Start Page

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Olive Downs Coking Coal Project

Draft Environmental Impact Statement

Section 5

Rehabilitation Strategy

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

5 REHABILITATION STRATEGY

This section describes the rehabilitation strategy for the Project.

Pembroke has considered relevant guidelines, current best practice approaches and legislative requirements during the development of the Project rehabilitation strategy. This included consideration of the following:

- *Mined Land Rehabilitation Policy* (DES, 2018).
- *Application requirements for activities with impacts to land* (DEHP, 2017f).
- *Rehabilitation Requirements for Mining Resources Activities Guideline* (DEHP, 2014).
- *EIS information guideline – Land* (DEHP, 2016d).
- *EIS information guideline – Rehabilitation* (DEHP, 2016e).
- *Planning for Integrated Mine Closure: Toolkit* (International Council on Mining and Metals, 2008).
- *Strategic Framework for Mine Closure* (Australian and New Zealand Minerals and Energy Council and the Minerals Council of Australia, 2000).
- *Leading Practice Sustainable Development Program for the Mining Industry: Mine Rehabilitation* (Commonwealth Department of Industry, Innovation and Science, 2016a).
- *Leading Practice Sustainable Development Program for the Mining Industry: Mine Closure* (Commonwealth Department of Industry, Innovation and Science, 2016b).

The objective of the *Mined Land Rehabilitation Policy* (DES, 2018) is for land disturbed by mining activities to be rehabilitated to a safe and stable landform that does not cause environmental harm and is able to sustain a post-mining land use which has been approved through a 'Progressive Rehabilitation and Closure Plan' (PRC Plan).

Further, it states that voids situated wholly or partially in a floodplain are to be rehabilitated to a safe and stable landform that is able to sustain an approved post-mining land use that does not cause environmental harm.

It is noted that, at the time of preparation of this EIS, a PRC Plan is not a requirement of the *Environment Protection Act 1994*, the *State Development and Public Works Organisation Act 1971* or the *Mineral Resources Act 1989*. It is understood that it is proposed to be introduced as part of the *Mineral and Energy Resources (Financial Provisioning) Bill 2018*. This Bill is not expected to be legislated until late 2018. Similarly, key terms (e.g. 'post-mining land use', 'floodplain') used in the *Mined Land Rehabilitation Policy* have not yet been defined.

Notwithstanding, Pembroke has developed the Project in consideration of the *Mined Land Rehabilitation Policy*. In particular, the Project has been designed to:

- Be rehabilitated to a safe and stable landform:
  - Waste rock emplacements have been designed with shallow slopes (7 degrees) that would be revegetated to enhance erosion protection (Section 5.2.2).
  - Waste rock emplacements have been located, or set back, an adequate distance from open cut pits to avoid potential interactions with them (Section 5.2.4).
  - Final voids highwalls would be fenced to prevent access and designed to remain stable in the long term, based on site specific geological data and geotechnical modelling (Section 5.2.3).
- Not cause environmental harm:
  - Permanent waste rock emplacements would surround the final voids and isolate them from all flood events, up to and including a PMF event (Section 5.2.3).
  - Final landforms have been designed to minimise changes to flood characteristics (Section 4.4).
  - Final voids would act as groundwater sinks into perpetuity, preventing the migration of potentially saline pit water into adjacent aquifers and watercourses (Section 5.2.3).
  - Final void water bodies would equilibrate well below the point at which they would spill to the surrounding environment (Section 5.2.3).

- Sustain post-mining land uses:
  - Mine scheduling has maximised opportunities for progressive backfilling of open cut pits to improve final land use outcomes. Significant volumes of overburden material are proposed to be hauled large distances to completely backfill the majority of the open cut pits (Section 5.2.3).
  - the areas proposed to be disturbed by the Project would be rehabilitated to sustain low intensity cattle grazing and native fauna habitat. The final voids would provide habitat for native fauna, and the water bodies would act as groundwater sinks into perpetuity (Section 5.2.1).

As described above, it is acknowledged that the *Mineral and Energy Resources (Financial Provisioning) Bill 2018* proposes a requirement for the development of a PRC Plan for mining operations operating under site-specific Environmental Authorities.

The *Mineral and Energy Resources (Financial Provisioning) Bill 2018* describes that the purpose of the PRC Plan is to:

- plan for how and where environmentally relevant activities will be carried out on land in a way that maximises the progressive rehabilitation of the land to a stable condition; and
- provide for the condition to which the holder must rehabilitate the land before the authority may be surrendered.

The Project rehabilitation strategy has been prepared in consideration of this purpose, however, the final legislation and, importantly, the associated guidance material, was not available during preparation of this EIS to inform the preparation of a PRC Plan. Notwithstanding, Pembroke will comply with the legislation upon enactment, and if required, prepare a PRC Plan for the Project.

5.1 REHABILITATION REQUIREMENTS

The Project would be progressively rehabilitated to achieve the rehabilitation objectives established for each domain. The progress of the rehabilitation would be monitored against indicators, and ultimately against completion criteria to demonstrate successful rehabilitation of the Project.

The rehabilitation goal, domains, objectives, indicators/performance criteria and completion criteria for the Project are described herein.

5.1.1 Rehabilitation Goal

The rehabilitation goal for the Project is consistent with the Queensland Government's goals, as developed from the ecologically sustainable development objective of the EP Act. The rehabilitation goal for the Project requires rehabilitation of areas disturbed by mining to create a post-mining landform that is:

- safe;
- non-polluting;
- stable; and
- able to sustain a post-mining land use.

5.1.2 Rehabilitation Domains

The Project can be divided into a number of domains with similar geophysical characteristics. Individual domains contain elements that require different rehabilitation techniques, and therefore each domain will have specific rehabilitation objectives, performance criteria and completion criteria (Sections 5.1.3 to 5.1.5) to achieve the rehabilitation goals.

Project rehabilitation domains are shown on Figure 5-1 and include:

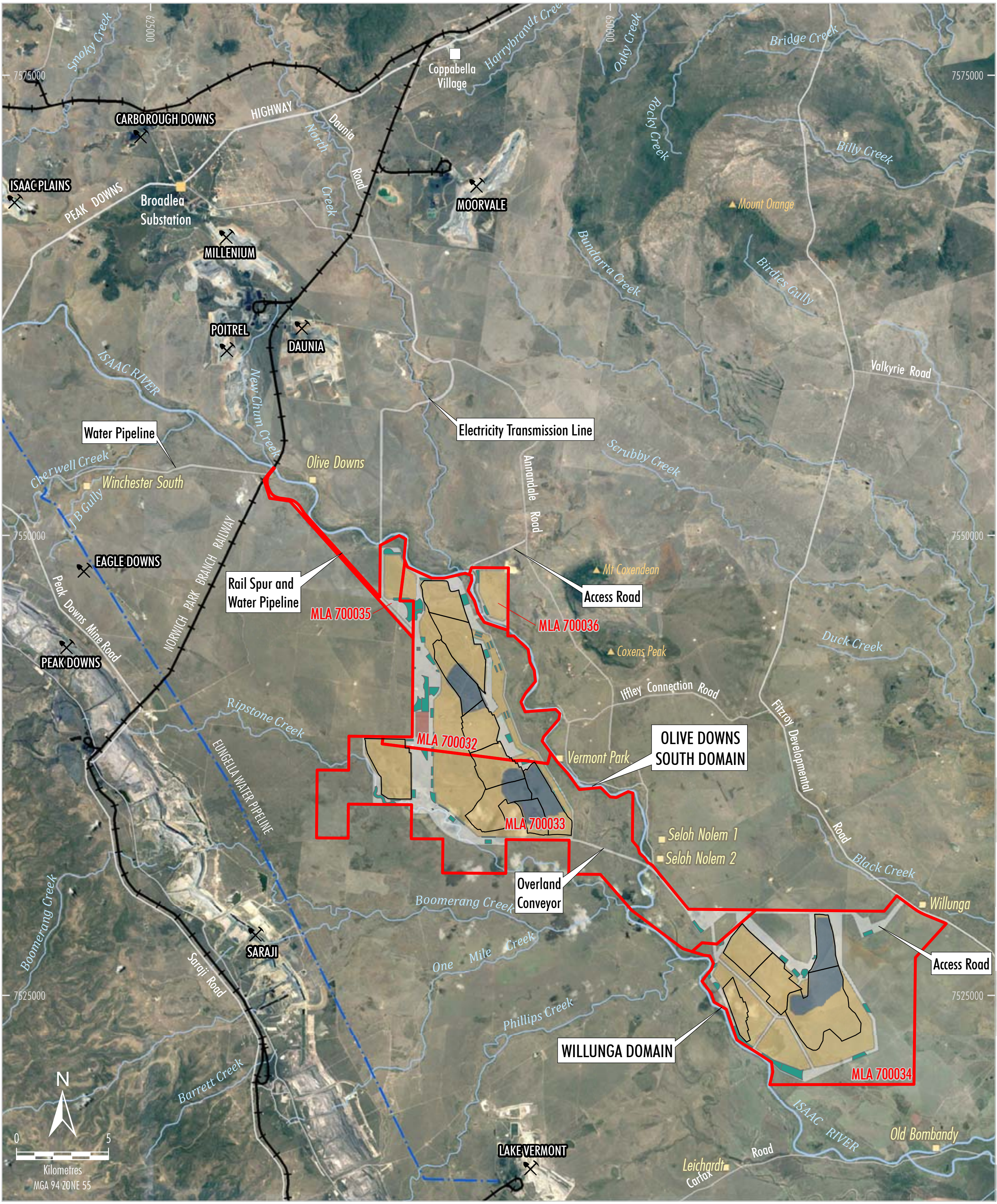
- waste rock emplacements;
- final voids;
- infrastructure areas;
- water management infrastructure; and
- ILF cells.

5.1.3 Rehabilitation Objectives

Rehabilitation objectives describe proposed rehabilitation outcomes, to achieve the rehabilitation goal described in Section 5.1.1.

Table 5-1 describes the general short-term and medium to long-term general rehabilitation objectives for the Project.

Preliminary rehabilitation objectives specific to each mine domain have been developed and are presented in Table 5-2.



LEGEND
- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Infrastructure Area
- Waste Rock Emplacement
- ILF Cells
- Final Void
- Water Management Infrastructure

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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Rehabilitation Domains

Figure 5-1

Table 5-1
General Rehabilitation Objectives for the Project

Short-term	Medium to Long-term
• Minimise active disturbance areas by progressively rehabilitating, and restricting clearing to the minimum required for operations. • Salvage vegetation and habitat resources during clearing activities and re-use in rehabilitated areas to provide habitat resources for fauna (e.g. tree hollows and logs). • Install erosion and sediment control measures prior to the commencement of soil stripping and rehabilitation activities. • Strip soil from areas of disturbance, as required, to reduce the potential for erosion and sediment generation, and to minimise the extent of soil stockpiles and the period of storage. • In preference to stockpiling, replace stripped soil directly on completed sections of the final landform, wherever practicable. • Plant cover crops as appropriate on newly rehabilitated mine landform areas (and soil stockpiles) within two years of becoming available, to minimise the potential for soil erosion. • Stabilise new infrastructure disturbance areas (e.g. roads and dam embankments) as soon as possible by placement of soil and seeding. • Stabilise areas which interact with the Isaac River which have been affected by mine operations (e.g. road crossings). • Progressively place waste rock within the footprint of the open cut voids and reshape completed areas to their final landform shape so that they can be progressively rehabilitated.	• Provide self-maintaining, geotechnically stable and safe landforms that complement existing surrounding landforms in terms of slope, geomorphological characteristics, vegetation and land use. • Remediate safety hazards at the mine infrastructure areas and any potentially contaminated sites to remove safety risks to people and animals. • Rehabilitate the mine infrastructure areas and mine landforms with either groundcover (i.e. grass species) and scattered trees that would return these areas to land suitable for grazing or native woodland/forest. • Establish woodland vegetation in areas of the rehabilitated final landform which would benefit from enhanced stability effects. • Construct the final top surface of the waste emplacements so that rainfall runoff drains in a natural, stable manner. • Create final voids that do not impact the receiving surface waters surrounding the Project. • Isolate the final voids from the Isaac River floodplain through the development of a permanent highwall waste rock emplacement and minimise the final void catchment areas with up-catchment diversions.

Table 5-2
Preliminary Rehabilitation Requirements

Mine Domain	Rehabilitation Goal	Rehabilitation Objectives	Performance Indicators	Completion Criteria
Waste Rock Emplacements	(a) Long-term safety	1. Backfill to original ground level (or higher) to allow for settlement. 2. Structurally sound; safe to people and animals.	a) Engineering design of waste emplacements. b) Exposure to spontaneous combustion material near surface. c) Landform hazards to people and animals.	I. Evidence that rehabilitated landforms have a rate of erosion similar or below that in the relevant reference sites. II. Evidence that spoil sodicity has been managed. III. Record of compliance with procedures and management plans. IV. Evidence that safety issues and physical risks (e.g. falls from height) have been addressed.
	(b) Non-polluting	1. Waste emplacements are adequately managed to avoid exposure to hazardous materials and yield runoff and seepage that is unlikely to detrimentally affect known environmental values.	a) Exposure to acid forming/generating materials. b) Water quality parameters.	I. Evidence that risk assessment has been carried out on potential long-term pollution aspects and that appropriate control measures are in place. II. Water quality monitoring post closure indicates water quality to be similar to relevant reference sites. III. No exposure of hazardous materials due to erosion of covering material.
	(c) Stable	1. Slopes and surfaces are geotechnically stable. 2. Landform with very low probability of slope slippage or failure with serious environmental consequences. 3. Waste rock emplacements have self sustaining vegetative cover. 4. Landform designs achieve soil loss rates similar to or lower than those on relevant reference sites.	a) Engineering design of waste rock emplacements. b) Erosion. c) Slope failure. d) Vegetation cover (foliage projective cover, type and density).	I. Waste rock emplacements are set back the appropriate distance from final void pit crests. II. Evidence that stability has improved over time as rehabilitation has become established. III. Soil loss rates similar to corresponding relevant reference sites. IV. Evidence that the landform is stable under regular and irregular climatic events. V. Evidence that vegetation cover, types and densities are comparable to relevant reference sites.

Table 5-2
Preliminary Rehabilitation Requirements (Continued)

Mine Domain	Rehabilitation Goal	Rehabilitation Objectives	Performance Indicators	Completion Criteria
Waste Rock Emplacements (cont.)	(d) Sustainable Land Use	1. Soil, biological, chemical and physical properties provide support to preferred land use. 2. Vegetation diversity and sustainability are commensurate with the preferred final land use.	a) Adequate topsoil is present to allow vegetation cover establishment. b) Soil organic matter, soil nutrients, invertebrate activity and soil texture are comparable with relevant reference sites. c) Vegetation contains a diversity (trees, shrubs, herbs, grass) comparable to relevant reference sites. d) Native vegetation recruitment. e) Exotic species diversity and abundance.	I. Evidence that physical, chemical and biological properties of the growth media are similar to relevant reference sites. II. Evidence of nutrient cycling/accumulation occurs at a rate comparable with relevant reference sites. III. Evidence that diversity of plant species are similar to that of relevant reference sites. IV. Evidence of generational succession of trees and shrubs apparent in rehabilitation areas.
Final Voids	(a) Long-term safety	1. Structurally sound. 2. Safe to people and animals.	a) Fall hazards. b) Drowning hazards.	I. Perimeter bunding formed and security fencing and signage installed.
	(b) Non-polluting	1. Final voids are isolated from the Isaac River. 2. Final void area and volumes are minimised. 3. Final void hydrology is understood. 4. Interconnectivity between final voids and groundwater is understood. 5. Final voids predicted to act as groundwater sinks into perpetuity.	a) Isaac River flood waters isolated from the final voids. b) Surface water and groundwater quality parameters. c) Groundwater monitoring and modelling.	I. Evidence that the final void water is contained with no overflows as predicted by modelling. II. Final void is protected from possible inflows associated with floods from the Isaac River. III. Evidence through monitoring that the groundwater quality is as predicted and stable.

Table 5-2
Preliminary Rehabilitation Requirements (Continued)

Mine Domain	Rehabilitation Goal	Rehabilitation Objectives	Performance Indicators	Completion Criteria
Final Voids (cont.)	(c) Stable	1. Slopes and surfaces are geotechnically stable. 2. Landform with very low probability of slope slippage or failure with serious environmental consequences. 3. Landform designs achieve soil loss rates similar to or lower than those on relevant reference sites.	a) Engineering design. b) Erosion. c) Record of slope failure.	I. Final voids profiled for long-term stability as evidenced by geotechnical surveys of highwalls and endwalls. II. Evidence that stability of the final void low walls has improved over time as rehabilitation is established. III. Soil loss rates similar to corresponding relevant reference sites.
	(d) Sustainable Land Use	1. Final void acting as a groundwater sink. 2. Final void providing potential habitat for native fauna (including the highwall and waterbody).	a) Groundwater modelling. b) Groundwater monitoring. c) Fauna monitoring.	I. Updated groundwater modelling based on ongoing groundwater data collection indicates the final voids will act as groundwater sinks into perpetuity. II. Evidence through monitoring of native fauna use.
Infrastructure Areas (Note: infrastructure associated with the Project would be assessed on an individual basis for possible removal or to be retained for future land owners)	(a) Long-term safety	1. Structurally sound; safe to people and animals.	a) Structural integrity of retained infrastructure.	I. Evidence that risk from retained infrastructure has been minimised.
	(a) Non-polluting	1. Infrastructure areas are free of waste and hazardous material both domestic and industrial.	a) Presence of waste and hazardous material.	I. Evidence that all waste and hazardous material has been removed.
	(b) Stable	1. Infrastructure areas are located on a stable uniform ground surface suitable for preferred final land use.	a) Structural integrity of retained infrastructure. b) Safe access routes.	I. Evidence that risk from remnant infrastructure have been minimised and, if necessary, control measures are in place to meet agreed requirements.
	(c) Sustainable Land Use	1. Infrastructure areas are commensurate with the preferred final land use.	a) Useability of retained infrastructure.	I. Evidence of use of the retained infrastructure.
Water Management Infrastructure	(a) Long-term safety	1. Structurally sound; safe to people and animals.	a) Presence of waste material. b) Structural integrity of retained infrastructure. c) Appropriate decommissioning of regulated structures and other dams.	I. Perimeter bunding formed and security fencing installed. II. Record of compliance with procedures and management plans. III. Evidence that safety issues and physical risks have been addressed.

Table 5-2
Preliminary Rehabilitation Requirements (Continued)

Mine Domain	Rehabilitation Goal	Rehabilitation Objectives	Performance Indicators	Completion Criteria
Water Management Infrastructure (cont.)	(b) Non-polluting	1. Retained water management infrastructure is free from hazardous materials. 2. Final landform water storages are non-polluting and meet water quality parameters suitable for preferred closure options (e.g. agricultural use).	a) Presence of waste and/or hazardous material. b) Exposure to saline or sodic materials. c) Surface water monitoring upstream and downstream.	I. Evidence that contaminated land has been remediated in accordance with environmental regulation. II. Evidence through monitoring that surface water quality is not negatively impacted by final rehabilitation.
	(c) Stable	1. Diversion with very low probability of erosion or failure with serious environmental consequences. 2. Final landform drainage features follow natural contours. 3. Vegetation cover is established to minimise rate of soil loss. 4. All water infrastructure is structurally and operationally compliant at point of closure.	a) Engineering design. b) Erosion monitoring. c) Vegetation type and density. d) Downstream water impacts.	I. Evidence that stability of the diversion has improved over time as rehabilitation is established. II. Soil loss rates similar to corresponding relevant reference sites. III. Vegetation types and density are comparable with relevant reference sites.
	(d) Sustainable Land Use	1. Soil, biological, chemical and physical properties provide support to preferred land use. 2. Native ecosystem diversity and sustainability are commensurate with the preferred final land use.	a) Water quality established by monitoring or modelling validated by monitoring. b) Structural report on integrity of structure. c) Vegetation contains a diversity (trees, shrubs, herbs, grass) comparable to relevant reference sites. d) Native vegetation recruitment. e) Exotic species identification and management.	I. Evidence that physical, chemical and biological properties of the growth media are similar to relevant reference sites. II. Evidence of nutrient cycling/accumulation occurs at a rate comparable with relevant reference sites. III. Meets specified water quality guidelines.

Table 5-2
Preliminary Rehabilitation Requirements (Continued)

Mine Domain	Rehabilitation Goal	Rehabilitation Objectives	Performance Indicators	Completion Criteria
ILF Cells	(a) Long-term safety	1. Structurally sound; safe to people and animals.	a) Landform hazards to people and animals.	I. Record of compliance with procedures and management plans.
	(b) Non-polluting	1. Runoff and seepage do not affect known environmental values.	a) Water quality parameters.	I. Water quality monitoring post closure indicates water quality to be similar to relevant reference sites. II. No exposure of hazardous materials due to erosion of covering soil.
	(c) Stable	1. Surfaces are geotechnically stable. 2. Landform with very low probability of slope slippage or failure with serious environmental consequences.	a) Erosion. b) Vegetation cover (type and density).	I. Evidence that stability has improved over time as rehabilitation has become established. II. Soil loss rates similar to corresponding relevant reference sites. III. Evidence that the landform design is stable under regular and irregular climatic events. IV. Evidence that vegetation cover, types and densities are comparable to relevant reference sites.
	(d) Sustainable Land Use	1. Soil, biological, chemical and physical properties provide support to preferred land use. 2. Native ecosystem diversity and sustainability are commensurate with the preferred final land use.	a) Adequate topsoil is present to allow vegetation cover establishment. b) Soil organic matter, soil nutrients, invertebrate activity and soil texture are comparable with relevant reference sites. c) Exotic species diversity and abundance.	I. Evidence that physical, chemical and biological properties of the growth media are similar to relevant reference sites. II. Evidence of nutrient cycling/accumulation occurs at a rate comparable with relevant reference sites.

5.1.4 Performance Indicators

Indicators can be used to assess the performance of rehabilitation and the progress towards meeting the rehabilitation objectives, or guide the implementation of any additional measures considered necessary.

Preliminary performance indicators have been developed for the Project and are presented in Table 5-2.

The preliminary performance indicators have been selected as they have:

- a sound scientific meaning;
- represent an aspect relevant to the rehabilitation objectives;
- are measurable; and
- can be easily analysed to assess performance.

5.1.5 Completion Criteria

Completion criteria are used to clearly define rehabilitation success.

Preliminary rehabilitation completion criteria have been developed for the Project in accordance with the *Rehabilitation Requirements for Mining Resources Activities Guideline* (DEHP, 2014) and are presented in Table 5-2.

Rehabilitated lands would be considered suitable for relinquishment when the completion criteria have been met.

If required at the time of certification of rehabilitation, residual risk payments may be required to cover potential rehabilitation costs incurred by the Queensland Government.

5.2 CONCEPTUAL FINAL LANDFORM DESIGN

As described in Section 5.1.1, the rehabilitation goal for the Project is to create a post-mining landform that is:

- safe;
- non-polluting;
- stable; and
- able to sustain a post-mining land use.

The conceptual design of the post-mining landform, as described in the below sub-sections, seeks to achieve the above rehabilitation goal.

Figures 5-2 and 5-3 illustrate the conceptual final landforms for the Project. The figures show that all sediment dams and mine water dams are removed (i.e. decommissioned), but the raw water dams are retained. Decommissioning of infrastructure is described in Section 5.3.8.

Conceptual cross-sections of the rehabilitated Project landform are shown on Figures 5-4a and 5-4b.

5.2.1 Conceptual Post-mining Land Use

Land within the Project area is currently used predominately for cattle grazing, with small areas showing some evidence of opportunistic cropping. The land has been largely cleared through past agricultural practices, however some tracts of remnant vegetation exist, particularly along the riparian corridor of the Isaac River.

Pembroke has considered potential post-mining land uses (e.g. nature conservation, agriculture) taking into account the rehabilitation hierarchy described in the *Rehabilitation Requirements for Mining Resource Activities Guideline* (DEHP, 2014), relevant strategic land use objectives of the area in the vicinity of the Project and the potential benefits of the post-mining land use to the environment, future landholders and the community.

The conceptual post-mining land use for the Project is to reinstate land that would be suitable for the existing land uses, namely low intensity cattle grazing, while establishing woodland vegetation in areas which would benefit from enhanced stability effects (e.g. near watercourses and drainage lines and on the permanent highwall emplacements and adjacent areas). Parts of the final voids above the equilibrated water body would provide habitat for native fauna, and the final voids would act as groundwater sinks into perpetuity.

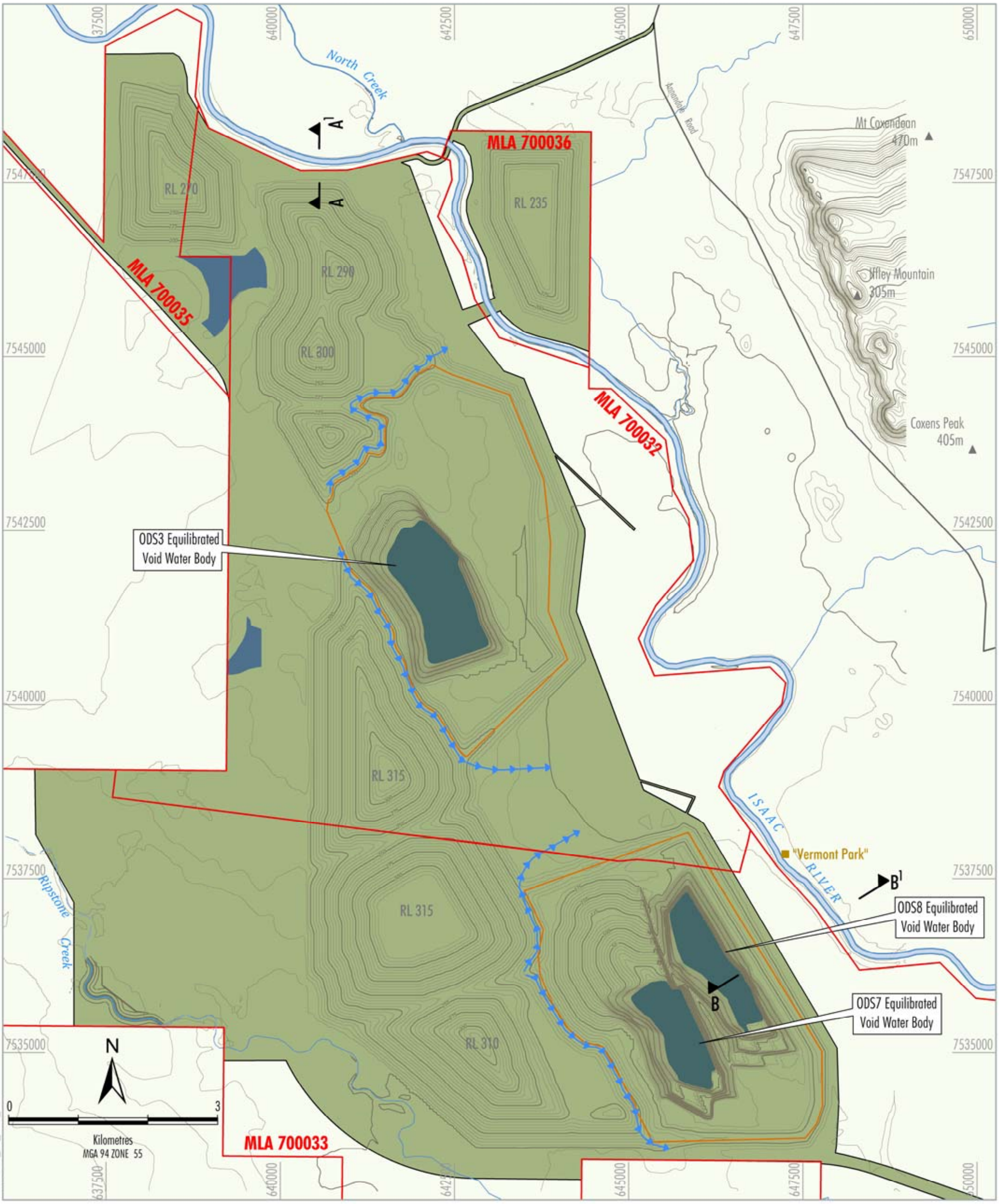
An illustration of the conceptual post-mining land use across the Project final landform is presented on Figures 5-5a and 5-5b.

5.2.2 Waste Rock Emplacements

Waste rock emplacements would be initially developed adjacent to the open cut pits, until such time as sufficient space is available within the mined-out voids of the open cuts to be progressively backfilled with waste rock material. Accordingly, waste rock emplacements would be both elevated above, at and below ground level.

Progressive rehabilitation of the waste rock emplacements would be carried out when final placement is achieved.

TOC



LEGEND

- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Rehabilitated Project Landform
- Equilibrated Void Water Body
- Perimeter Bund
- Dam
- Drain

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

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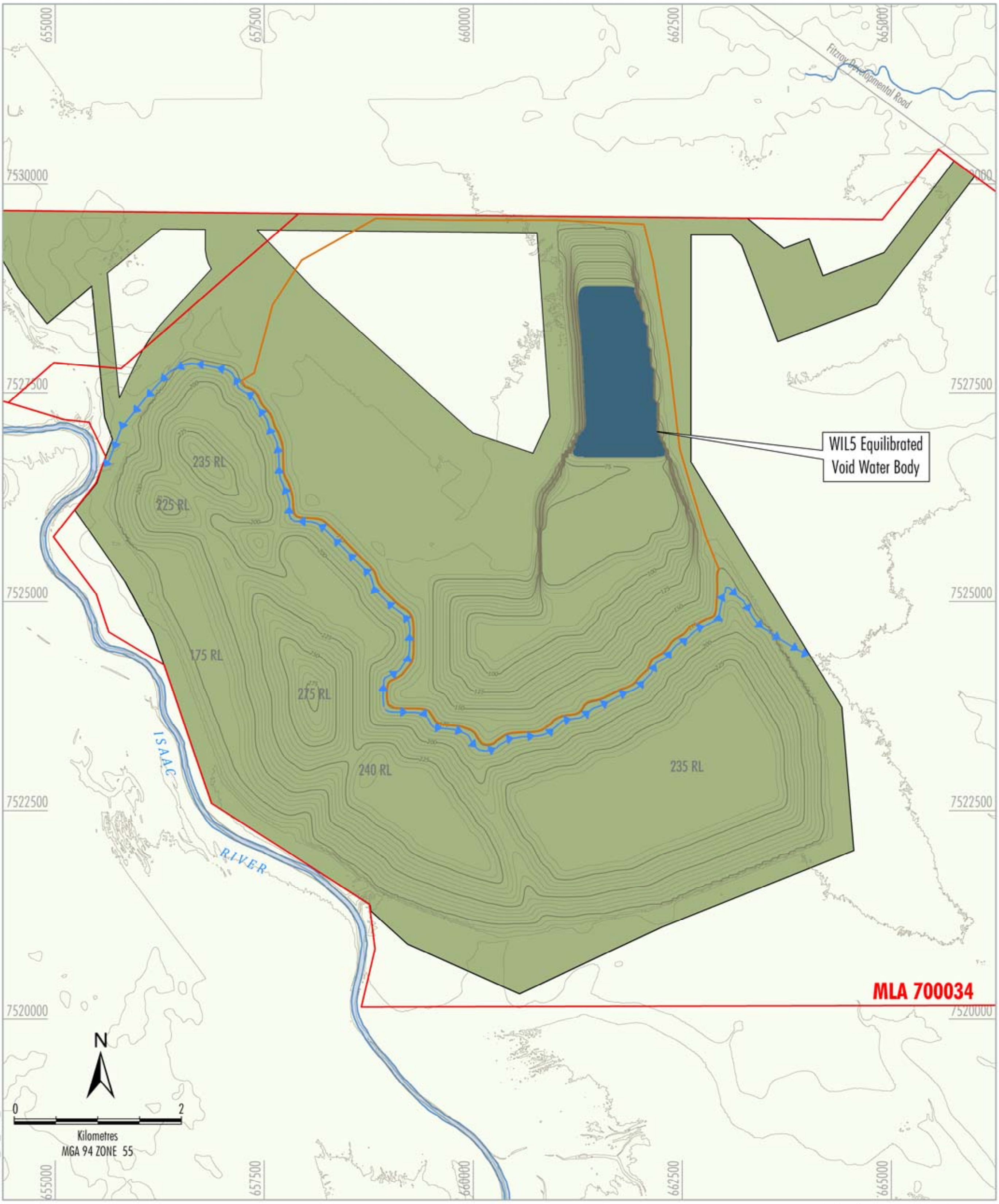
Conceptual Final Landform - Olive Downs South Domain

Figure 5-2



LEGEND
- Mining Lease Boundary
- Watercourse
- Rehabilitated Project Landform
- Equilibrated Void Water Body
- Perimeter Bund
- Drain

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

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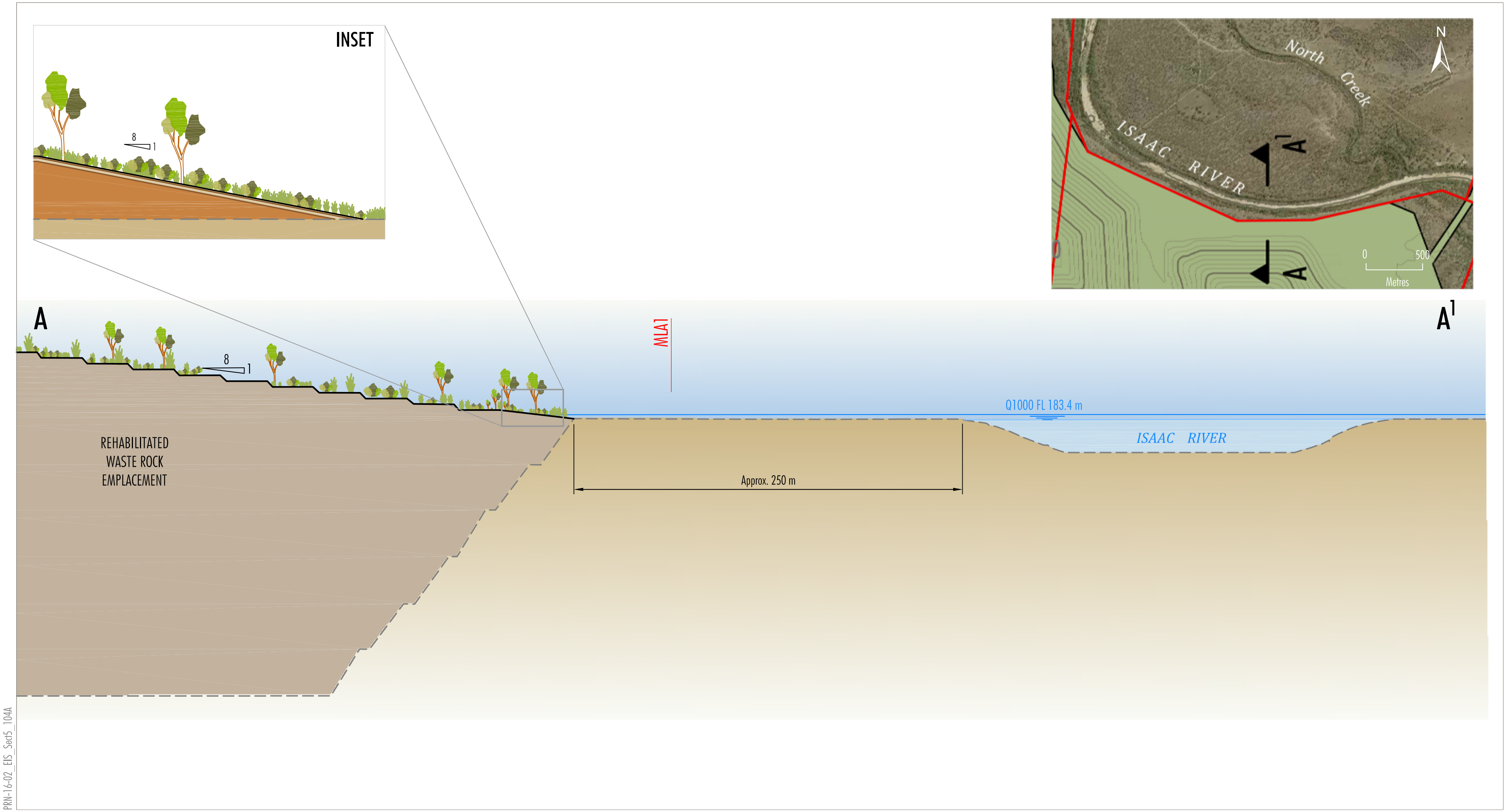
Conceptual Final Landform - Willunga Domain

Figure 5-3



Source: Phronis (2018)

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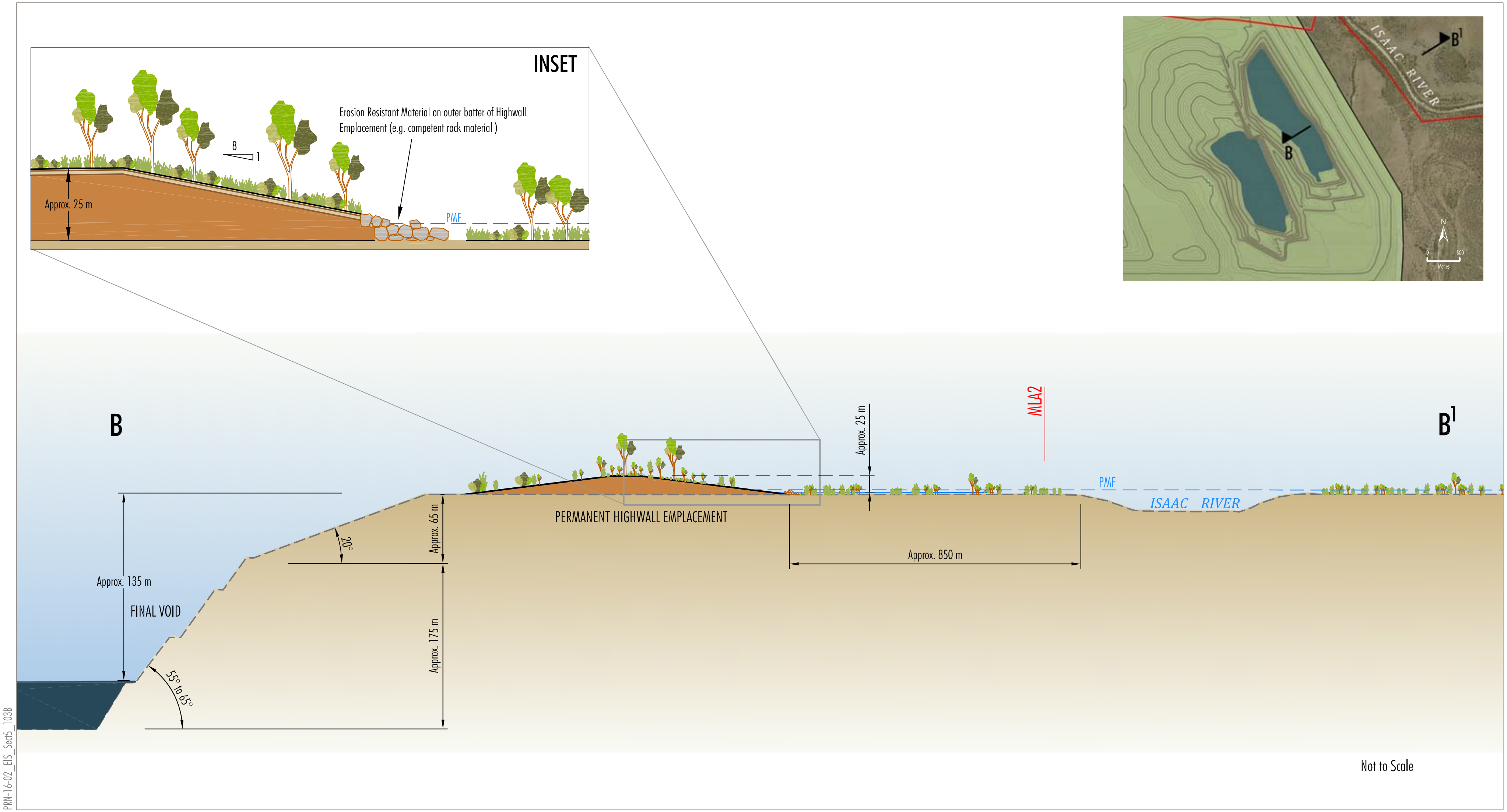
Conceptual Final Landform Cross Section
Backfilled Open Cut

Figure 5-4a



Source: Phronis (2018)

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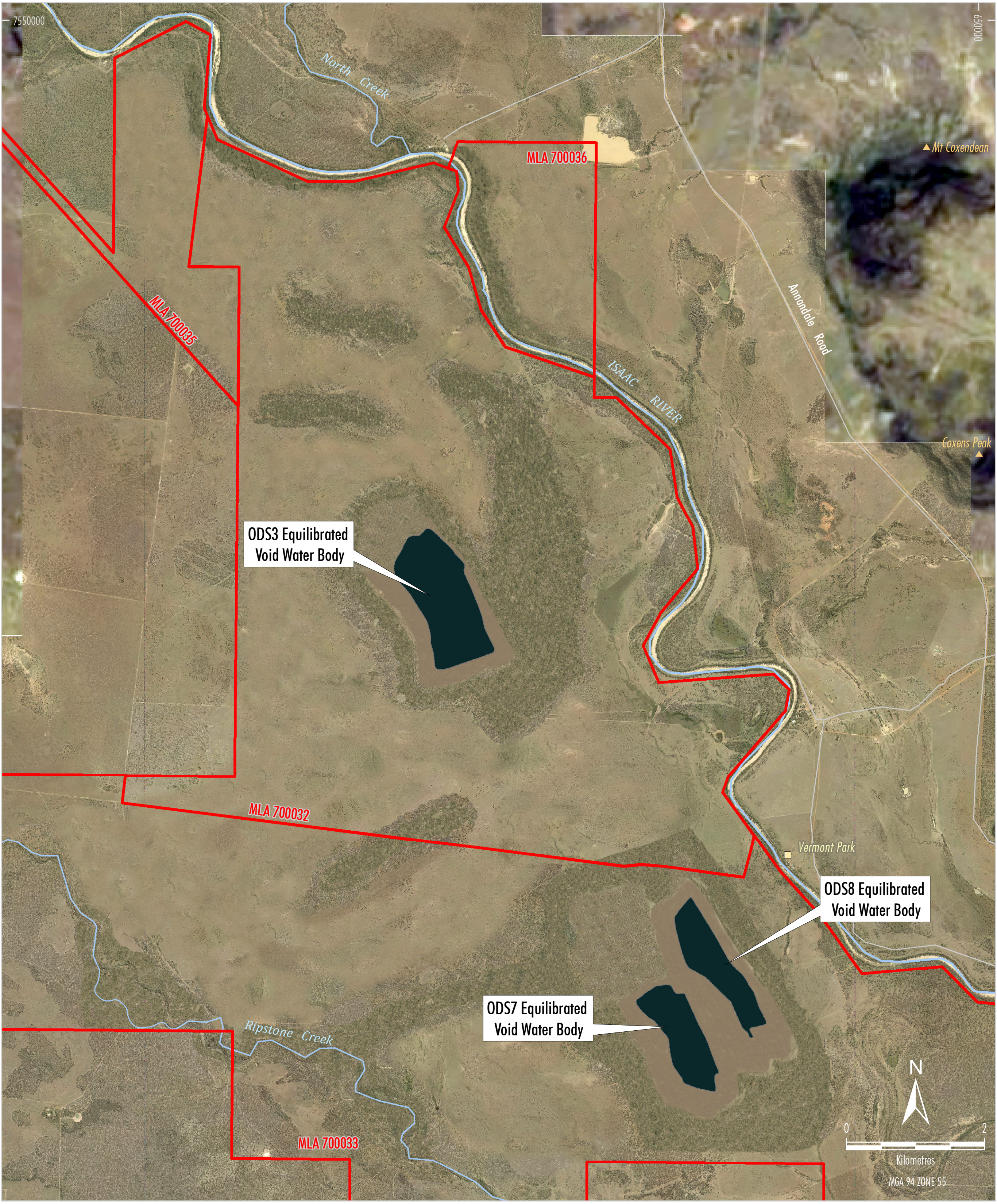
Conceptual Final Landform Cross Section
Highwall Emplacement and Final Void

Figure 5-4b



LEGEND
Mining Lease Application Boundary
Dwelling
Grazing
Woodland

Source: Pembroke (2018)

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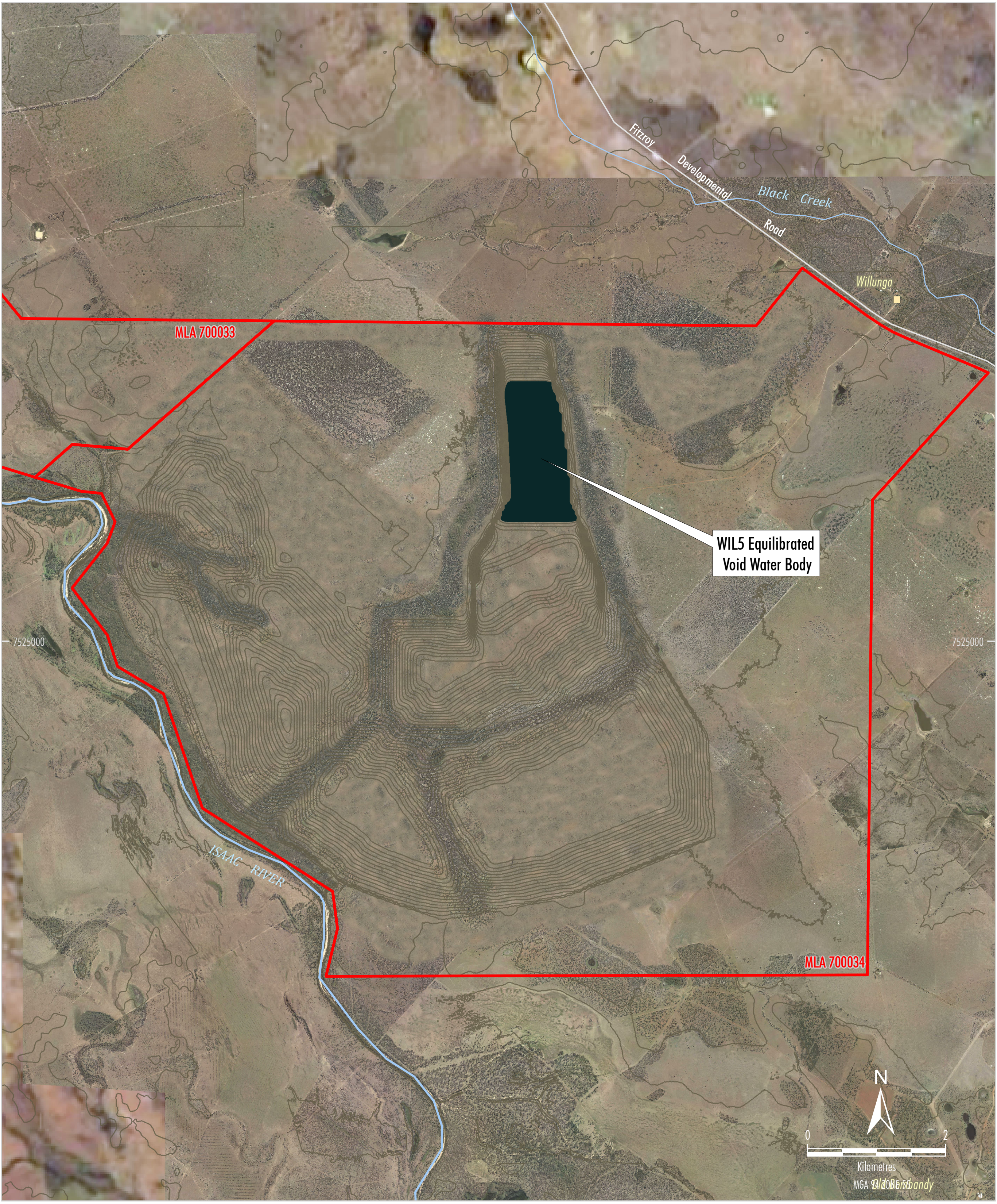
Conceptual Final Land Use

Olive Downs South Domain

Figure 5-5a



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LEGEND
- Mining Lease Application Boundary
- Dwelling
- Grazing
- Woodland

Source: Pembroke (2018)

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Conceptual Final Land Use
Willunga Domain

Figure 5-5b

To create stable landforms, the design parameters of the elevated landforms would target:

- slopes of approximately 7 degrees (1V:8H) which are suitable for the proposed post-mining land uses;
- contour banks installed on side slopes (to limit effective slope lengths and reduce the potential for erosion);
- gently sloped surfaces on the elevated plateau and shaped to direct water off the waste rock emplacements;
- soil placement and ripping on the contour; and
- application of an appropriate seed mix (pasture seed with a selection of native trees and shrubs) with fertiliser if necessary.

Geotechnical consideration of the waste rock emplacements is described in Section 5.2.4.

5.2.3 Final Voids and Permanent Highwall Emplacements

Progressive backfilling of the open cut pits behind the advancing operations would be undertaken to minimise the potential for environmental harm consistent with the rehabilitation hierarchy outlined in the *Rehabilitation Requirements for Mining Resources Activities Guideline* (DEHP, 2014). The mine schedule has been optimised to maximise opportunities to backfill advancing open cut pits during mining operations (Section 2.10). Table 5-3 summarises the backfill status of the individual open cut pits (Figures 5-2 and 5-3) at the completion of mining.

Table 5-3
Backfill Status of Open Cut Pits at Mine Closure

Pit Number	Status
Olive Downs South Domain	
ODS1	Completely backfilled
ODS2	Completely backfilled
ODS3	Partially backfilled – final void remains
ODS4	Completely backfilled
ODS5	Completely backfilled
ODS6	Completely backfilled
ODS7/ODS8[1]	Partially backfilled – final void remains
ODS9	Completely backfilled
Willunga Domain	
WIL1 (Satellite)	Completely backfilled
WIL2 (West 1)	Completely backfilled
WIL3 (West 2)	Completely backfilled
WIL4 (South)	Completely backfilled
WIL5 (East)	Partially backfilled – final void remains

[1] Pits ODS7 and ODS8 connect to form one final void.

The Project final landform would include three final voids. Two final voids would remain in the Olive Downs South domain (Figure 5-2) and one final void in the Willunga domain (Figure 5-3). The geometry of the final voids is summarised in Table 5-4.

As described in Sections 4.3 and Appendices D and E, final void waterbodies are predicted to equilibrate below the regional groundwater table, meaning the voids would act as groundwater sinks into perpetuity, preventing potentially contaminated water migrating into surrounding aquifers. The final void waterbodies are not predicted to spill to the surrounding environment, as they would remain at least 90 m below ground level (Table 5-4).

Final voids ODS3 and ODS7/ODS8 would be isolated from all flood waters up to and including a PMF event by permanent waste rock emplacements (referred to as permanent highwall emplacements). These permanent highwall emplacements would integrate with the in-pit and out-of-pit waste rock emplacements, effectively surrounding the final voids and redefining the Isaac River floodplain extent. Final void WIL5 would be protected from overland flows by a perimeter bund (rising flood waters from the Isaac River would not reach WIL5).

A conceptual layout of the part of the Olive Downs South domain final landform, illustrating how the permanent highwall emplacements integrate with the in-pit and out-of-pit waste rock emplacements and surround the final voids is shown on Figures 5-4a and 5-4b.

The permanent highwall emplacements would be in the order of 300 m to 400 m wide, and approximately 25 m high. The highwall emplacements would be constructed with the same design parameters as the other waste rock emplacements (Section 5.2.2).

As described in Section 2.5.7, the waste rock material is expected to be overwhelmingly NAF with excess ANC and have a negligible risk of developing acid conditions. It is also predicted to generate relatively low-salinity surface run-off and seepage with low soluble metals concentrations. Where highly sodic and/or dispersive waste rock is identified, the material would be selectively handled so that it does not report to final landform surfaces of the permanent highwall emplacements. This would allow the permanent highwall emplacements to be safe, stable, non-polluting and able to sustain the post mining land use of woodland vegetation.

Table 5-4
Final Void Geometry

Final Void	Approx. Volume	Approx. Depth to Water Body	Overall Highwall Angle		Isolated from All Future Flood Events
			Cenozoic Overburden	Weathered/Fresh Permian	
ODS3	360 Mm^3	100 mbgl	20º	45º	Yes
ODS7/ODS8	670 Mm^3	145 mbgl	20º	45º to 55º	Yes
WIL5	720 Mm^3	90 mbgl	20º	55º	Yes

Mm^3 = million cubic metres.
mbgl = metres below ground level.

During a PMF event, the flood water along the highwall emplacements is predicted reach a maximum height of 6 m. Accordingly, there is a significant freeboard above the PMF event to protect the final voids from all flood waters.

Although the velocities of flood waters along the highwall emplacements are generally predicted to be below 2.5 m/s (Appendix F), the outer, lower slopes of the emplacements would be protected (e.g. placement of erosion resistant material such as competent rock) to minimise erosion where floodwaters interact with the permanent highwall emplacement.

As shown on Figure 5-5a, the final land use for the permanent highwall emplacements would be woodland vegetation. Once rehabilitation is complete (including construction of the erosion protection described above) and the woodland vegetation is established, the permanent landforms would not require ongoing management.

Once mining operations cease, inflows to the final voids would no longer be pumped out, and as a result, the voids would gradually begin to fill with water. Inflows into the final voids would comprise incident rainfall, runoff within the final void catchment area and groundwater (including waste rock emplacement infiltration).

The catchment areas of the final voids would be minimised and defined by the surrounding highwall emplacements and upslope perimeter bunds, which would divert runoff around the voids. Indicative locations of the upslope perimeter bunds are shown on Figures 5-2 and 5-3. The upslope perimeter bunds would be designed to manage flows for a 1:1000 AEP event, with 1 m of freeboard.

Final void recovery analyses have been conducted as part of the Surface Water Assessment (Appendix E). The assessment includes consideration of predicted groundwater recovery inflow rates developed as part of the Groundwater Assessment (Appendix D), incident rainfall runoff and void water body evaporation rates.

Over time, water would accumulate in the final voids. As the voids are predicted to act as groundwater sinks into perpetuity (Appendix D), evapo-concentration effects would slowly increase the salinity of the final void water bodies. It is predicted that the final voids would become hypersaline (>35,000 mg/L) at the end of the recovery simulations (approximately 550 years after mine closure).

Fencing and signage would be installed around the final void highwalls to prevent access by humans and livestock.

The final void design would be periodically reviewed in consultation with relevant government departments as part of ongoing mine closure planning for the Project.

5.2.4 Geotechnical Stability of Final Landforms

A preliminary geotechnical stability assessment of the final landforms at the Project, focussing on final voids and the waste rock emplacements, has been conducted by GeoTek Solutions (2018). The assessment considered a number of site specific data sources, including previous geotechnical assessments conducted across the Project area and core drilling data.

The recommendations from the preliminary geotechnical assessment have been adopted as design criteria, including the following:

- Final void highwalls would be laid back to 20º where they pass through the alluvium and tertiary clays (known as the Cenozoic overburden) (Figure 5-4b) to achieve a factor of safety of 1.5. GeoTek identified that much of the Cenozoic material consists of Tertiary clay which has a low shear strength, requiring the 20º set back in the final landform.

- Final void highwalls would have a maximum overall angle of 45º where located within a fault fractured zone, and 55º where they are located away from fault zones. An overall angle of 55º could be achieved by 50 m high batters at 65º incorporating 10 m wide intermediate benches.
- The toe of out-of-pit waste rock emplacements would stand off the crest of the final voids by at least 50 m.
- The slopes of the waste rock emplacements would be approximately 7º and would not pose any geotechnical stability issues.
- Further investigations (including additional drilling programs) would be conducted, focussing on the Cenozoic overburden, to further characterise the materials and refine the final void design.

Pembroke has designed the final void highwall angles and waste rock emplacements based on the parameters recommended by GeoTek (2018). The additional investigations recommended by GeoTek will commence in 2018. These investigations will improve the spatial distribution of existing datasets, particularly in regard to the presence of lateritic clays, and improve the geological model. The investigations may also use sonic velocity and acoustic scanner tools. These investigations as well as additional data gained over the life of the Project, will be used to refine the final landform design.

5.2.5 Water Management Infrastructure

As described in Section 5.2.1, the post mining land use is to generally reinstate land that would be suitable for the existing land uses, namely low intensity cattle grazing. In consultation with the future land user, Pembroke would selectively decommission water storages which are not considered to provide a beneficial use following mine closure.

The Ripstone Creek diversion would be constructed as a permanent diversion, and as such would remain following mine closure.

5.2.6 ILF Cells

As outlined in Section 2.4.6, until such time as in-pit disposal areas become available for the dried fine rejects to be reclaimed and placed in-pit, the fine rejects would be temporarily stored in the ILF cells while return water is decanted for reuse in the mine water management system.

Once dry, the ILF cells would be excavated and disposed in-pit. Upon decommissioning, the excavated ILF cells would be assessed for potential land contamination, and remediated if required, before being topsoiled and rehabilitated.

5.3 GENERAL REHABILITATION PRACTICES AND MEASURES

General rehabilitation practices and measures that would be implemented for the Project are described in the following sub-sections.

Rehabilitation progress and rehabilitation activities would regularly be re-evaluated and the results would inform future rehabilitation initiatives and refinement, and amendment to the practices and measures described below.

5.3.1 Progressive Rehabilitation

The Project would be progressively rehabilitated to achieve the rehabilitation objectives established for each domain. As described in Section 5.1, the progress of the rehabilitation would be monitored against indicators, and ultimately against completion criteria to demonstrate successful rehabilitation of the Project.

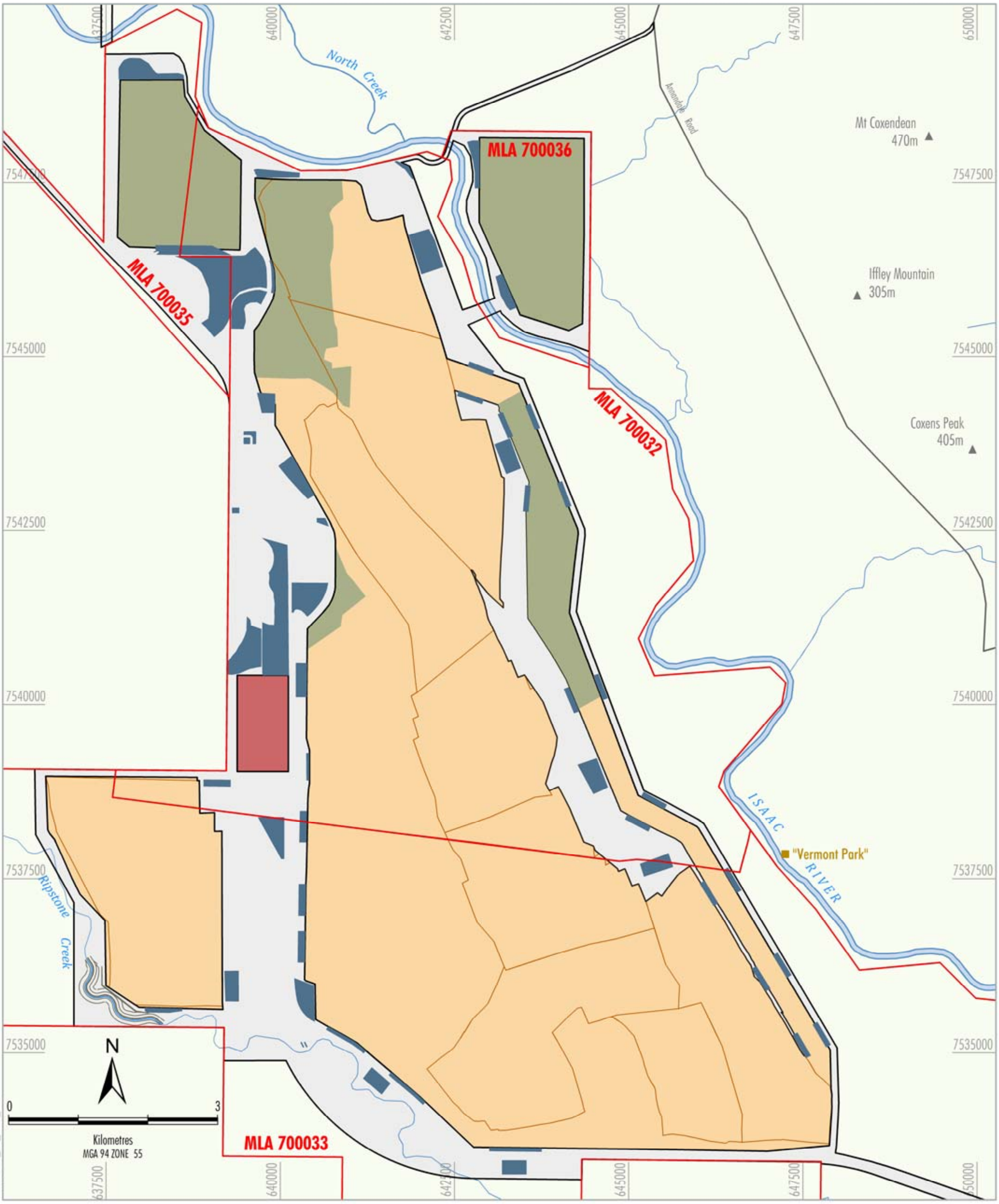
Progressive rehabilitation of the rehabilitation domains at the completion of each of the seven Project stages (Section 2.5.1) and at the completion of infrastructure decommissioning (Section 5.3.8) is shown on Figures 5-6 to 5-19. These areas of progressive rehabilitation show the parts of the rehabilitation domains that have reached their ultimate profile and where rehabilitation activities have commenced.

Table 5-5 presents the indicative progressive rehabilitation schedule corresponding to Figures 5-6 to 5-18.

5.3.2 Vegetation Clearance Procedures

Clearance of vegetation would be undertaken progressively, with the area of native remnant vegetation cleared at any particular time generally being no greater than that required to accommodate projected development activities for the next 12 months.

Further detail on management of potential impacts on biodiversity during vegetation clearance activities is provided in Section 4.1 and Appendices A, B and C.



LEGEND
Mining Lease Boundary
Watercourse
Proposed Creek Diversion
Dwelling
Open Cut Pit Extents
Rehabilitation Extent
Infrastructure Area
Extent of Waste Rock Emplacement
Extent of ILF Cells
Extent of Water Management

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

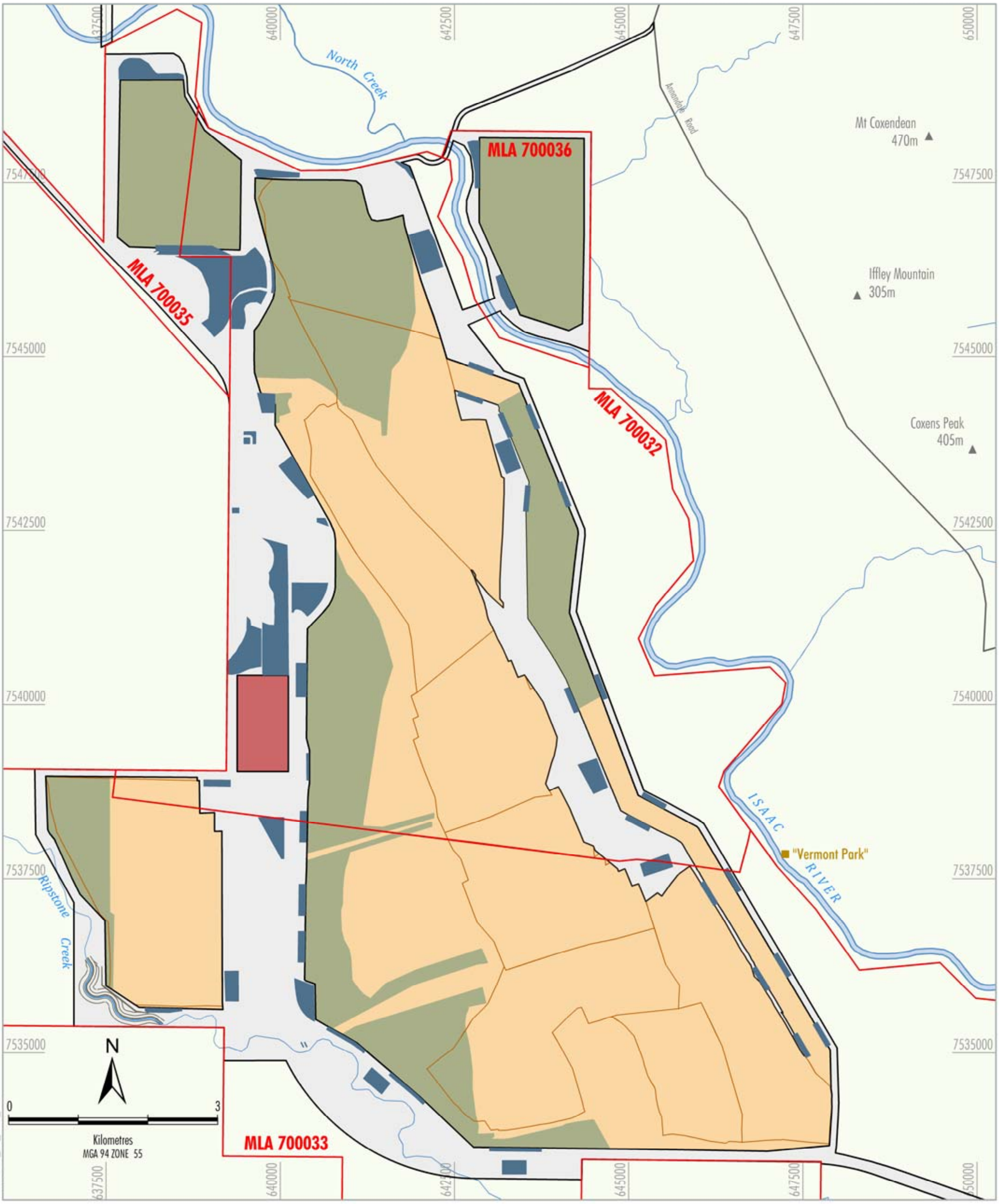
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2030

Figure 5-6

TOC



LEGEND
- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of ILF Cells
- Extent of Water Management

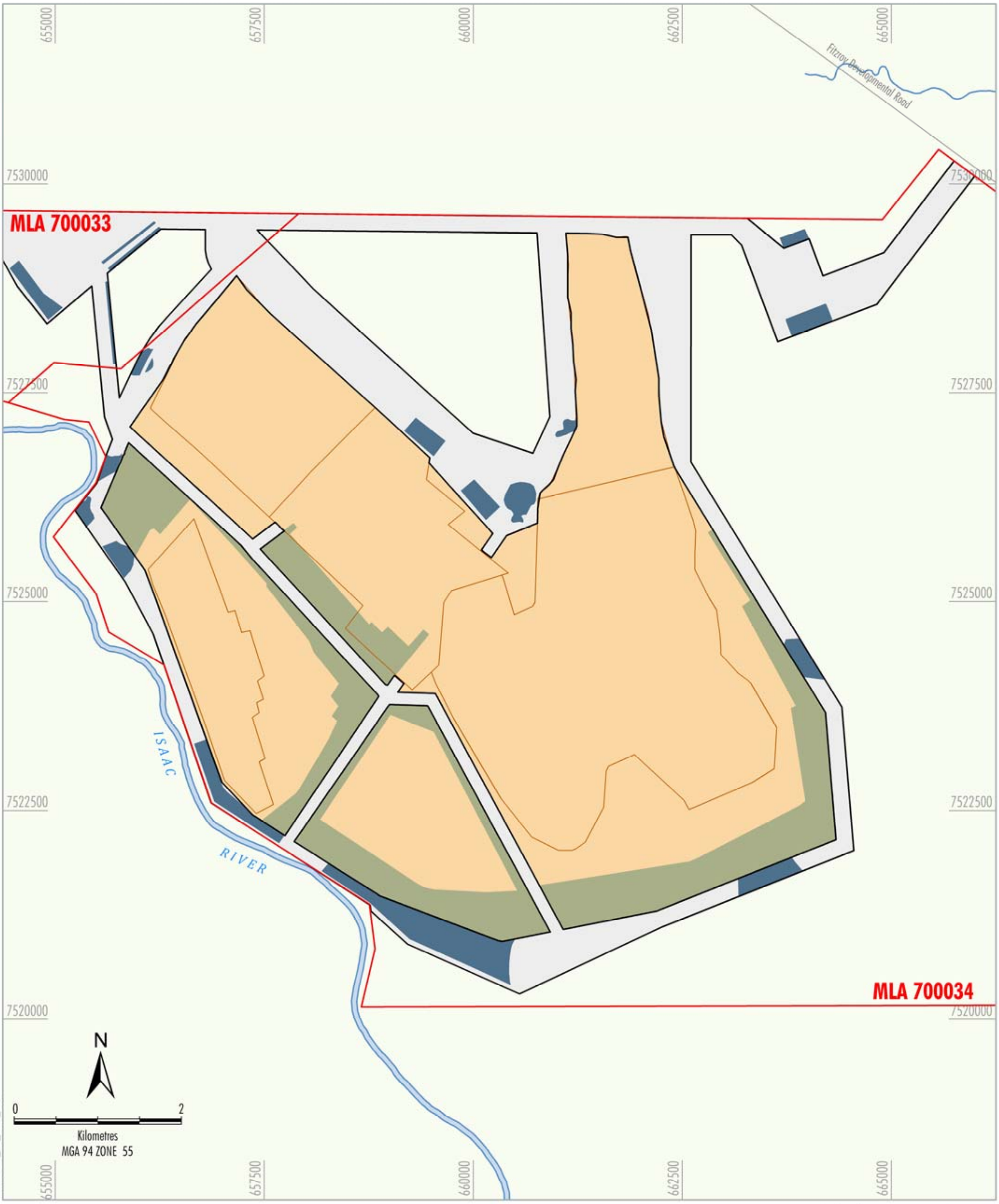
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2040

Figure 5-7



LEGEND
- Mining Lease Boundary
- Watercourse
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of Water Management

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

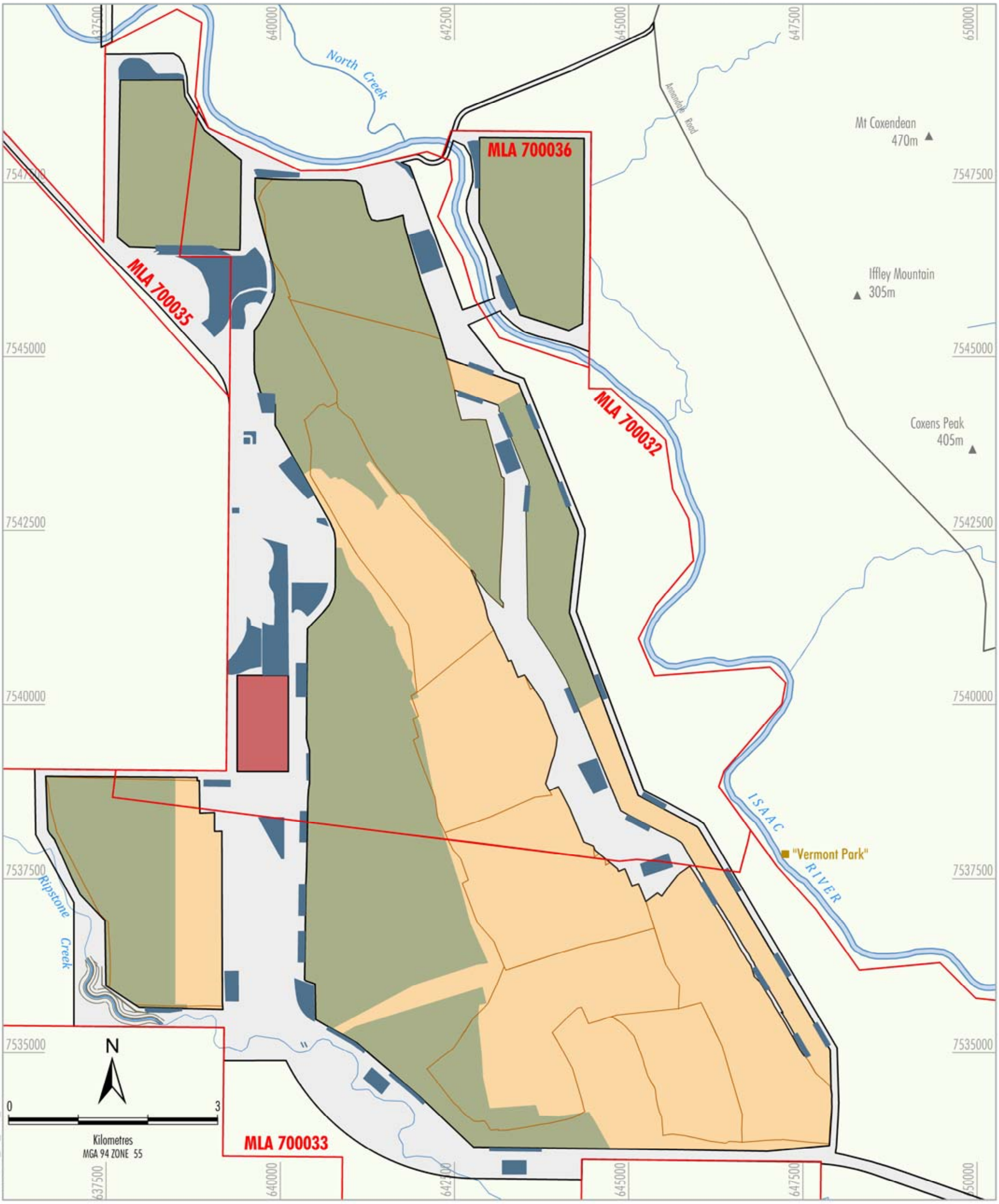
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain
Progressive Rehabilitation - 2040

Figure 5-8

TOC



LEGEND

- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of ILF Cells
- Extent of Water Management

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

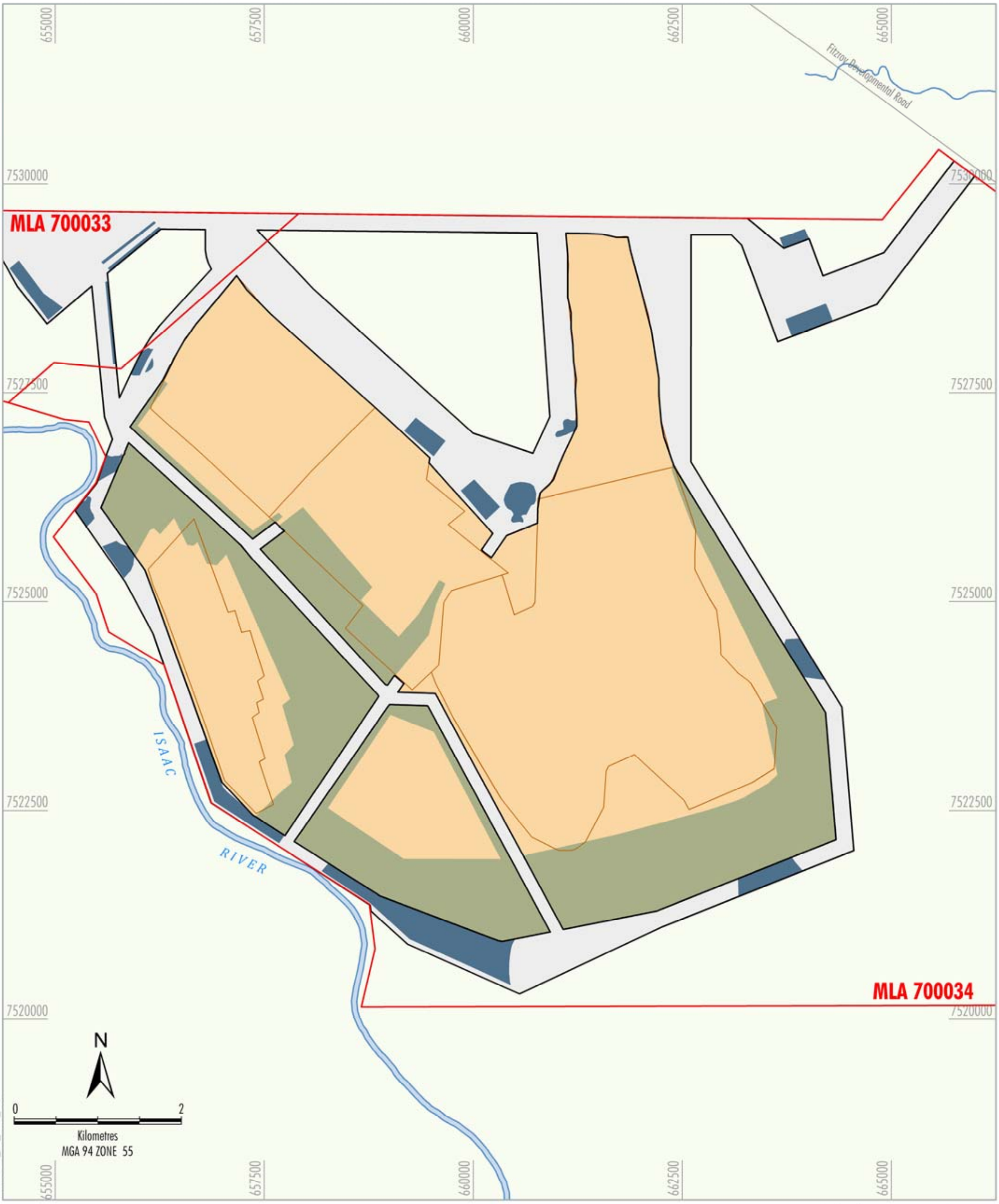
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2050

Figure 5-9

TOC



LEGEND
- Mining Lease Boundary
- Watercourse
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of Water Management

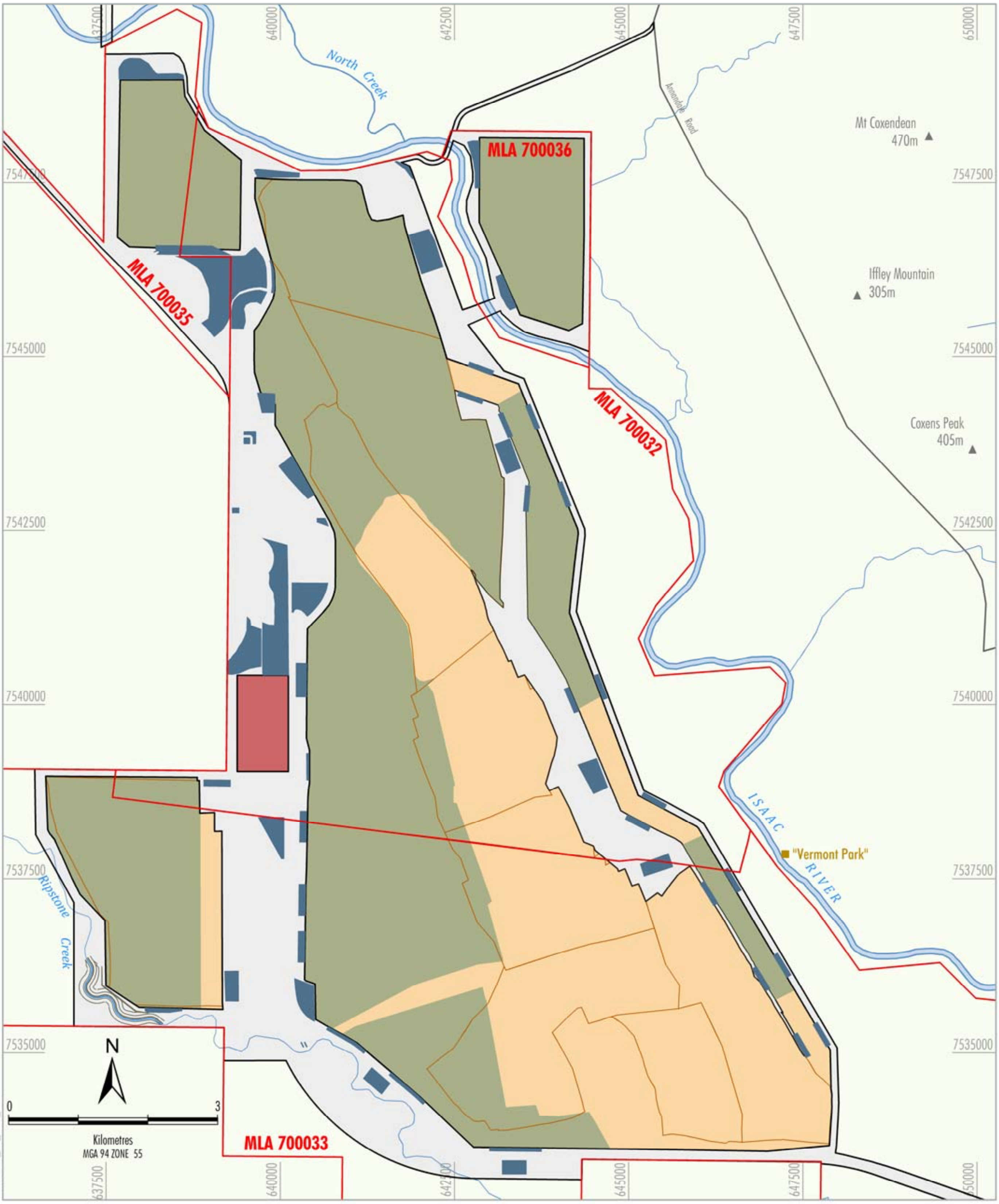
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain
Progressive Rehabilitation - 2050

Figure 5-10



LEGEND

- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of ILF Cells
- Extent of Water Management

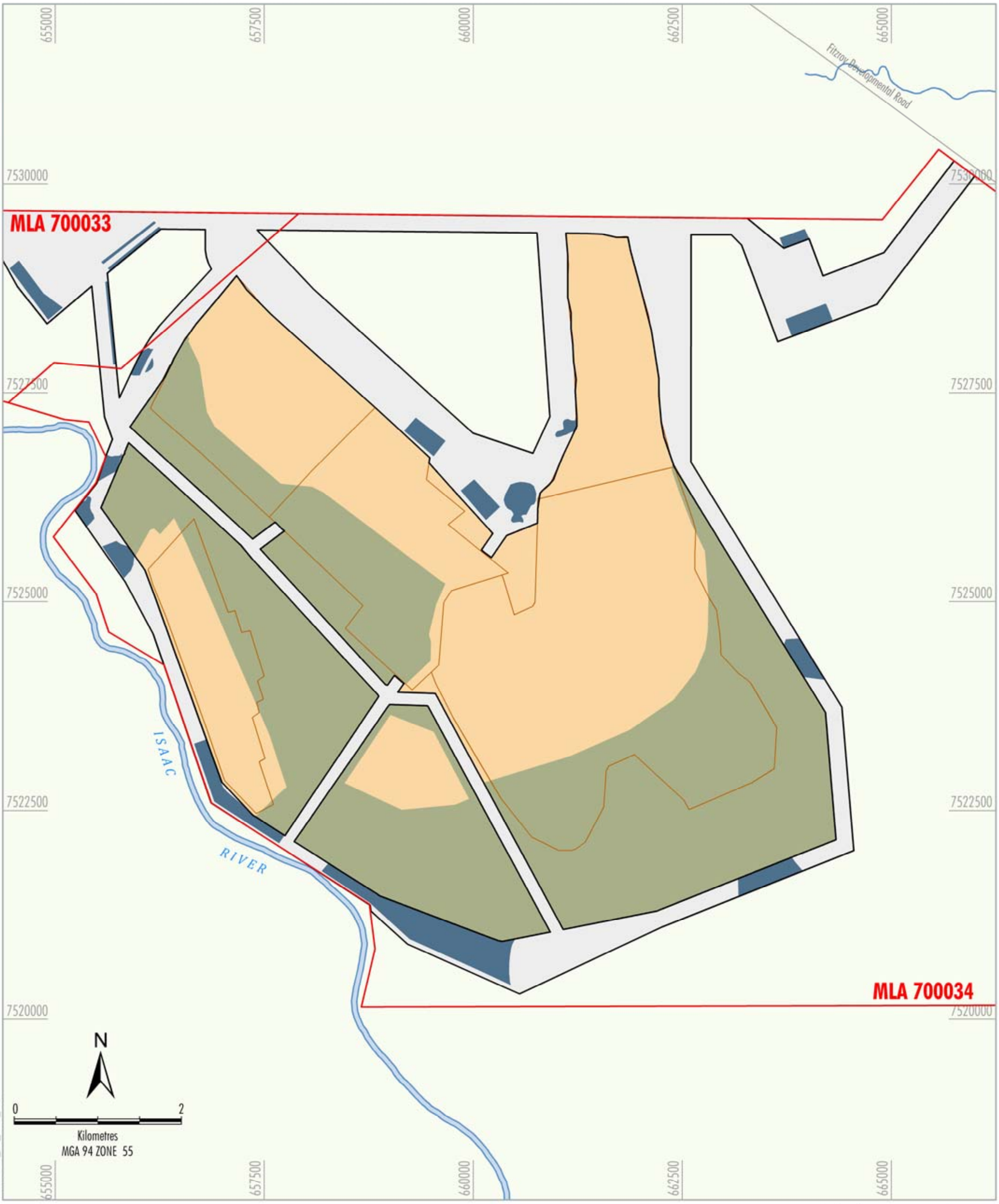
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2060

Figure 5-11



LEGEND
- Mining Lease Boundary
- Watercourse
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of Water Management

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

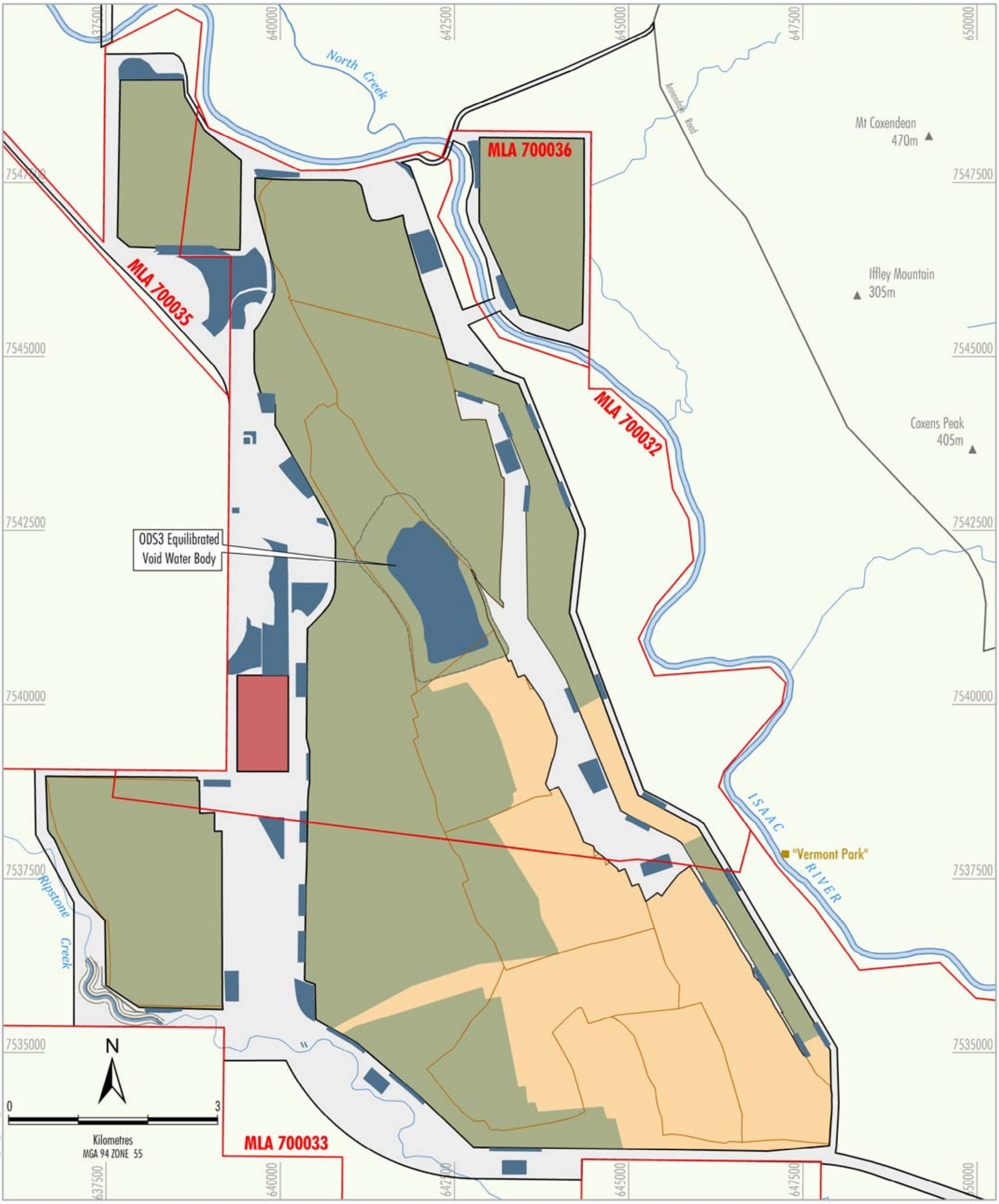
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain

Progressive Rehabilitation - 2060

Figure 5-12



LEGEND
- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of ILF Cells
- Extent of Water Management
- Final Void Extent

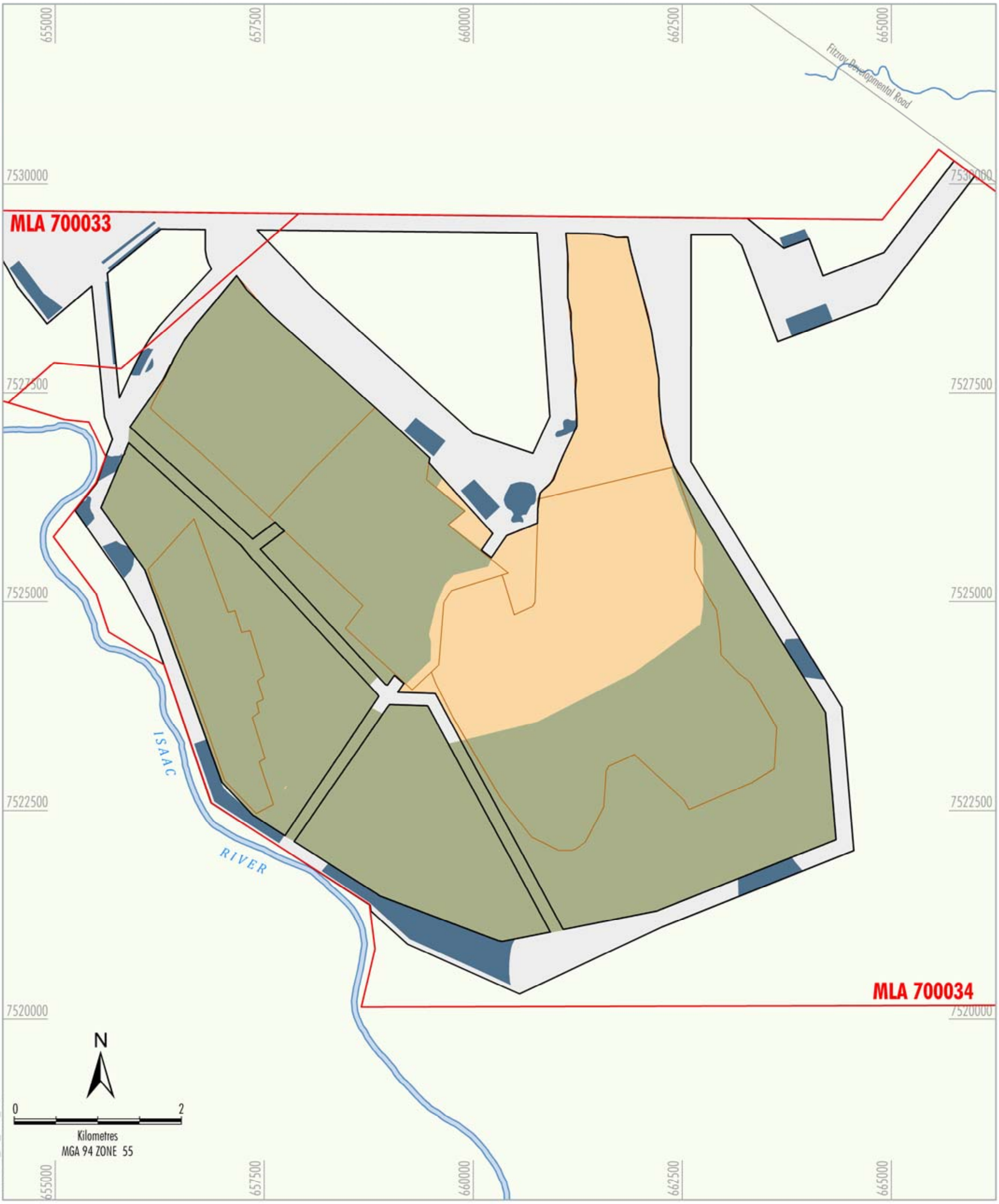
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2072

Figure 5-13

TOC



LEGEND
- Mining Lease Boundary
- Watercourse
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of Water Management

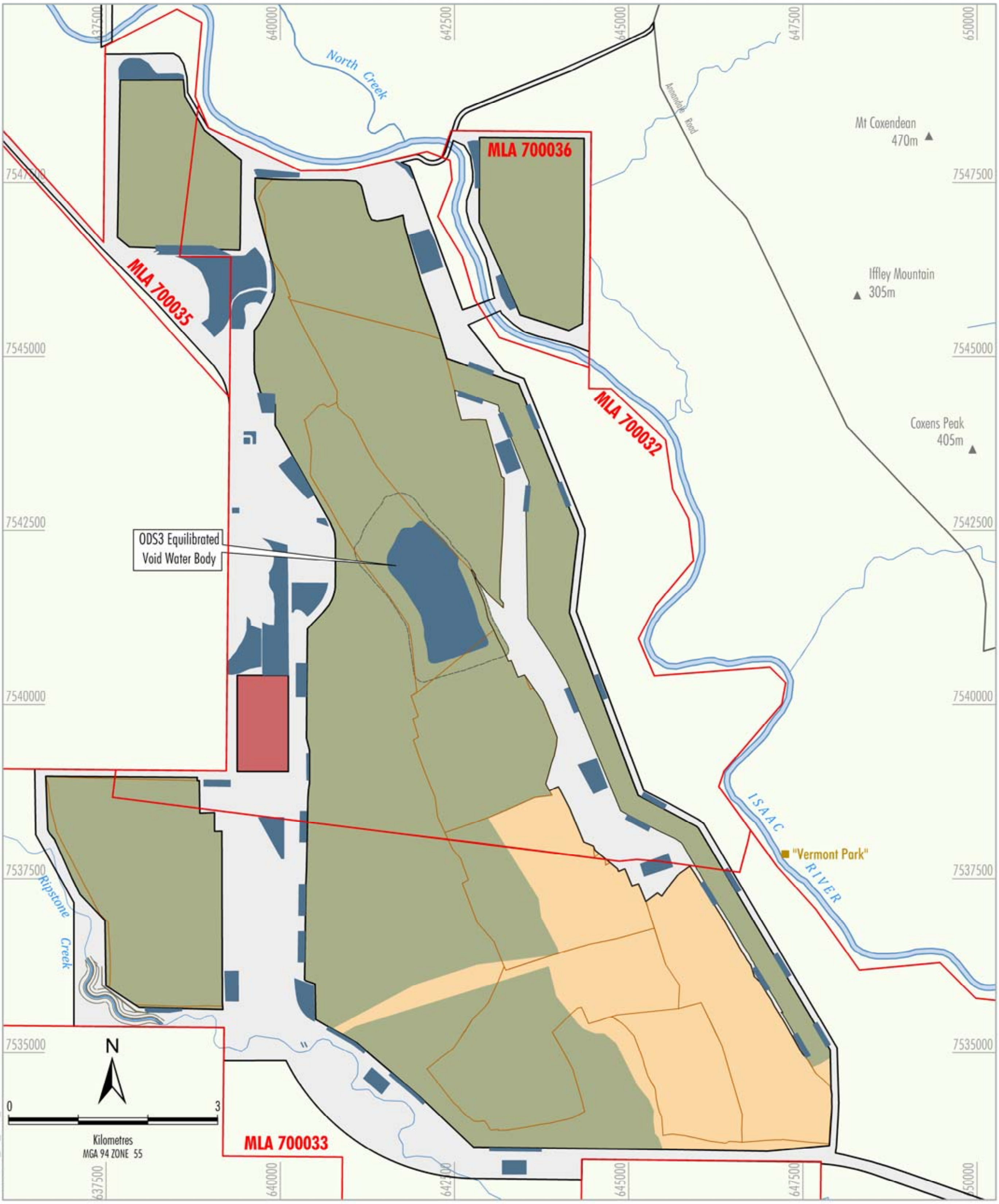
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain

Progressive Rehabilitation - 2072

Figure 5-14



LEGEND

- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of ILF Cells
- Extent of Water Management
- Final Void Extent

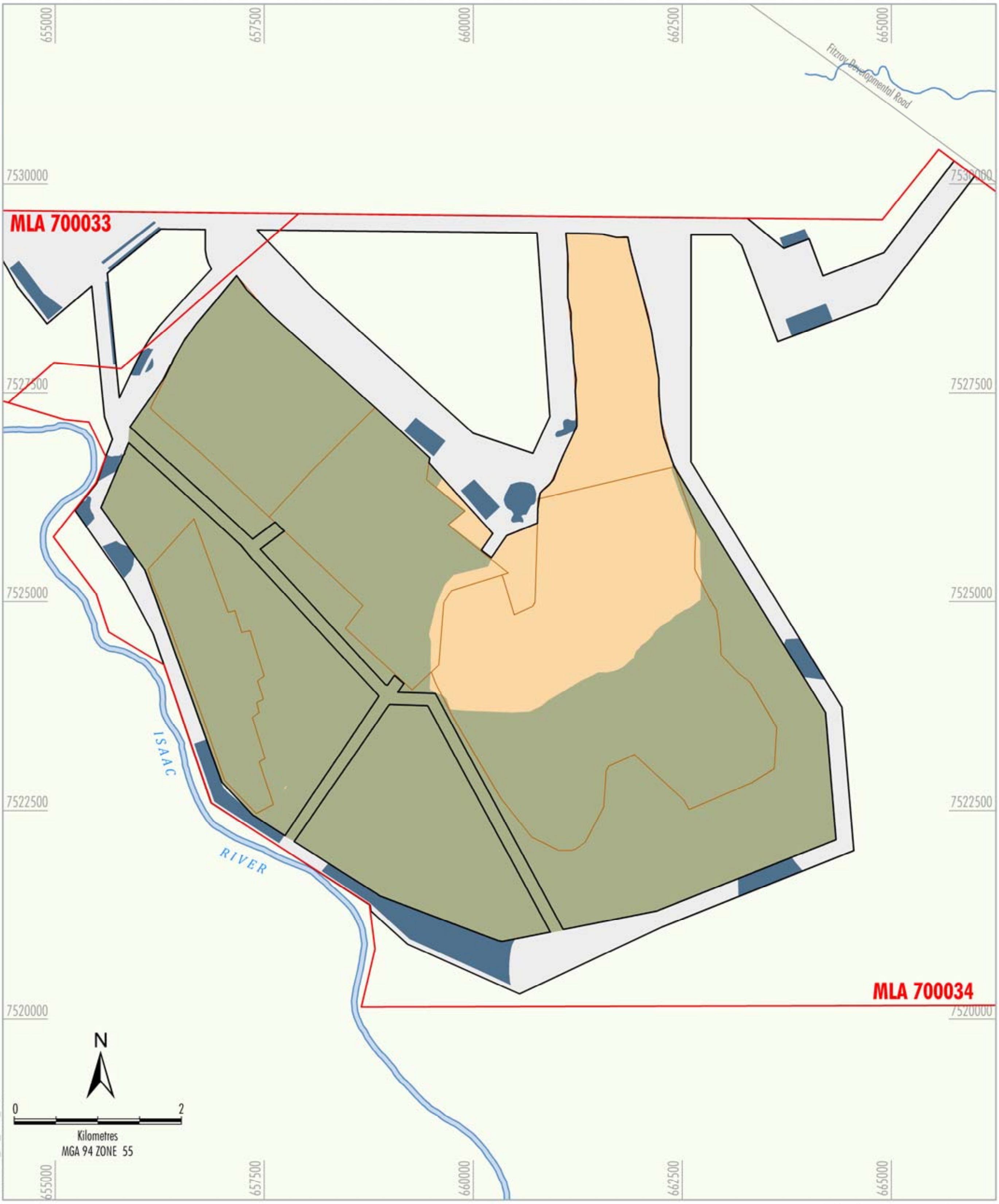
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2085

Figure 5-15



LEGEND
- Mining Lease Boundary
- Watercourse
- Open Cut Pit Extents
- Rehabilitation Extent
- Infrastructure Area
- Extent of Waste Rock Emplacement
- Extent of Water Management

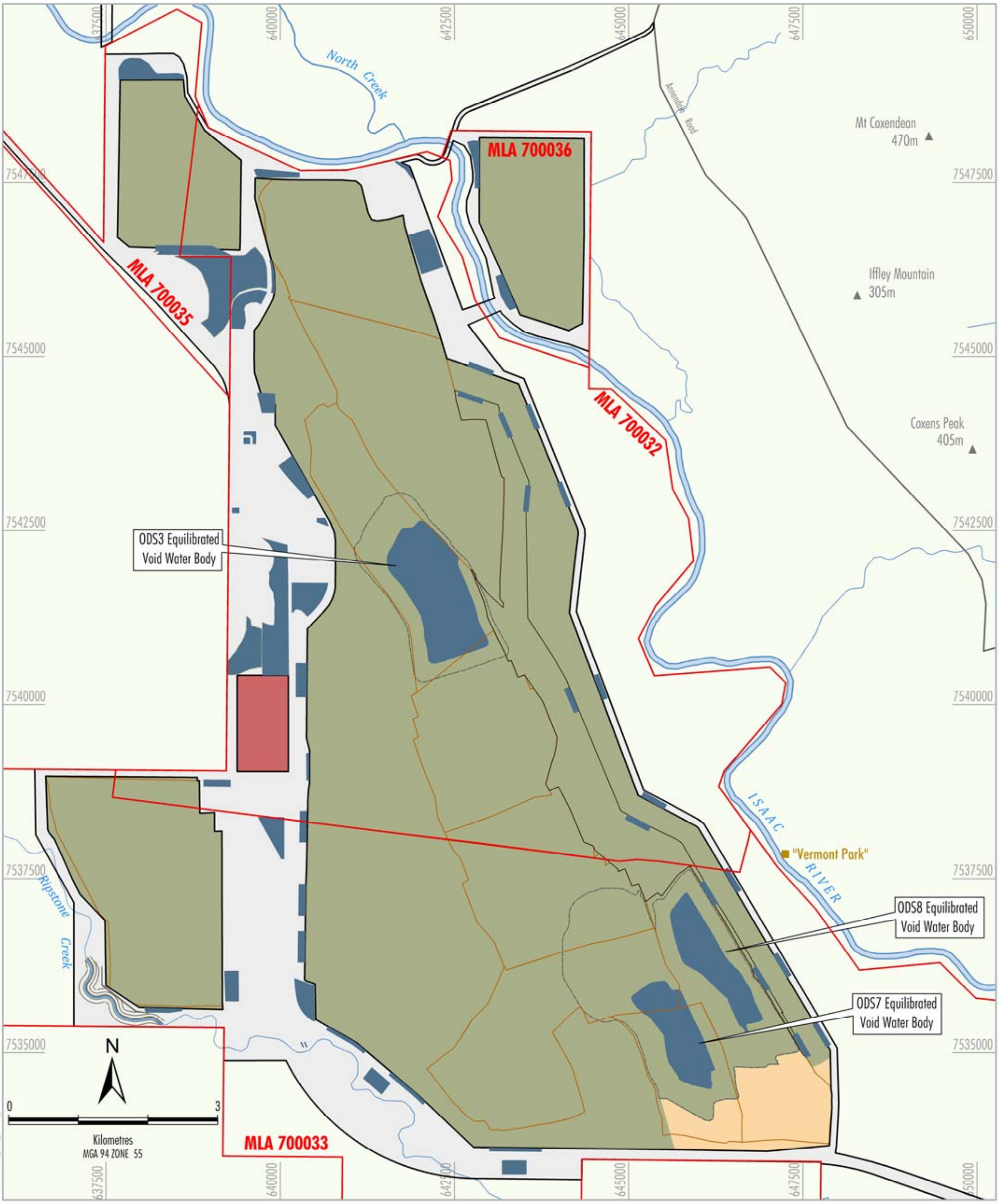
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain
Progressive Rehabilitation - 2085

Figure 5-16



LEGEND
Mining Lease Boundary
Watercourse
Proposed Creek Diversion
Dwelling
Open Cut Pit Extents
Rehabilitation Extent
Infrastructure Area
Extent of Waste Rock Emplacement
Extent of ILF Cells
Extent of Water Management
Final Void Extent

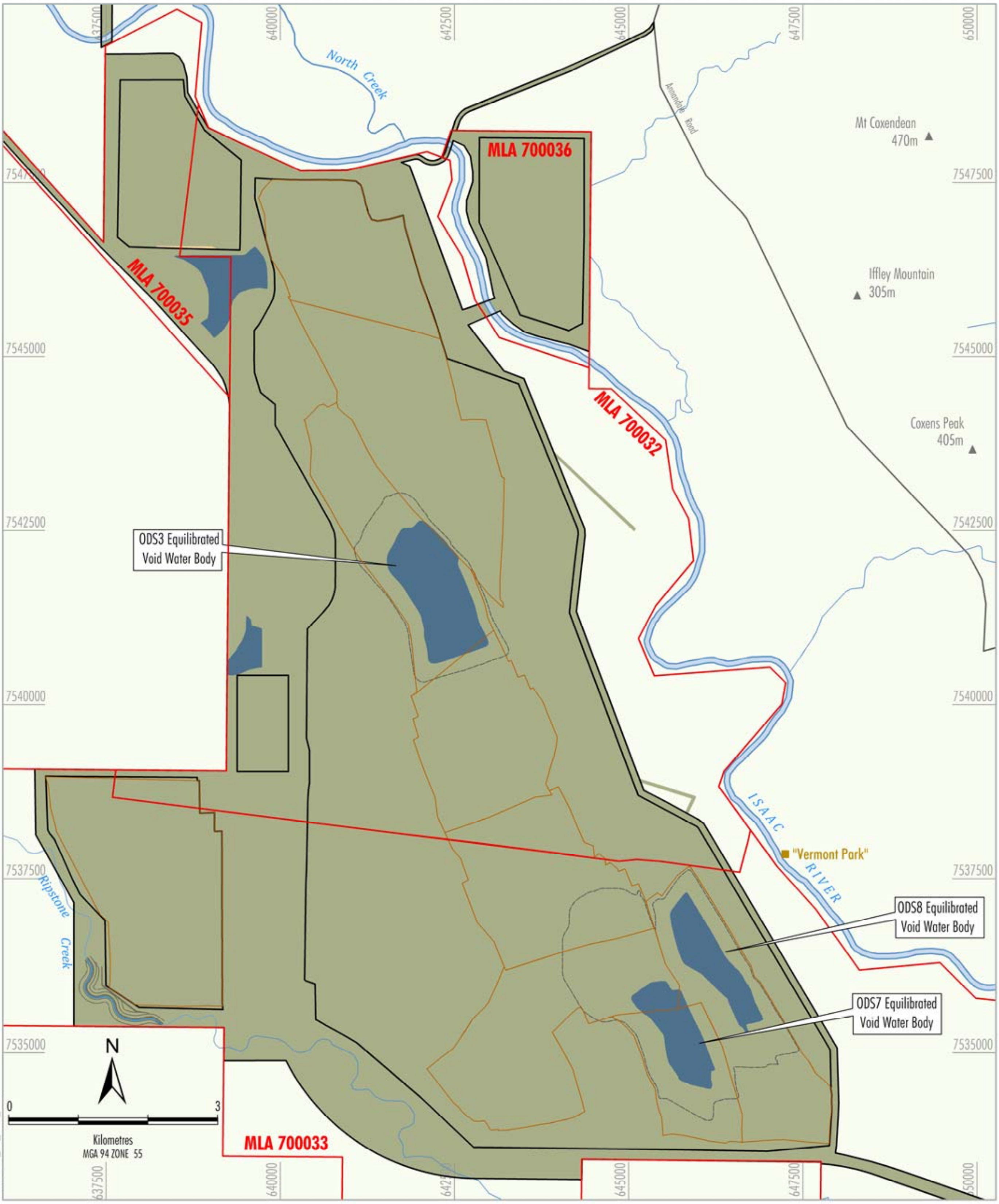
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - 2098

Figure 5-17



LEGEND
- Mining Lease Boundary
- Watercourse
- Proposed Creek Diversion
- Dwelling
- Open Cut Pit Extents
- Rehabilitated Project Landform
- Extent of Water Management
- Final Void Extent

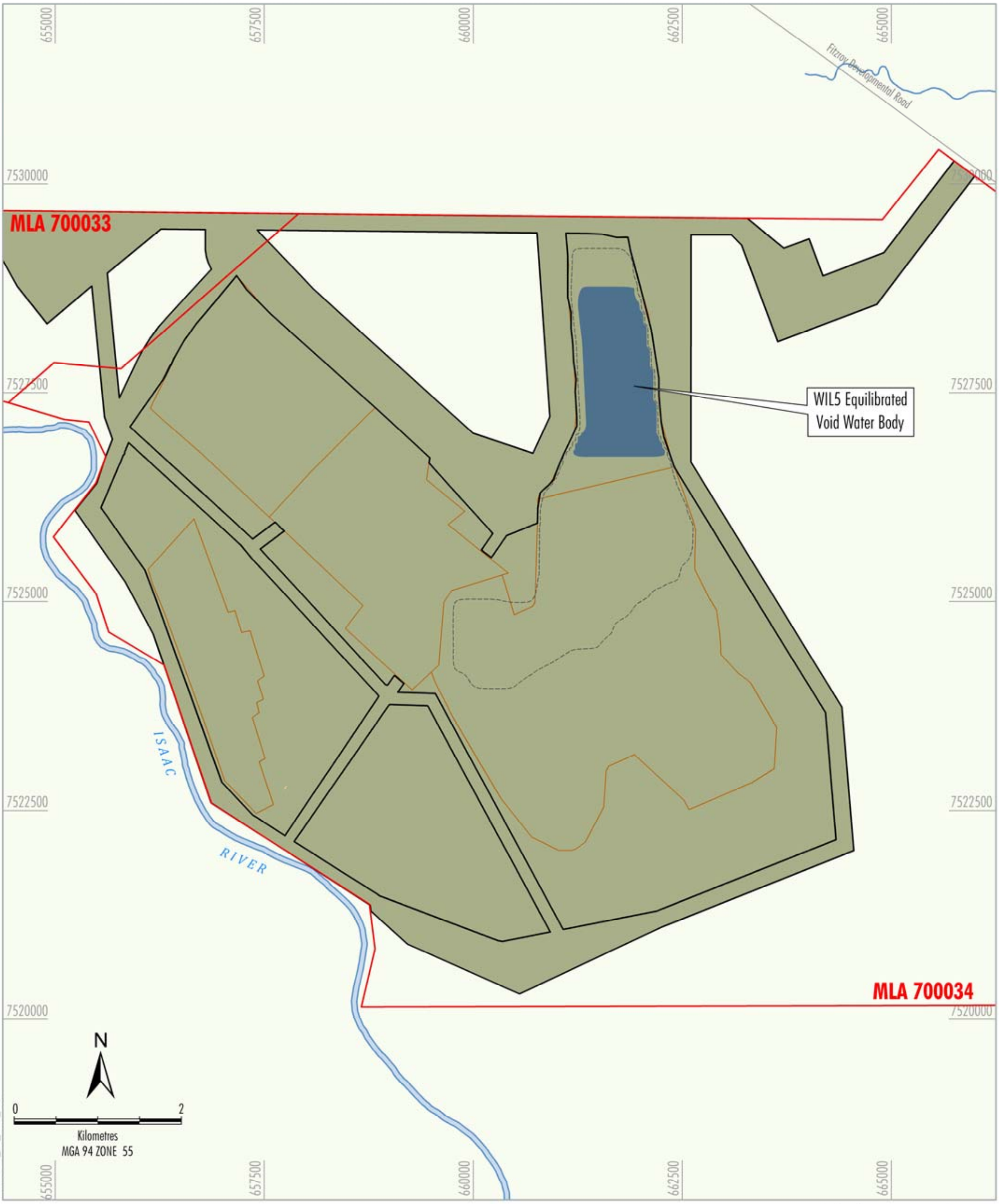
Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
Progressive Rehabilitation - Final

Figure 5-18



LEGEND
- Mining Lease Boundary
- Watercourse
- Open Cut Pit Extents
- Rehabilitation Extent
- Extent of Water Management
- Final Void Extent

Source: Pembroke (2018); Department of Natural Resources, Mines and Energy (2018)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Willunga Domain
Progressive Rehabilitation - Final

Figure 5-19

Table 5-5
Indicative Progressive Rehabilitation Schedule

Project Stage	Rehabilitation Domain (ha)				
	Waste Rock Emplacements	Final Voids	Infrastructure Areas	Water Management Infrastructure	ILF Cells
Stage 1 (2030)	1,280	0	0	0	0
Stage 2 (2040)	3,125	0	0	0	0
Stage 3 (2050)	5,110	0	0	0	0
Stage 4 (2060)	6,480	0	0	0	0
Stage 5 (2072)	8,098	155	0	0	0
Stage 6 (2085)	8,921	155	0	0	0
Stage 7 (2098)	9,725	650	430	0	0
Decommissioning (2100)	9,955	1,105	4,120	570	145

Woody vegetation salvaged from clearing may be spread on rehabilitated areas to assist natural regeneration, erosion control and provide habitats for native fauna. Salvaged vegetation would be stored adjacent to areas undergoing rehabilitation or in the footprint of future mining areas.

5.3.3 Topsoil Management

Soil stripping and handling measures would be undertaken in accordance with a Topsoil Management Plan to be developed for the Project.

A topsoil inventory would be maintained during the life of the Project and detailed in the Topsoil Management Plan. The topsoil inventory would account for the volumes and locations of topsoil to be progressively stripped, stockpiled and reapplied.

The soil inventory would be used for early identification of potential issues such as soil balance deficits or poorer quality soils, enabling remedial actions such as soil improvement (including treatment if necessary) to be planned well in advance of mining operations.

The Topsoil Management Plan would describe measures to ensure the stability and minimise the release of contaminants from stockpiles by installation of sediment fences and/or up-catchment diversions, minimising the stockpile heights (i.e. up to approximately 3 m), maintaining stockpile slopes (i.e. no greater than 1:3), vegetating stockpiles and re-using stockpiles as soon as possible.

Soil Reserves

GT Environmental (2018a) has completed a preliminary soil balance to determine the quality and quantity of soil available for rehabilitation over the Project disturbance footprint (Appendix M).

The assessment identified the limitations of each of the soil management units and recommended topsoil and subsoil stripping depths.

All the topsoil reserves across the Project area are considered suitable for supporting native vegetation and grasses in rehabilitation activities (Appendix M). Subsoil reserves are suitable for capping materials and supporting material for topsoil, by either selectively placing below the topsoil to increase total soil depth or mixing with topsoil to increase soil fertility and increasing the topsoil reserves.

Recommended topsoil stripping depths varies across the Project area (based on the soil management units), and generally ranges from 0.1 m to 0.5 m. Additional subsoil resources were identified that could be stripped and used for rehabilitation purposes, if required.

GT Environmental recommends a topsoil application depth of 0.2 m to 0.3 m as part of rehabilitation activities. The estimated volume of soil required for rehabilitation activities at the Project, would range from approximately 31,000,000 m^3 to 46,000,000 m^3, based on application depths of 0.2 m and 0.3 m respectively.

The results of the preliminary soil balance calculations are summarised in Table 5-6. The balance indicates that sufficient topsoil would be available for rehabilitation, using an application depth of 0.2 m. Where the final landform would support more productive grazing (e.g. in flatter areas adjacent to existing grazing areas), additional topsoil would be applied (e.g. up to 0.3 m depth) to improve the final land use outcome.

Table 5-6
Preliminary Soil Balance

Soil Mapping Unit	Recommended Topsoil Stripping Depth (mbgl)	Recommended Subsoil Stripping Depth (mbgl)	Soil Mapping Unit Area (ha)	Approximate Topsoil Volume (m^3)
C1	0.10	0.10-1.00	4,541	4,540,900
C2	0.20	0.20-1.00	3,082	6,163,400
S1	0.30	0.30-1.00	2,895	8,685,000
S2	0.50	0.50-1.00	1,573	7,863,000
R1	0.35	0.35-1.00	892	3,121,800
R2	0.50	0.50-1.00	783	3,915,600
L1	0.10	0.10-0.35	178	178,300
L2	0.30	0.30-1.00	272	815,900
B1	0.30	0.30-1.00	1,198	3,593,200
B2	0.20	0.20-0.50	475	949,300
A1	0.40	0.40-1.00	92	368,300
A2	0.15	0.15-1.00	380	569,500
Total for Project			**16,361**	**40,764,200**

Source: After Appendix M.

Subsoil may also be selectively stockpiled to make up any unexpected shortfalls over the Project life.

Further details of the soil resources, stripping depth recommendations and stockpile management is presented in Appendix M.

5.3.4 Erosion and Sediment Control Plan

Erosion and sediment control works would be conducted in accordance with management methods to be described in an Erosion and Sediment Control Plan for the Project.

Elevated landforms (i.e. waste rock emplacements) would be rehabilitated as soon as practicable (e.g. by establishment of a protective vegetation cover [i.e. cover crop], construction of graded banks, rock-lined waterways, and/or diversion banks) to minimise potential for release of sediment-laden surface runoff.

Exposed surfaces would be ripped and left rough to minimise erosive potential.

Surface runoff from the waste rock emplacements would be directed to dedicated sediment dams. If necessary, perimeter drains would be installed around the toe of the waste rock emplacements.

During mine operations, erosion and sediment control structures would be designed and installed in accordance with the *Best Practice Erosion and Sediment Control* (International Erosion Control Association Australasia, 2008) and *Soil Erosion and Sediment Control Engineering Guidelines for Queensland Construction Sites* (IE Aust [Qld], 1996).

Erosion and sediment control structures would not be removed until disturbed areas have been stabilised and ground cover has established, and where runoff has similar water quality characteristics to areas that are undisturbed by mining activities.

5.3.5 Revegetation Program

Following establishment of a protective vegetation cover (i.e. cover crop), vegetation would be established as soon as practicable to prevent slope face degradation. Consistent with the vegetation currently present on-site, the areas of the final landform that are proposed to be revegetated to grazing land would comprise a combination of grass species including Buffel Grass (*Cenchrus ciliaris*), Wiregrass (*Aristida sp*) and Kangaroo Grass (*Themeda triandra*).

Species that would be used in establishment of Eucalypt woodland areas (i.e. along the highwall emplacements, near final voids and near watercourses) would comprise predominantly Poplar Box (*Eucalyptus populnea*), Clarkson's Bloodwood (*Corymbia clarksoniana*) and Broad-leaved Ironbark (*Eucalyptus fibrosa*).

Seeding activities would be timed to ensure best possible germination rates are achieved (i.e. not prior to heavy rainfall and not during winter when rainfall is generally low). Seed selection would involve species which are suitable for the growth in the area. Pembroke would either harvest seed locally or purchase commercially with priority placed on locally sourced product.

In addition to establishing vegetation on rehabilitated mining landforms, vegetation would also be encouraged to grow (e.g. through exclusion of grazing) or actively seeded/planted between the mining area and the Isaac River and along the river banks where localised areas of increased velocity are predicted during flood events (Section 4.4.3). This would assist in stabilising these areas to resist erosion during flood events.

5.3.6 Weed Management

A Weed and Pest Management Plan will be implemented at the Project to prevent the spread of weeds off-site and the introduction of new weeds onto the site.

Weed control would be implemented in key areas as required and any weeds present would be controlled (e.g. if a Declared Weed was found on-site, or if the weeds were likely to impact on revegetation success).

Weed and pest control measures for the Project are described further in Section 4.13.

5.3.7 Exploration Areas

Disturbance due to exploration activities in areas not scheduled or authorised to be mined within two years would be rehabilitated in accordance with provisions detailed in the *Code of Environmental Compliance for Exploration and Mineral Development Projects* (DEHP, 2013c).

5.3.8 Decommissioning

All infrastructure associated with the Project would be assessed on an individual basis for possible removal or to be retained for future land owners. Where infrastructure is removed, the land would be re-contoured, topsoiled, ripped and seeded. All disturbed areas would be rehabilitated with an appropriate seed mix to enable revegetation.

Potentially contaminated areas will undergo Stage 1 and Stage 2 contaminated land assessments and a Remediation Plan will be developed.

Remediation works would be undertaken to remove contaminated material, or rip, cap and topsoil inert areas. Areas would then be seeded with native grasses.

Decommissioning of the Project would be conducted progressively towards the end of the mine life, as infrastructure and operational areas are no longer required.

As shown on Chart 2-1 (Section 2.5.1), the ROM coal production rate tapers off over the last 20 years of the Project. During this period, decommissioning of infrastructure would commence as less demand is placed on the coal handling and processing equipment, and infrastructure areas in general. This period of the mine life would provide a good opportunity for decommissioning of large parts of the Project, when product coal would still be produced, supporting decommissioning exercises which would otherwise be left to after the completion of mining activities.

It is anticipated that all Project infrastructure would be decommissioned within two years of the completion of mining operations.

5.4 REHABILITATION MONITORING

The rehabilitation monitoring program for the Project would be designed to track the progress of revegetation and to determine the requirement for intervention measures, such as alternate species or species mix, thinning to reduce the density of revegetated areas, or additional plantings in areas where vegetation establishment has been sub-optimal.

The Project rehabilitation monitoring program would be documented in the Rehabilitation and Mine Closure Plan (Section 5.6) and would describe the methods that would be used to:

- evaluate the coverage and application of soil prior to seeding;
- monitor drains and assess water quality to determine whether substantial silting of inverts and/or any localised failure of drain embankments has occurred;
- evaluate areas recently covered with soil after rain events (particularly on sloping ground) to assess whether significant rilling or loss of soil has occurred;
- evaluate the behaviour of placed soil over time (i.e. erosion or dispersion, compaction, salting or hard setting);
- assess the initial germination success in revegetation areas (including recording of diversity and abundance);

- monitor revegetation success over time (e.g. survival rate, plant growth, species diversity, weed content, fauna usage);
- evaluate potential threats to rehabilitated areas (e.g. weed invasion, pest species, dispersive soils or potentially acid forming-low capacity materials, erosion); and
- record key rehabilitation information (e.g. photographic records, surveys).

Revegetation surveys would be undertaken by an appropriately qualified and experienced person to identify the success of rehabilitation and identify any additional measures required to achieve ongoing rehabilitation success. The frequency of surveys would be six monthly initially, with the frequency reviewed based on monitoring results. A detailed monitoring report would be prepared that includes a summary of previous monitoring reports, results of the current year's monitoring and planned remedial works, if required.

Remedial works could include:

- weed management to limit the spread and colonisation of weeds, including mechanical removal and application of herbicides;
- additional planting and/or seeding if revegetation is not progressing satisfactorily;
- implementation of additional erosion and sediment controls; and
- re-profiling of slopes to improve geotechnical stability and improve drainage.

5.5 REHABILITATION MILESTONES

Rehabilitation milestones would be established as significant steps in the rehabilitation process that are able to be used to demonstrate the progress of rehabilitation over time. The milestones would be developed as part of the Rehabilitation and Mine Closure Plan, in consultation with DES.

The development of rehabilitation milestones would generally be based on the following stages:

1. Active rehabilitation of land, e.g.:
    a. Removal of infrastructure.
    b. Landform development complete.
    c. Cover placement complete.
    d. Cover establishment complete.
2. Land rehabilitated to a safe, stable, non-polluting condition which is progressing towards achieving the completion criteria, e.g.:
    a. Landform assessed as being safe.
    b. Landform and vegetative cover demonstrated as being stable (e.g. across seasonal variations).
    c. Landform demonstrated as being non-polluting (e.g. through water quality monitoring).
3. Rehabilitation complete:
    a. Able to sustain the agreed post-mining land use.
    b. Completion criteria met.

5.6 REHABILITATION AND MINE CLOSURE PLAN

A Rehabilitation and Mine Closure Plan would be prepared for the Project and would develop on the preliminary rehabilitation requirements described in Table 5-2 (i.e. the rehabilitation goals, domains, objectives, performance indicators and completion criteria), in consultation with DES, and based on more detailed mine planning and scheduling information.

The Rehabilitation and Mine Closure Plan would contain landform design criteria (including end of mine design), schematic representation of the final landform, planned native vegetation rehabilitation areas and a description of post-mining land uses across the site, based on the conceptual post-mining land use described in Section 5.2.1.

The Rehabilitation and Mine Closure Plan would also describe maintenance requirements and include a contingency plan for rehabilitation maintenance or re-design, to be informed by rehabilitation monitoring (Section 5.4).

The Rehabilitation and Mine Closure Plan would include detailed and quantifiable performance measures and completion criteria for the Project. The rehabilitation performance measures and completion criteria included in the Rehabilitation and Mine Closure Plan would be specific, measureable, achievable, realistic and time-bound.

Mine closure planning has been a key consideration in the development of the mine schedule, conceptual final landform development and specialist environmental assessments, including consideration of:

- conceptual post-mining land uses (Section 5.2.1);
- final void design and consideration of long term environmental harm (Section 5.2.3);
- final landform stability and geotechnical considerations (Section 5.2.4); and
- social impacts (Appendix H).

Mine closure planning would continue to develop over the life of the Project and become more detailed as the Project approaches the end of the mine life (around 2100). Ongoing mine closure planning would be conducted in consultation with relevant State government agencies and the Isaac Regional Council.

The development of mine closure planning would be documented in iterations of the Rehabilitation and Mine Closure Plan.