated by undertaking baseline monitoring, undertaking the actions over at least five years and, as far as practicable, widely distributing impact and control monitoring sites so as to reduce the overall impact of a single major wildfire and provide the context of broader regional population trends. Moreover, fuel loads will be monitored for the duration of the TSOP and implementation of a fire management plan will be considered if monitoring indicates a significant risk of extensive fire. Rainfall and other climatic variables will be monitored (Section 11.4) and included as factors when evaluating management outcomes.

There is also a risk that significant rainfall or other external factors (e.g. wildfire) may restrict or prevent the delivery of management actions within the LMA. In such cases the actions will be postponed until such time as they can be implemented safely, efficiently and in a scientifically appropriate manner. Unavoidable delays and actions to mitigate their impact on the TSOP will be captured in annual reporting.

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14 APPENDICES

Appendix 1: Correspondence from the WA EPA regarding Management of Offset Funds

Appendix 2 Rio Tinto Biodiversity Offset Advisory Panel

Appendix 3 Shapefiles of the Yarraloola Land Management Area

Appendix 4: Biophysical Characteristics of the Land Management Area

Appendix 5 Rationale for Selection of the Land Management Area

Appendix 6: Northern Quoll Bait Uptake and Survivorship Study Science Project Plan

Appendix 7: Operational Introduced Predator Control Program