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Olive Downs Coking Coal Project
Draft Environmental Impact Statement

Section 2

Project Description

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2 PROJECT DESCRIPTION

2.1 PROPOSED DEVELOPMENT

2.1.1 Project Title and Objective

This EIS has been prepared for the Olive Downs Coking Coal Project (the Project).

The Project is located within the Bowen Basin, approximately 40 km south-east of Moranbah, Queensland (Figure 1-1).

The Project provides an opportunity to develop a greenfield open cut mine metallurgical coal resource in an existing (brownfield) mining precinct for export of coking and PCI coal products to the steel production industry. The Project would produce up to 20 Mtpa of ROM coal over an anticipated operational life of approximately 79 years.

2.1.2 Nature and Scale of the Olive Downs Coking Coal Project

The Project comprises the Olive Downs South and Willunga domains and associated linear infrastructure corridors, including a rail spur connecting to the Norwich Park Branch Railway, a water pipeline connecting to the Eungella pipeline network, an ETL and access roads.

The maximum ROM coal production rate for the Project is expected to peak at approximately 20 Mtpa. Based on the indicative mine schedule for the life of the Project (Section 2.5.1), the maximum ROM coal production rate would occur from approximately 2034.

The proposed Olive Downs South domain open cut pit areas are generally aligned from north to south and are located on the western side of the Isaac River (Figure 2-1). At peak development of Olive Downs South domain, production of ROM coal is expected to reach approximately 12 Mtpa.

The proposed Willunga domain open cut mine areas are located on the eastern side of the Isaac River (Figure 2-2). The Willunga domain is expected to produce approximately 8 Mtpa of ROM coal at peak operation.

The approximate extent of the Project open cut mining area, waste rock emplacements and infrastructure areas (i.e. the Project disturbance footprint) is 16,300 hectares (ha).

For the purpose of this EIS, the ‘study area’ is defined as MLA 700032, MLA 700033, MLA 700034, MLA 700035 and MLA 700036 and the pipeline and ETL corridors where they area located outside the Project MLAs.

Open cut mining areas would be developed, and rehabilitated, in a progressive manner. The total extent does not equate to the total disturbance footprint at any one point in time. Staged mine plans are provided on Figures 2-3 to 2-9 which show the progressive development and rehabilitation of the open cut mining areas over the life of the Project. Figure 2-10 shows the progression of the open cut pits over the operational life of both the Olive Downs South and Willunga domains.

Mine support infrastructure would include a CHPP, mine offices, crib facilities, bathhouse, warehouse, workshops and re-fuelling facilities, ETLs, communication facilities and other associated amenities at the Olive Downs South and Willunga domains.

Access to the respective domains would be provided by two local access roads:

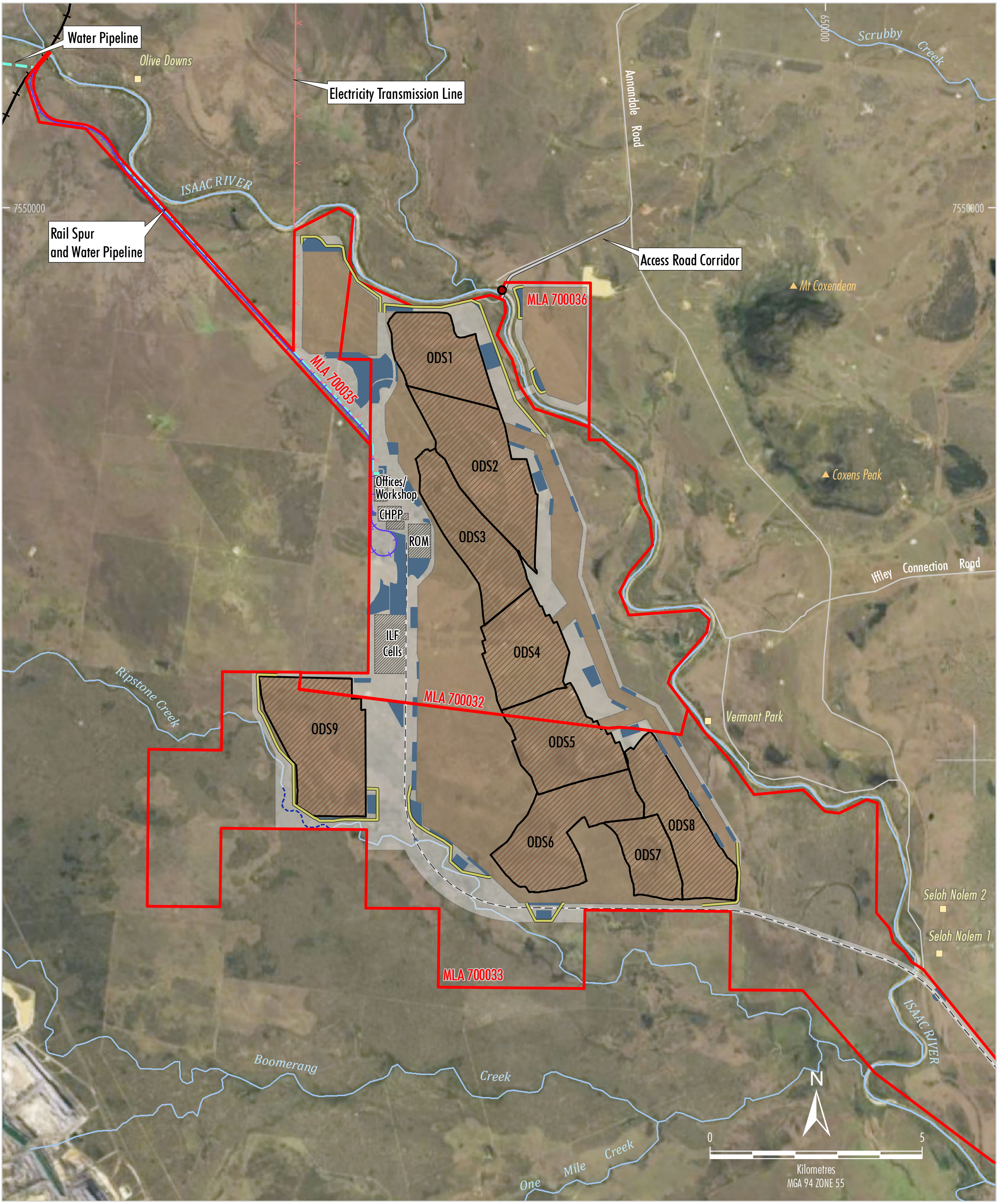
1. from Annandale Road to the Olive Downs South domain infrastructure area (including a crossing of the Isaac River); and
2. from the Fitzroy Developmental Road to the Willunga infrastructure facilities.

The Isaac River passes between the Olive Downs South and Willunga domains. The two domains would be connected by crossings of the Isaac River for vehicular access and transfer of crushed ROM coal via overland conveyor. A separate crossing of the Isaac River would also be utilised (subject to weather permitting) for waste rock emplacement and vehicular access in the north-east of the Olive Downs South domain.

2.1.3 Project Capital Expenditure

Total capital expenditure is estimated at $1,009 million (M) over the Project life (Appendix I). These development costs include an allowance for biodiversity offsets, funds for agreements with impacted landholders, funds for a road infrastructure arrangement with the Isaac Regional Council, and funding for impact management and monitoring.

The total estimated capital cost for development of Project infrastructure is approximately $980M.



LEGEND

- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Access Road
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline
- Proposed Creek Diversion
- Open Cut Pit Extent (and Pit Numbering)
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Water Storage
- Temporary Levee
- Overland Conveyor
- Olive Downs Water Pump

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

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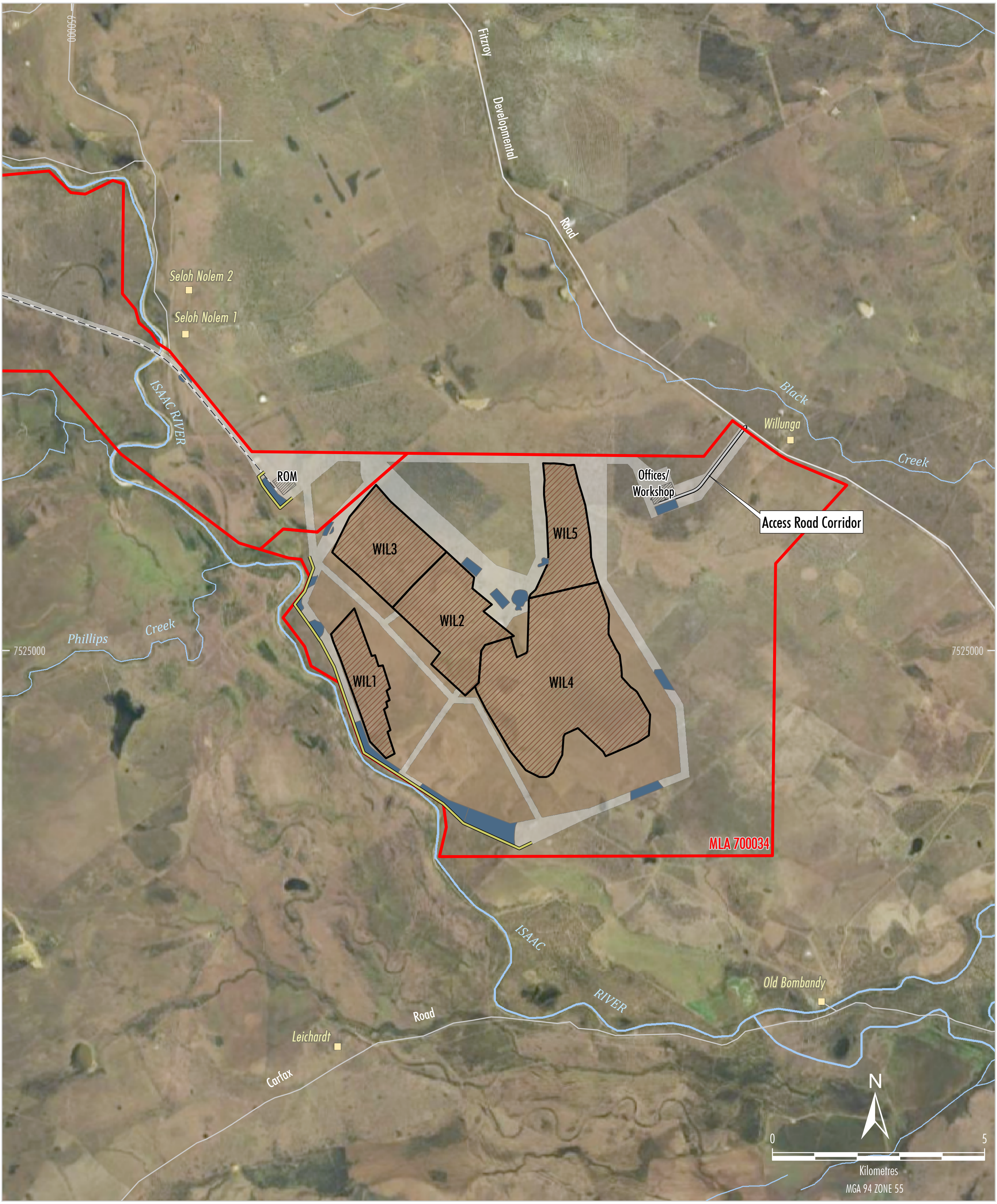
OLIVE DOWNS COKING COAL PROJECT

General Arrangement - Olive Downs South Domain

Figure 2-1



LEGEND

- Mining Lease Application Boundary
- Dwelling
- Open Cut Pit Extent (and Pit Numbering)
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Temporary Levee
- Water Storage
- Overland Conveyor
- Key Infrastructure Component

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

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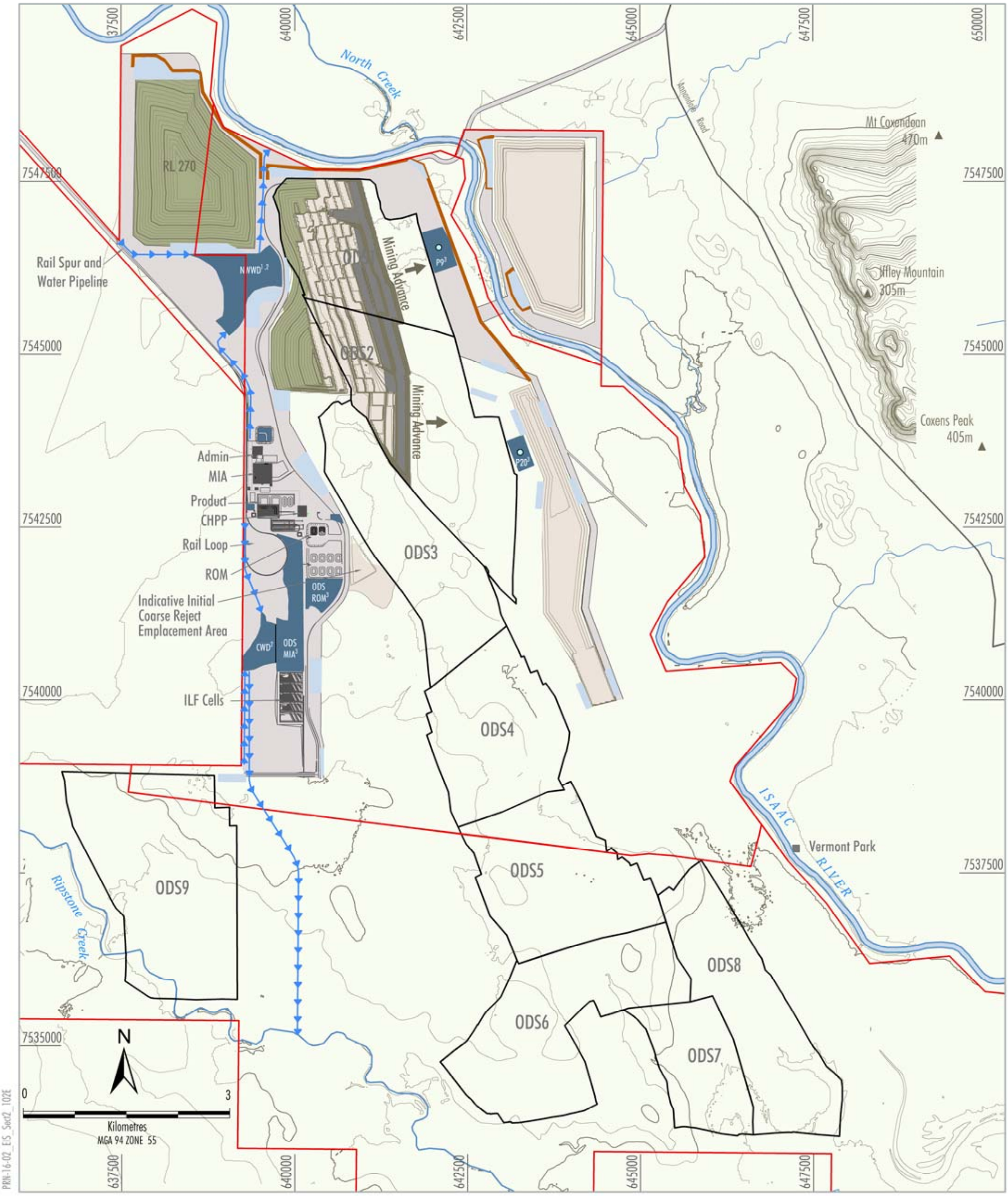
OLIVE DOWNS COKING COAL PROJECT

General Arrangement - Willunga Domain

Figure 2-2

TOC



LEGEND

- Mining Lease Application Boundary
- Drainage
- Infrastructure Area
- Active Open Cut
- Active Waste Rock Emplacement
- Rehabilitated Waste Rock Emplacement
- Temporary Flood Levee
- Water Storage
- Sediment Dam
- Controlled Released Point
- 1 Raw Water
- 2 Up-catchment Water
- 3 Mine Affected Water
- Drain

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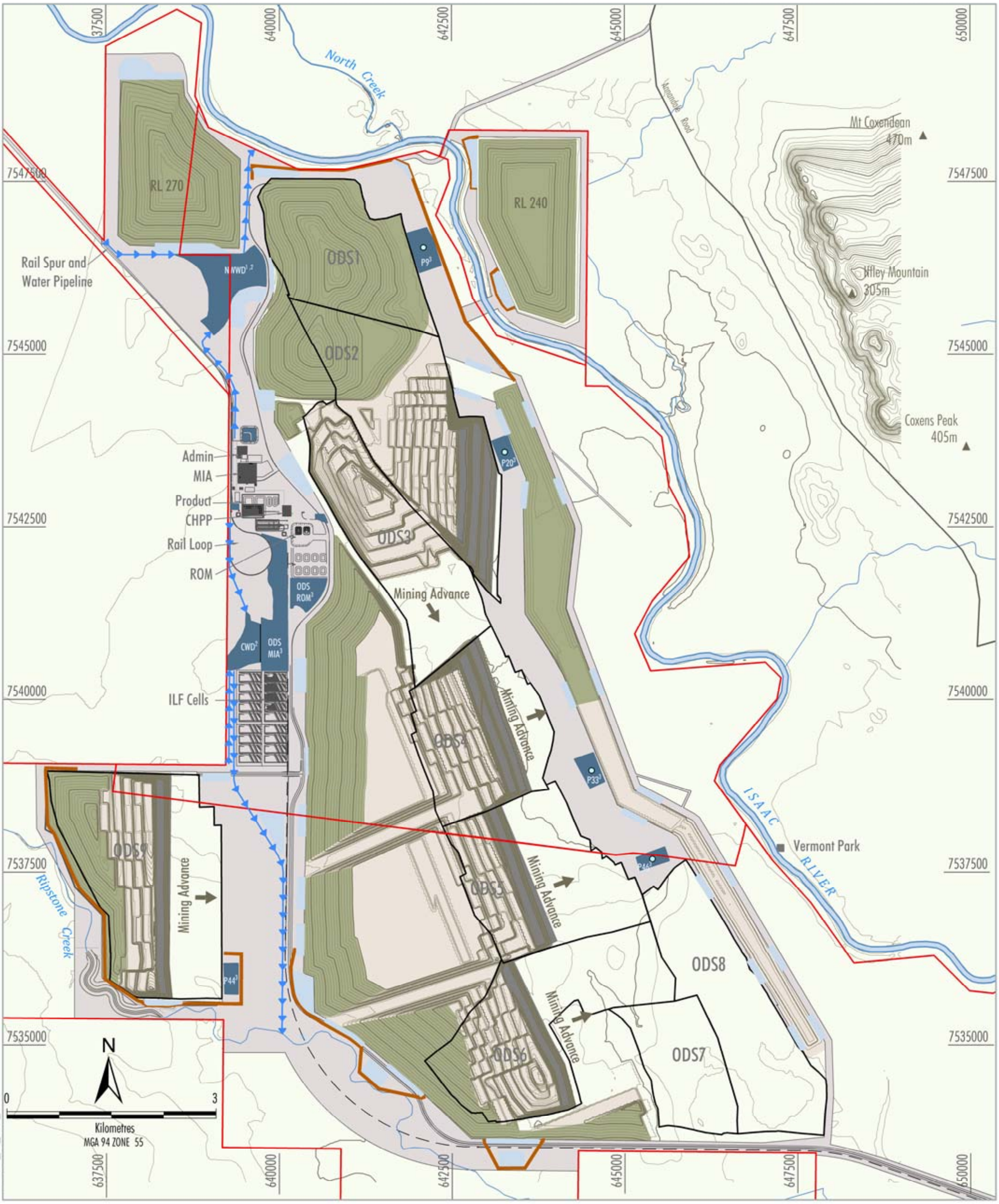
OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
General Arrangement - 2027

Figure 2-3



LEGEND

- Mining Lease Application Boundary
- Drainage
- Watercourse Diversion
- Infrastructure Area
- Active Open Cut
- Active Waste Rock Emplacement
- Rehabilitated Waste Rock Emplacement
- Temporary Flood Levee
- Overland Conveyor
- Water Storage
- Sediment Dam
- Controlled Released Point
- 1 Raw Water
- 2 Up-catchment Water
- 3 Mine Affected Water
- Drain

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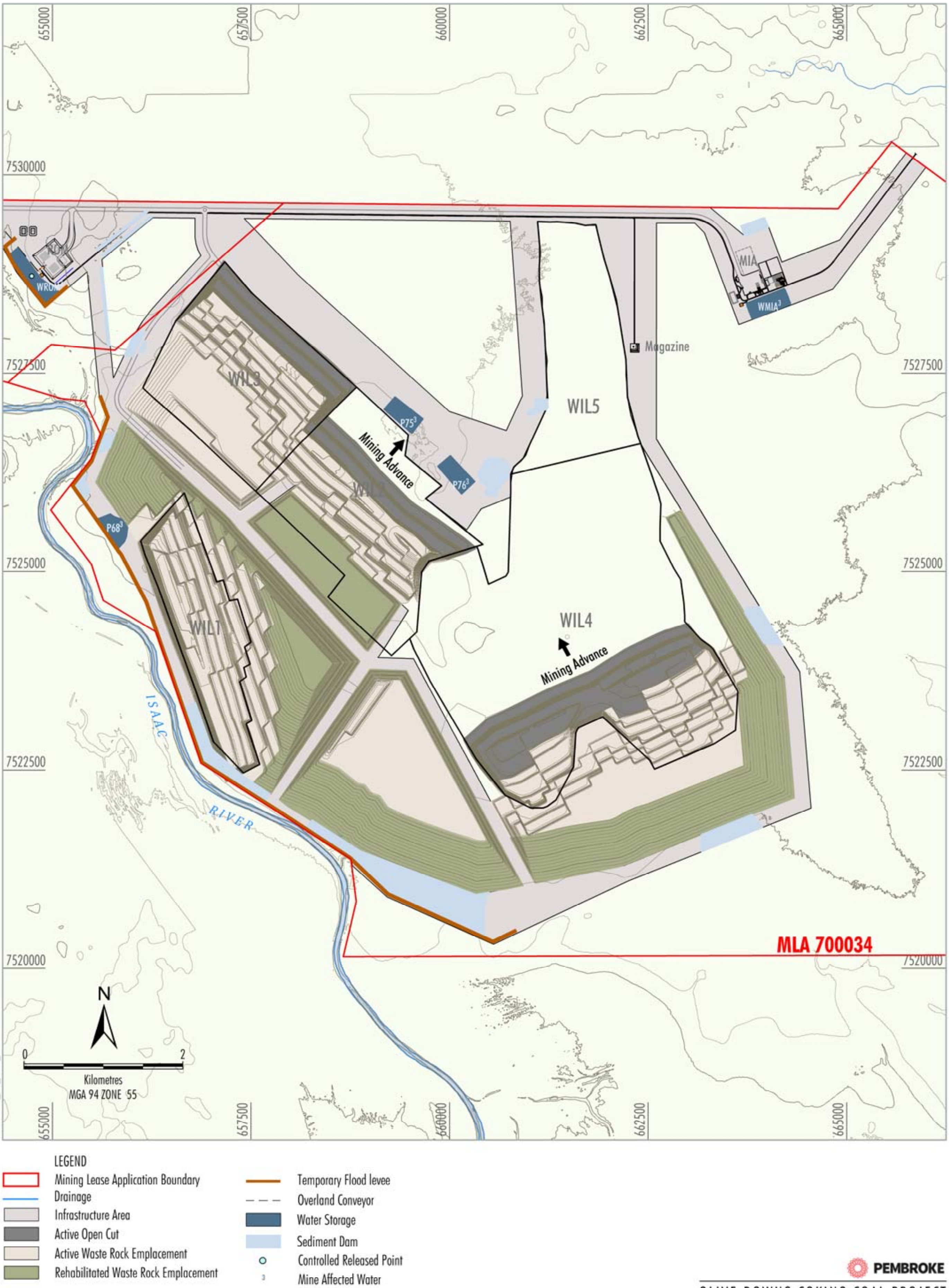
OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
General Arrangement - 2043

Figure 2-4



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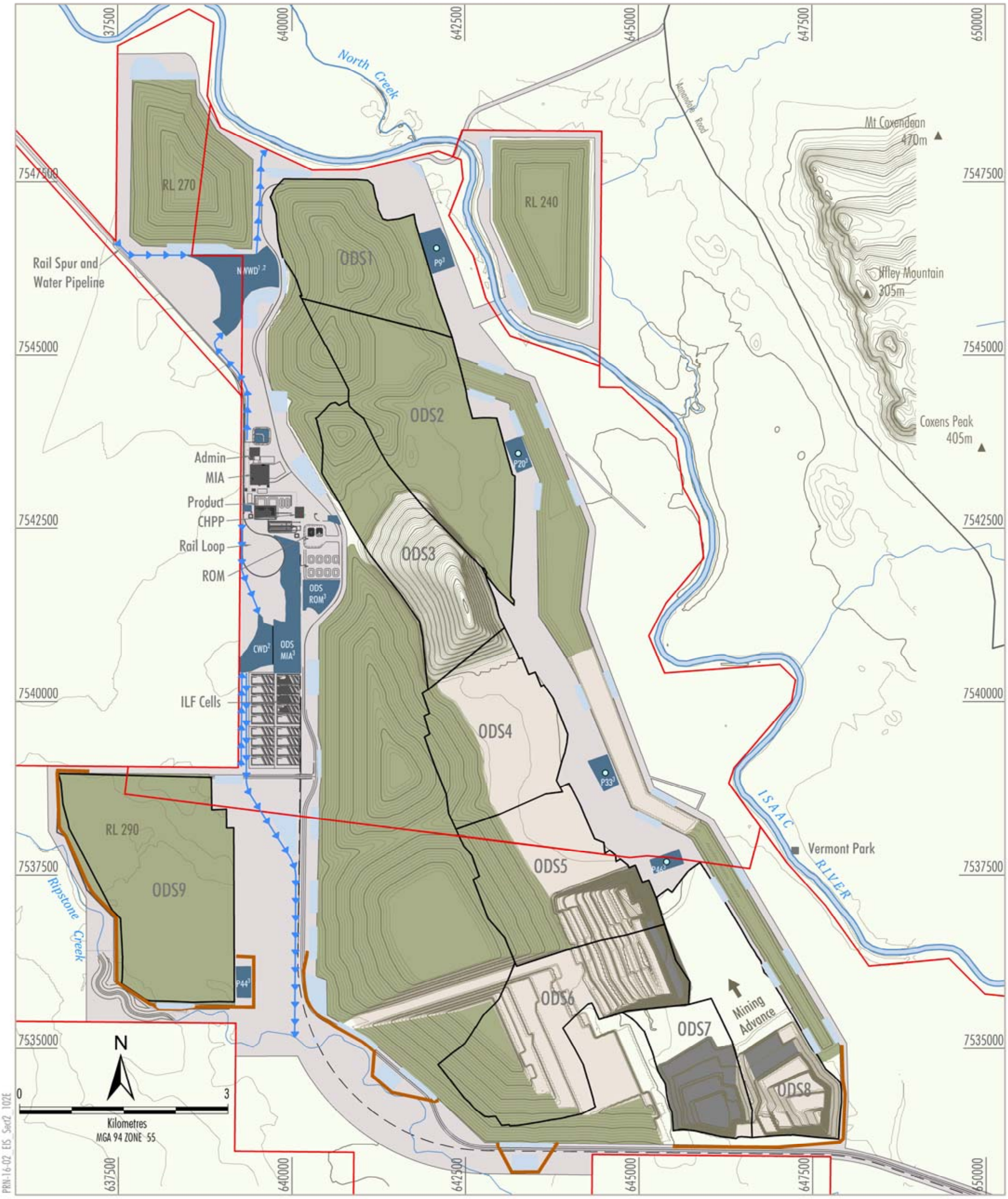
OLIVE DOWNS COKING COAL PROJECT

Willunga Domain

General Arrangement - 2043

Figure 2-5

TOC



LEGEND

- Mining Lease Application Boundary
- Drainage
- Watercourse Diversion
- Infrastructure Area
- Active Open Cut
- Active Waste Rock Emplacement
- Rehabilitated Waste Rock Emplacement
- Temporary Flood Levee
- Overland Conveyor
- Water Storage
- Sediment Dam
- Controlled Released Point
- 1 Raw Water
- 2 Up-catchment Water
- 3 Mine Affected Water
- Drain

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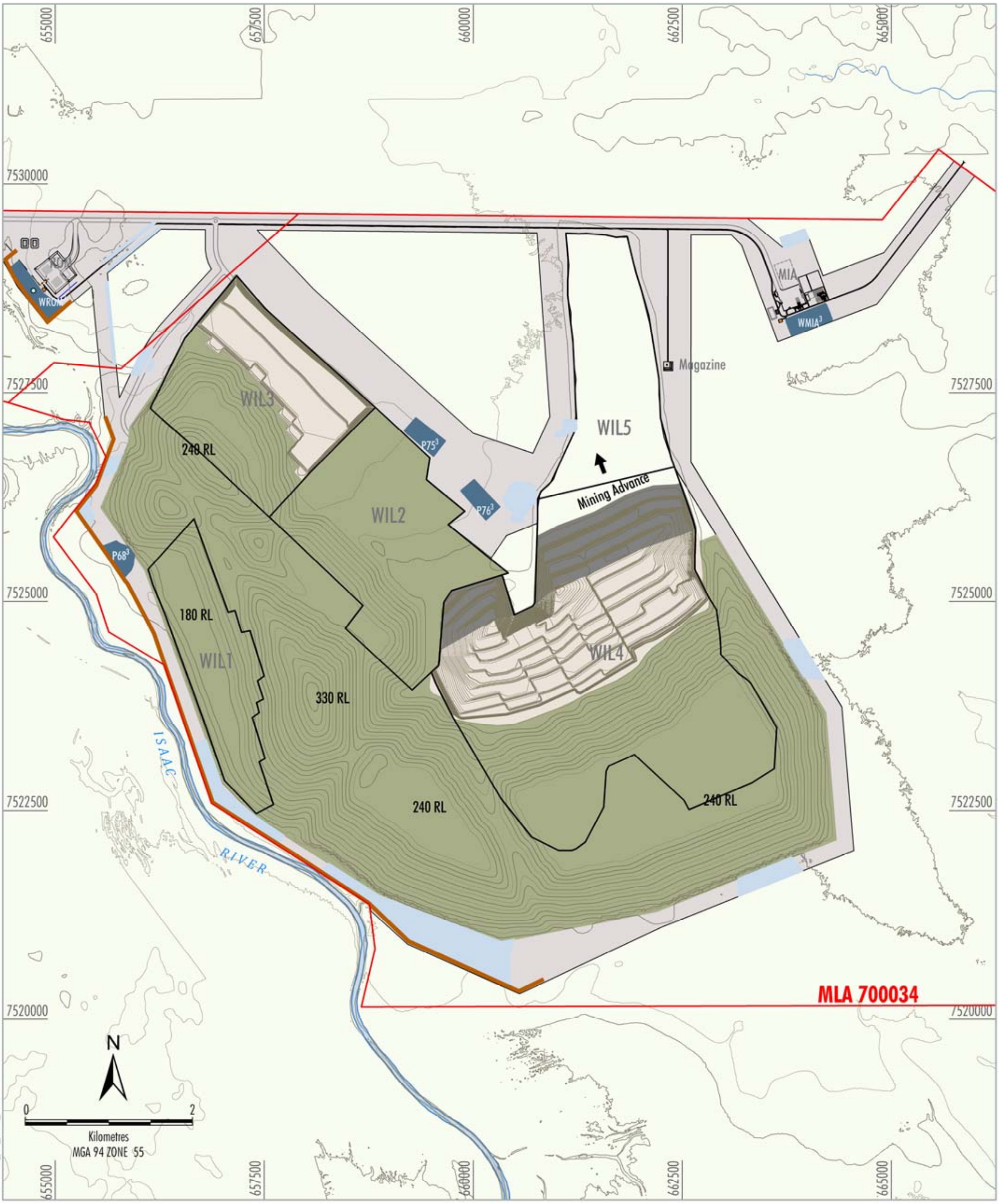
OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
General Arrangement - 2066

Figure 2-6



LEGEND
- Mining Lease Application Boundary
- Drainage
- Infrastructure Area
- Active Open Cut
- Active Waste Rock Emplacement
- Rehabilitated Waste Rock Emplacement
- Temporary Flood levee
- Overland Conveyor
- Water Storage
- Sediment Dam
- Controlled Released Point
- 3 Mine Affected Water

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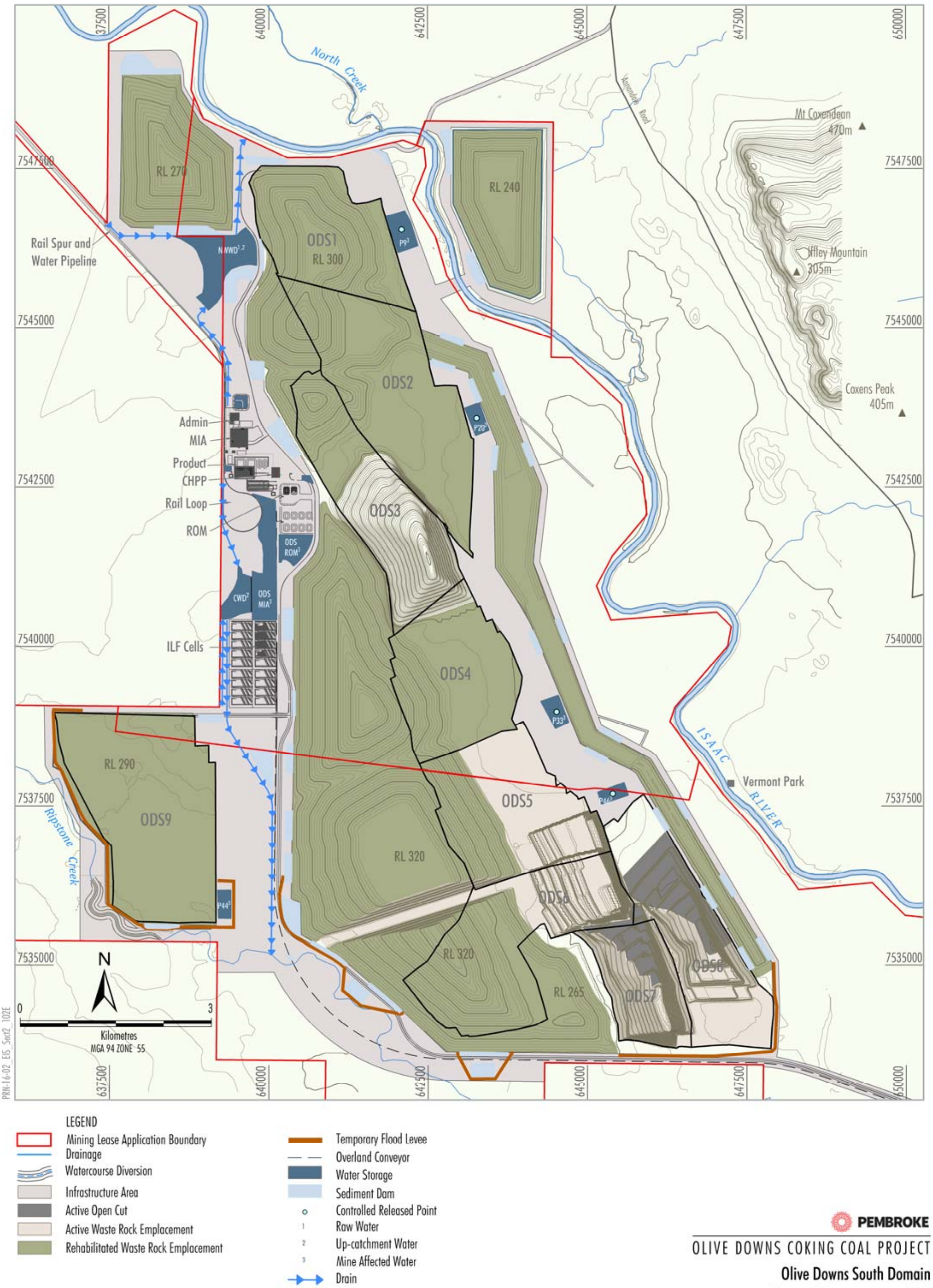
OLIVE DOWNS COKING COAL PROJECT

Willunga Domain
General Arrangement - 2066

Figure 2-7



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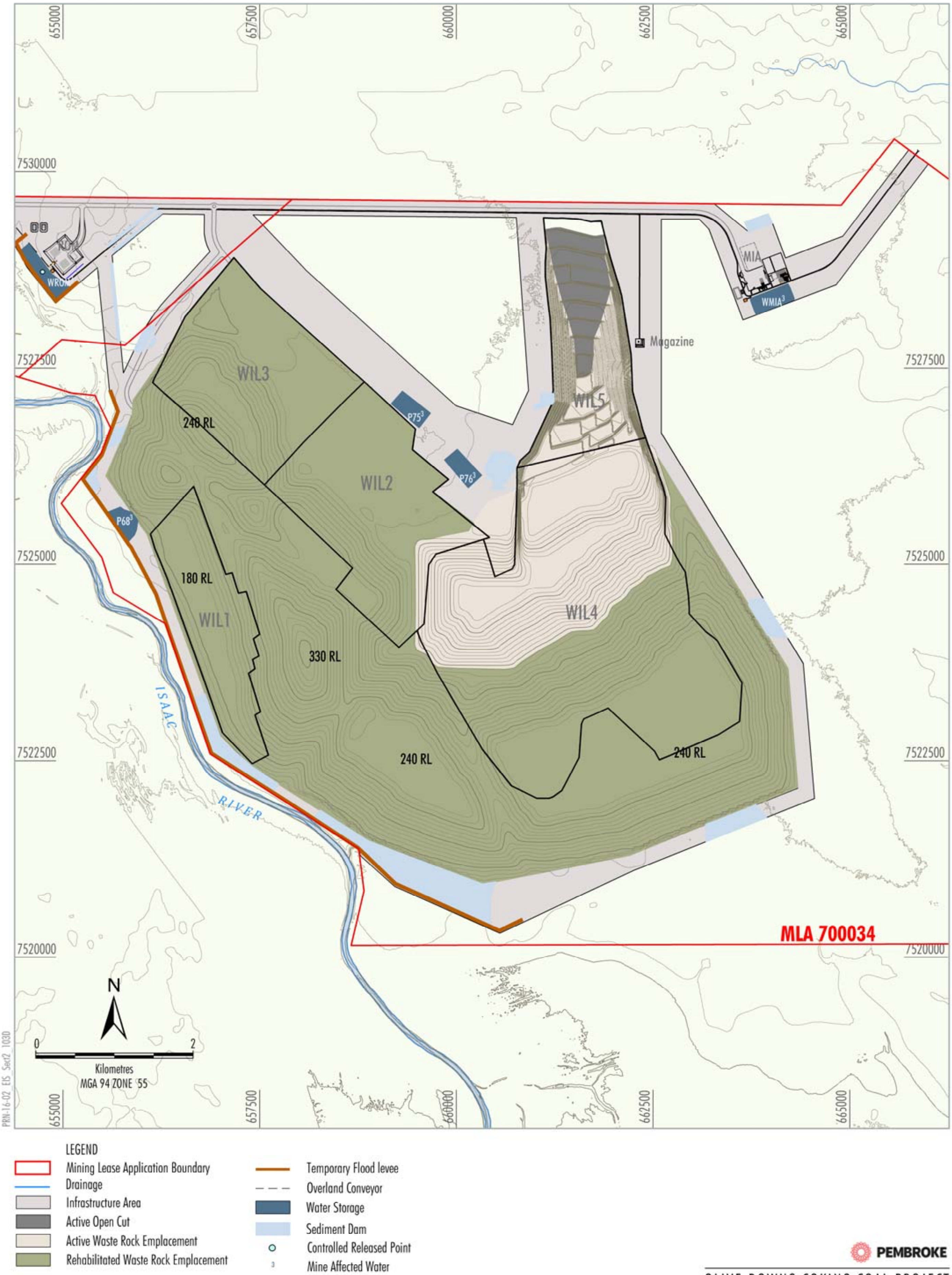
OLIVE DOWNS COKING COAL PROJECT

Olive Downs South Domain
General Arrangement - 2085

Figure 2-8



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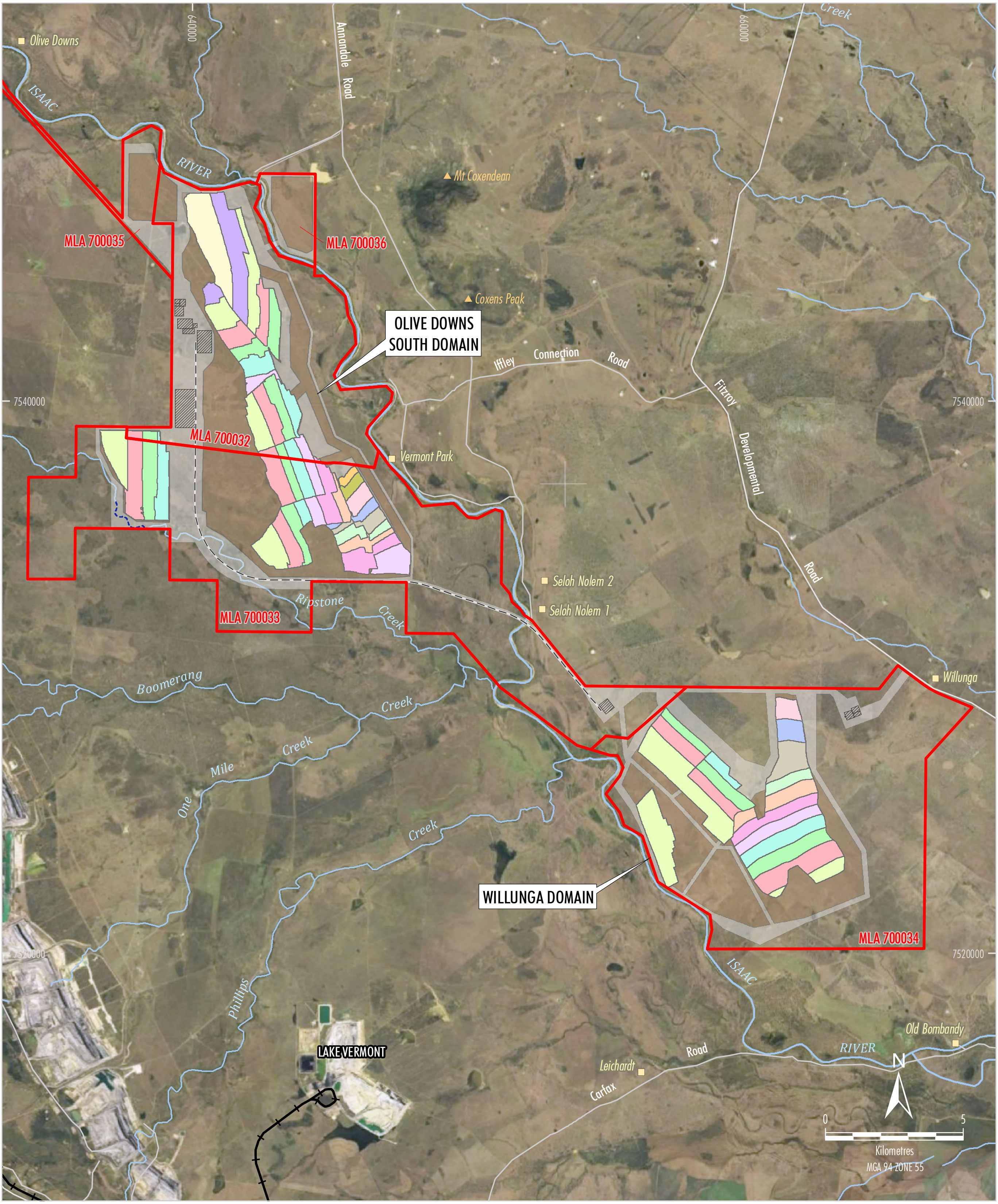
OLIVE DOWNS COKING COAL PROJECT

Willunga Domain

General Arrangement - 2085

Figure 2-9



LEGEND
- Mining Lease Application Boundary
- Railway
- Dwelling
- Proposed Creek Diversion
- Out-of-Pit and In-Pit Waste Rock Emplacement
- Infrastructure Area
- Key Infrastructure Component
- Overland Conveyor

Period Progress
- 2020 - 2024
- 2025 - 2029
- 2030 - 2034
- 2035 - 2039
- 2040 - 2044
- 2045 - 2049
- 2050 - 2054
- 2055 - 2059
- 2060 - 2064
- 2065 - 2069
- 2070 - 2074
- 2075 - 2079
- 2080 - 2084
- 2085 -2089
- 2090- 2098

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

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OLIVE DOWNS COKING COAL PROJECT
Period Progress Plot

Figure 2-10

The estimated capital cost for the initial development of infrastructure to establish operations at the Olive Downs South domain (to allow for production of up to 6 Mtpa ROM coal) is approximately $440M. This would include costs associated with the development of:

- access roads;
- rail spur;
- ETL;
- water pipeline;
- data and communication services;
- mine infrastructure area;
- civil works;
- buildings and facilities;
- workshop; and
- CHPP.

Additional capital expenditure of approximately $540M would be required to construct the Willunga domain, construct the overland conveyor and increase the capacity of the Olive Downs South domain facilities to handle the peak ROM coal production.

2.1.4 Project General Arrangement

The main activities associated with the development of the Project would include:

- up to 20 Mtpa of ROM coal production for an operational mine life of approximately 79 years (commencing approximately in 2020 or upon grant of all required approvals), including mining operations using conventional mining equipment (e.g. excavators, dozers, front end loaders and trucks) and strip mining, associated with:
  - development of the Olive Downs South domain open cut mine areas and out-of-pit waste rock emplacements within MLA 700032, MLA 700033 (within MDL 3012 and MDL 3013), MLA 700035 and MLA 700036; and
  - development of the Willunga domain open cut mine areas and out-of-pit waste rock emplacements within MLA 700034 (within MDL 3014 and MDL 3025);
- exploration activities;
- progressive development of soil stockpiles, laydown areas and borrow areas (e.g. for road base and ballast material);
- use of local quarries to source road base and ballast material (e.g. in the case where material is unavailable from sources within MLA 700032, MLA 700033 and MLA 700034);
- drilling and blasting (daytime only) of competent waste rock material;
- progressive placement of waste rock in emplacements adjacent to and nearby the open cut mine extents;
- progressive backfilling of the mine voids with waste rock behind the advancing open cut mining operations;
- progressive rehabilitation of waste rock emplacement areas;
- construction of an access road from Annandale Road to the Olive Downs South domain infrastructure area including a crossing of the Isaac River, and a second access road from the Fitzroy Developmental Road to the Willunga infrastructure facilities;
- progressive development of new haul roads and internal roads, including an Isaac River road crossing to provide access between the Olive Downs South and Willunga domains;
- installation and operation of on-site CHPP at the Olive Downs South domain;
- installation and operation of on-site ROM coal handling and crushing facilities at the Willunga domain;
- transfer of crushed ROM coal from the Willunga domain to the CHPP at the Olive Downs South domain, via either haul road or overland conveyor with an Isaac River crossing;
- storage and disposal of CHPP rejects (coarse and fine rejects) during the initial years (until in-pit containment facilities become available) in initial rejects storage facilities including In-line Flocculation (ILF) cells;
- disposal of CHPP rejects (coarse and fine rejects) on-site within appropriate in-pit containment facilities, including mine voids behind the advancing open cut mining operations and, where circumstances allow, disposal in other out-of-pit containment facilities;
- progressive development of sediment dams and water storage dams (including the North Western Water Dam, Central Water Dam, mine affected water dams, raw water dams, etc.) and installation of pumps, pipelines and other water management equipment and structures (including up-catchment diversions and temporary levees);

- wastewater and sewage treatment by package sewage treatment plants;
- installation of a raw water supply pipeline from the existing Eungella pipeline network;
- discharge of excess water off-site in accordance with relevant principles and conditions of the *Final Model Water Conditions for Coal Mines in the Fitzroy Basin* (DEHP, 2013);
- electricity supply from the existing regional power network, via construction of a 66 kilovolt (kV) ETL and switching/substation;
- construction of a rail loop and rail spur from the Norwich Park Branch Railway, and rail-loadout facility including product coal stockpiles at the Olive Downs South domain for rail transport of coking and PCI coal products and by-products (i.e. thermal coal) for the export market via the DBCT (subject to availability of rail and port allocation); and
- other associated minor infrastructure, plant, equipment and activities.

Existing local and regional infrastructure would be used to transport product coal to the port for export, including the Norwich Park Branch Railway and the DBCT.

Indicative general arrangements for Years 2027, 2043, 2066 and 2085 of the Project are shown on Figures 2-3 to 2-9. These indicative general arrangements are based on planned maximum production and mine progression. The mining layout and sequence may vary to take account of localised geological features, coal market volume and quality requirements, mining economics and Project detailed engineering design.

The detailed mining sequence and rehabilitation program over any given period would be documented in the relevant Plan of Operations as required by the EP Act.

2.1.5 Project Location

Regional Context

The Project is located approximately 170 km south-west of Mackay, in the Bowen Basin region of Central Queensland, within the IRC Local Government Area (LGA) (Figure 1-1).

The Project is located approximately 40 km south-east of Moranbah and approximately 40 km north of Dysart, in an existing mining precinct comprising several existing or approved nearby coal mining operations, including (Figure 1-1):

- Olive Downs North (2 km north of the Project);
- Saraji (5 km south-west of the Project);
- Daunia (10 km north-west of the Project);
- Peak Downs (12 km west of the Project);
- Lake Vermont (12 km south of the Project);
- Poitrel (12 km north-west of the Project);
- Millennium (15 km north-west of the Project);
- Eagle Downs (15 km west of the Project);
- Moorvale (18 km north of the Project);
- Carborough Downs (20 km north-west of the Project); and
- Isaac Plains (25 km north-west of the Project).

The Project is located:

- within the Brigalow Belt North Bioregion as defined by the *Interim Biogeographic Regionalisation for Australia (IBRA)* (DEE, 2016a) (Figure 2-11);
- within the Isaac Connors Sub-catchment Area of the Fitzroy Basin under the *Water Plan (Fitzroy Basin) 2011 (Queensland)* (Figure 2-12);
- within the Isaac Connors Groundwater Management Area (GMA) declared under the *Water Plan (Fitzroy Basin) 2011 (Queensland)* with parts of the Project within and proximal to the Isaac Connors Alluvium Groundwater Sub-area declared under the *Water Plan (Fitzroy Basin) 2011 (Queensland)* (Figure 2-13);
- within zones identified and mapped as Regional Landscape and Rural Production Area under *Mackay, Isaac and Whitsunday Regional Plan* (Department of Local Government and Planning, 2012), but outside zones mapped as good quality agricultural land;
- outside strategic cropping areas mapped as potential Strategic Cropping Land (SCL) under section 10 of the RPI Act (Figure 2-14);
- within the Barada Barna People's Native Title Determination Area (QC2016/007) registered with the NNTT (2016) (Figure 2-15);

PRN-16-02_EIS_Sect2_212B

Source: Geoscience Australia - Topographical Data 250K (2006)

LEGEND
- Mining Lease Application Boundary
- Brigalow Belt North Bioregion
- Major Road
- Port

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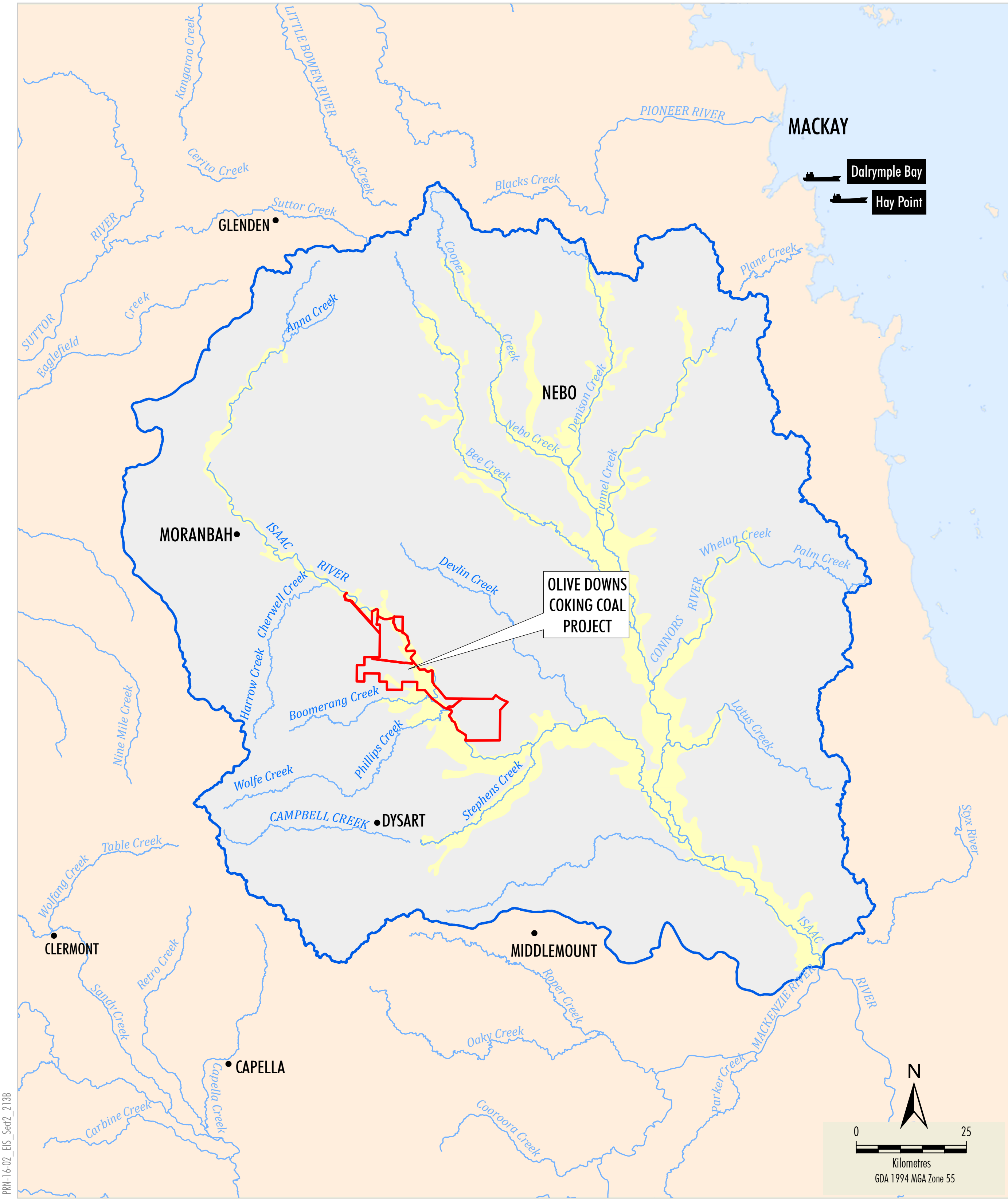
Brigalow Belt North Bioregion

Figure 2-11



LEGEND
- Mining Lease Application Boundary
- Isaac Connors Groundwater Management Area
- Isaac Connors Alluvium Groundwater Sub-area
- Port

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources, Mines and Energy (2016)

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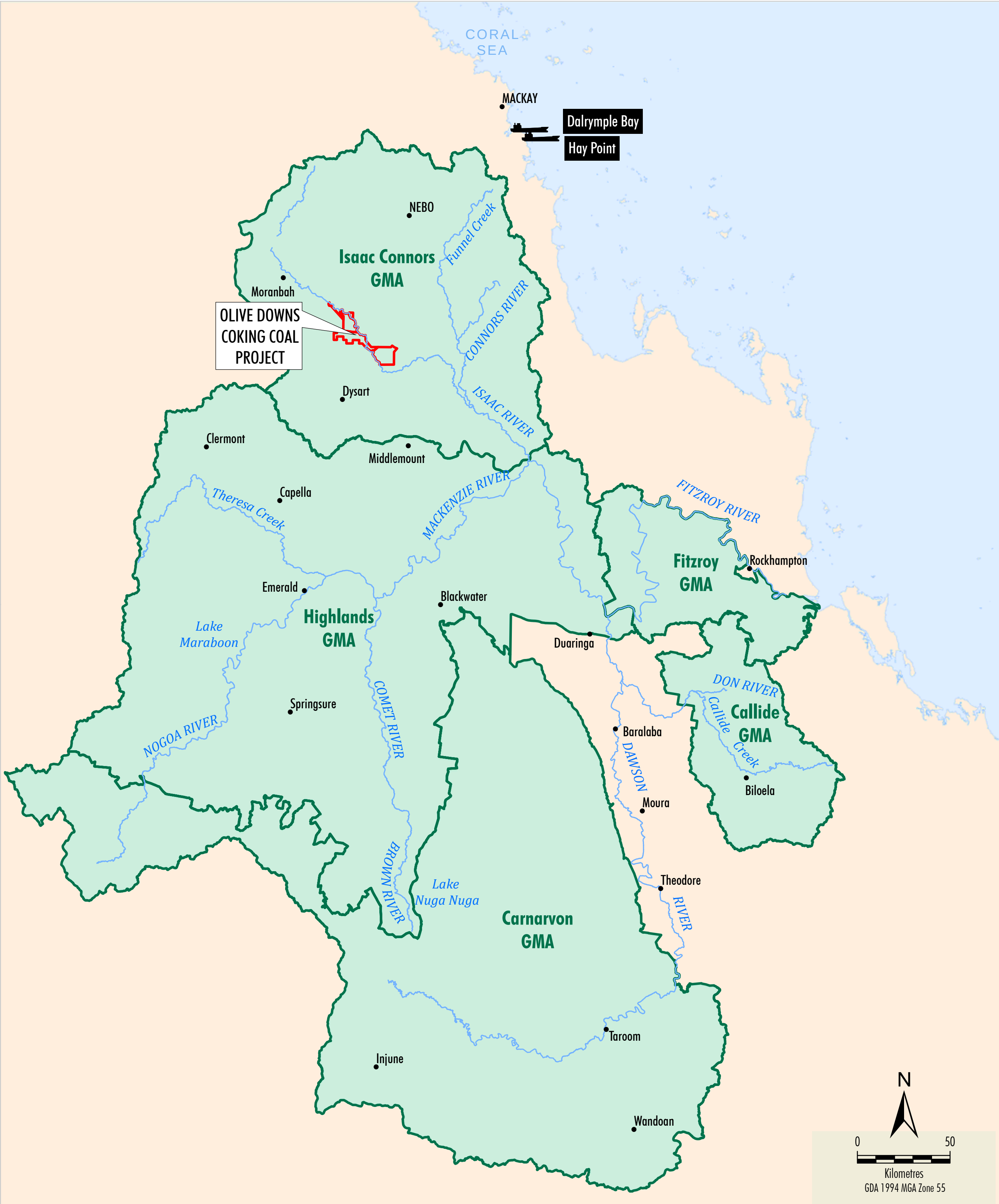
OLIVE DOWNS COKING COAL PROJECT

Isaac Connors Sub-Catchment of the Fitzroy Basin

Figure 2-12



LEGEND
- Mining Lease Application Boundary
- Groundwater Management Area
- Port

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources, Mines and Energy (2016)

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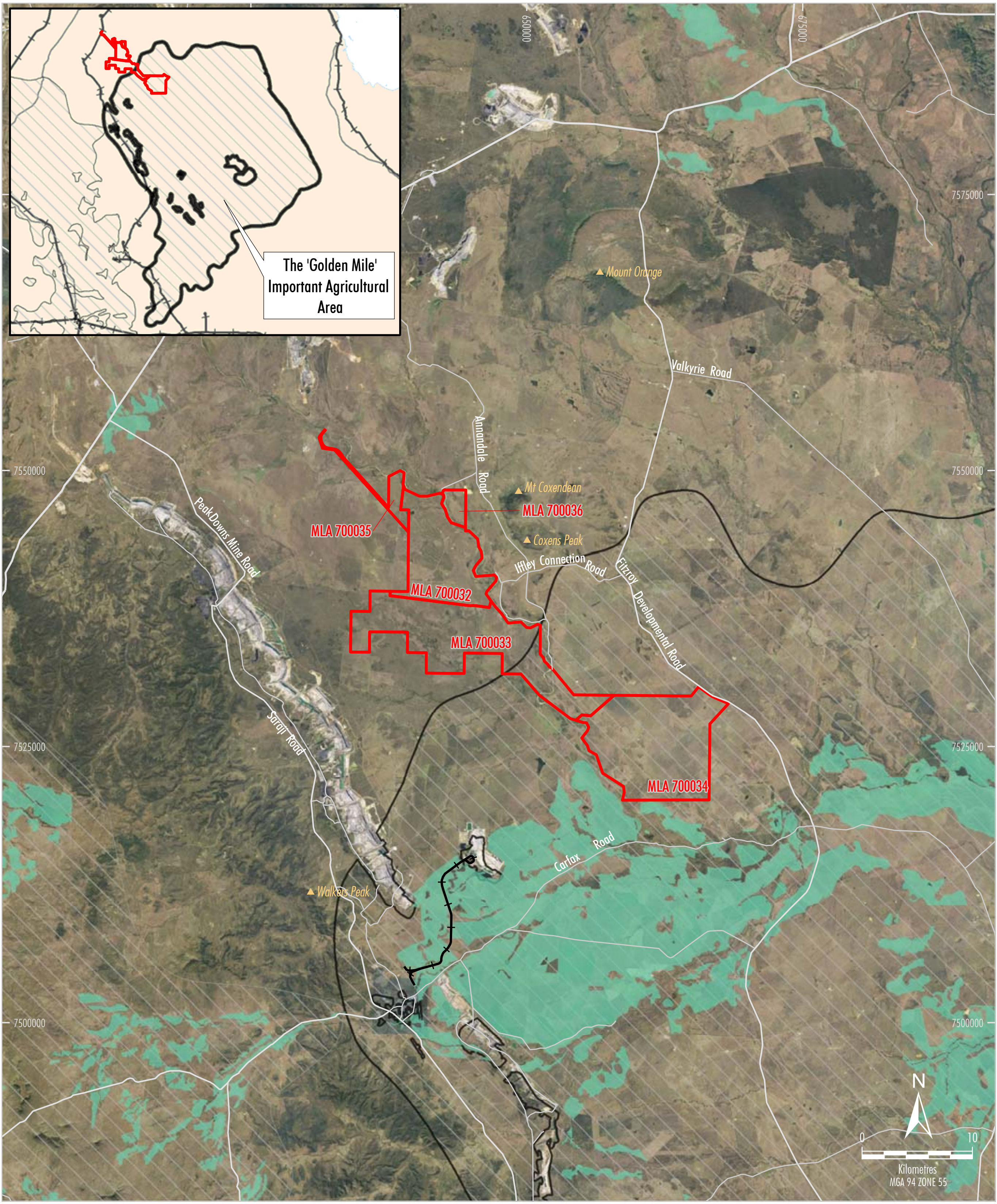
OLIVE DOWNS COKING COAL PROJECT

Groundwater Management Areas of the Fitzroy Basin

Figure 2-13



LEGEND
- Mining Lease Application Boundary
- Strategic Cropping Land
- Agricultural Land Audit - Important Agricultural Areas

Source: Geoscience Australia - Topographical Data 250K (2006), Department of Natural Resources and Mines (2016), Queensland Department of Agriculture and Fisheries (2018)
Orthophotography: Google Image (2015)

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OLIVE DOWNS COKING COAL PROJECT

Potential Strategic Cropping Land Trigger Map and Important Agricultural Area Mapping

Figure 2-14

LEGEND
- Mining Lease Application Boundary
- Registered Native Title Applications
- Native Title Area
- Eungella Pipeline Network
- Railway
- Approved/Operating Coal Mine
- Dwelling

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

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OLIVE DOWNS COKING COAL PROJECT

Native Title Determination and Indigenous Land Use Agreement

Figure 2-15

- within areas subject to private ILUAs QI2011/031 and QI2012/062 between the Barada Barna People and petroleum mining companies (Arrow and QGC, respectively) (Figure 2-15); and
- within the area covered by the *Inland Fitzroy and Southern Burdekin Suitability Framework* (DNRM and DSITIA, 2013).

The Project is not located within an area of regional interest under the RPI Act. Areas of regional interest include priority agricultural areas, priority development areas, strategic cropping areas (formerly Strategic Cropping Land) and strategic environmental areas.

The Project is not located within a declared underground groundwater area under the *Water Regulation, 2016* (Queensland).

A small section of the ETL (approximately 600 m) would pass through the corner of a parcel of land (Lot 6 RP845780) owned by the IRC, which has a Community Infrastructure Designation (ID 573) for the “Powerlink Queensland proposed Northern Bowen Basin Stage 1 (Nebo-Broadlea) Transmission Line Project”. It is not expected that the Project ETL would have an impact on the future use of this lot.

No other sites with a Community Infrastructure Designation under the Queensland *Planning Act, 2016* are located within the Project area.

The Bowen Gas Project (part of the Arrow liquefied natural gas [LNG] Project) is approved within the overlapping petroleum tenements across the Project area and surrounds (Section 2.2.1). The Bowen Gas Project has targeted coal seams of the Rangal Coal Measures (also targeted by the Project) and deeper Moranbah Coal Measures. Pembroke has engaged with Arrow Energy, the holder of Petroleum Lease Application (PLA) 488, regarding the terms of a Joint Development Plan in accordance with the *Mineral and Energy Resources (Common Provisions) Act, 2014* (MERCP Act). The Joint Development Plan will be formed as part of the mining lease application process for the Project and will describes the activities proposed to be carried out in the overlapping tenure area by the mining and petroleum lease holders.

The existing and operating Moranbah Gas Project is located approximately 20 km to the north-west of the Project.

Other coordinated projects and major projects in the region include (Figure 1-1):

- Connors River Dam and Pipeline Project (75 km north-northeast of the Project);
- Goonyella Riverside and Broadmeadow Mines (50 km north-west of the Project);
- Goonyella Riverside to South Walker Creek Dragline Move (25 km north of the Project);
- Isaac Plains Extension (24 km north-west of the Project);
- Saraji East Mining Lease Project (5 km south-east of the Project); and
- Lake Vermont Northern Extension Project (3 km south of the Project).

Exploration works have commenced at Bowen Coking Coal’s Isaac River Coking Coal Project, located immediately to the east of the Daunia mine (Figure 1-1), however an application for an EA for the Project has not yet been lodged.

Local Context

The Project is located directly south of the approved Olive Downs North Mine.

The Olive Downs South domain is located to the south and west of the Isaac River (Figure 2-1).

The Willunga domain is located to the north and east of the Isaac River, downstream of the Olive Downs South domain (Figure 2-2).

Land ownership in the vicinity of the Project is described in Section 2.2.1.

2.1.6 Workforce

Employment and other opportunities expected to be generated by the Project include:

- a Project operational workforce of up to approximately 1,300 on-site personnel, when ROM production reaches 20 Mtpa (i.e. from 2034) (an average of 1,000 over the life of the Project);
- a construction workforce of up to 700 people during the construction of the Olive Downs South domain mine infrastructure area in the initial years of the Project (an average of 500 over the entire construction period); and
- a construction workforce in the order of 200 people during the construction of the Willunga domain mine infrastructure area and expansion of the Olive Downs South domain mine infrastructure area around Year 10 of the Project.

The operational hours at the Project would be 24 hours a day, seven days a week. Construction rosters are expected to be 12 hour shifts with 21 days on and seven days off. Operational rosters are expected to be:

- mining operations on a 12.5 hour shift, seven days on, seven days off; and
- senior management and administration staff working a daytime shift, five days on, two days off.

The proposed construction staging and schedule of works is described in Section 2.4.

It is estimated that the mine decommissioning workforce, when required, would include approximately 50 people toward the end of the life of the Project.

2.1.7 Workforce Accommodation

As well as numerous hotels for temporary accommodation, Moranbah and Coppabella contain a number of accommodation villages. These include (Figure 1-1):

- Coppabella Village;
- Moranbah Village;
- Grosvenor Accommodation Village;
- Moranbah Accommodation Centre;
- Smart Stay Village; and
- Terowie Village.

A number of other accommodation villages are located in Dysart, Nebo and Middlemount (Figure 1-1).

The Isaac Regional Council's most recent data on accommodation villages indicate that there were approximately 9,000 beds in and around Moranbah and 4,794 beds in and around Coppabella.

Occupancy rates were only available for Coppabella Village which had 52 percent (%) occupancy, however, the Queensland Government Statistician's 2016 Bowen Basin Non-resident Population Report noted that the Isaac Regional Council LGA's supply of accommodation village accommodation currently exceeds the number of non-resident workers on-shift by a considerable margin.

The construction and use of additional accommodation facilities for the Project's construction and operational workforce is not expected to be required, and so is not proposed as part of the Project.

The Project's recruitment strategy would provide equitable access to employment opportunities and prioritise recruitment of people from the Isaac Regional Council LGA in the first instance, before seeking candidates from other areas.

2.2 SITE DESCRIPTION

2.2.1 Tenure

Tenements

The Project is located within (Figure 2-16):

- MDL 3012, 3013, 3014 and 3025; and
- Parts of EPC 649, 676, 688, 721, 850, 1949 and 1951.

The proposed mining lease applications for the Project within the above tenements include (Figure 1-2) MLA 700032, MLA 700033, MLA 700034, MLA 700035 and MLA 700036.

Parts of the water pipeline and ETL (located outside a mining lease application for the Project) are located within MDLs 183, 277 and 495 and EPCs 649 and 755.

Petroleum tenements overlapping the Project area and surrounds include (Figure 2-16):

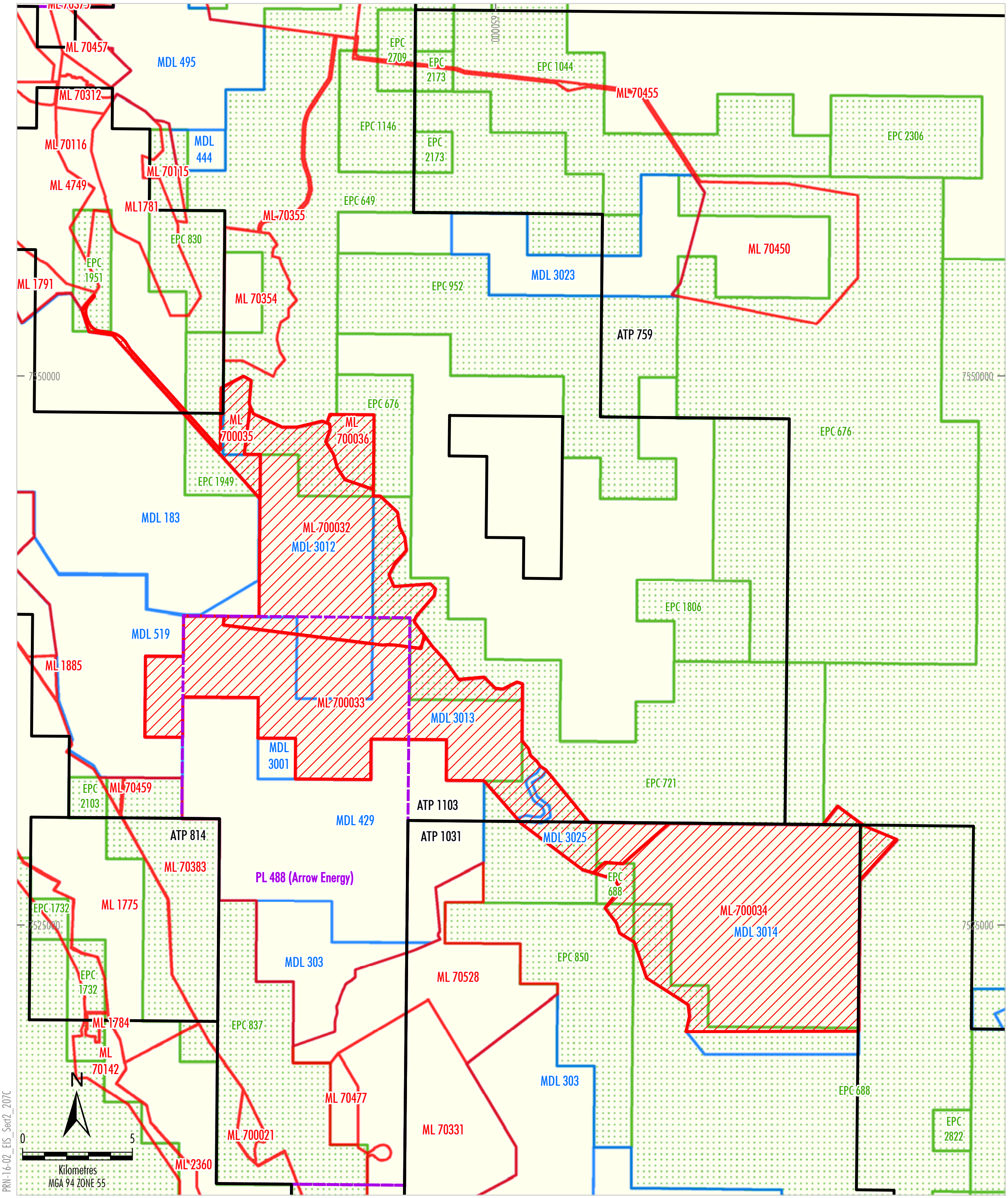
- PLA 488 (across parts of MLA 700032 and MLA 700033);
- Petroleum Leases (PL) 222 and 223 (across the infrastructure corridors); and
- Authorities to Prospect (ATP) 759, 1031 and 1103 (across the Project MLA areas and infrastructure corridors).

Land Ownership

Relevant land ownership of key lots directly impacted by the Project is shown on Figures 2-17a and 2-17b.

The key lots and rural premises directly impacted by the Project include:

- Iffley (11KL135);
- Vermont Park (9CNS98);
- Willunga (8KL95);
- Seloh Nolem (7KL96);
- Deverill (18SP113322);
- Old Bombandy (9KL97); and
- Wynette (4CNS15).



LEGEND
- Mining Lease Application Boundary
- EPC Granted
- PL Application
- MDL Permit Granted
- ML Permit
- ATP Granted

Source: Department of Natural Resources, Mines and Engery (2018)

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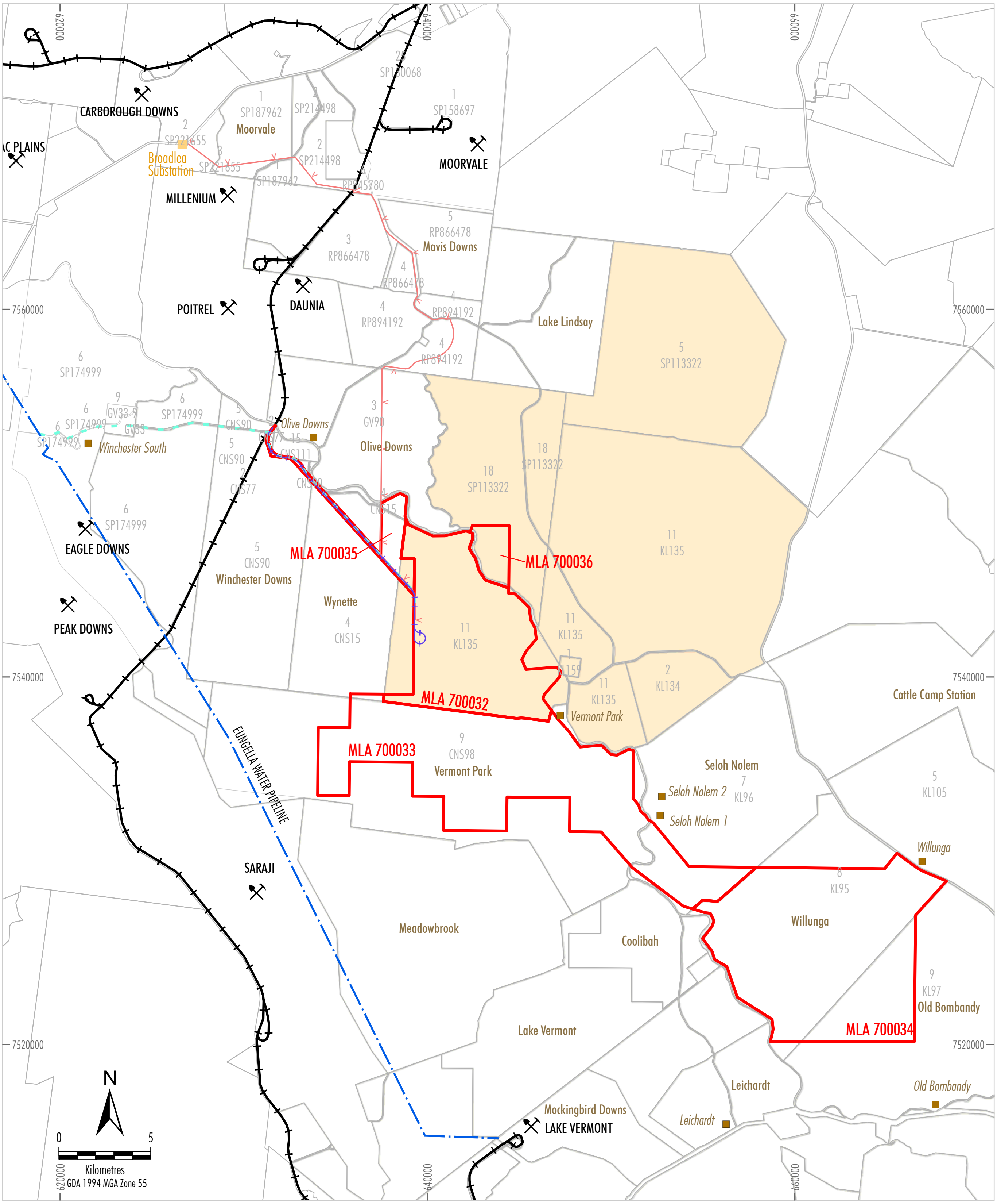
OLIVE DOWNS COKING COAL PROJECT

Resource Tenements

Figure 2-16

TOC



LEGEND

- Mining Lease Application Boundary
- Pembroke Owned Land
- Privately Owned Land and Other Land
- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Proposed Electricity Transmission Line
- Proposed Rail Spur
- Proposed Water Pipeline

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

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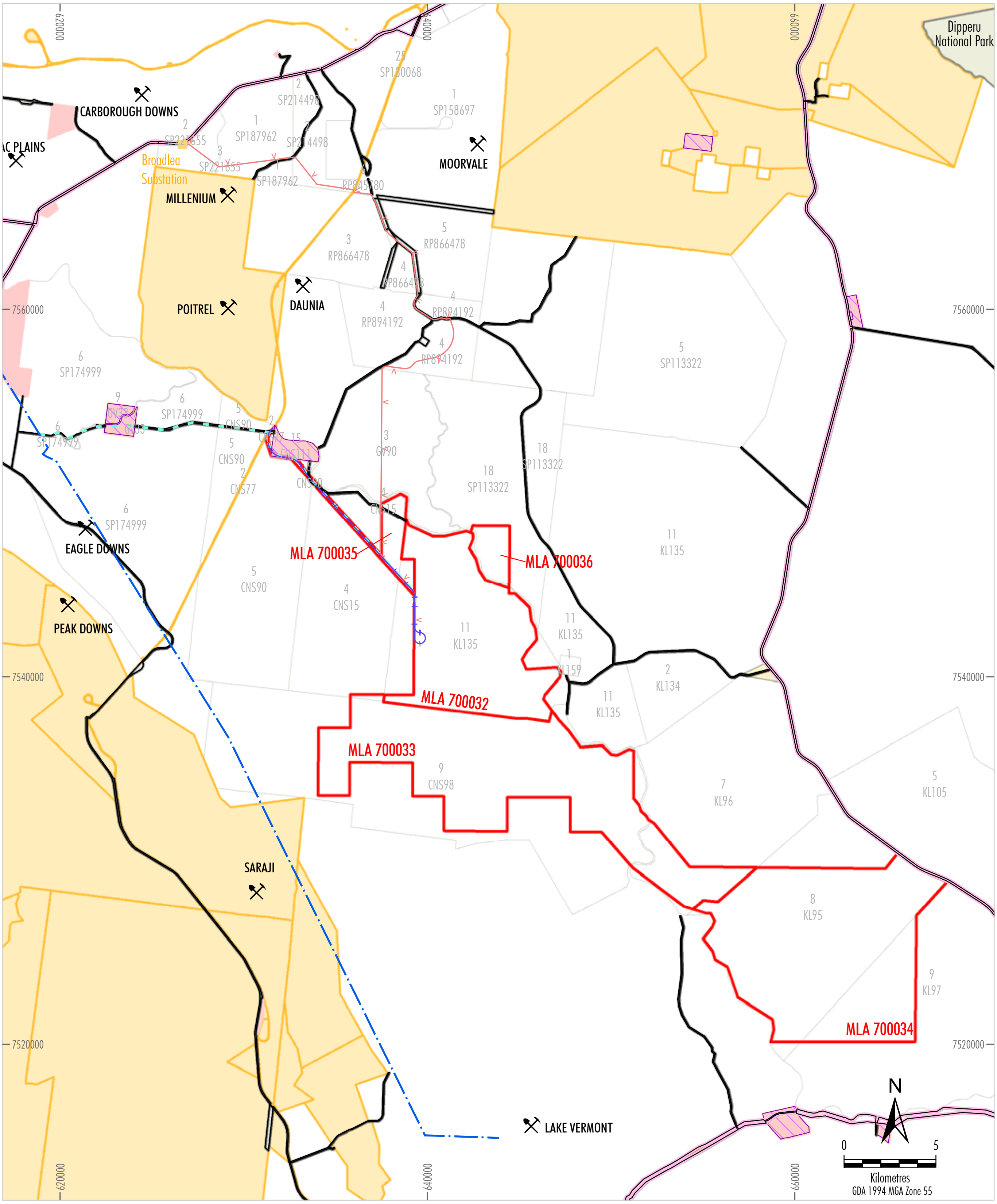
OLIVE DOWNS COKING COAL PROJECT

Tenure - Land Ownership

Figure 2-17a



LEGEND

- Mining Lease Application Boundary
- Cadastral Boundary
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Proposed Electricity Transmission Line
- Proposed Rail Spur
- Proposed Water Pipeline

State Land

- Travelling Stock Routes - Reserve
- Travelling Stock Routes - Road
- Road
- Lands Lease
- National Park
- Reserve
- Unallocated State Land

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources, Mines and Energy (2017)

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OLIVE DOWNS COKING COAL PROJECT

Tenure - State Lands

Figure 2-17b

The key lots and rural premises directly impacted by the Project infrastructure corridors include:

- Rail corridor:
  - Iffley (11KL135);
  - Wynette (4CNS15);
  - Winchester Downs (5CNS90);
  - Aurizon Railway Corridor (2CNS77); and
  - Isaac Regional Council Camping and Water Reserve Land (15CNS111).
- ETL:
  - Iffley (11KL135);
  - Wynette (4CNS15);
  - Olive Downs (3GV90);
  - Moorvale (3SP221655; 1SP187962; 2SP214498; 4RP894192);
  - Annandale Road reserve;
  - Mavis Downs (4RP866478;5RP866478; 6RP845780);
  - Daunia (2SP214498);
  - 2SP221655 and 3SP221655;
  - Daunia Road reserve; and
  - Poitrel Road reserve.
- Water pipeline:
  - Iffley (11KL135);
  - Wynette (4CNS15);
  - Winchester Downs (5CNS90; 8SP277384);
  - Reserve (9GV33); and
  - unnamed road reserves.
- Access road:
  - Deverill (18SP113322);
  - Willunga (8KL95); and
  - Iffley (11KL135).

Restricted and Reserve Land

Besides road reserves, two reserves (stock routes) are located within the Project footprint. The reserves are located along parts of the rail spur and pipeline alignments (Figure 2-17b). These reserves form part of the Barada Barna People Native Title Determination Area (QC2016/007).

An assessment of restricted land will be undertaken at the time the mining lease applications are made.

State Forests, National Parks and Conservation Tenure

There are no State Forests, National Parks or conservation tenure within or adjacent to the Project MLAs or infrastructure corridors (Figure 2-17b).

2.2.2 Existing Transport Infrastructure

Road Infrastructure

The major road transport routes in the vicinity of the Project are the Peak Downs Highway, located approximately 15 km to the north-west of the Project, and Fitzroy Developmental Road, located to the east of the Project (Figure 1-1).

Fitzroy Developmental Road runs directly along the Project eastern boundary at the Willunga domain and will provide access to the Willunga infrastructure facilities in the south-east of the Project extent. Additionally, the Peak Downs Mine Road, which becomes Saraji Road when it intersects with the Saraji Coal Mine, runs generally north-south, approximately 10 km to the west of the Project (Figure 1-2).

The Iffley Connection Road (including Vermont Park Road) and Annandale Road are located to the east of the Project boundary and provide access from the Deverill, Iffley, Vermont Park, and Seloh Nolem properties to the Fitzroy Developmental Road and the Peak Downs Highway (via Daunia Road), respectively (Figures 1-2 and 2-1). Carfax Road runs east-west to the south of the Project boundary, connecting the Fitzroy Developmental Road with Dysart (Figure 1-2).

Rail Infrastructure

Rail transportation in the region is serviced by the Norwich Park Branch Railway which runs generally north-south, approximately 10 km to the west of the Project (Figure 1-2). This branch forms part of the Goonyella Branch Railway line which transports coal from the Bowen Basin to Hay Point and DBCT south-east of Mackay (Figure 1-1).

Regionally, the Moorvale, Millennium, Peak Downs, Saraji and Lake Vermont mines have spurs and loops, branching off the Norwich Park Branch Railway line (Figure 1-2).

As part of the Project, a new rail loop and rail spur is proposed to be constructed from the western boundary of the Project to connect to the Norwich Park Branch Railway (Figure 1-2) for the transport of product coal.

Several railway stops and junctions are located along the Norwich Park Branch Railway immediately up-line and down-line of the proposed new rail spur including (up-line): Winchester; Peak Downs Junction; Harrow; Saraji Junction; and Dysart, and (down-line): Red Mountain; Millenium Junction; Ingsdon; and Coppabella.

Port/Sea Infrastructure

Existing port infrastructure at Hay Point and DBCT are located south-east of Mackay (Figure 1-1).

The existing port infrastructure at DBCT would be utilised by the Project for the export of product coal.

Air Infrastructure

Mackay Airport is the nearest major regional airport servicing the region (Figure 1-1).

Other smaller airports located near the Project include (Figure 1-1):

- Moranbah (approximately 5 km south-east of the township); and
- Dysart (approximately 2 km south-east of the township).

The Project workforce will utilise the existing regional air infrastructure if and as required.

2.2.3 Existing Energy Infrastructure

Electricity supply to the Bowen Basin area is provided via Powerlink's 275/132 kV substations at Strathmore, Nebo and Lilyvale. From these substations, the area is supplied from a number of 132 kV substations and Queensland Rail substations. Energy Queensland further distributes electricity from these substations to local customers.

A 66 kV ETL and switching/substation would be constructed to connect to the existing regional power network at the Broadlea Substation (Figure 1-2).

2.2.4 Existing Water Infrastructure

SunWater operates the Eungella pipeline network (part of the Bowen Broken Rivers Scheme) which supplies water from the Eungella Dam (located on the Broken River) to the towns of Collinsville, Glenden, Moranbah and Dysart, a number of coal mines, the Collinsville Power Station and several irrigated farms.

The southern extension of the Eungella water pipeline network runs generally north-south, approximately 15 km west of the Project, between Moranbah and Dysart (Figure 1-2). The Project would include the construction and use of a pipeline from the southern extension of the Eungella water pipeline, to provide a reliable water supply source to the Project.

2.2.5 Business Precincts and Other Existing Public and Private Facilities

The key business precinct that would service the Project workforce and the Project itself is located in Moranbah (Figure 1-1). Other business precincts that would service the Project are located in Dysart, Middlemount and Nebo (Figure 1-1).

Health facilities in the region include hospitals in Moranbah and Dysart, and medical centres in Moranbah, Middlemount, Nebo and Dysart. Potential impacts to health services are described in Appendix H.

Three State schools are located in Moranbah (two primary and one secondary), two in Dysart (one primary and one secondary), and one in each of Middlemount (merged primary and secondary), Nebo (primary) and Coppabella (primary).

Other public facilities such as libraries, sports facilities, cemeteries, halls, arts and community centres are located within Moranbah, Dysart, Middlemount and Nebo (Figure 1-1).

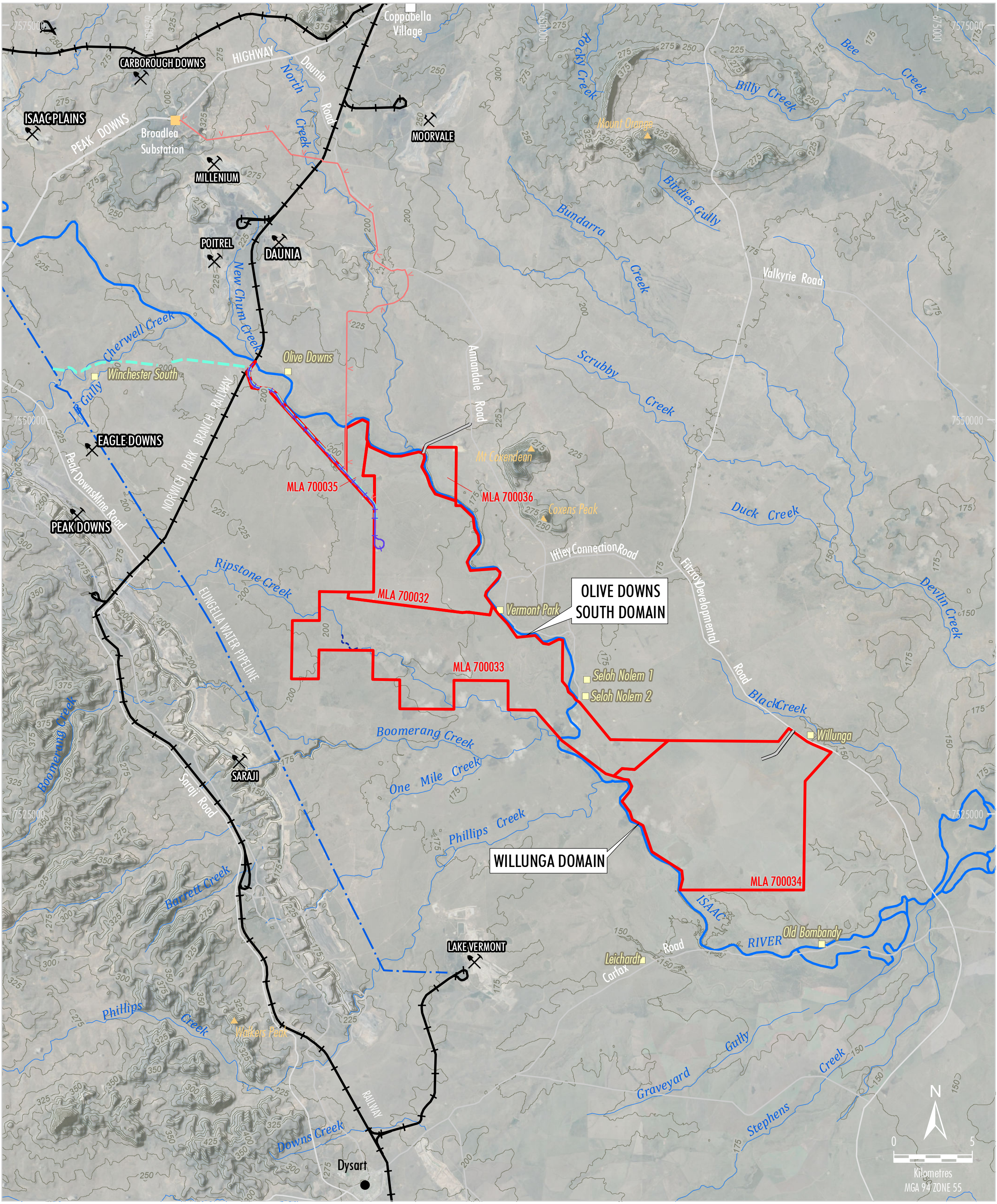
2.2.6 Topography, Landform and Catchments

The general landscape of the Project area includes gently undulating to flat plains, with elevations of approximately 200 metres (m) Australian Height Datum (AHD). The overall elevation of the Project area ranges from 150 m AHD in the low-lying south-east of the Willunga domain to 200 m AHD in the higher areas to the west and north-west of the Project area (Figure 2-18).

Although the topography of the Project site is relatively flat, a cluster of mountains approximately 5 km east of the Olive Downs South domain (Mt Coxendean, Coxens Peak and Iffley Mountain) reach elevations of 310 m AHD to 471 m AHD and the Harrow and Cherwell Ranges, 15 km to 20 km west of the Project, reach elevations of 400 m AHD to 500 m AHD (Figure 2-18).

Regional Catchment

The Project is located within the headwaters of the Isaac River catchment of the greater Fitzroy Basin (Figures 2-12 and 2-19).



LEGEND

- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Proposed Creek Diversion
- Proposed Access Road
- Proposed Electricity Transmission Line
- Proposed Rail Spur and Loop
- Proposed Water Pipeline

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

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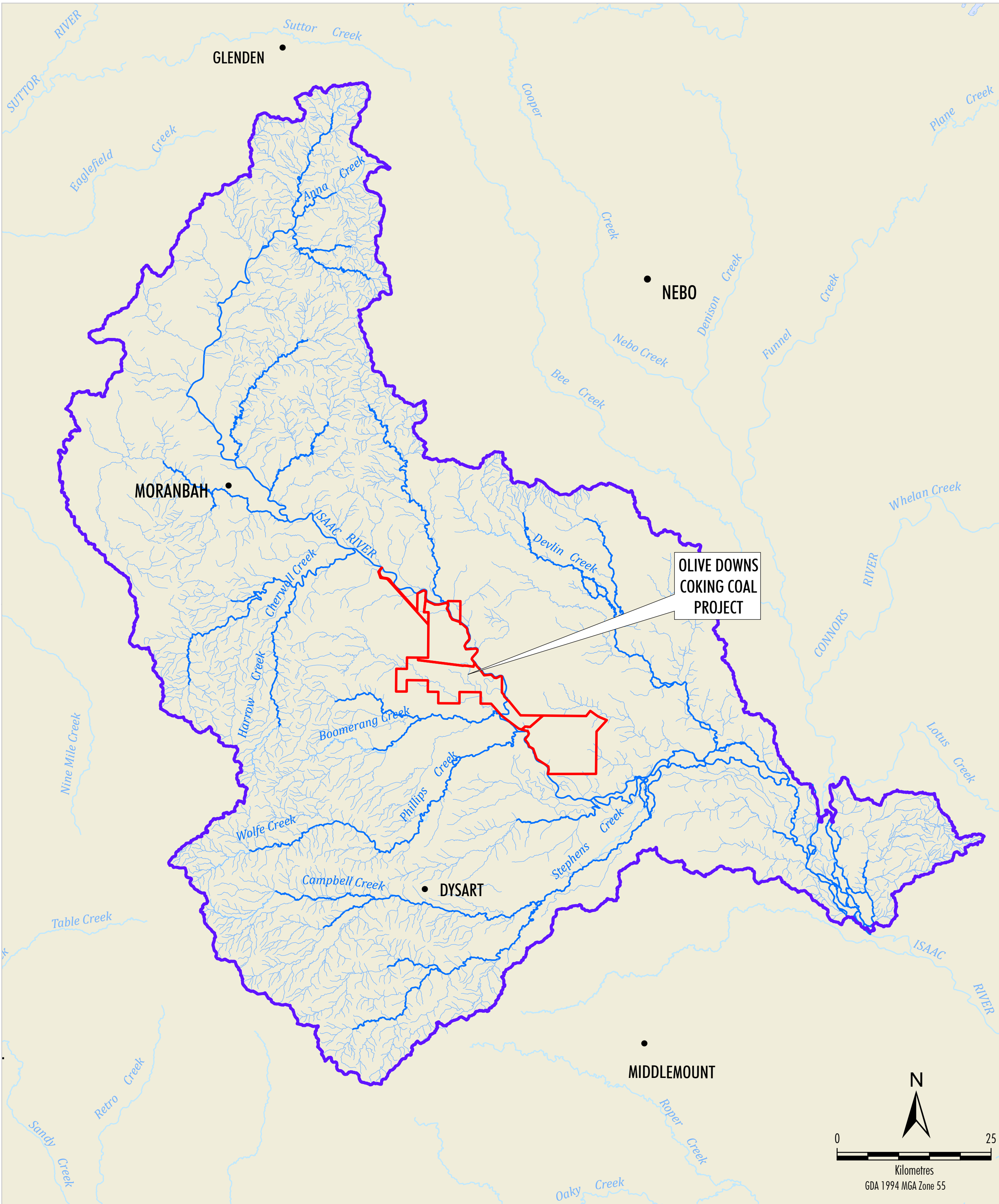
OLIVE DOWNS COKING COAL PROJECT
Topography

Figure 2-18



LEGEND

- Mining Lease Application Boundary
- Upper Isaac River Catchment Area

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OLIVE DOWNS COKING COAL PROJECT

Isaac River Catchment

Figure 2-19

The Isaac River is the main watercourse which bisects the Project area and flows in a north-west to south-east direction, passing the township of Moranbah. The existing Isaac Plains, Millennium, Poitrel and Daunia mines are immediately upstream of the Project area (Figure 1-1). The Isaac River flows to the north-east of the Olive Downs South domain and then further downstream to the south of the Willunga domain, before continuing in a south-easterly direction (Figure 1-2).

The Connors River flows into the Isaac River approximately 85 km downstream of the Project area (Figure 2-19), with the Isaac River finally converging with the Mackenzie River a further 50 km downstream (Figure 2-12).

Ultimately, the Mackenzie River joins the Fitzroy River, which flows initially north and then east towards the east coast of Queensland, and discharges into the Coral Sea south-east of Rockhampton near Port Alma (Figure 2-13).

At a regional scale, the greater Isaac-Connors sub-catchment area (at the confluence with the Mackenzie River) is approximately 22,364 square kilometres (km^2) of the total Fitzroy River catchment of 142,665 km^2 or, if represented as a percentage, it accounts for 15% of the overall Fitzroy River catchment area.

The Project lease application areas are approximately 250 km^2 and represent approximately 1% and 0.2% of the overall Isaac-Connors and Fitzroy river catchment areas, respectively.

Local Catchments

Tributaries of the Isaac River in the vicinity of the Project area include (from upstream to downstream) (Figure 2-19):

- North Creek;
- Ripstone Creek;
- Boomerang Creek (including One Mile Creek); and
- Phillips Creek.

North Creek enters the Isaac River immediately upstream of the Deverill gauging station, north of the Project area. The North Creek catchment area upstream of its confluence with the Isaac River is approximately 342 km^2, with predominant land use within the catchment being stock grazing and the Moorvale Mine. The Moorvale Mine has approval to release water to North Creek.

Ripstone Creek runs west to east, south of the Olive Downs South domain, and would be diverted around the south of Pit ODS9 (Figure 2-1).

The Ripstone Creek catchment area is approximately 286 km^2, with predominant land use within the catchment being stock grazing and the Peak Downs mine (which has approval to release water to Ripstone Creek).

Boomerang Creek runs west to east, south of the Olive Downs South domain and joins the Isaac River between the Olive Downs South domain and Willunga domain. One Mile Creek is a tributary of Boomerang Creek, with its confluence approximately 4 km upstream of the point at which Boomerang Creek enters the Isaac River.

The Boomerang Creek catchment area (including One Mile Creek) is approximately 156 km^2, with predominant land use within the catchment being stock grazing and the Saraji Coal Mine. The Saraji Coal Mine has an existing diversion of Boomerang Creek and has approval to release water to Boomerang Creek.

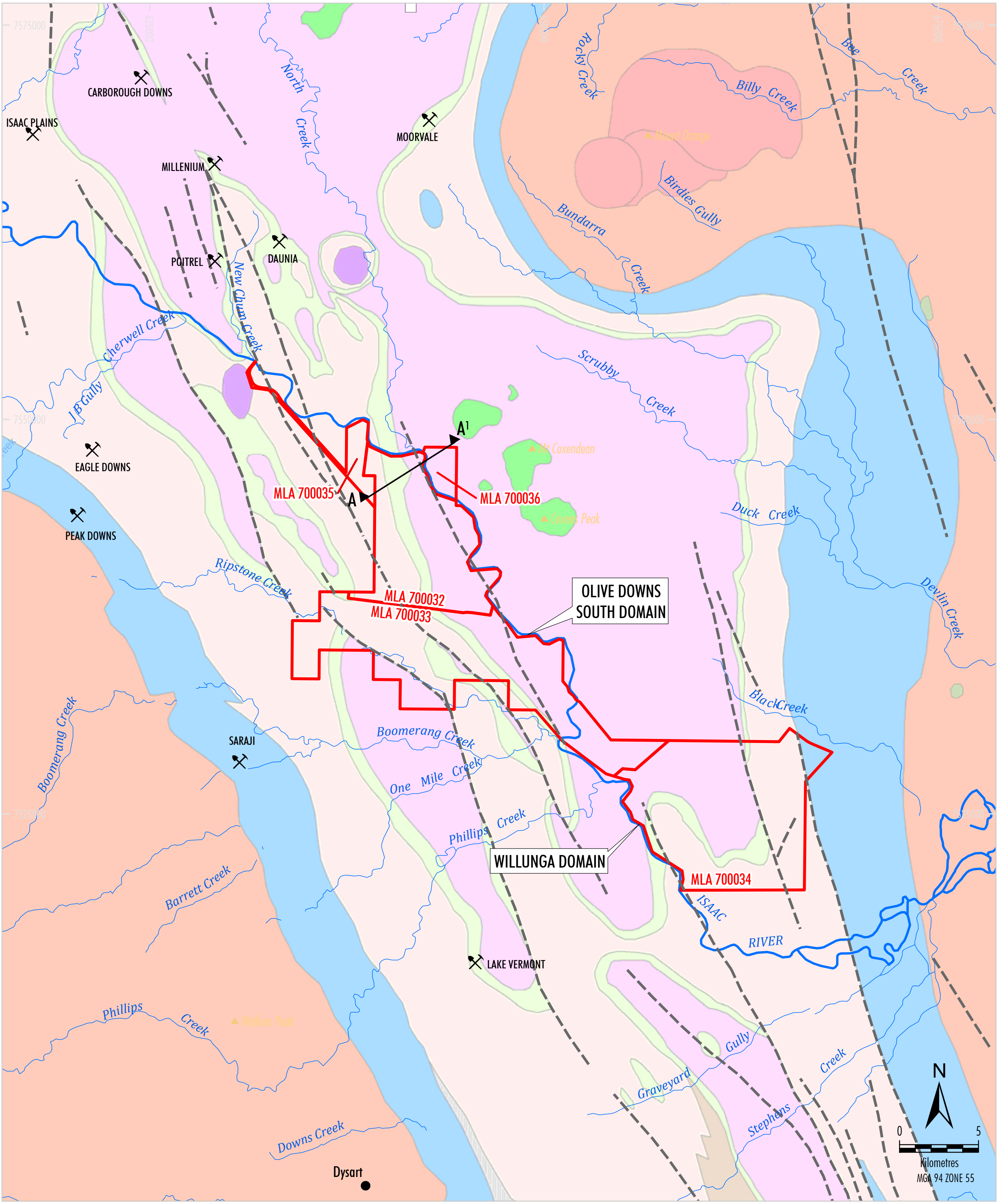
Phillips Creek has a catchment area of approximately 487 km^2 to the confluence with the Isaac River. Land uses within the Phillips Creek catchment include low intensity cattle grazing and open cut mining. The Saraji and Lake Vermont mines both have existing diversions/levees on Phillips Creek and approval to discharge waters to Phillips Creek.

2.2.7 Geology, Exploration History and Coal Resource

Depositional Geology

The Project coal resource is located within the northern part of the Permo-Triassic Bowen Basin.

The Permian sediments occur at outcrop on the eastern and western edges of the basin and are unconformably overlain by the Triassic aged terrestrial sediments within the basin. The outcrop geology of the Permian and Triassic sediments based on 1:500,000 scale mapping of the Bowen Basin (Commonwealth Scientific and Industrial Research Organisation [CSIRO], 2008) is shown on Figure 2-20a. Regional faulting is also shown on Figure 2-20a.



LEGEND

- Mining Lease Application Boundary
- Approved/Operating Coal Mine

Geology

- Clematis Group
- Rewan Formation
- Rangal Coal Measures, Bandanna Formation, Baralaba Coal
- Fair Hill Formation
- Moranbah/German Creek Coal Measures
- Back Creek Group
- Bundarra Granodiorite
- Burngrove Formation
- MacMillan Formation
- Undifferentiated volcanics
- Undivided Intrusives
- Faults

Source: Geoscience Australia - Topographical Data 250K (2006); Department of Natural Resources and Mines (2016); HydroSimulations (2018)

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OLIVE DOWNS COKING COAL PROJECT

Regional Geology - Outcrop Mapping and Faulting

Figure 2-20a

The regional outcrop geology mapping shows the Permian Fair Hill Formation and Rangal Coal Measures (overlain by the Triassic Rewan Formation) across the Project area. An indicative geological cross-section is presented on Figure 2-20b.

The Permian and Triassic sediments are covered by a thin veneer of unconsolidated to semi-consolidated Cainozoic sediments (Tertiary to Quaternary alluvium and colluvium). Broadscale geology testing undertaken by the Department of Environment and Resource Management (DERM) in 2011, indicated the region is dominated by Tertiary sediments, with the Project area predominantly containing Cainozoic alluvium, as well as mixed Mesozoic sediments (Raymond and McNeil, 2011). The alluvial sediments are localised along rivers (i.e. Isaac River) and their tributaries.

A transient electromagnetic (TEM) survey was conducted by Groundwater Imaging Pty Ltd in July 2017 to verify the extent of the unconsolidated sediments in the Project area. The TEM survey identified that alluvial sediments are present across the Project area to depths of up to 8 m, with sequences up to 30 m thick present within a narrow corridor along Isaac River.

Within the Project area in the Olive Downs South domain there are several regional fault structures with a dominant north-west trend.

The Isaac fault (a thrust fault with a throw of approximately 500 m) divides the area into two structural domains, with the eastern domain being moderately to highly faulted with thrust fault throws of up to 100 m (JBMS, 2016).

Two-dimensional (2D) seismic sections clearly indicate at least four other north-north-west trending east over west thrust fault zones with throws up to 100 m. Seismic data indicates that the fault zones are composed of many smaller faults. Some folding occurs with north-west trending fold axes.

Local folding and thrust faults have caused vertical displacement in some places in the Olive Downs South domain, which has had the effect of the one seam occurring at multiple depths at the one location (e.g. in a bore). Dips are to the east and appear to be lower in the north, approximately 7 degrees, steepening to up to 15 degrees in the south. Higher dips occur adjacent to faults.

Conversely, the Willunga domain does not appear to have any significant faulting, but rather is subject to localised deformation from folding.

Exploration History

Early Exploration

Past coal exploration, drilling programs and mapping exercises have been undertaken in the Project area and surrounds including:

- 1960 – Enterprise Exploration Pty Ltd for ConZinc: Mapping of the Olive Downs South Project Area.
- 1968 – Bellambi Coal (Clutha): Scout drilling program for the Olive Downs South Project Area.
- 1960-70s – Utah Development Company: Coal exploration under AP 6C to the west within EPC 850 in the Bombandy region.
- 1960s-70s – UDC/BHP Coal/Capcoal/Anglo: Coal exploration in the Picardy area (south).

The exploration potential of the region was reviewed in the lead up to the Department of Minerals and Energy's release of Reserve Area 55 in the early 1990s, with an emphasis on contract mining and utilisation of existing rail infrastructure. It was recognised that the emerging new structural understanding could resolve many of the improbable structural geometries proposed in the 1:500,000 scale mapping of the Bowen Basin being compiled at the time by the Queensland Department of Minerals and Energy (Queensland Government Printer, 1988).

In 1997, target exploration areas were recommended to Macarthur Coal Pty Ltd by Lance Grimstone and Associates, following their involvement in the data compilation for CSIRO study teams to re-evaluate the structure of the Bowen Basin.

It was further realised that modern geophysical logging could provide greater certainty in coal seam correlation that was not available to previous exploration programs.

EPC 688, 721 and 850 were targeted and properties recommended to Macarthur Coal Pty Ltd (Grimstone, 1997, unpublished), and subsequently its Joint Venture partners, CITIC Exploration Pty Ltd.

Olive Downs South Exploration

Broad-spaced chip and core drilling commenced at the Olive Downs South Project area in 1998 and continued through to 2014. Three mini-sosie seismic lines were also completed in the Olive Downs South resource area in 2000.

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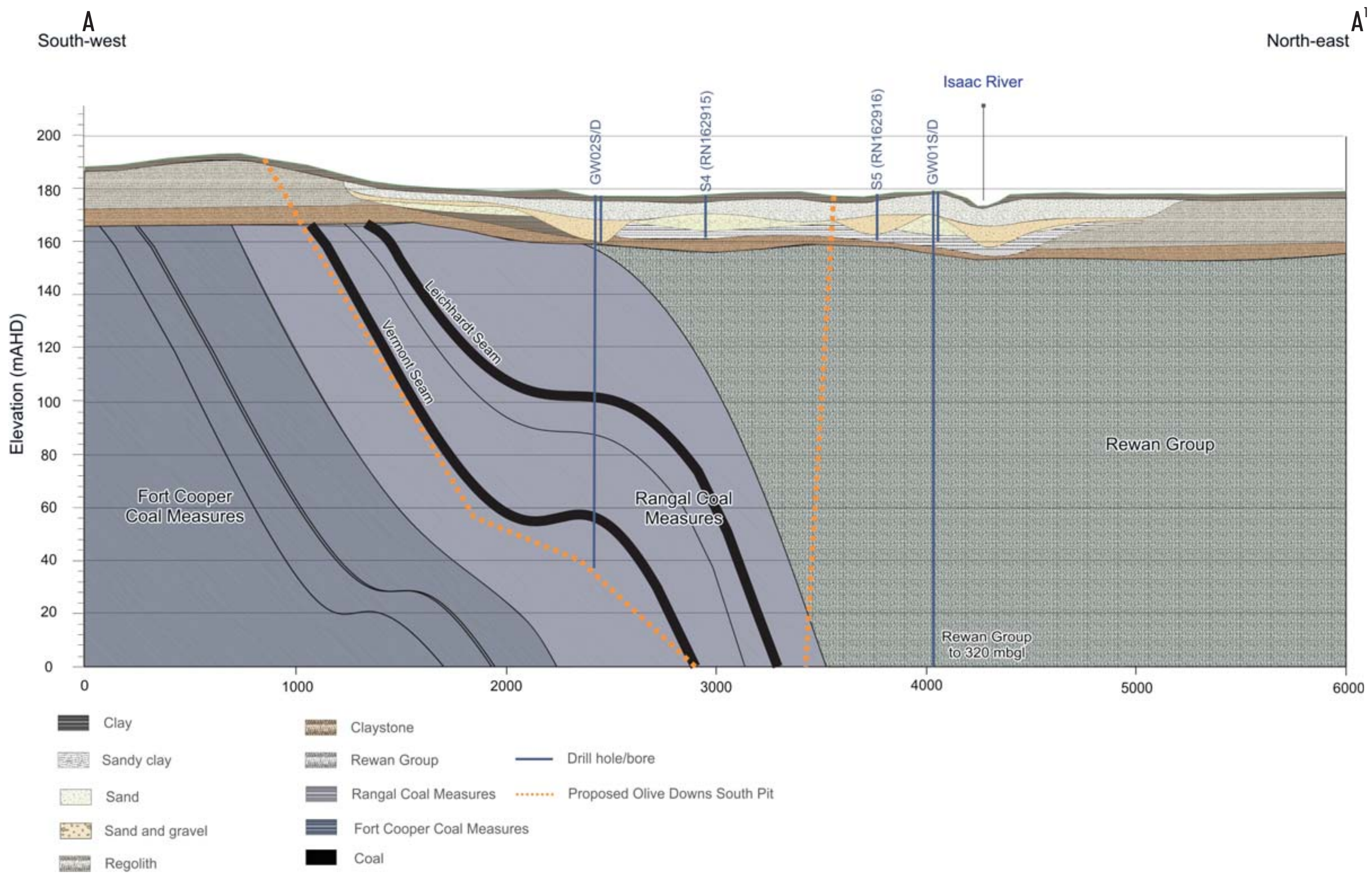

PRN-16-02_EIS_Sect2_007A

Source: HydroSimulations (2018)

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Indicative Geological Cross Section

Figure 2-20b

There are 498 holes in the lithological database, of which 312 are chip holes and 186 are core holes. Approximately 208 holes are drilled on the same site as an existing hole (pilot for core, redrill, gas and geotechnical).

Willunga Exploration

Broad-spaced chip and core drilling commenced at the vicinity of the Willunga domain in June 2000.

Scout drilling identified the laterally continuous nature of the 4 m to 5 m thick Leichhardt Lower 2 (LL2) Seam and the Vermont Upper Seams throughout the area. Subsequent drilling campaigns were completed in 2001, 2003, 2006 and 2007 through to 2013.

There are 656 holes in the lithological database for the Willunga area. Of the 656 holes, 322 are in the Willunga domain area. Approximately 113 holes are drilled on the same site as an existing hole (pilot for core, redrill, gas and geotechnical).

Coal Resource and Target Seams

Coal-bearing sediments of the Permian Blackwater Group form the main resource of the numerous mines surrounding the Project area.

In increasing depth (age) order, the coal measure sequences of the Blackwater Group include the:

- Rangal Coal Measures;
- Fort Cooper Coal Measures; and
- Moranbah Coal Measures.

The Rangal Coal Measures include the target coal seams for the Project. The Rangal Coal Measures range from 90 m to 195 m thick light grey, cross-bedded, fine to medium grained labile sandstones, grey siltstones, mudstones and coal seams.

The Leichhardt and Vermont Seams of the Rangal Coal Measures form the principal economic coal resources in the Olive Downs South and Willunga domains with the cumulative Leichhardt and Vermont Upper Seam coal thickness in the order of 10 m.

The Leichhardt Seam is typically 1.5 m to 2.5 m thick and the Vermont Upper Seam is typically 3.5 m to 4 m thick.

The Olive Downs South domain coal seams will deliver a high rank, low volatile coking coal product and have a Joint Ore Reserve Committee (JORC) resource of 460 million tonnes (Mt).

The Willunga domain coal seams will deliver a low volatile PCI product and have a JORC resource of 353 Mt.

2.2.8 Soils and Land Use

A soil survey conducted by GT Environmental (Appendix M) identified that the Project area includes areas of flat to gently undulating plains dominated by uniform and gradational clays, gently undulating plains dominated by sandy duplex with gradational sandy loams, relic alluvial plains and low-lying plains and recent alluvial floodplain and active channels with stratified loamy sands.

No acid sulphate soils have been identified within the Project area (Appendix M).

The results of the Soil and Land Suitability Assessment are described in further detail in Section 4.10 and Appendix M.

The Project is located within the Bowen Basin mining area where open cut coal mining is a key land use, and a number of existing and approved coal mines, including Moorvale, Daunia, Poitrel, Millennium, Eagle Downs, Peak Downs, Saraji, Lake Vermont surround the Project.

Coal and petroleum (e.g. coal seam gas) mining exploration activities have been conducted within the Project area and surrounds for decades, and continues.

Land within the Project area is used predominately for cattle grazing, which reflects the land use suitability assessment findings that the majority of the Project site is Class 3, considered to be suitable for grazing but with moderate limitations. 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.

As described in Section 2.1.5, the Project is located outside of zones mapped as good quality agricultural land in the *Mackay, Isaac and Whitsunday Regional Plan* (Department of Local Government and Planning, 2012).

There are no strategic cropping areas mapped within the Project MLA areas or along the infrastructure corridors (Figure 2-14), and no cropping is currently conducted within the Project area.

The properties on which the Project is proposed are owned by Pembroke (i.e. Iffley and Deverill), other mining companies (i.e. Wynette) and private landholders (i.e. Vermont Park, Willunga, Seloh Nolem, Old Bombandy and Winchester South) (Figure 2-17a).

Surrounding land to the west of the Project is owned predominantly by other mining companies (Figure 2-17a).

The Project is located within zones identified and mapped as Regional Landscape and Rural Production Area under the *Mackay, Isaac and Whitsunday Regional Plan* (Department of Local Government and Planning, 2012) and is generally consistent with the '*identified coal reserves'*.

The Project area overlaps with existing petroleum tenements in the region, including those for the approved Bowen Gas Project (Figure 2-16).

Recreational Land Use

There are no tourist destinations or sites used for recreation in the Project area or adjacent to the proposed infrastructure corridors.

2.2.9 Queensland Agricultural Land Audit

The Queensland Agricultural Land Audit (the Audit) was prepared by the Department of Agriculture, Fisheries and Forestry (DAFF) in 2013 and is updated annually. It identifies land important to current and future agricultural production and the constraints to agricultural development.

The Audit describes 'important agricultural areas' as land that has all of the requirement for agriculture to be successful and sustainable, is part of a critical mass of land with similar characteristics and is strategically significant to the region or state.

The southern part of the Project is located within what is known as the 'Golden Mile' important agricultural area (Figure 2-14). This area covers approximately 1,000,000 ha and has been identified as an area of high quality grazing and cropping land. The Project would impact approximately 1% of the Golden Mile important agricultural area but would not impact any existing high-quality cropping land, as described in Section 2.2.8.

Given the proportionally small footprint of the Project within the important agricultural area, and the fact that no supply chains or agricultural industries would be impacted by the Project, impacts to the sustainability or success of the important agricultural area are not predicted.

As described in Section 2.2.8, there are no strategic cropping areas mapped within the Project MLA areas or along the infrastructure corridors (Figure 2-14). The closest strategic cropping area to the Project is located approximately 2 km to the south of the Willunga domain, adjacent to the Isaac River.

Agricultural land classifications indicate the majority of the Project area lies on C1 (sown pastures, and native pasture on high-fertility soils) and C2 (Native Pastures) class agricultural lands (Queensland Government, 2016a). This indicates that the land is suitable for pasture, but is not suitable for wide-scale cropping (DAF, 2016).

2.3 CLIMATE

Long-term meteorological data for the region is available from a range of Commonwealth Bureau of Meteorology (BoM) meteorological stations (Figure 2-21 and Table 2-1). The Carfax Station (34016), located approximately 5 km south-east of the Project (Figure 2-21), provides the most extensive rainfall dataset in the vicinity of the Project.

The Moranbah Water Treatment Plant weather station (34038), located approximately 40 km north-west of the Project (Figure 2-21), provides the most extensive temperature dataset, however, it was decommissioned in 2012 and replaced with the Moranbah Airport weather station (34035).

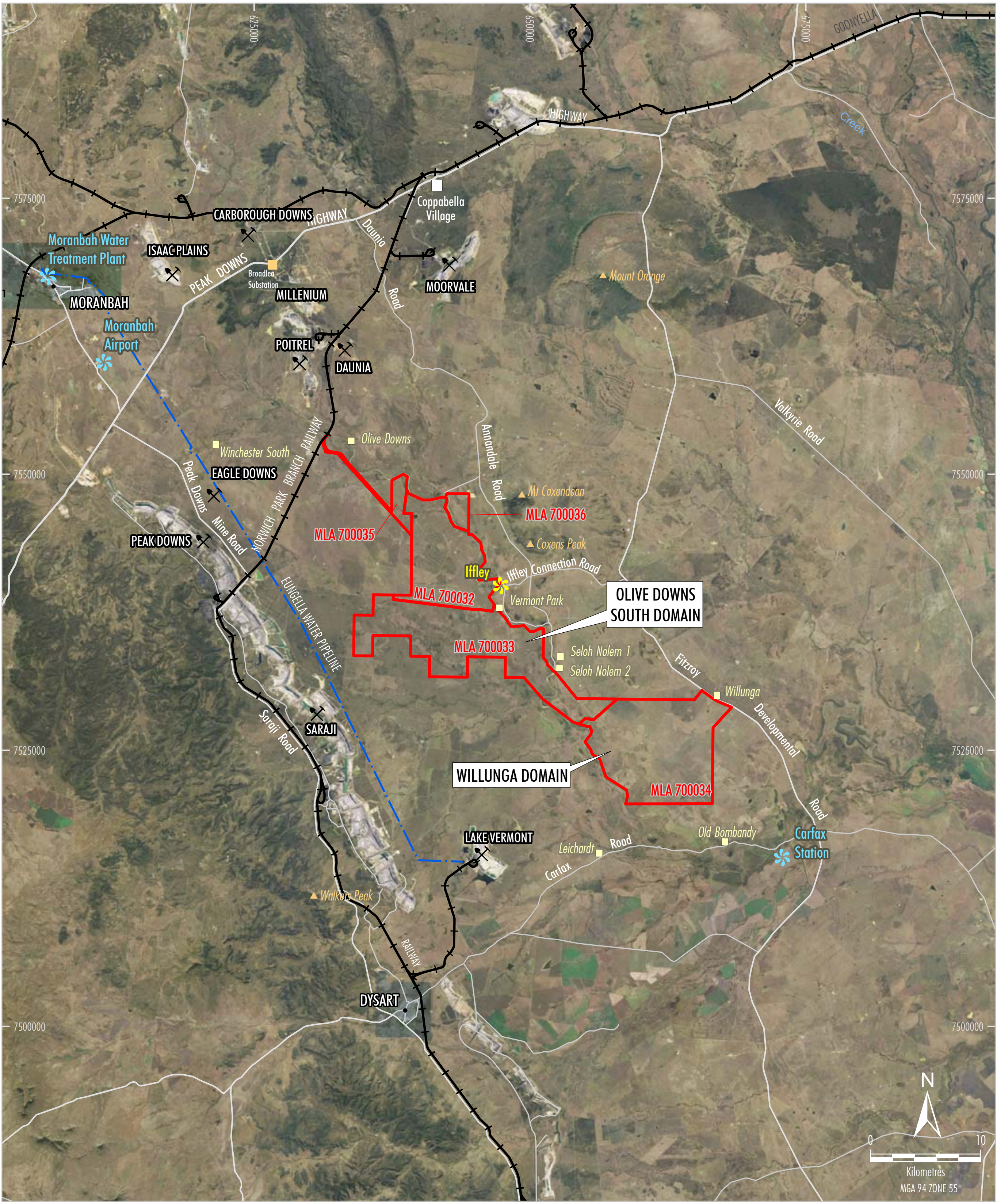
Short-term local records (since February 2017) are available from the on-site weather station (Figure 2-21). The on-site weather station monitors a number of meteorological parameters, including rainfall, temperature, humidity, wind speed and wind direction.

A summary of meteorological parameters in the vicinity of the Project relevant to the environmental studies in this EIS are provided below.

2.3.1 Rainfall Data and Statistics

The long-term average annual rainfall recorded at the Carfax Station (34016) is 619 millimetres (mm) based on records dating back to 1962 (Table 2-1).

The Carfax weather station (34016) data shows that the period between 1992 and 2009 was predominately dryer than average. Rainfall from 2011 to 2017 at Carfax Station (34016) is more or less consistent with the long-term average.



LEGEND
- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Eungella Pipeline Network
- Railway
- Dwelling
- On-Site Weather Station
- Weather Station

Source: Pembroke (2018), Geoscience Australia - Topographical Data 250K (2006), Department of Natural Resources and Mines (2016)
Orthophotography: Google Image (2016)

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Meteorological Stations

Figure 2-21

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Table 2-1
Meteorological Summary – Average Rainfall, Evaporation, Temperature and Humidity

Period of Record	Average Monthly Rainfall (mm)			Average Monthly Potential Evaporation (mm)		Average Daily Temperature (ºC) [Minimum-Maximum]	Average Monthly Humidity (%) [9am-3pm]
	Carfax (34016)	Moranbah Water Treatment Plant (34038)	Moranbah Airport (34035)	Carfax (34016)	Moranbah Airport (34035)	Moranbah Water Treatment Plant (34038)	Moranbah Water Treatment Plant (34038)
	1962-2017	1972-2012	2012-2017	1962-2017	2012-2017	1986-2012	1986-2010
January	111.2	103.8	104.6	187	175	21.9-33.8	69-43
February	94.1	100.7	103.1	155	147	21.8-33.1	74-48
March	61.5	55.4	103.8	170	163	20.2-32.1	70-41
April	32.3	36.4	32.3	124	120	17.6-29.5	72-43
May	35.7	34.5	33.2	96	95	14.2-26.5	73-43
June	29	22.1	18.9	80	80	11.2-23.7	73-44
July	23.1	18.0	36.6	81	81	9.9-23.7	69-39
August	23.5	25.0	9.3	100	98	11.1-25.5	66-35
September	19.5	9.1	9.8	126	124	14.1-29.2	60-30
October	34.4	35.7	19.0	172	171	17.6-32.3	58-31
November	55.9	69.3	50.7	189	186	19.4-33.1	60-34
December	98.6	103.9	69.4	188	179	21.1-34.0	64-38
Annual Average	***619***	***614***	***601***	***1,668***	***1,619***	***16.7-29.7***	***67-39***

Source: BoM (2017) and Appendix D.
ºC = degrees Celsius.

The long-term average annual rainfall recorded at the Moranbah Water Treatment Plant weather station (34038) is 614 mm, based on records from 1972 to 2012 (Table 2-1). This corresponds with the long-term average observed at Carfax Station (34016). Figure 2-22 displays the long-term monthly rainfall and rainfall residual mass curve at Carfax Station (34016). Although only providing five years of data, the Moranbah Airport weather station (34035) rainfall data is also included in Table 2-1.

Figure 2-22 displays the highest and mean rainfall at the Moranbah Water Treatment Plant (34038).

2.3.2 Evaporation and Evapotranspiration Data and Statistics

Evaporation records are available from the Carfax Station (34016) and the Moranbah Airport (33047) meteorological stations (Figure 2-21), which have recorded average annual potential evaporation (Class A pan) of approximately 1,668 mm and 1,619 mm, respectively (Table 2-1).

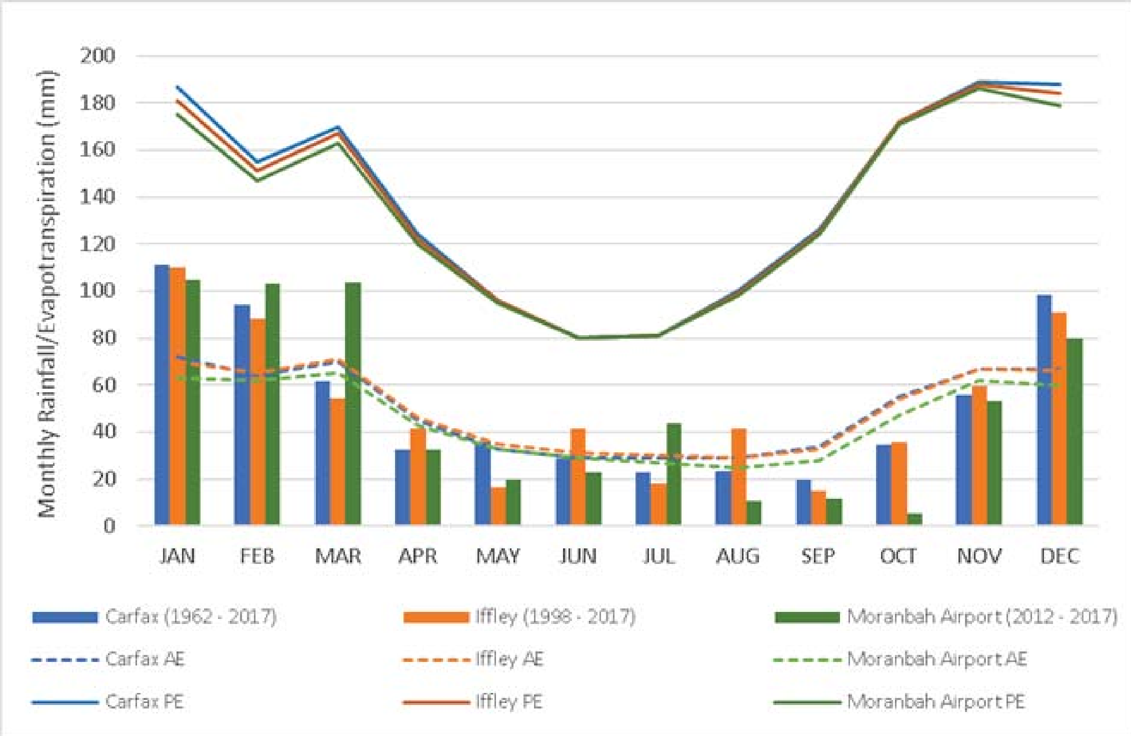
The BoM has mapped average actual evapotranspiration rates (collective term used for the transfer of water from vegetated and un-vegetated land surfaces) in the vicinity of the Project as between 544 to 597 millimetres per year (mm/year) (Appendix D), which is approximately 35% of the measured Class A pan evaporation.

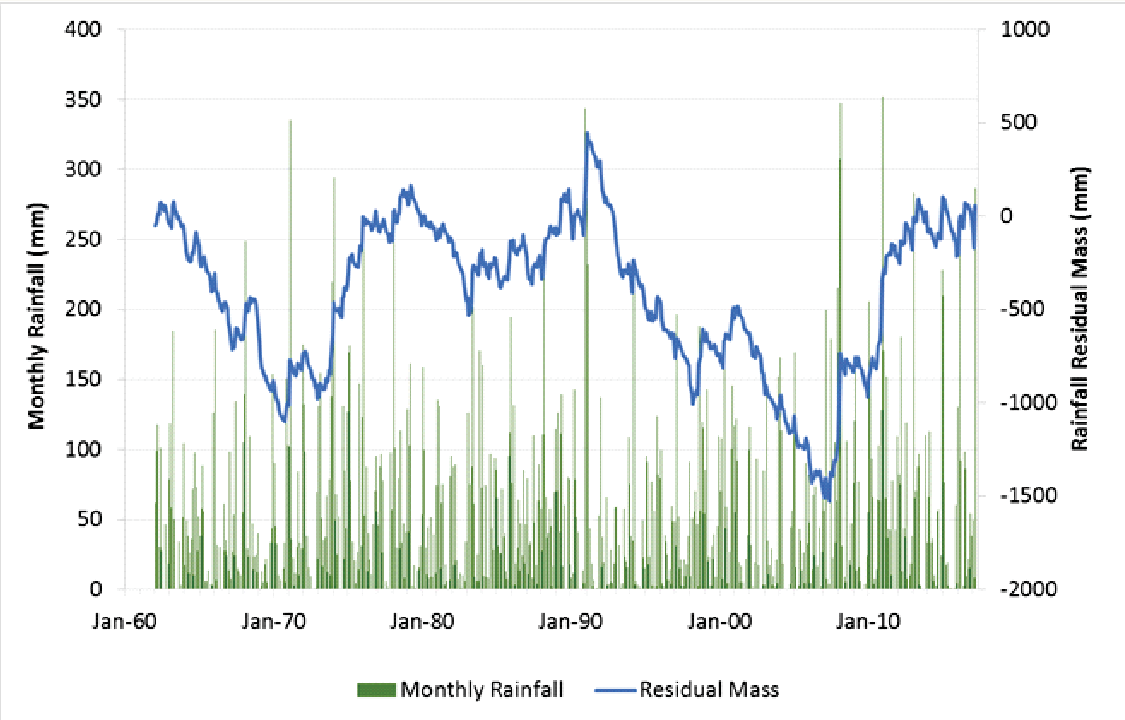
Based on the available datasets, measured monthly-average potential evaporation exceeds the measured monthly-average rainfall all year round (Table 2-1).

2.3.3 Temperature Data and Statistics

The closest BoM meteorological station to the Project with sufficient temperature data is Moranbah Water Treatment Plant (34038) (BoM, 2017) (Figure 2-21). Monthly-average daily maximum temperatures and daily minimum temperatures for the Moranbah Water Treatment Plant meteorological station are provided in Table 2-1.

Temperature measurements continue to be recorded at the Pembroke-owned on-site weather station.





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Source: HydroSimulations (2018)

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Long-term and Average Rainfall Graphs

Figure 2-22

2.3.4 Humidity Data and Statistics

The closest BoM meteorological station to the Project with recorded humidity data is located at the Moranbah Water Treatment Plant (34038) (BoM, 2017) (Figure 2-21). Monthly-average relative humidity records at 9.00 am and 3.00 pm for the Moranbah Water Treatment Plant meteorological station are provided in Table 2-1.

Humidity levels continue to be recorded at the Pembroke-owned on-site weather station.

2.3.5 Bushfire Risk

The Project is located on areas of 'medium potential bushfire intensity' bushfire hazard (Figure 2-23) (Department of Infrastructure, Local Government and Planning, 2016).

All reasonable and practicable fire prevention measures would be implemented by Pembroke during construction and operation, including the construction and maintenance of fire breaks (if required), the provision of fire-fighting equipment around the site and the training of staff in the proper use of the fire-fighting equipment.

Bushfire risk has been assessed further in Section 4.12.

2.3.6 Wind Speed Direction

Wind data is available from the BoM Moranbah Airport meteorological station.

The 2015 annual, seasonal and diurnal frequencies of winds at the Project site are shown as wind roses in Figure 2-24 (Appendix G).

On average, 70% of winds at the site are from the north-east through to the south-east. During the year winds vary with the seasons, with south-easterlies most frequent during autumn and winter, and north-easterlies most frequent during spring. The highest frequency of winds above 6 metre per second (m/s) occur during summer, from the east and east-southeast which are also the most frequent wind directions (Figure 2-24).

These results are consistent with the 2015 data collected at the DEHP's Moranbah dust monitoring station, which recorded light winds averaging 2 m/s, originating predominantly from the south-east (Queensland Government, 2016c).

2.3.7 Atmospheric Stability

Atmospheric stability classification is a measure of the stability of the atmosphere. Stability classes range from A class stability, which represents very unstable atmospheric conditions that may typically occur on a sunny day, to F class stability, which represents very stable atmospheric conditions that typically occur during light wind conditions at night.

No specific monitoring data at the Project site is available to confirm whether temperature inversions occur at the Project site. Model generated data (Appendix G) indicates that A class stability is rare at the Project site, while B, C and E class stability conditions each occur approximately 10 to 15% of the time. D and F class stability conditions each occur approximately 30% of the time.

Unstable conditions (Classes A to C) are characterised by strong solar heating of the ground that induces turbulent mixing in the atmosphere close to the ground. This turbulent mixing is the main driver of dispersion during unstable conditions.

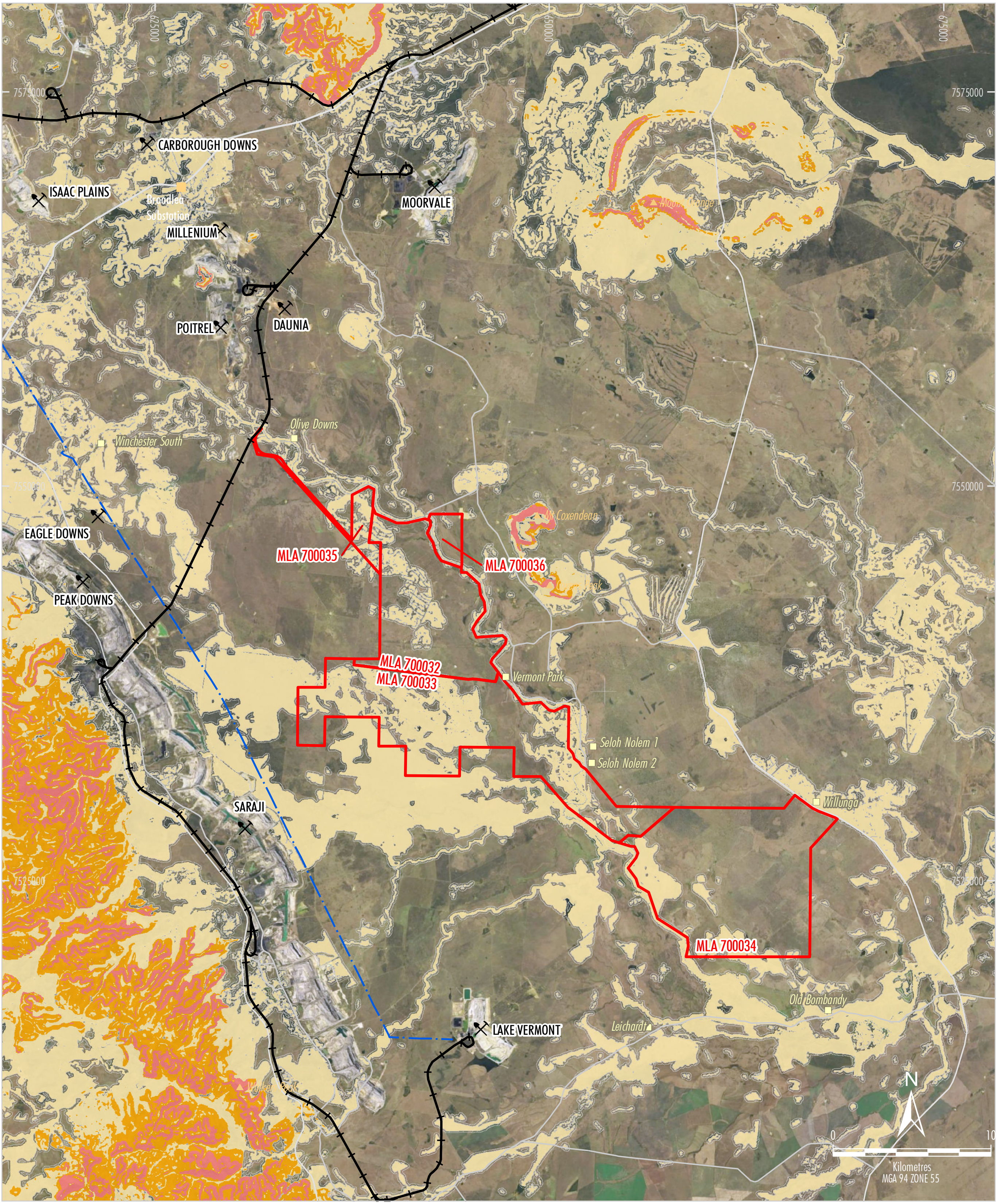
Dispersion processes for the most frequently occurring Class D conditions are dominated by mechanical turbulence generated as the wind passes over irregularities in the local surface. During the night, the atmospheric conditions are generally stable (classes E and F) (Appendix G).

2.3.8 Consideration of Climate Change Projections for Australia and Queensland

Consideration of the potential implications of climate change involves complex interactions between climatic, biophysical, social, economic, institutional and technological processes.

Although understanding of climate change has improved markedly over the past several decades, climate change projections are still subject to uncertainties such as (CSIRO, 2015):

- scenario uncertainty, due to the uncertain future emissions and concentrations of greenhouse gases and aerosols;
- response uncertainty, resulting from limitations in our understanding of the climate system and its representation in climate models; and
- natural variability uncertainty, the uncertainty stemming from unperturbed variability in the climate system.



LEGEND
- Mining Lease Application Boundary
- Approved/Operating Coal Mine
- Dwelling
- Eungella Pipeline Network
- Railway
- Very High Potential Bushfire Intensity
- High Potential Bushfire Intensity
- Medium Potential Bushfire Intensity
- Potential Impact Buffer

Source: Geoscience Australia - Topographical Data 250K (2006)
Department of Natural Resources and Mines (2018)
Orthophotography: Google Image (2016)

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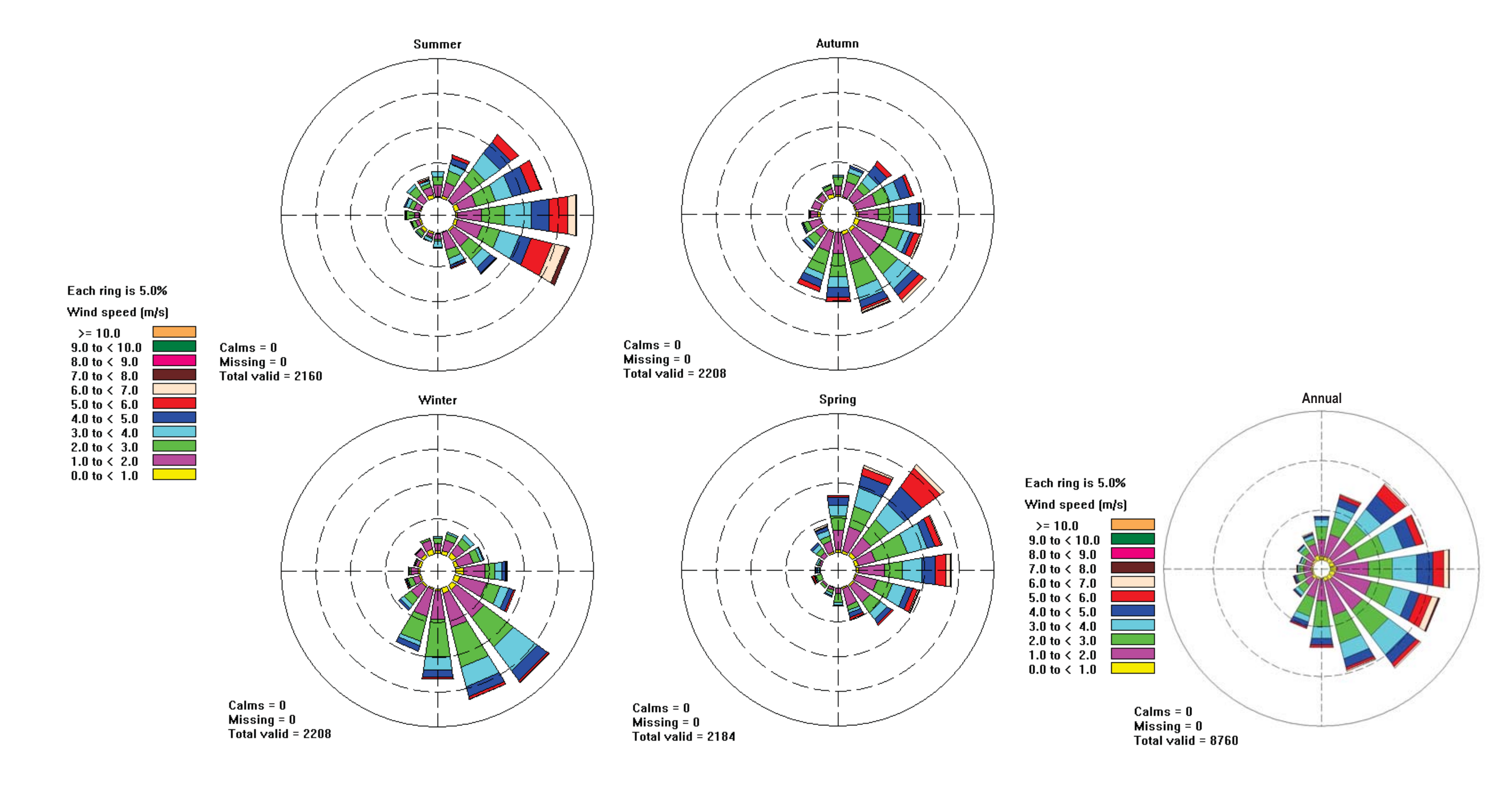
Bushfire Hazard Mapping

Figure 2-23

TOC



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Source: Katestone (2018)

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Annual and Seasonal Wind Roses from CALMET Model

Figure 2-24

Climate Change in Australia, produced by CSIRO and the BoM provides climate change projections relevant to the Project area.

In Australia, the climate is projected to become warmer and drier.

Climate change may result in changes to rainfall patterns, runoff patterns and river flow. The long-term (2090) climate predictions for the 'best case' and 'worst case' RCP4.5 climate change scenarios adopted in the Surface Water Assessment (Appendix E) are presented in Table 2-2.

Table 2-2
Adopted Climate Change Impact Projections

Case	Change in Annual Rainfall	Change in Annual Evapotranspiration
Best Case	-19.8%	+6.9%
Worst Case	+4.4%	+5.5%

Source: After Appendix E.

The potential implications of climate change on local surface water resources is considered in Appendix E.

2.4 CONSTRUCTION

The construction program for the Project has many stages and individual construction work packages to be delivered over an extended period of time of approximately 13 years, to enable the production rate to reach 20 Mtpa.

The first phase of construction activities, including early works, are anticipated to commence approximately 18 months to two years in advance of the planned operations (i.e. Stage 1). The works would commence as soon as the relevant planning approvals, EA and mining lease tenements (where required) are granted.

A second phase of construction activities would occur after approximately 10 years to allow the full development rate at the Olive Downs South domain to be achieved (i.e. Stage 2). This would involve expansion of the CHPP, workshops and the ILF cells.

A third phase of construction activities (Stage 3) would be conducted at the Willunga domain following the establishment of operations at the full development rate at the Olive Downs South domain and approximately 12 months in advance of the planned commencement of operations at the Willunga domain.

At the completion of the Stage 3 construction program, the Project infrastructure would be capable of delivery of up to 20 Mtpa.

These first phase packages would be focused on site access and basic infrastructure, such as water supply, roads, rail, power supply, coal crushing facilities, coal processing facilities, water management and the first stage of building infrastructure. In particular, the western part of the water pipeline, where it is located outside the mining leases, would form part of the early works. This would provide a construction water supply closer to the rail spur corridor and mine infrastructure area.

Construction activities would be undertaken generally during daytime hours up to seven days per week.

Proposed infrastructure, construction and other development activities, including early works, for the Project would be focused initially at establishing operations at the Olive Downs South domain within MLA 700032 and specifically include:

- the access road from Annandale Road to the mine infrastructure area and facilities (including a crossing of the Isaac River) and associated car parking and site security;
- the mine infrastructure area;
- explosives magazine;
- temporary flood protection levees;
- CHPP and associated coal handling infrastructure;
- a dry weather road crossing of the Isaac River to provide access to the eastern out-of-pit waste emplacement area;
- initial rejects storage facilities and ILF cells for storage and disposal of CHPP rejects; and
- rail-loadout facility including product coal stockpile areas.

Water management infrastructure, including up-catchment diversions, sediment dams and water storage dams, would be progressively constructed.

In addition, other key supporting infrastructure elements would be developed including:

- a raw water supply pipeline from the existing Eungella pipeline network;
- widening and upgrading of the road pavement along Daunia Road and Annandale Road;

- a rail spur and rail loop from the Norwich Park Branch Railway to the rail-loadout facility; and
- a 66 kV ETL and switching/substation from the existing regional power network for electricity supply.

Proposed infrastructure, construction and other development activities to establish operations at the Willunga domain would include:

- the access road from the Fitzroy Developmental Road to the Willunga domain mine infrastructure area and facilities and associated car parking and site security;
- the mine infrastructure area;
- overland conveyor to transfer crushed ROM coal to the Olive Downs South domain CHPP;
- explosives magazine;
- temporary flood protection levees;
- installation of on-site ROM coal handling and crushing facilities;
- expansion of the Olive Downs South domain coal processing facilities to process the Willunga domain ROM coal; and
- crossings of the Isaac River between the Olive Downs South and Willunga domains for direct vehicular access and ancillary infrastructure (i.e. water pipeline, electricity supply, fibre-optic communications, overland conveyor).

Similarly, water management infrastructure at the Willunga domain, including up-catchment diversions, sediment dams and water storage dams would be progressively constructed.

2.4.1 Access Roads, Car Parking and Site Security

Olive Downs South Domain

The main vehicle access route to the Olive Downs South domain is proposed to be via Daunia Road (off the Peak Downs Highway), connecting to Annandale Road and then a new intersection and dry weather access road constructed to the mine infrastructure area and facilities (including a crossing of the Isaac River) (Figure 1-2).

The proposed alignment of the new access road to the Olive Downs South domain is shown on Figure 2-1, and follows the existing driveway and Isaac River crossing on the Deverill property within MLA 700036, before entering the Iffley property within MLA 700032.

The intersection of the new access road with Annandale Road would be constructed in accordance with local government standards.

Initial Construction Phase

An access road from the intersection with Annandale Road to the mine infrastructure area and facilities would be constructed to allow construction activities to be carried out during the first phase.

A crossing of the Isaac River would be constructed using selected materials for the pavement with low flow culverts laid under the pavement at the lowest point in the river bed to convey low river flows beneath the access road.

The concept design for the Isaac River crossing is shown on Figure 2-25.

Both Daunia Road and Annandale Road are unsealed gravel roads approximately five metres wide. These roads would be widened (up to 8 m) where required, and the pavement upgraded to cater for the design loading of vehicles using the access route and in compliance with IRC requirements. These works would be conducted by the IRC through a road infrastructure arrangement with Pembroke.

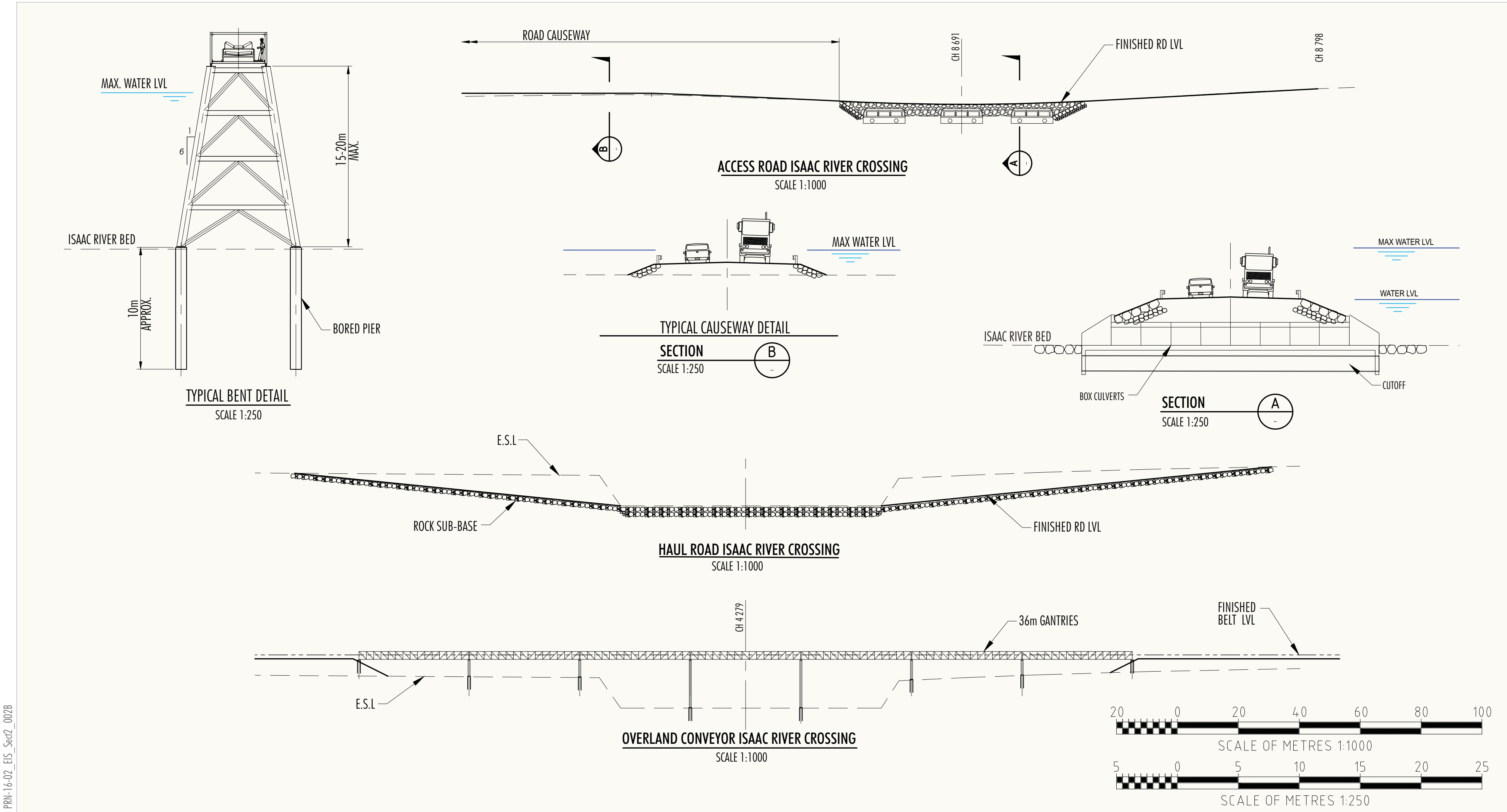
If suitable material is identified on-site for road construction, a quarry may be developed within the Project disturbance footprint of the Olive Downs South or Willunga domains. Alternatively, existing hard rock quarries located in the region (Section 2.4.12) would be used to meet the Project requirements.

A car parking area would be installed adjacent to the administration buildings at the Olive Downs South domain and sized to cater for approximately 100 vehicles.

A boom gate would be installed at the entrance to the mine on the access road to prevent inadvertent access to the mine site operations. It would be positioned to direct visitors to the administration area and car park. Other fencing (e.g. stock and security fencing) would be installed progressively around select facilities as required.

Initial Operations Phase

Following the establishment of operations, the mine access road would be upgraded as required, to provide a permanent mine access road from Annandale Road to the mine infrastructure area and facilities.



Source: Phronis (2018)

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Isaac River Crossing - Conceptual Design

Figure 2-25

The Isaac River crossing would also be upgraded (i.e. culvert/causeway arrangement) to provide a 50% Annual Exceedance Probability (AEP) (two-year average recurrence interval [ARI]) flood immunity.

Following the initial construction period, the mine access road, Daunia Road and Annandale Road would be repaired as required in preparation for the commencement of operations.

Willunga Domain

The proposed access route to the Willunga domain requires the construction of a new intersection and all-weather access road off the Fitzroy Developmental Road, which is an existing high quality rural highway. The alignment of the new access road is shown on Figure 2-2.

A new three-way intersection off Fitzroy Developmental Road is proposed to provide access to the Willunga Domain.

The intersection with the Fitzroy Developmental Road would be constructed in accordance with DTMR (2014) *'Road Planning and Design Manual (Edition 2) – Volume 3: Supplement to Austroads Guide to Road Design Part 4A'*. The indicative form for the new access intersection is provided in Appendix J.

GTA Consultants (2018) conducted a site inspection of the proposed intersection and confirmed that there were no constraints that could interfere with achieving the required minimum sight distances outlined in DTMR (2014).

Approximately 50 car park spaces would be provided for at the Willunga domain administration buildings.

A security gate would be installed east of the mine infrastructure area administration building and car park. Other fencing (e.g. stock and security fencing) would be installed progressively around select facilities as required.

2.4.2 Mine Infrastructure Areas

Olive Downs South Domain

The mine infrastructure area is proposed to be located to the west of the open cut pits within the Olive Downs South domain, as shown on Figure 2-1. This area was chosen for the mine infrastructure area, as it is located on high ground and provides appropriate clearance for blasting operations. The mine infrastructure area would be formed by cut and fill methods to minimise earthworks.

The mine infrastructure area at the Olive Downs South domain would comprise:

- administration buildings (including toilets, kitchen, reception, conference room and first aid room), covered muster area and bathhouse (including showers, toilets/urinals, basins and change rooms);
- CHPP (Section 2.4.5);
- ILF cells facilities (Section 2.4.6);
- rail loadout facility and rail loop (Sections 2.4.7 and 2.4.8);
- maintenance facilities (including heavy vehicle workshop with multiple bays and maintenance bay concrete aprons, hydraulic hose room, fitter and turner workshop, electrical workshop, tool room, multiple offices, toilets and crib room), fenced store yard, heavy vehicle wash down bay and fuel and lubricant facility (including self-bunded storage units and bunded concrete fill-point slabs);
- potable water treatment plant;
- sewage treatment plant; and
- effluent disposal areas.

The buildings, maintenance and fuel and lubricant facilities would be expanded (e.g. additional building floor area, additional bays, additional storage tanks, etc.) as the production increases over the life of the Project.

Willunga Domain

The mine infrastructure area at the Willunga domain would be a satellite operation from the mine infrastructure area facilities at the Olive Downs South domain. The Willunga domain mine infrastructure area would be located to the east of the open cut pit, adjacent to the Fitzroy Developmental Road (Figure 2-2) in an area which has good road access and provides appropriate clearance for blasting operations. As the site is relatively flat, limited earthworks would be necessary to prepare the area for the mine infrastructure area.

The mine infrastructure area at the Willunga domain would include administration buildings, maintenance facilities, potable water treatment plant, a sewage treatment plant and effluent disposal areas (similar to the Olive Downs South domain mine infrastructure area).

2.4.3 Explosives Magazines

Olive Downs South Domain

The initial location for the explosives magazine at the Olive Downs South domain to provide for acceptable separation distances would be east of the ILF cells.

The explosives magazine would be relocated to the northern side of the mined open cut to provide for acceptable separation distances as mining progresses to the south (Figure 2-10).

Willunga Domain

The initial location for the explosives magazine at the Willunga domain to provide for acceptable separation distances would be south-west of the mine infrastructure area.

The explosives magazine would be relocated to the southern side of the mined open cut to provide for acceptable separation distances as mining progresses to the north (Figure 2-10).

2.4.4 Dry Weather Road Crossing to the Eastern Emplacement

A two-lane haul road crossing of the Isaac River would be constructed to provide dry weather access to the eastern out-of-pit emplacement area from the Olive Downs South domain (Figure 2-1).

To minimise potential impacts to the Isaac River banks and the river bed, the following management measures would be implemented:

- batters on the river banks would be revegetated following construction;
- upstream and downstream faces of the causeway would be protected with geotextile and rock armour; and
- the haul road crossing will be watered and maintained to provide a hard surface that minimises dust and sediment generation.

A conceptual design cross-section of the haul road is shown on Figure 2-25.

2.4.5 CHPP and Associated Infrastructure

Olive Downs South Domain

The CHPP would be constructed within the Olive Downs South domain (Figure 2-1) to accommodate washing of ROM coal to meet the customer's product coal specifications.

The CHPP would be constructed in three stages, with each having a capacity of up to 1,100 tonnes per hour (tph) feed and, when fully developed, would operate at a capacity of 20 Mtpa (ROM coal feed), capable of producing up to approximately 15 Mtpa of product coal.

The CHPP would comprise the following key infrastructure elements:

- a ROM dump wall and truck dump hopper;
- feeder breaker (primary crushing station), secondary and tertiary sizers, and tramp magnet;
- modular wet coal processing plants;
- hardstand for stockpiles of ROM coal, crushed ROM coal and washed product coal;
- rejects bin and/or hardstand for coarse rejects stockpiles prior to reclaim and disposal;
- pipeline infrastructure for the transfer of the fine rejects slurry to the ILF cells; and
- reclaiming systems with dozer fed stockpile activators and conveyors, or machine-based reclaimer systems as the production rates increase.

Further details of the coal processing operations are provided in Section 2.5.5.

A coal handling building (including control room office, crib room and toilet) would be constructed adjacent to the CHPP.

Willunga Domain

ROM coal handling and crushing facilities would be installed at the Willunga domain (Figure 2-2). Crushed ROM coal from the Willunga domain would be transferred to the CHPP at the Olive Downs South domain via overland conveyor.

The ROM coal handling and crushing facilities would comprise the following key infrastructure elements:

- a ROM stockpile and truck dump hopper;
- primary crushing station, secondary and tertiary sizers, with intermediate screening (depending upon the coal specification required for the transfer of crushed ROM coal to the CHPP at the Olive Downs South domain);
- surge bin (100 tonne [t]); and
- hardstand for stockpiles of ROM coal and crushed ROM coal.

A small building (including control room office, crib room and toilet) would be constructed adjacent to the coal crushing plant.

The alignment of the 25 km long overland conveyor between the ROM coal handling and crushing facilities at the Willunga domain and the CHPP at the Olive Downs South domain is shown on Figures 2-1 and 2-2. A conceptual cross-section of the overland conveyor to be constructed across the Isaac River and Ripstone Creek is shown on Figure 2-26. The overland conveyor would cross the Isaac River once and Ripstone Creek in two locations (Figure 2-1).

With the exception of the watercourse crossings, the overland conveyor gantry would generally be approximately 1 m to 2 m above the ground level.

At its greatest height, the overland conveyor would be approximately 15 to 20 m directly above the Isaac River crossing.

The overland conveyor would be fully enclosed where it crosses the Isaac River. The enclosure of the overland conveyor at the Isaac River crossing would also minimise noise impacts at nearby privately-owned dwellings.

The remaining sections of the overland conveyor would include a roof/cover to minimise coal loss and dust generation and provide protection against the weather elements (i.e. rainfall).

2.4.6 Initial Rejects Storage Facilities and In-line Flocculation Cells

Upon commissioning of the CHPP, coarse and fine rejects would require specific management until such time as in-pit disposal areas become available behind the advancing mining operations.

Therefore, during the initial two to three years of coal production, the coarse rejects would be placed in a separate emplacement area adjacent to and south of the ROM coal handling areas.

The emplacement design involves placement of coarse rejects in layers to a total depth of approximately 10 m. Decommissioning and rehabilitation of the ILF cells is described in Section 5.

As the mine operations progress, and in-pit disposal areas become available, the coarse rejects would then be trucked to in-pit waste emplacements within the final pit footprint.

Fine rejects would initially be transferred (via pipeline) to the purpose-built drying cells for mixing with flocculants. The ILF cells would be constructed from homogeneous clay embankments with twin pipe outlet facilities at one end of the cells to encourage beaching and water flow to the opposite end of the cell. Three intermediate ‘weir’ walls would also be built (utilising coarse rejects) to assist the natural filtration of the water.

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.

Based on the indicative mine schedule (Section 2.5.1) there is more than sufficient storage capacity for the first two to three years of Stage 1 production of fine rejects in the ILF cells.

The locations of the initial rejects storage facilities and ILF cells are shown on Figures 2-3, 2-4, 2-6 and 2-8.

Further detail on coal reject management is provided in Section 2.5.7.

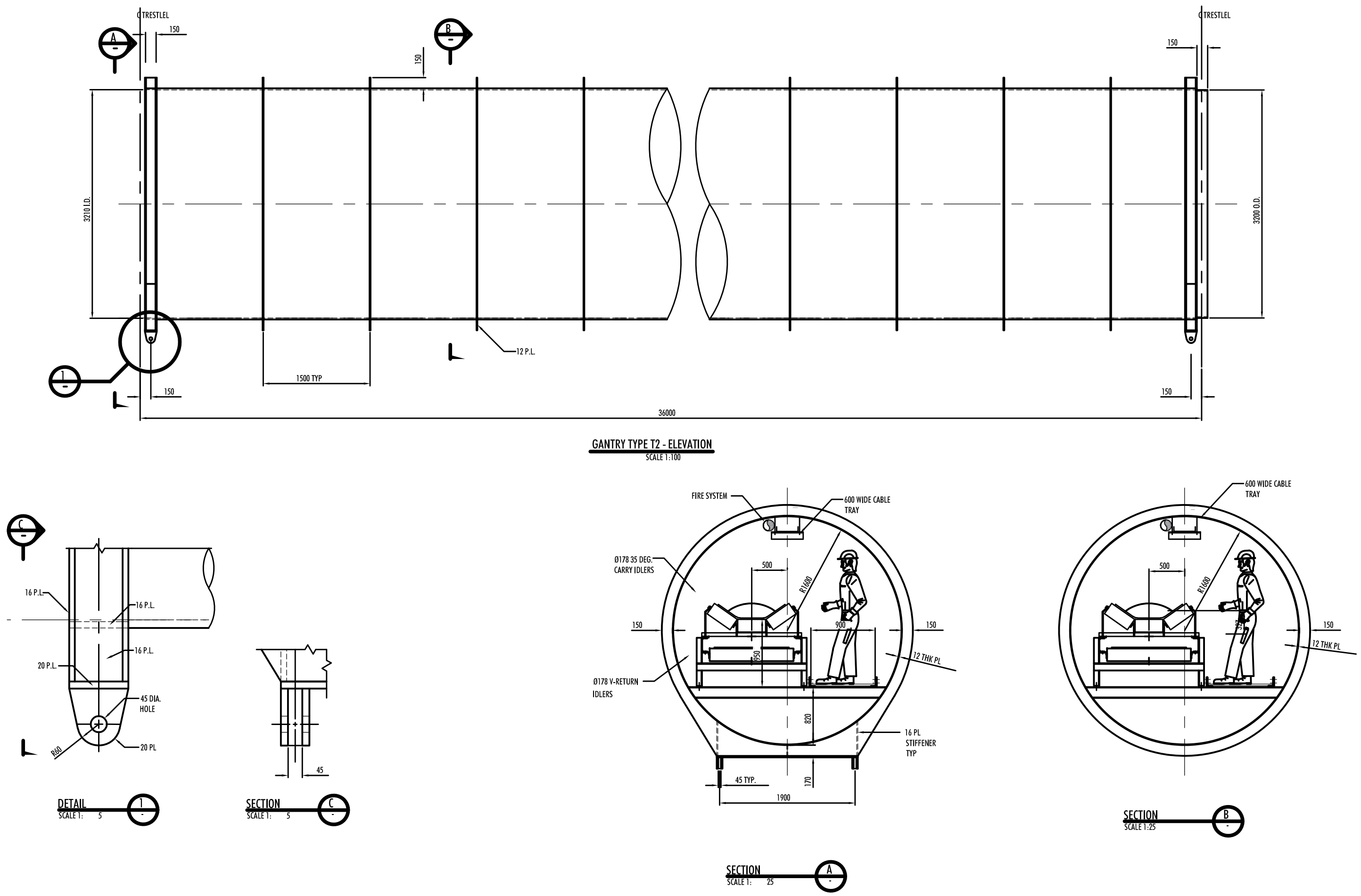
2.4.7 Rail-Loadout Facility and Product Coal Stockpiles

The rail-loadout and product coal stockpile areas would be located at the Olive Downs South domain adjacent to the rail loop (Figure 2-1).

The product coal stockpiles would accommodate up to 550,000 t at full development. The product coal stockpile area would be progressively developed and supported by two overhead product stacker conveyors requiring the use of dozers during operation to spread the coal.

The rail-loadout facility would comprise reclaim systems (including a train loading conveyor rated at 4,500 tph), train loading bin (500 t) and coal sampling station for loading of product coal to train wagons to meet rail haulage provider policy requirements (i.e. no less than 4,000 tph).
A control room and motor control centre room would also be installed at the rail-loadout facility.

If, during the initial establishment of the Olive Downs South domain, opportunities were to arise for the loading of product to coal trains in advance of commissioning the rail-loadout facility, early coal may be loaded directly to train wagons for rail transport and export to customers.



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Source: Phronis (2017)

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Overland Conveyor - Conceptual Design

Figure 2-26

2.4.8 Rail Spur and Rail Loop

The Project would include the construction of a new rail spur line from the Norwich Park Branch Railway and rail loop adjacent the rail-loadout facility at the Olive Downs South domain (Figure 1-2).

The rail spur and rail loop would be approximately 19 km in length (and corridor width of approximately 20 m), connecting to the main line between the Red Mountain (down-line) and Winchester (up-line) railway stops.

New culvert crossings would be installed along the rail spur to the Olive Downs South domain, with the final locations to be determined during the detailed design.

Overhead line equipment (OHLE) may be installed for traction power to facilitate train operations, as well as other connecting infrastructure to the main line. Diesel train operations may also be used. Communications and control systems would also be established to integrate with the existing network.

The track and formation levels would be designed to achieve a desirable 1% AEP flood immunity (to the top of ballast), or otherwise match the existing main line level of immunity. Diversion channels and supplemental earthworks would be undertaken if required to protect the alignment and control flood behaviour.

The rail loop adjacent to the rail-loadout facility at the Olive Downs South domain would be designed for a two-train capacity.

2.4.9 Water Supply Pipelines and Potable Water Treatment Plants

A raw (external supply) water pipeline (approximately 23 km long) would be constructed for the Project from the existing Eungella water pipeline network (the Eungella Pipeline Southern Extension), with the take-off point to be located north of Eagle Downs (Figure 1-2). The water pipeline would initially terminate at an existing onsite dam (Figures 2-3, 2-4, 2-6 and 2-8) and would supply up to approximately 500 megalitres (ML) per year for construction and the initial establishment of operations.

Until such time as the raw (external supply) water pipeline is commissioned, water demands for construction and initial establishment of operations may be met by:

- capture of incident rainfall and runoff within the mine water management system as it is developed (i.e. stormwater and mine affected water); and
- capture of overland flow (i.e. up-catchment water) in select dams once constructed (i.e. North Western Water Dam).

The North Western Water Dam is an existing farm dam that will continue to collect up-catchment runoff, and during the Project would be used as a buffer storage for raw water direct from the Eungella pipeline. The overland flow capture in the North Western Water Dam has been calculated in the Surface Water Assessment (Appendix E) and ranges from 417 ML/annum during Phase 1 on average, reducing to 151 ML/annum by the end of the Project.

The raw (external supply) water reticulation system would be installed to pump directly to the CHPP Process Water storage tanks (approximately 500 kilolitre [kL] capacity located adjacent the mine infrastructure area), which would also feed the raw water storage tank (approximately 250 kL capacity) upstream of the potable water treatment plant and fire system.

The raw (external supply) water reticulation system would also include allowances to mix and store water with the above onsite and offsite sources in the Raw Water Dam to provide a minimum of 10 days' storage capacity (250 ML) in advance of operations.

A water pipeline would also be installed between the Olive Downs South mine infrastructure area and the ROM coal handling and crushing facilities at the Willunga domain for provision of makeup water supply, as required, when demands for dust suppression water are unable to be met locally by on-site recycled water collected within the mine water management system.

Potable Water Supply and Storage

It is anticipated that potable water supply would be trucked to site during construction. Once the raw (external supply) water pipeline is constructed and commissioned it would be suitable for potable water supply purposes.

In the event of raw (external water) supply being unavailable, a package potable water treatment plant would be utilised to treat water from the Raw Water Dam to produce potable water in accordance with the National Health and Medical Research Council's (NHMRC) *Australian Drinking Water Guidelines* (NHMRC, 2011), and be developed generally in accordance with the Queensland Water Resources Commission (QWRC), *Guidelines for Planning and Design of Urban Water Supply Schemes* (QWRC, 1989) and relevant Australian Standards. Pembroke will assess potential risks associated with producing potable water from alternative sources, if required.

The potable water treatment plant at the Olive Downs South domain would accommodate a maximum daily volume of approximately 100 kL, and up to approximately 36 ML per year at full development.

Potable water would be stored in a potable water tank of 250 kL capacity in the Olive Downs South domain mine infrastructure area, and the reticulation system would distribute potable water to the administration building, bathhouse, covered muster area, maintenance facilities, sewage treatment plant and CHPP buildings.

Potable water would be regularly tested to ensure it complies with the *Australian Drinking Water Guidelines* (NHMRC, 2011).

Fire system water at the Olive Downs South domain would be reticulated in a dedicated fire system, separate to the potable water.

A second potable water treatment plant would be installed at the Willunga domain. The Willunga domain plant would be designed for ablutions, wash down and fire-fighting potable water requirements for the Willunga domain, accommodating a maximum daily volume of approximately 25 kL.

Potable water would be stored in a potable water tank of 100 kL capacity in the Willunga domain mine infrastructure area and the reticulation system would distribute potable water to the administration building, bathhouse, covered muster area, maintenance facilities, sewage treatment plant and coal handling and crushing facilities.

Fire system water at the Willunga domain would be reticulated in a dedicated fire system, separate to the potable water.

2.4.10 66 kV Electricity Transmission Line and Power Supply

At full development, the estimated operational electrical load for the Project is approximately 38 megawatts (MW).

Electricity supply for the Project would be provided from the existing regional power network via construction of a 66 kV ETL from the Broadlea Substation, and an on-site switching/substation located at the Olive Downs South domain mine infrastructure area.

The alignment for the ETL between the Broadlea Substation and the Project is shown on Figure 1-2.

Power supply at 11 kV/66 kV would be required for the following three key areas at the Olive Downs South domain:

- mine infrastructure area facilities;
- CHPP and associated coal handling facilities; and
- rail-loadout facilities.

The power demands at each area would progressively increase in line with the product coal outputs for the various stages of the operation.

During the construction phase for establishment of operations at the Willunga domain, the 11 kV/66 kV overhead distribution system would be extended on-site from the main switching/substation at the Olive Downs South domain approximately 30 km, to service the power demand of the overland conveyor and mine infrastructure area and coal handling and crushing facilities at the Willunga domain.

Diesel power generation would also be used for construction start-up activities and to power dewatering pumping sets and other remote power demands on-site.

2.4.11 Internal Roads, Hardstand/Laydown Areas and Other Miscellaneous Infrastructure

Internal roads to provide for authorised mine traffic to access the various facilities across the Olive Downs South and Willunga domains would be constructed as required.

The alignment of the haul road connection between the ROM coal handling and crushing facilities at the Willunga domain and the CHPP at the Olive Downs South domain is shown on Figures 2-1 and 2-2. A conceptual cross-section of the haul road to be constructed across the Isaac River is shown on Figure 2-25.

The haul road crossing of the Isaac River would comprise a rock sub-base and be located within an infrastructure corridor approximately 25 m wide. The approaches at the banks of the Isaac River would also be levelled to allow for a safe and serviceable ramping (gradient) of the road surface.

Hardstand and laydown areas would also be used adjacent to most facilities for items such as shipping containers, equipment spare parts (e.g. buckets/ chains/tracks, etc.), conveyor components, cable drums, storage drums or steel/timber/precast concrete components. Such areas would also be used for waste storage (for sorting and removal by waste contractors), storage for tyres and other consumable materials.

2.4.12 Internal Roads, Hardstand/Laydown Areas and Other Miscellaneous Infrastructure

Internal roads to provide for authorised mine traffic to access the various facilities across the Olive Downs South and Willunga domains would be constructed as required.

The alignment of the haul road connection between the ROM coal handling and crushing facilities at the Willunga domain and the CHPP at the Olive Downs South domain is shown on Figures 2-1 and 2-2. A conceptual cross-section of the haul road to be constructed across the Isaac River is shown on Figure 2-25.

The haul road crossing of the Isaac River would comprise a rock sub-base and be located within an infrastructure corridor approximately 25 m wide. The approaches at the banks of the Isaac River would also be levelled to allow for a safe and serviceable ramping (gradient) of the road surface.

Hardstand and laydown areas would also be used adjacent to most facilities for items such as shipping containers, equipment spare parts (e.g. buckets/ chains/tracks, etc.), conveyor components, cable drums, storage drums or steel/timber/precast concrete components. Such areas would also be used for waste storage (for sorting and removal by waste contractors), storage for tyres and other consumable materials.

2.4.13 Construction Materials

The majority of infrastructure components (e.g. CHPP, package plants, buildings, pipelines, etc.) would be manufactured offsite and transported to site for assembly and installation.

The initial Project construction period is expected to require approximately 460,000 t of road base gravel for construction of site access roads, rail formation, hardstands and upgrades to existing roads. This material is expected to be sourced at a rate of approximately 92,000 t per quarter (over a period of approximately 15 months). An additional 200,000 t of engineered fill material would be required during this period for drainage aggregate, bedding, rock armour and railway ballast, supplied at a rate of approximately 40,000 t per quarter.

Construction of the Willunga domain and expansion of the Olive Downs South domain during approximately Year 10 of the Project would require approximately 80,000 t of road base gravels and engineered fill, supplied over the course of approximately 12 months.

As described in Section 2.4.1, if suitable material is identified on-site for road construction, a quarry may be developed within the Project disturbance footprint of the Olive Downs South or Willunga domains. Suitable clay and rock materials (for embankments, bunds, levees, cells, etc.) would also be predominantly sourced from the on-site Project disturbance footprint of the Olive Downs South or Willunga domains. Alternatively, existing hard rock quarries located in the region such as the Moranbah South Quarry, the Grosvenor Quarry, the Nebo Quarry or the Doctor's Claim Quarry may be used to meet the Project construction, in accordance with the quarrys' licence conditions.

Other construction materials would generally be sourced from the region, where available, and subject to meeting material quality requirements (e.g. road base gravels, etc.).

2.4.14 Disturbance Areas – Construction

The development footprint (including itemised approximation of disturbance areas) during the course of the three Project construction phases (Section 2.4) is provided in Table 2-3.

2.4.15 Construction Fleet

Equipment used to construct the Project would include excavators, haul trucks, dozers, drills, graders, scrapers, front end loaders, cranes/frannas and water trucks.

Table 2-3
Approximate Disturbance Areas – Project Construction Components

Project Component	Approximate Disturbance Area per Construction Phase		
	1	2	3
Rail Spur (outside Mine Infrastructure Area)	43 ha	-	-
Water Pipeline[1]	46 ha	-	-
ETL	39 ha	-	-
Olive Downs South Domain Mine Infrastructure Area	1,672 ha	1,492 ha	-
Willunga Domain Mine Infrastructure Area	-	-	1,918 ha
Total Disturbance Area (Approximate)	**1,800 ha**	**1,492 ha**	**1,918 ha**
	5,210 ha (Total)		

[1] From the take-off point at Eungella Pipeline Southern Extension to the Olive Downs South mine infrastructure area.
Note: totals may have minor discrepancies due to rounding.

2.5 OPERATIONS

2.5.1 Resource Base and Mine Life Staging

The total estimated coal resource proposed to be mined over the 79 year life of the Project is approximately 612 Mt.

The staged progression of mining operations at the Project is shown on Figures 2-3 to 2-10. An indicative mine schedule for the Project based on the staged progression is provided in Table 2-4.

In summary, and for the purposes of this assessment, the Project would comprise seven mining operations stages:

Stage 1: Initial establishment of operations to 6 Mtpa ROM coal production at the Olive Downs South domain within Pits ODS1, ODS2 and ODS3. The two out-of-pit waste rock emplacements in the north of the Olive Downs South domain would be constructed and rehabilitated, and backfilling of Pits ODS1, ODS2 and ODS3 would have commenced. The northern section of the permanent highwall emplacement would have been constructed to isolate the open cuts from the Isaac River.

Stage 2: 6 to 12 Mtpa (peak) ROM coal production at the Olive Downs South domain, as well as establishment of operations at the Willunga domain up to 8 Mtpa (peak) ROM coal production. All pits in the Olive Downs South domain (except Pits ODS7 and ODS8) would be operating. The Ripstone Creek diversion would be constructed prior to development of the Ripstone Pit. The remaining southern section of the permanent highwall emplacement would have been constructed, isolating the open cuts from the Isaac River floodplain.

Stage 3: Continued peak total ROM coal production up to approximately 20 Mtpa (total) from the Olive Downs South and Willunga domains, before production reduces towards 10 Mtpa. The final voids in Pits ODS1 and ODS2 would be backfilled in this stage, and the western faces of the out-of-pit waste rock emplacements would be rehabilitated.

Stage 4: Steady ROM coal production at approximately 8 to 9 Mtpa from the Olive Downs South and Willunga domains. Mining within Pits ODS1, ODS2, ODS3, ODS4 and ODS9 within the Olive Downs South domain has completed.

Stage 5: Continued steady ROM coal production at approximately 5 to 7 Mtpa from the Olive Downs South and Willunga domains, before reducing production to approximately 2 Mtpa as mining within the Olive Downs South domain Pits ODS5 and ODS6 is completed.

Table 2-4
Indicative Mine Schedule

Project Stage	Project Years*	Waste Rock (Mbcm)	ROM Coal Mined (Mtpa)	CHPP Rejects (Mtpa)		Product Coal (Mtpa)
				Coarse Rejects	Fine Rejects	
Stage 1	2020 – 2030	12.2 – 116.3	1.0 – 6.0	0.2 – 1.3	< 0.1 – 0.4	0.8 – 4.5
Stage 2	2031 – 2040	189.0 – 297.2	11.0 – 20.0	2.5 – 4.2	0.7 – 1.3	7.8 – 15.0
Stage 3	2041 – 2050	199.3 – 298.3	13.7 – 20.0	2.7 – 3.9	0.8 – 1.2	10.2 – 15.0
Stage 4	2051 – 2060	123.0 – 148.6	6.4 – 10.8	1.1 – 1.9	0.3 – 0.6	4.9 – 8.4
Stage 5	2061 – 2072	48.9 – 115.2	0.8 – 6.9	0.1 – 1.3	< 0.1 – 0.4	0.7 – 5.3
Stage 6	2073 – 2085	47.5 – 49.3	1.6 – 3.3	0.3 – 0.6	< 0.1 – 0.2	1.2 – 2.6
Stage 7	2086 – 2098	6.3 – 19.4	0.4 – 1.8	< 0.1 – 0.3	< 0.1 – 0.1	0.3 – 1.4
Totals (Stages 1 – 7)			**612 Mt**	**120 Mt**	**36 Mt**	**459 Mt**

Assumed Project commencement date is 1 January 2019 and allowing an initial 18 months to two years initial construction phase.
Mbcm = million bank cubic metres.
Note: totals may have minor discrepancies due to rounding.

Stage 6: Steady ROM coal production of approximately 2 to 3 Mtpa from the Olive Downs South domain Pits ODS7 and ODS8 (operating during daytime hours) and Willunga domain Pits WIL4 and WIL5. Olive Downs South domain pits ODS5 and ODS6 and Willunga domain Pits WIL1, WIL2 and WIL3 have been backfilled.

Stage 7: Mining within the Willunga domain has completed, and ROM coal production at the Olive Downs South domain steadily declines as mining in Pits ODS7 and ODS8 is completed.

The indicative mine schedule for each Project year corresponding with the seven stages is also presented on Chart 2-1.

2.5.2 Mining Sequence, Methods and Equipment

The open cut mining areas for the Project would be mined conventional truck and shovel mining methods. The open cut mining operational areas would generally include supporting infrastructure such as haul roads, bunding/embankments, soil stockpiles, hardstands and water management structures.

Mining Sequence

Mining operations would generally occur 24 hours per day, seven days per week, however mining operations in Pits ODS7 and ODS8 would be conducted during daytime hours only, to minimise air quality and noise impacts at nearby privately-owned dwellings.

The open cut mining activities and general sequence at the Olive Downs South and Willunga domains would entail:

- progressive clearing of vegetation occurring on areas required for the mining operation in accordance with prescribed procedures (Section 4.1);
- stripping and stockpiling of topsoil from disturbed areas for storage and reuse in future rehabilitation of the mine landforms in accordance with prescribed procedures (Section 5.3.2);
- pre-stripping of weathered tertiary sediments (e.g. unconsolidated/friable overburden including clays) using scrapers, excavators and trucks;
- drilling and blasting (using commercial products, with the principal blasting agent being ammonium nitrate fuel oil [ANFO] only to be conducted during daytime) for fragmentation of competent overburden and interburden material as waste rock;
- removal of waste rock and inter-seam partings to expose the underlying coal seams, and placement in out-of-pit waste rock emplacements, or as infill in the mine void behind the advancing mining operations, using a combination of dozers, excavators and trucks;
- mining of coal and haulage to the ROM coal handling facilities using a combination of dozers, excavators, loaders and trucks; and
- re-shaping of the waste rock emplacements, re-application of topsoil and revegetation of the final landform surfaces as described in the rehabilitation strategy (Section 5).

Chart 2-1
Indicative Production Schedule

The open cut pits would be excavated to depths ranging up to 300 m.

2.5.3 Temporary Flood Levees and Permanent Highwall Emplacements

Temporary Flood Levees

Construction of temporary flood levees (or sufficiently robust waste rock emplacements) (Figures 2-3 to 2-9) are required to provide immunity for infrastructure and mining operations to flood levels during a 1:1000 AEP flood event, if such an event was to occur during the course of the Project.

Each temporary flood levee would be installed progressively, and in advance of the open cut mining operational areas it would protect.

The configuration (i.e. design heights) of temporary flood levees would vary across the Project depending on the location in the landscape. By way of example, the temporary flood levees in the north-east of the Olive Downs South domain could range from 0.5 m to 6.0 m, where as in the southern areas the temporary flood levees could range from 0.5 m to 4.7 m. Similarly, the temporary flood levees at the Willunga Domain could range from 0.5 m to 6.0 m (Appendix F).

By way of example, the temporary flood levees in the north-east of the Olive Downs South domain could range from 0.5 m to 6.0 m, where as is in the southern areas the temporary flood levees could range from 0.5 m to 4.7 m. Similarly, the temporary flood levees at the Willunga Domain could range from 0.5 m to 6.0 m.

The temporary flood levee in the north-east of the Olive Downs South domain would be removed or reshaped once the open cut is backfilled and rehabilitated in the northern areas, to provide additional flood storage areas adjacent to the Isaac River to reduce flood velocities and stream power (Figures 2-3, 2-4, 2-6 and 2-8). Similarly, the temporary flood levees in the south and south-west of the Olive Downs South domain adjacent Ripstone Creek would be removed or reshaped once the waste rock emplacements are rehabilitated (Figures 2-3, 2-4, 2-6 and 2-8).

The temporary flood levee in the west of the Willunga domain would also be removed or reshaped once the Pit WIL1 is backfilled and the waste rock emplacements rehabilitated (Figures 2-5, 2-7 and 2-9).

Permanent Highwall Emplacements

The construction of permanent highwall emplacements to the east and south-east of the proposed Olive Downs South domain open cut pits adjacent to the Isaac River floodplain would isolate the mining operation from the floodplain and provide immunity to flood levels up to a PMF event (Figures 2-3, 2-4, 2-6 and 2-8). In effect, the highwall emplacements would redefine the floodplain extent, such that the open cut mining operation (and the final voids [Sections 2.17 and 4.2.2]) would not be located within a floodplain.

The permanent highwall emplacements would be developed progressively during the mine life and would generally be approximately 300 m to 400 m wide and approximately 25 m high. In contrast, the PMF event flood level in the vicinity of the permanent highwall emplacements would generally be below 6 m (Appendix F).

In addition to a vegetative cover, the outer, lower slopes of the permanent highwall emplacements would include specific erosion protection measures where required (e.g. placement of erosion resistant material such as competent rock) to minimise erosion where floodwaters interact with the permanent highwall emplacement. Areas where localised higher velocities are predicted (where the erosion protection measures would be required) are described in Section 4.4.

The southernmost section of the permanent highwall emplacement would be constructed across part of the backfilled ODS7 open cut pit. Waste rock material used to backfill this area would be selectively handled and compacted to achieve appropriate consolidation and moisture levels. Geotechnical testing of the backfilled area would be conducted to confirm (and validate as required) it is suitable as a foundation for the permanent highwall emplacement.

Further description of the highwall emplacements and how the Project has been designed in consideration of the *Mined Land Rehabilitation Policy* is provided in Section 5.

2.5.4 Mining Fleet and Supporting Equipment/Plant

The mine fleet for the Project is forecast to vary according to the production rates and equipment requirements associated with the open cut mining operations.

The mining equipment is expected to consist of large (600 t or 800 t class) hydraulic excavators to remove the bulk of the waste rock material, supplemented by smaller 350 t and 200 t class hydraulic excavators and front end loaders to remove interburden and partings and to mine coal. It is planned that both 360 t and 220 t class trucks would be used to haul the waste rock and coal, respectively.

A fleet of ancillary equipment would be used to support the mining equipment, including dozers, graders and water trucks. Rotary drills would also be used to drill the waste rock material and coal as required.

The forecast equipment list at full development would include:

- up to 26 excavators;
- up to 167 haul trucks;
- up to 30 dozers;
- up to 11 drills;
- up to 11 graders;
- up to four front end loaders; and
- up to 11 water trucks.

The scraper fleet would be contracted as required, on a campaign basis only.

A small, separate fleet including a dozer, crane, trucks, loaders and light vehicles would also service the CHPP, ROM and product coal stockpiles.

An indicative mine fleet over the life of the Project is provided in the Noise Assessment (Appendix K). The final fleet selection would be dependent on a competitive tendering process and operating mine schedules.

2.5.5 ROM Coal Handling and Processing

The indicative mine schedule (Table 2-4) demonstrates the ramping of the ROM coal mining rates during the different stages of the Project.

ROM coal would be hauled by a fleet of rear dump trucks to the ROM dump hoppers (Olive Downs South and/or Willunga domains) where it would be crushed and screened and then transferred for washing in the CHPP (at the Olive Downs South domain). Product coal would be stockpiled for blending to meet customer specifications and then loaded to trains.

A description of the crushing and screening plants and processed (washed) coal handling circuit is provided below.

The conceptual materials handling flowsheet and mine infrastructure area layout are shown on Figures 2-27 and 2-28.

Crushing and Screening Plants

Crushing and screening plants would be located at both the Olive Downs South and Willunga domains.

The crushing and screening plants would operate 24 hours, seven days per week.

Primary sizing would break the coal down to a maximum of 250 mm diameter. Secondary sizing would then reduce the top size coal below 130 mm diameter.

Screening would be used to separate (dry) coal rejects following secondary sizing to minimise excess fines generation, prior to tertiary sizing to produce a crushed coal grade of less than 50 mm for the CHPP feed. The coal rejects processing is described further in Section 2.5.7.

The Willunga crushing and screening plant would be designed to crush coal to a size to minimise the width of the overland conveyor (i.e. larger coal top size requires a larger edge distance on the overland conveyor).

The ROM coal stockpiles at the Olive Downs South domain would be delivered progressively up to approximately 250,000 t capacity as the production rate increases. The ROM coal stockpile at the Willunga domain would be up to approximately 150,000 t capacity.

The Olive Downs South and Willunga domains would use the crushing and screening plants stationed in their respective domains and once prepared to a sufficient standard, the crushed coal would be transported to the CHPP for processing.

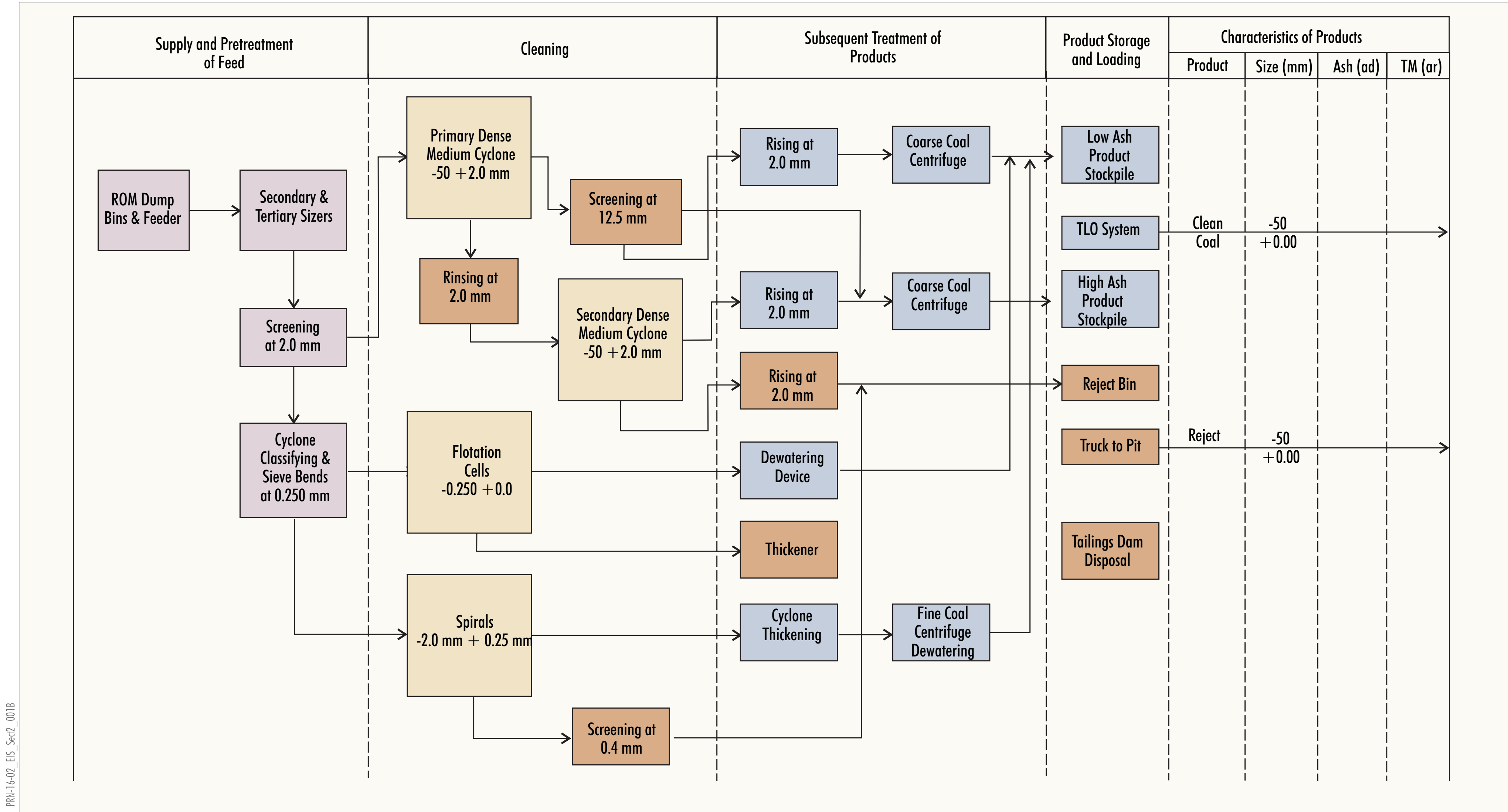
Coal Processing (Washing)

The CHPP at the Olive Downs South domain would operate 24 hours, seven days per week.

Crushed ROM coal from the Olive Downs South and Willunga domains would be stockpiled adjacent to the CHPP for direct reclaim and feed.

An indicative mine infrastructure area layout is provided on Figure 2-28.

The coarse coal circuit would comprise dense medium cyclones and centrifuges to separate the coarse rejects from the washed product coal.



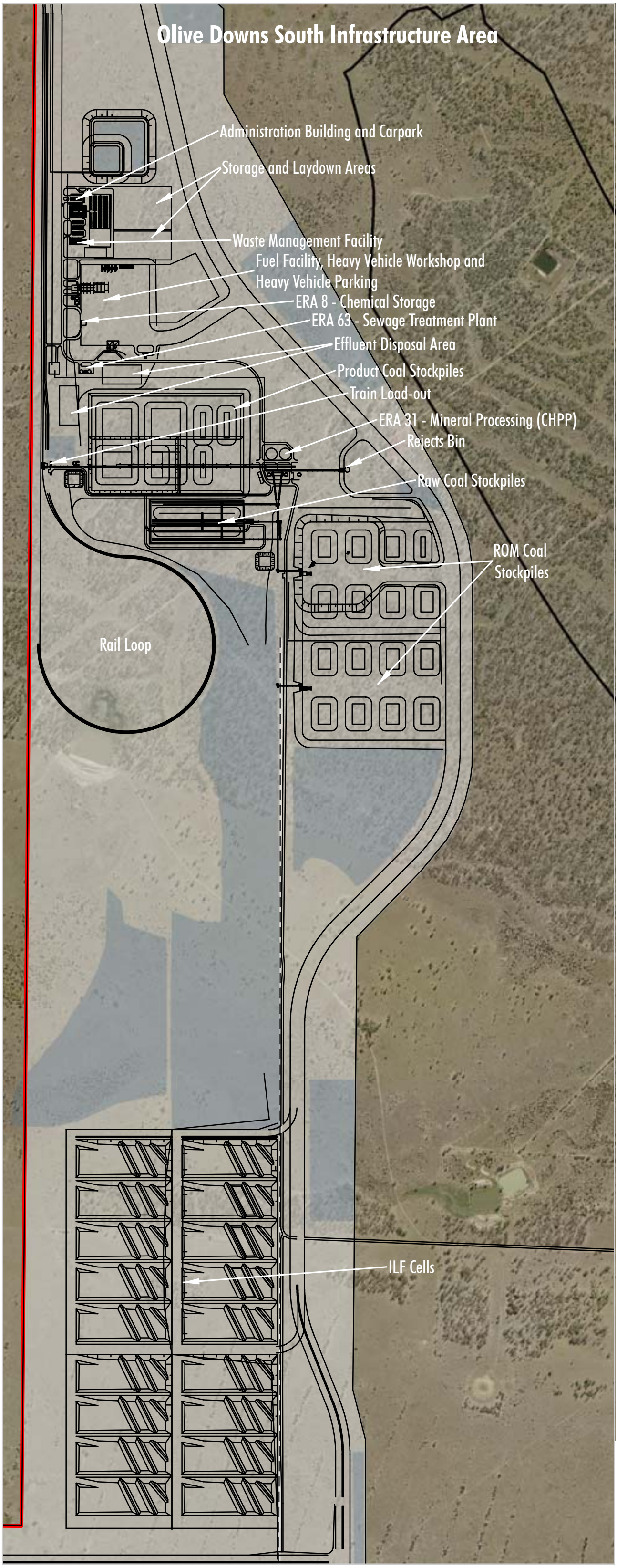
Source: Phronis (2017)

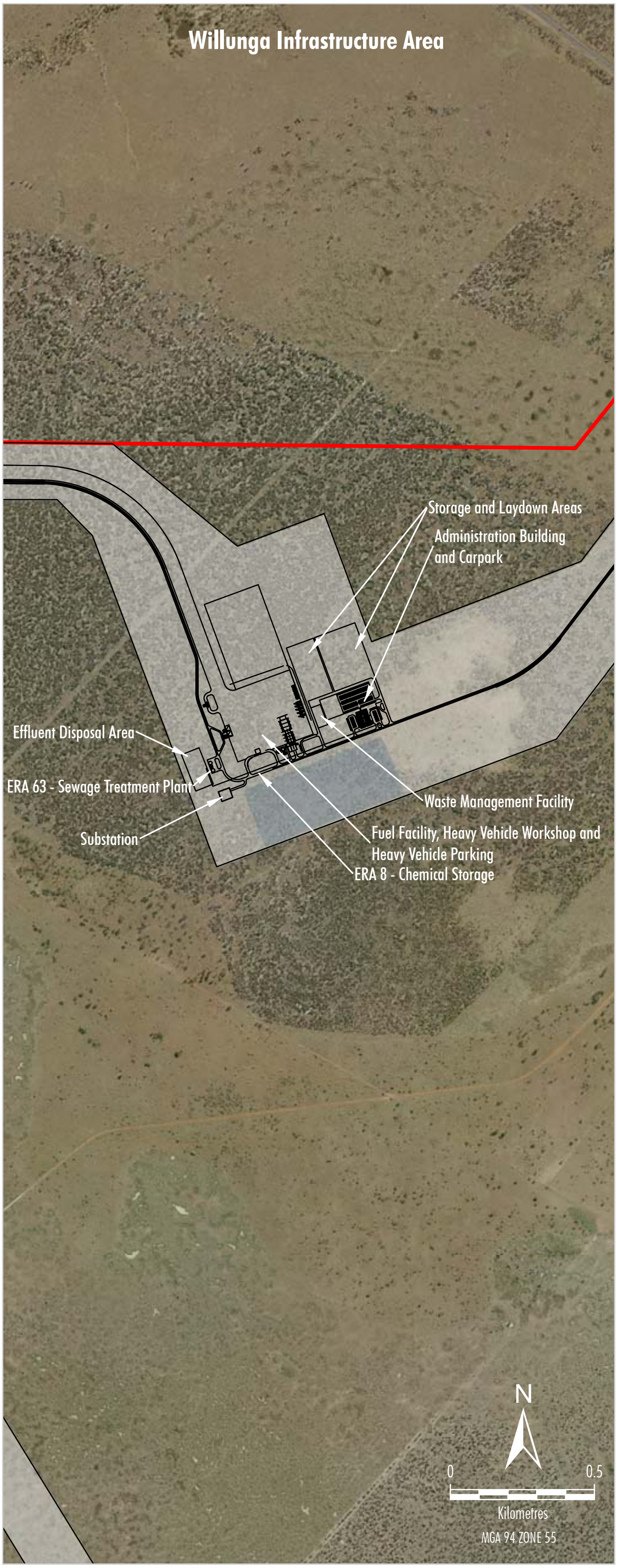
PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Indicative ROM Coal Handing Schematic

Figure 2-27





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LEGEND
Mining Lease Application Boundary
Infrastructure Area
Water Storage
Overland Conveyor

Source: Pembroke (2018); Phronis (2018);
Department of Natural Resources and Mines (2018)
Orthophotography: Google Image (2016)

PEMBROKE

OLIVE DOWNS COKING COAL PROJECT

Indicative Mine Infrastructure Area Layout

Figure 2-28

The fine coal circuit would separate the fine product coal from the fine rejects and comprise:

- cyclones and sieve bends;
- flotation cells and thickeners;
- spirals and screening;
- dewatering devices; and
- centrifuges.

The product coal from the coarse coal and fine coal circuits would be transferred to the product coal stockpiles for blending and subsequent reclaim for loading to trains.

Coarse rejects would be transferred to the rejects bin for reclaim by truck and placement within in-pit waste rock emplacements within the final pit footprint, or a separate emplacement area until such time as in-pit disposal areas become available.

Fine rejects from the fine coal circuit would be thickened for transfer (via pipeline) to the ILF cells and drying, prior to being reclaimed and placed in-pit. As described in Section 2.4.6, until such time as in-pit disposal areas become available, the fine rejects would be temporarily stored in the ILF cells while return water is decanted for reuse in the mine water management system.

2.5.6 Waste Rock Management

The life of mine waste rock material handled is estimated to be in the order of 9,000 Mbcm for the Project. The annual volumes of waste rock handled during the various mining stages of the Project are provided in Table 2-4.

Olive Downs South Domain

Initially, the waste rock produced by mining at the Olive Downs South domain would be placed in out-of-pit waste rock emplacements located immediately to the north-west and east of the open cut mining area (i.e. to establish the highwall emplacements) and would include the haulage of waste rock to the eastern emplacement, across the Isaac River (via the dry weather road crossing – refer Section 2.4.5).

Construction of the waste rock emplacement within MLA 700036 (east of the Isaac River) would only occur during periods when there is low or no flow within the Isaac River. It is anticipated that haulage to this waste rock emplacement would be limited to the dry season (nominally April to October).

When sufficient space is created within the mined-out areas, subsequent waste rock would be placed within in-pit waste rock emplacements.

As open cut mining areas are developed in the central and southern areas of the Olive Downs South domain, the waste rock would be placed in out-of-pit waste rock emplacements located immediately to the west (Figures 2-3, 2-4, 2-6 and 2-8). When sufficient space is created within the mined-out areas, waste rock would be placed within in-pit waste rock emplacements at the Olive Downs South domain.

Willunga Domain

Initially, the waste rock produced by mining at the Willunga domain would be placed in out-of-pit waste rock emplacements located immediately to the south and south-west of the open cut mining area.

When sufficient space is created within the mined-out areas, waste rock would be placed within in-pit waste rock emplacements at the Willunga domain.

Waste Rock Geochemistry

A geochemistry assessment has been prepared by Terrenus (2018) (Appendix L).

Based on the geochemical testwork, waste rock is expected to:

- be overwhelmingly non-acid forming (NAF) with excess acid neutralising capacity (ANC) and have a negligible risk of developing acid conditions; and
- generate relatively low-salinity surface run-off and seepage with low soluble metals concentrations.

Where waste rock is used for construction purposes, this would be limited (as much as practicable) to unweathered Permian sandstone materials, as these materials have been found to be more suitable for construction and for use as embankment covering on final landform surfaces.

It is noted that some waste rock materials are expected to be sodic (to varying degrees) with potential for dispersion and erosion (to varying degrees).

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, where practicable, and would generally not be used in construction activities. In general, tertiary waste rock has been found to be unsuitable for construction use or on final landform surfaces (Australian Coal Association Research Program [ACARP], 2004).

However, in the absence of such selective handling, waste rock emplacements would be constructed with short and low (shallow) slopes (indicatively, slopes less than 15% and less than 200 m long), and progressively rehabilitated to minimise erosion.

2.5.7 Coal Rejects Management

Based on the indicative mine schedule (Table 2-4) and planned coal processing rates, approximately 36 Mt of fine rejects and approximately 120 Mt of coarse rejects would be produced over the life of the Project and require management and disposal on-site.

A description of the initial rejects storage facilities and ILF cells is provided in Section 2.4.6.

By comparison to the life of mine waste rock material (approximately 8,824 Mbcm), the total proportion of rejects would be less than 2%.

A geochemistry assessment has been prepared for the Project by Terrenus (2018) (Appendix L). Appropriate management practices have been recommended and would be adopted for the handling and placement of rejects as summarised below.

Validation testwork of actual coal reject materials from the CHPP as the Project develops would be undertaken, particularly during the first year of CHPP operation following commissioning, and following commencement of mining at the Willunga domain.

Coarse Rejects

The proposed strategy for the disposal of coarse reject material is to truck from the CHPP to dispose within in-pit disposal areas (below existing ground level) and later bury with spoil (generally within three months of placement).

Coarse rejects disposed into the open cut pit would be placed below the expected final (post-closure) groundwater level and buried by at least 5 m (cover thickness) of spoil.

As described in Section 2.4.6, the emplacement design for the initial rejects storage facility involves placement of coarse rejects in layers to a total depth of approximately 10 m, which would then be covered with an appropriate capping layer and rehabilitated.

Fine Rejects

The proposed strategy for disposal of fine rejects is for the thickened material to be pumped to solar drying ponds in the infrastructure area, where flocculants would be added (i.e. ILF cells) and water would be recovered and recycled in the CHPP.

Dewatered and dried fine rejects would be excavated and trucked for disposal within the in-pit disposal area (below existing ground level) and later buried by waste rock (generally within three months of placement).

The dried fine rejects disposed into the pit would be placed below the expected final (post-closure) groundwater level and buried by at least 5 m (cover thickness) of waste rock.

2.5.8 Ongoing Evaluation and Exploration Activities

During the course of operations, mine exploration activities would continue to be undertaken within, and adjacent to, the Olive Downs South and Willunga domains.

These activities occur within, and external to, the open cut footprint and are to be used to investigate aspects such as geological features, seam structure, and coal and overburden/interburden characteristics as input to detailed mine planning, processing (i.e. washability), and feasibility studies.

2.5.9 Product Coal Handling and Transport (Rail)

The product coal stockpiles at the Olive Downs South domain would be delivered progressively up to approximately 550,000 t capacity as the production rate increases over the life of the Project. Approximately 480,000 t would be utilised for coking and PCI coal products with the remaining stockpile capacity for by-products (i.e. thermal coal).

A number of management measures to minimise the generation of coal dust from rail loading and transport would be implemented, consistent with the dust mitigation activities presented in the *Coal Dust Management Plan* (QR Network, 2010), including:

- automated loading of train wagons to prevent overloading;

- sill beam brushes to remove coal on the outside faces of the train wagons;
- veneering system to prevent coal dust generation during transit to port;
- water sprays on the train load out to minimise dust generation; and
- use of a spill pit to recover spilt coal under the train load out.

Based on the indicative mine schedule (Table 2-4), up to approximately 15 Mtpa of product coal would be transported by rail to the port for export.

Based on a "Goonyella-based" train configuration with 126 wagons and a total payload of 10,800 t, an average of four product coal trains would be loaded per day for the Project at full development.

Based on a "Blackwater-based" train configuration with 98 wagons and a total payload of 8,200 t, an average of 35 product coal trains would be loaded per week for the Project at full development.

However, to allow for cargo assembly for loading of ships to meet the required performance standards at the port, a peak of up to eight product coal trains per day may be required at times.

Based on a 180,000 t capacity ship (e.g. Cape size vessel), up to approximately 83 ships would be loaded at full development in any one year. Based on 35,000 t capacity ship (e.g. Handymax size vessel) up to 9 ships would be loaded each week on average at full development.

2.5.10 Hazardous Substances

An indicative list of all hazardous materials and substances being used or stored at the Project (including the quantity of each substance) is presented in Table 2-5.

2.5.11 Disturbance Areas – Operations

The progressive development footprint (including itemised approximation of disturbance and rehabilitation areas) during the course of the operations for the Project is provided in Table 2-6.

The total disturbance footprint for the Project, including the mining area, infrastructure areas and linear infrastructure corridors is approximately 16,300 ha.

2.6 INFRASTRUCTURE REQUIREMENTS

2.6.1 Transport

Road Transport

Vehicle access for employees, contractors and deliveries to the Olive Downs South domain would be via the new mine access road from the new intersection off Annandale Road (Section 2.4.1 and Figure 2-1).

As described in Section 2.4.1, both Daunia Road and Annandale Road are unsealed gravel roads and would require widening and pavement upgrades from the Peak Downs Highway to the new mine access road intersection off Annandale Road.

Access for employees, contractors and deliveries to the Willunga domain would be provided via the new unsealed access road from the new intersection off the Fitzroy Developmental Road (Section 2.4.1 and Figure 2-2).

No additional infrastructure requirements or upgrades are required for the Fitzroy Developmental Road, which is an existing high quality rural highway.

Heavy vehicles would move between the Olive Downs South and Willunga domains via internal access roads.

Rail Transport and Port Operations

As described in Section 2.4.8, a rail spur from the Norwich Park Branch Railway to the Olive Downs South domain mine infrastructure area and an on-site rail loop would be constructed for the Project. The proposed alignment for the rail spur between the Norwich Park Branch Railway and the Olive Downs South domain is shown on Figure 1-2. Aurizon has approved the proposed connection to the Norwich Park Branch Railway.

A rail-loadout facility, including product coal stockpiles, would be constructed adjacent the rail loop to allow for rail transport from the Olive Downs South domain direct to the DBCT (via the Norwich Park Branch Railway and Goonyella Branch Railway). The rail distance to the DBCT is approximately 195 km.

The port facilities at DBCT operate to a cargo assembly mode. This means that the volume of coal on the ground at any time is dependent of vessel arrivals. At full development, the maximum port storage capacity requirements for the Project would be approximately 120,000 t.

Table 2-5
Indicative List of Hazardous Substances

Hazardous Substance	DG Class[1]	UN Number[2]	Packing Group[3]	Maximum Quantity Stored	Maximum Annual Rate of Use	Purpose/Use
Ammonium nitrate	1.1D	0241	N/A	350 t	116,000 t	Mining activities (i.e. blasting).
Acetylene	2.1	1001	N/A	100 x 70 kg cylinders	300 x 70 kg cylinders	Welding and cutting.
Liquefied petroleum gas	2.1	1075	N/A	20 x 50 kg cylinders	40 x 50 kg cylinders	Fuel for forklifts.
Diesel oil/fuels	3	1202	III	550,000 L	133 ML	Fuel for mine fleet, vehicles and equipment and use at the CHPP.
Lubricating oils, grease and waste oil	9	3082	III	80,000 L (new oil) 80,000 L (used oil)	630,000 L	Used to lubricate vehicle engine and hydraulic machines.
Oils rags	4.2	1856	N/A	1,000 kg	5,000 kg	Waste product.
Acetone	3	1090	II (if quantity stored is > 1 L)	1,000 L	5,000 L	Used as a solvent.
Chlorine	2.3 (5.1, 8)	1017	N/A	20,000 L	100,000 L	Water treatment.
Methyl isobutyl carbinol	3	2053	III	100,000 kg	600,000 kg	Required at the CHPP.
Solvents and thinners (Acetone)	3	1090	II	60,000 kg	800,000 kg	Degreasing agent.
Paints	3	1263	I	5,000 L	5,000 L	Paint during construction and operations.

1 DG Class - Dangerous Goods class means the hazard class of the dangerous goods as stated in the Australian Dangerous Goods Code.

2 UN numbers - A number that identifies hazardous substances and articles (such as explosives, flammable liquids, toxic substances, etc.) in the framework of international transport. UN numbers are assigned by the United Nations Committee of Experts on the Transport of Dangerous Goods.

3 Packaging Group - Assigned to dangerous goods (other than Class 1, 2 and 7) according to the degree of risk the goods present (I – great danger; II – medium danger; and III – minor danger).

Table 2-6
Approximate Disturbance and Rehabilitation Areas – Project Operations

Project Operations	Total Disturbance Area	Total Rehabilitation Area	Total Development Footprint
Olive Downs South Domain			
Stage 1 – Year 2027	1,011 ha	493 ha	1,504 ha
Stage 2 – Year 2043	2,567 ha	2,485 ha	5,053 ha
Stage 3 – Year 2066	1,512 ha	4,702 ha	6,214 ha
Stage 4 – Year 2085	1,315 ha	5,579 ha	6,894 ha
Willunga Domain			
Stage 1 – Year 2027	-	-	-
Stage 2 – Year 2043	5,095 ha	1,017 ha	6,113 ha
Stage 3 – Year 2066	2,432 ha	3,137 ha	5,569 ha
Stage 4 – Year 2085	930 ha	3,346 ha	4,276 ha

Note: Some disturbance areas associated with the Mine Infrastructure Areas in Table 2-3 are subsumed by Project operations disturbance areas described in Table 2-6, i.e. the total Project disturbance footprint is less than the sum of the disturbance areas in Tables 2-3 and 2-6.

Note: Totals may have minor discrepancies due to rounding.

The DBCT (and the Port of Hay Point itself) would not require expansion to handle coal from the Project, or the shipping movements associated with the transport of Project coal.

Pembroke has secured capacity at the DBCT for the first 10 years of operation of the Project. Capacity for the remainder of the Project life would be secured as it is required.

2.6.2 Energy

Electricity Supply

Electricity supply to the Bowen Basin area is provided via Powerlink's 275/132 kV substations at Strathmore, Nebo and Lilyvale. From these substations, the area is supplied from a number of 132 kV substations and Aurizon substations. Ergon Energy further distributes electricity from these substations to local customers (Powerlink, 2013).

As described in Section 2.4.10, electricity supply for the Project would be provided from the existing regional power network via construction of a 66 kV ETL from the Broadlea Substation, and an on-site switching/substation located at the Olive Downs South domain mine infrastructure area.

The alignment for the ETL between the Broadlea Substation and the Project is shown on Figure 2-1.

Temporary Supply

Power may be supplied to some of the required infrastructure locations for the Project using packaged diesel generator units until permanent power supply becomes available.

Fuel Supply

Fuels (including diesel) would be transported to the Project by contractors.

The transport, storage and handling of fuels (including diesel) at the Project would be undertaken in accordance with relevant legislation and guidelines.

All equipment and vehicle operators would be trained in the safe operation of the equipment (including operating procedures for the refilling and maintenance of fuel storage tanks and mine vehicles) and the relevant emergency response procedures in the event of an incident.

Regular inspection programs would be undertaken to monitor the structural integrity of fuel tanks and bunds.

2.6.3 Water Supply

As described in Section 2.4.9, a raw (external supply) water pipeline would be constructed for the Project from the existing Eungella water pipeline network, with the take-off point to be located north of Eagle Downs (Figure 1-2).

SunWater has indicated that there is sufficient water availability within the Eungella water pipeline network to provide the estimated raw water supply requirement for the Project at full development.

As described in Section 2.4.9, a package potable water treatment plant would be utilised at the Olive Downs South domain. A second package potable water treatment plant would also be installed at the Willunga domain.

2.6.4 Sewage and Effluent Disposal

Containerised sewage treatment plants and effluent disposal systems would be constructed to service the mine infrastructure areas at the Olive Downs South and Willunga domains. Until the sewage treatment plants are operational, sewage from temporary ablution blocks (to be used during the construction phase) would be pumped by a licensed contractor and transported to a local council sewage treatment plant.

The sewage treatment plants have been designed as moving bed bioreactor (MBBR) systems. Raw sewage would be pumped to balance chambers in the sewage treatment plant bioreactor vessels which would provide buffer capacity during peak inflow periods, enabling the plants to process influent at steady treatment process flow rates. Influent from the balance chambers would be delivered to the MBBR chambers, where biological treatment would take place. Aeration would be achieved by a series of diaphragm aeration blowers. Following the MBBR chambers, effluent would pass to secondary clarification chambers for suspended solids removal. Clarified effluent would then be delivered to disinfection/effluent storage tanks ready for discharge to the wet weather irrigation storage tanks which would have a capacity of 260 KL each.

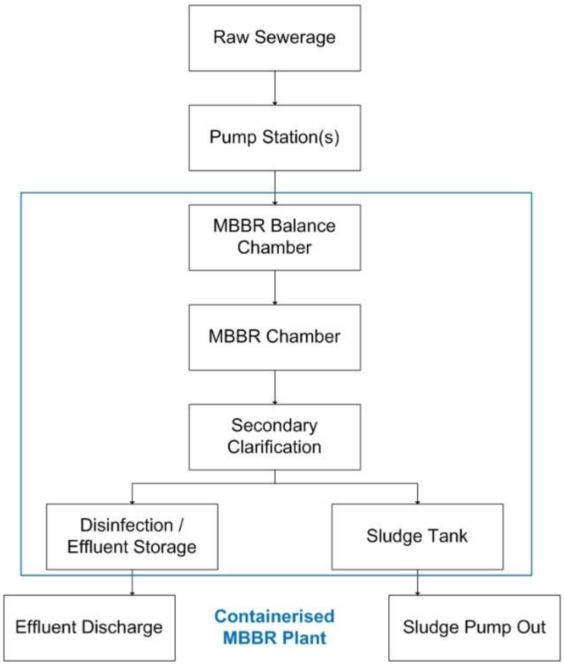
Waste sludge would be pumped to storage tanks before being pumped out and transported off-site by a licensed contractor to a licensed disposal facility.

An indicative flow diagram of the sewage treatment process is presented in Diagram 2-1.

All equipment and control panels would be located in a control room incorporated into the containerised plants, with the exception of the wet weather irrigation storage tanks, which would be located adjacent to the plants.

The effluent disposal systems would discharge through an irrigation system. Based on the design capacity of 50 kL per day per plant, a minimum effluent irrigation area of 2.5 ha would be required at the Olive Downs South and Willunga domains. The proposed treated effluent irrigation areas are shown on Figure 2-28.

Diagram 2-1
Indicative Sewage Treatment Flow Diagram



The irrigation areas would be located within Project mining tenements and have been designed with prescribed setback distances, but strategically positioned beyond the extent of the 1:1000 AEP flood event to reduce the potential for dispersion off-site.

The irrigation areas have been positioned to optimise exposure to sunlight and wind, increasing the rate of evapotranspiration. Evapotranspiration increases the operational capacity of the irrigation system, minimising the potential for pooling and runoff of effluent.

Other design parameters considered for the design of the irrigation system, include selection of irrigation areas with soils that exhibit low potential for erosion and increased drainage capacity. These design parameters would optimise the operation of the irrigation systems and reduce potential for dispersion off-site.

The location of the irrigation areas also considered the proximity to existing groundwater users to reduce potential of effluent seepage to groundwater sources.

The irrigation system has been conceptually designed so that the sprinklers would operate at an average operating pressure of 400 kilo Pascals (kPa), each capable of delivering approximately 1,776 litres per hour. The irrigation application rate for the sprinklers at a spacing of 15 m (rows) and 15 m (sprinklers) would require a run time of 15 minutes each to apply 2 mm/day as a total daily application rate. The sprinkler pressure and the spacing is required in order for the minimum distribution uniformity of the sprinklers to be achieved at the chosen spacing and ensure that the entire field is irrigated uniformly without wet and dry spots and minimise the possibility of pooling/ponding.

Effluent would not be irrigated immediately prior to expected rainfall or if pooling of water was evident at the site, to reduce the potential for runoff contamination. During these periods, effluent would be stored within wet weather storage tanks until such time as irrigation could recommence.

As part of the detailed design phase, modelling will be conducted to confirm the design of the effluent irrigation system and wet weather storage tank capacities, using the Model for Effluent Disposal Using Land Irrigation (MEDLI) software.

The sewage treatment plants would be designed and installed in accordance with the Queensland Government guidelines and relevant Australian Standards. Table 2-7 provides the effluent quality for release to land, consistent with the model mining conditions.

2.6.5 Telecommunications

High speed telecommunication data services are provided to Moranbah and coal mines in the Bowen Basin via an existing fibre optic network. Connection to the existing fibre optic network would be undertaken for the Project. The connection will be either microwave or fibre optic cable. A cable connection would follow the Project's ETL alignment or access road corridor.

Communications systems would be integrated at the Olive Downs South and Willunga domains to provide enhanced communications capacity across the network for the Project.

2.6.6 Accommodation and Other Infrastructure

As described in Section 2.1.7, given the numerous hotels for temporary accommodation and a number of accommodation villages in Moranbah and Coppabella, the construction and use of additional accommodation facilities for the Project's construction and operational workforce is not proposed as part of the Project.

2.7 WATER MANAGEMENT

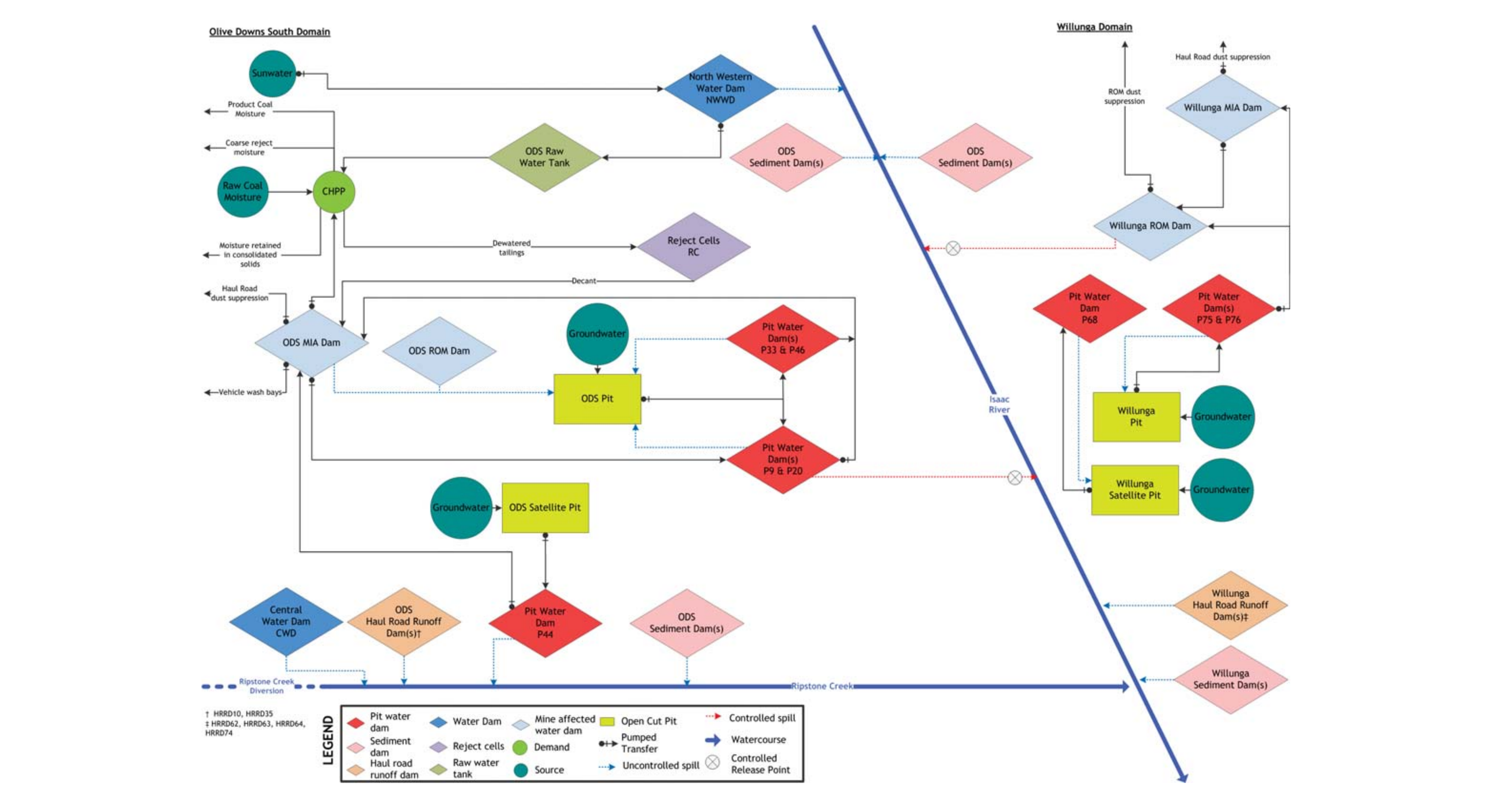
A detailed description of the Project water management system is provided in the Surface Water Assessment prepared by Hatch (Appendix E), with design input from Pembroke. The Project water management schematic is shown on Figure 2-29.

The water management system would be progressively developed and augmented as water management requirements change over the life of the Project. Water management infrastructure proposed for the Project include:

- up-catchment diversions and drains (including the Ripstone Creek Diversion);
- temporary flood levees and permanent highwall emplacements;
- internal catchment runoff drains;
- sediment dams and haul road runoff dams;
- water storage dams (including the North Western Water Dam, Central Water Dam, mine affected water dams, pit water dams, raw water dams, etc.);
- pumps, pipelines and other water reticulation equipment;

Table 2-7
Sewage Treatment Effluent Quality

Indicator	Unit	Release Limit	Limit Type	Frequency
5-day Biochemical Oxygen Demand (BOD)	mg/L	20	Maximum	Monthly
Total suspended solids	mg/L	30	Maximum	Monthly
Nitrogen	mg/L	30	Maximum	Monthly
Phosphorus	mg/L	15	Maximum	Monthly
E-coli	Organisms/100mL	1,000	Maximum	Monthly
pH	pH units	6.0 – 9.0	Range	Monthly



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Source: Hatch (2018)

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Indicative Water Management Schematic

Figure 2-29

TOC

- discharge points/areas for controlled release of excess water off-site in accordance with relevant principles and conditions of the *Final Model Water Conditions for Coal Mines in the Fitzroy Basin* (DEHP, 2013); and
- package sewage treatment plants and effluent disposal systems (e.g. irrigation).

As described in Section 2.6.3, external supply of raw water would be provided by the water pipeline constructed from the existing Eungella pipeline network. Day-to-day external water supply requirements would be guided by the capture of incident rainfall and runoff within the mine water management system as it is developed (i.e. stormwater and mine affected water); and capture of overland flow as described in Section 2.4.9.

Subject to availability of flows and obtaining relevant licences, direct pumping of water from the Isaac River may be undertaken opportunistically to minimise the external water supply requirements as required. The pump and associated infrastructure would be located at the access road from Annandale Road. Pumping of water from the Isaac River would be undertaken in a manner as to avoid and minimise potential impacts on aquatic ecology, including:

- starting the pump slowly and then gradually ramping up velocity;
- installing a suitable self-cleaning screen; and
- regularly inspecting the pump and screen.

To supplement the external supply of raw water, Pembroke has applied to DNRME for licences for take of unallocated general reserve water from the Isaac River under the Water Act.

2.7.1 Water Management Objectives

The objectives of the water management system for the Project are summarised as follows:

- protect the integrity of local and regional water resources;
- provide flood immunity for mining and operational areas during the life of the mine, and for final voids post-mining;
- design to operate such that there is no uncontrolled mine affected water overflow to the receiving environment;
- maintain separation between runoff from areas undisturbed by mining and water generated within active mining areas where practicable; and
- provide a reliable source of water to meet the operational requirements.

The following key principles would be applied for the Project to meet the objectives:

- all temporary flood levees would be designed to provide flood ingress protection to a flood level of a 1:1000 AEP plus suitably designed freeboard;
- permanent highwall emplacements would be designed to be self-sustaining and long-term stable;
- all water storage dams, structures and facilities would be designed, constructed and managed in accordance with *Manual for Assessing Consequence Categories and Hydraulic Performance of Structures* (DEHP, 2016);
- water storage dams that manage mine affected water would be designed and operated to achieve zero uncontrolled release to the receiving environment;
- water for mine operating purposes would be preferentially sourced from dedicated on-site water storage dams;
- water collected in water storage dams, sediment dams and/or haul road runoff dams would be captured and retained for reuse on-site and/or controlled release off-site to the receiving environment in accordance with *Guideline: Resource Activity - Mining: Model Water Conditions for Coal Mines in the Fitzroy Basin* (DEHP, 2013); and
- surface runoff from rehabilitated waste rock emplacements would be directed to dedicated sediment dams for settling and release to the receiving environment.

2.7.2 Up-catchment Diversions

The Project has been designed to minimise impacts on regional waterways and drainage paths by utilising existing farm dams/surface water storages and where possible, diverting flow corridors around surface disturbance areas (Appendix E).

This allows the runoff from undisturbed upslope catchments to flow around the operations, minimising the impact on downstream environment and water users, while also minimising the potential volume of water captured into the mine water management system.

With the exception of Ripstone Creek (discussed further below), the diverted flow corridors are all along unnamed drainage features that are not considered to be ‘watercourses’ as defined by the Water Act.

Ripstone Creek Diversion

The Project will require the diversion of the Ripstone Creek waterway (Figure 2-30). Functional design details for the Ripstone Creek Diversion have been provided in the Flood Assessment (Appendix F) and consider:

- relevant technical standards, design principles and design criteria;
- the existing conditions at the site, including geomorphology, vegetation, surface water hydrology and hydraulics;
- geometry of the diversion design;
- hydrology and hydraulic performance of the diversion design;
- substrate conditions as well as geomorphology and sediment transport;
- functional design quantities; and
- monitoring requirements.

The Ripstone Creek diversion has been designed to, as far as possible, replicate the natural hydraulic behaviour of the Ripstone Creek waterway. The geometric design of the Ripstone Creek diversion has considered:

- plan alignment and length; longitudinal grade;
- main channel cross section; and
- results of hydraulic modelling and waterway characteristics (Appendix F).

Table 2-8 provides a comparison of the geometric characteristics of the existing Ripstone Creek reach with the proposed diversion. The main channel cross-section is shown on Figure 2-30.

An assessment of the in-channel hydraulic parameters of the Ripstone Creek diversion has been undertaken using a one-dimensional HEC-RAS model and a two-dimensional TUFLOW model (Appendix F).

Table 2-8
Ripstone Creek Diversion Geometric Characteristics

Physical Characteristics	Existing Reach	Proposed Diversion
Channel Length	2,140 m	1,888 m
Valley Length	1,585 m	1,479 m
Sinuosity	1.35	1.28
Average Grade	0.00132 m/m	0.00149 m/m

Source: Appendix F.

The comparison of the average model results against the ACARP guidelines for Bowen Basin shows all sections of the Ripstone Creek (existing and developed scenarios) can be categorised either as “Incised” or “Limited Capacity” and the proposed Ripstone Creek Diversion would not change the hydraulic behaviour of the waterway significantly (Appendix F).

2.7.3 Water Consumption

The water consumption requirements for the Project and water balance of the system fluctuate with climatic conditions and as the extent of the mining operations change over time. A summary of main operational water demands for the Project (i.e. CHPP water supply and dust suppression) is provided below, as well as the estimated construction water supply requirements.

In addition, water would be required for coal crushing/conveyor dust suppression, supply for potable water treatment plant and other miscellaneous demands, including washdown of mobile equipment and other minor non-potable uses, such as fire fighting.

Construction Water Supply

It is estimated that use of water during construction would be approximately 570 ML per annum (i.e. approximately 1.6 ML per day).

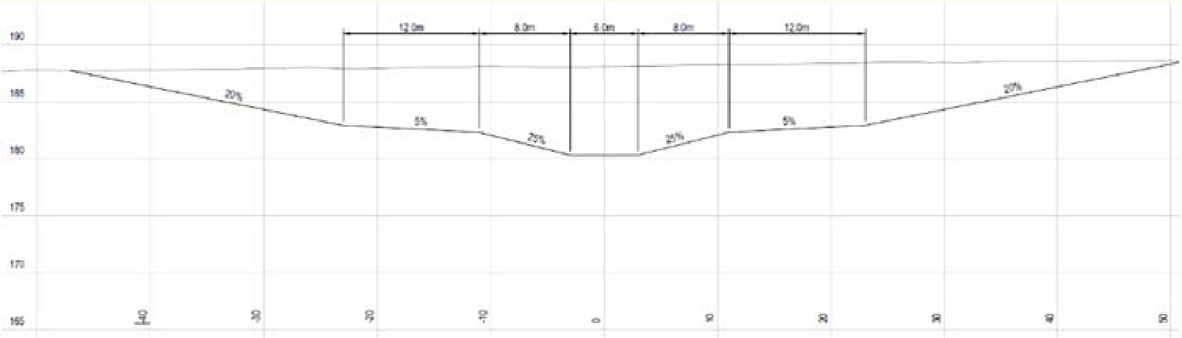
CHPP Water Supply

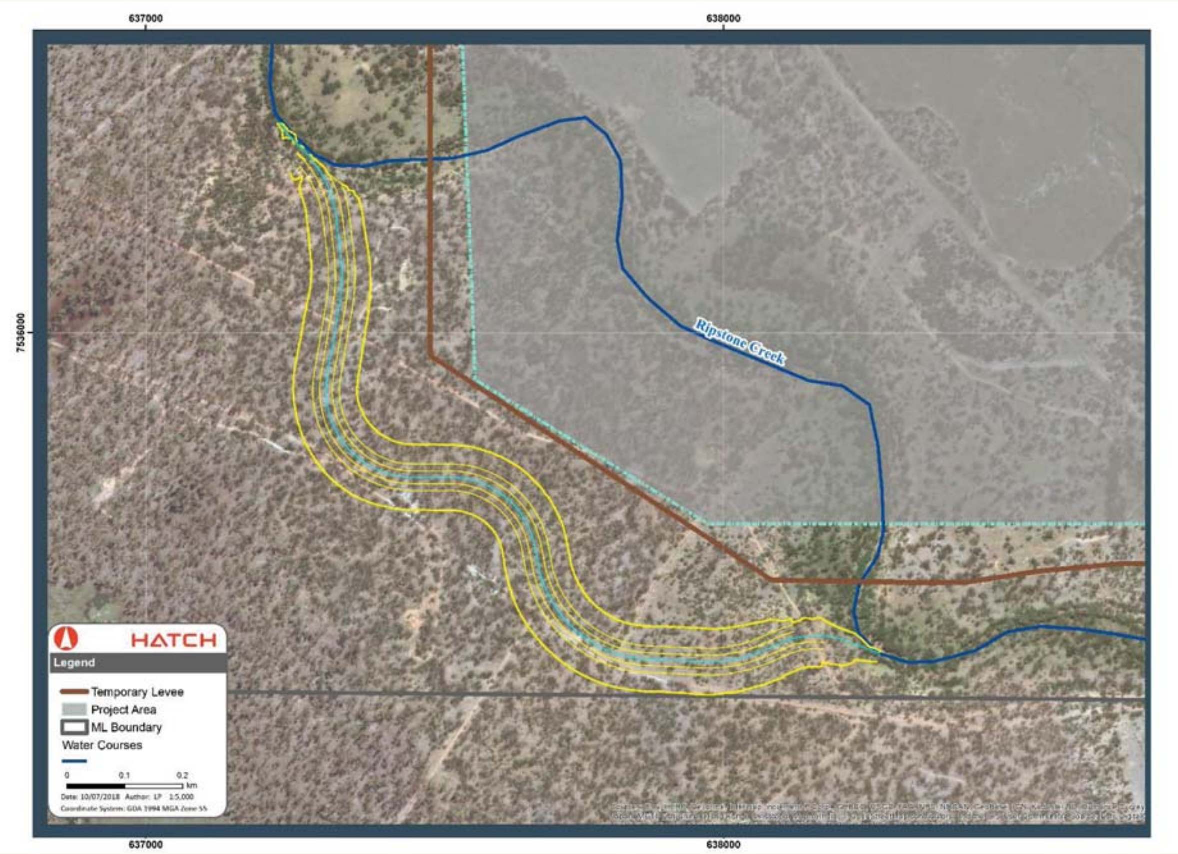
The CHPP is a net user of water, as during the washing and sizing process the moisture content of the coarse and fine rejects and coal product materials is increased.

The CHPP make-up water demand rate is related directly to the rate of ROM coal feed to the CHPP, and the rate of production and moisture content of the coarse and fine rejects.

Fine rejects from the final coal circuit would be thickened for transfer (via pipeline) to the ILF cells, where flocculants would be added and water recovered and recycled in the CHPP. The adopted decant return rate from the ILF cells to the CHPP is 70%. This decant rate significantly reduces the net CHPP makeup water requirement. A sensitivity analysis of the adopted decant rate was performed as part of the Surface Water Assessment (Appendix E).

The estimated gross and net annual CHPP makeup water requirements over the life of the Project are shown on Chart 2-2.





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Source: HydroSimulations (2018), Hatch (2018)

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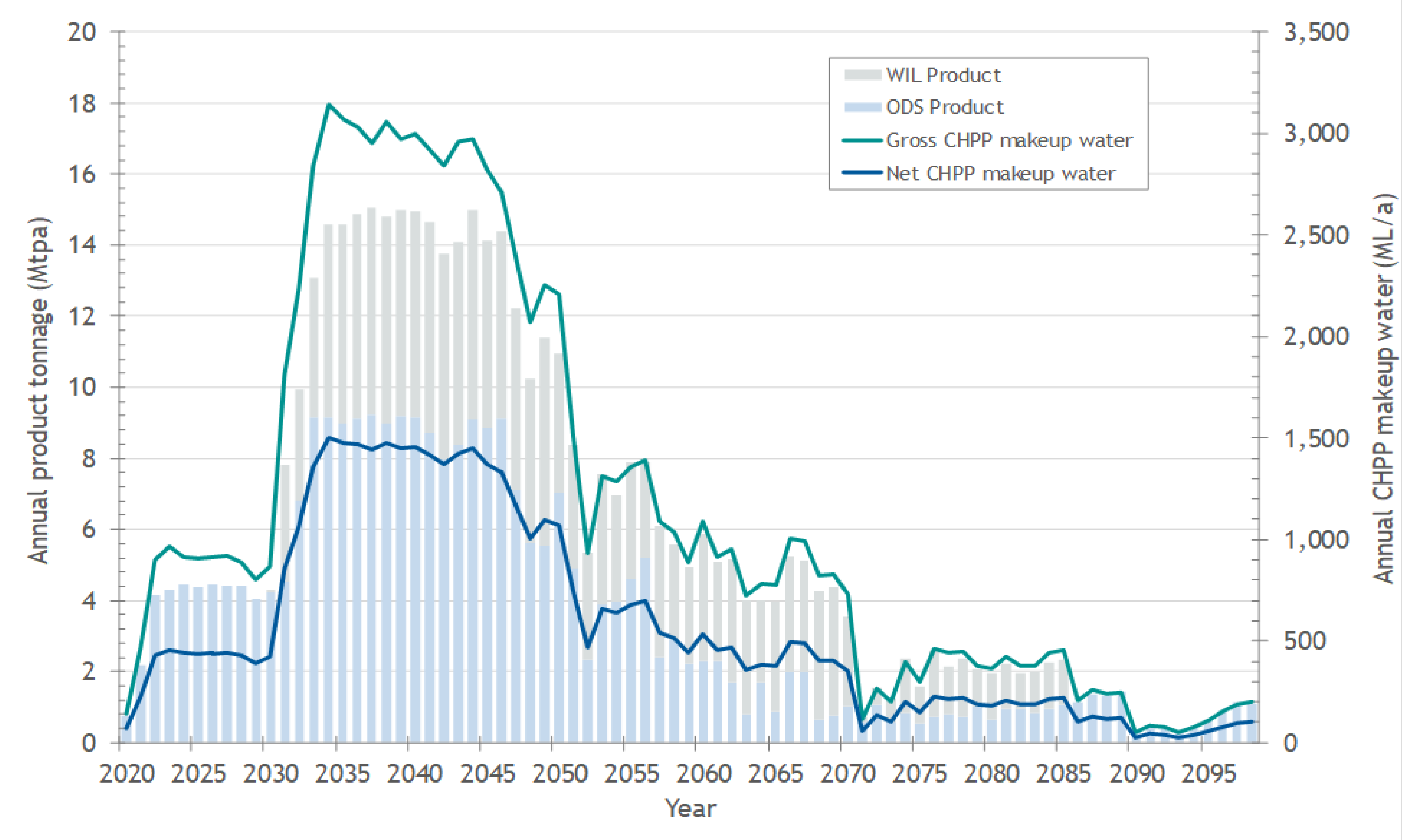
Proposed Ripstone Creek Diversion – Conceptual Design

Figure 2-30

Chart 2-2
Estimated Gross and Net Annual CHPP Makeup Water Requirements



Dust Suppression – Haul Roads

Water for haul road dust suppression would be sourced from the water storage dams on-site. If required, chemical or other dust suppressants may be used to reduce the amount of water required for dust suppression (Section 4.5.4).

Haul road dust suppression demands were calculated based on estimated haul road lengths which vary as mining progresses. The estimated average daily usage for haul road dust suppression for Stage 1 is 1.3 ML/day and up to 5.3 ML/day for subsequent stages (Appendix E).

2.7.4 Groundwater Inflows (Open Cut Dewatering)

Predicted groundwater inflows to each of the pits during the open cut mining operation over the life of the Project are presented in Appendix D and summarised for each domain by stage in Table 2-9 below.

The combined groundwater inflows to the open cut operations would peak during Stage 2. The Project peak groundwater inflow periods coincide with excavation of the WIL 1 Pit with predicted inflows ranging up to approximately 2.5 ML/day alone.

The total peak inflow due to the Project is expected to be about 4.5 ML/day (1,636 ML/year), while the average is expected to be about 1.7 ML/day (638 ML/year) over the duration of mining (Appendix D).

Water that accumulates in the pits would be transferred, preferentially, to contained water storages (i.e. pit dams) for beneficial use (i.e. dust suppression and/or CHPP water supply).

2.7.5 Sediment Dams

Sediment dams would contain runoff from waste rock emplacements. The sediment dams would allow for gravity settling of sediment prior to release off-site.

Sediment dams would be designed based on *Best Practice Sediment and Erosion Control Guideline* (International Erosion Control Association [IECA], 2008) for flows with an ARI of between 3 months and 1 year.

Sediment dams would be maintained until such time as vegetation within the catchment of the sediment dams successfully establishes and where runoff has similar water quality characteristics to areas that are undisturbed by mining activities. Sediment dams may be maintained in rehabilitated areas when site water demand requires it.

2.7.6 Controlled Release Strategy

Controlled water release conditions have been developed for releases to the Isaac River and Ripstone Creek, based on the *DEHP Guideline Model Mining Conditions*. The water balance model has been configured to simulate these release conditions, using salt measured as electrical conductivity (EC) as the target parameter. The proposed water release conditions are provided in Table 2-10, based on flow and EC monitoring at the Deverill gauging station on the Isaac River, and the proposed Project controlled release points (P9, P20, P33, P46 and WROM).

Table 2-9
Predicted Average Groundwater Inflows by Stage

Project Stage	Project Years*	Domain (ML/day)		Average (ML/day)
		ODS	Willunga	
Stage 1	2020-2030	0 – 1.1	0 – 0.2	0.8
Stage 2	2031-2040	1.5 – 2.3	0.3 – 2.3	3.3
Stage 3	2041-2050	0.5 – 2.1	0.1 – 2.5	2.3
Stage 4	2051-2060	0.6 - 2.0	<0.1 – 0.1	1.5
Stage 5	2061-2072	0.3 - 0.4	<0.1 – 0.1	0.4
Stage 6	2073-2085	0.2 - 0.3	<0.1 – 0.3	0.4
Stage 7	2086-2098	0.3 - 0.4	<0.1 – 0.1	0.4

Source: Appendix D.

Table 2-10
Proposed Controlled Release Conditions

Flow Rate	Receiving Water Flow Criteria (Isaac River*)	Maximum Release Rate (Controlled Release Points Combined Flows^)	Electrical Conductivity Limit (At Release Point)
Medium	4 m^3/s	0.5 m^3/s	1,000 μS/cm
	10 m^3/s	1.0 m^3/s	1,200 μS/cm
High	50 m^3/s	2.0 m^3/s	4,000 μS/cm
	100 m^3/s	3.0 m^3/s	6,000 μS/cm
Very High	300 m^3/s	5.0 m^3/s	10,000 μS/cm

Source: Appendix E.
* Deverill Gauging Station.
^ P9, P20, P33, P46 and WROM. Note: P44 and WMIA are designated release points, but are not part of the overall controlled release strategy.

The proposed controlled releases strategy comprises a number of mine affected water dams which will have the ability to discharge water to the Isaac River through a gravity pipe system. There are four proposed release points at the Olive Downs South domain and one at the Willunga domain. However, due to the progressive mining activities from north to south at the Olive Downs South domain, it is likely that only two of the four dams would operate simultaneously. It is noted that the proposed controlled release conditions (Table 2-10) are for combined releases from the release points (e.g. under very high flow rates in the Isaac River, a combined controlled release rate from the release points of 5.0 cubic metres per second (m^3/s) is proposed).

The controlled release point dams would be constructed as aboveground turkey's nest type dams around 5 m deep. Each would be constructed above the natural surface to provide sufficient driving head for gravity flow. The gravity flow solution is preferred because it allows for an efficient controlled release mechanism and can provide significant flow capacity during the relatively short timeframes under which the Isaac River flow regime would allow the opportunity to release to the receiving environment and meet the relevant water quality objectives. Potential pump solutions to supplement gravity flow system would be considered during the detailed design process.

Outlet pipes from the controlled release point dams would be constructed under the highwall emplacement and would connect to open drains approximately 5 m wide at the base with 1:3 side batters. The open drains would report to existing drainage lines or overland flow paths within the Project MLAs that ultimately flow into the Isaac River. These open drains would incorporate measures to reduce water velocities to less than 1 m/s after the pipe outlet to minimise erosion risk. Such measures would include gabion rock structures below the outlet pipe invert to absorb energy and reduce flow velocities.
EC has been continuously monitored and recorded at the Deverill gauging station since August 2011. The monitoring data has been analysed and a relationship between EC and discharge (expressed as runoff depth) has been developed and is presented in the Surface Water Assessment (Appendix E). The flow-EC relationship for the Isaac River has been incorporated into the water balance model.

2.7.7 Simulated Performance of the Project Water Management System

A predictive assessment of the performance of the Project water management system (including supply, containment, risk of disruption to mining operations and controlled release volumes) is presented in Appendix E.

The results of the assessment are summarised in Table 2-11 including the predicted external make-up requirements for the Project, water supply sources and storage volumes for the containment system for a range of different climatic scenarios.

The results presented are the average of all modelled realisations and includes wet and dry periods distributed throughout the mine life from Stages 1 to 7.

Key outcomes are as follows (Appendix E):

- Average annual inflows to the water balance from rainfall runoff are generally consistent across Stages 2 to 7.
- External water requirements are highest in Stage 1, and consistently reduce from Stages 2 to 7.
- The change in stored volume per stage is small in comparison to the inflow and outflow volumes and, therefore, the water management system is generally in balance.

Table 2-11
Indicative Project Water Supply System Performance (Average Annual Water Balance)

	Stage 1 (2020-2030)	Stage 2 (2031-2040)	Stage 3 (2041-2050)	Stage 4 (2051-2060)	Stage 5 (2061-2072)	Stage 6 (2073-2085)	Stage 7 (2086-2098)
Average Inflows (ML/year)							
Rainfall Runoff	6,170	17,531	18,016	18,619	19,147	18,498	18,940
Groundwater Inflows	258	1,214	787	398	147	116	80
External Water	1,129	775	700	522	465	378	371
CHPP Input *(ROM Coal Moisture)*	*361*	*1,279*	*1,224*	*601*	*361*	*190*	*76*
TOTAL AVERAGE INFLOWS	**7,918**	**20,799**	**20,727**	**20,141**	**20,119**	**19,183**	**19,468**
Average Outflows (ML/year)							
Undisturbed and/or Rehabilitation Areas	2,335	5,265	5,637	8,533	10,482	9,265	8,099
Sediment Dam Release	999	5,235	5,057	3,851	2,384	3,102	4,291
Evaporation from Storages	2,323	4,416	4,658	3,747	3,491	3,453	3,786
CHPP Output							
Product Coal Moisture	*381*	*1,346*	*1,308*	*666*	*392*	*207*	*84*
Coarse Rejects Moisture	*193*	*688*	*634*	*282*	*178*	*93*	*36*
Fine Rejects – Entrained	*216*	*609*	*565*	*288*	*206*	*137*	*91*
Dust Suppression – Haul Roads	475	1,551	1,688	1,709	1,600	1,524	977
Dust Suppression – Coal Crushing/Conveyors	400	400	400	400	400	400	400
Miscellaneous Raw Water Demands	80	80	80	80	80	80	80
Mine Infrastructure Demands	40	40	40	40	40	40	40
Potable WTP Demands	50	50	50	50	50	50	50
Controlled Releases	404	650	547	800	906	760	665
Mine Affected Dam Overflows	0	0	0	0	0	0	0
TOTAL AVERAGE OUTFLOWS	**7,896**	**20,331**	**20,666**	**20,446**	**20,209**	**19,112**	**18,600**

Source: Appendix E.

Notes: The difference between the total average inflows and total average outflows is the change in water stored on-site.
Totals may have minor discrepancies due to rounding.
Rainfall runoff values presented include undisturbed and rehabilitated catchments within the Olive Downs South and Willunga domains.
Italicised rows include allowances for differences in moisture contents between ROM coal and product coal (and rejects) and therefore the total CHPP make-up water supply volumes are not presented (as this is an internal component of the water balance).

Water Supply

The modelling results show that external water requirements generally reduce over the life of the Project. This is primarily due to the continual increase in mine disturbance area over time (and subsequent capture of rainfall runoff), as well as the reduction in predicted CHPP water consumption from Stage 3 onwards as the production throughput decreases (Appendix E).

The water balance model results also show that there is a greater than 90% probability that an annual water allocation of 2,250 ML would be sufficient to meet all site demands, in any one year across the Project life (Appendix E). Pembroke intends to source this external water demand from SunWater via the Project water pipeline.

Containment

To prevent uncontrolled releases from the mine water storages, target operating volumes (TOVs) would be set for the out-of-pit mine affected water storages. The model results show that, based on the TOVs, the combined out-of-pit mine affected water inventory is generally maintained well below the combined capacity of all the mine affected water dams (Appendix E). That is, the results suggest that sufficient out-of-pit storage has been provided.

Notwithstanding, the Project water balance model was used to assess the risk of uncontrolled releases from the mine affected water management system. No uncontrolled releases to the Isaac River were modelled (Appendix E).

To achieve the no mine affected water storage uncontrolled release objective, the Project would be operated with an operational risk of disruption to mining, which could occur as a result of exceedance of the design capacity of the water management system and the need to temporarily store water in the active open pit if required. Alternatively, Pembroke would construct additional pit water dams ahead of mining in the Olive Downs South domain to temporarily store any excess mine affected water until there is sufficient out-of-pit storage available.

Controlled Releases

The water balance model was configured to release water in accordance with the proposed controlled release conditions in Table 2-10. The model results show that:

- For wet climatic conditions (10%ile), predicted annual controlled releases range between 500 and 2,140 ML per annum, with the highest rate of controlled releases occurring during Stage 2 to Stage 5.
- For median climatic conditions (50%ile), predicted annual controlled releases range between 90 and 890 ML per annum.
- For dry climatic conditions (90%ile), predicted annual controlled releases range between 15 and 370 ML per annum.

The water balance modelling results indicate that the proposed controlled release strategy would achieve the water quality objectives for the Isaac River sub-basin (Appendix E).

2.8 ENVIRONMENTALLY RELEVANT ACTIVITIES AND NOTIFIABLE ACTIVITIES

The EP Act regulates ERAs, including mining activities, as well as providing for the application for and assessment and issuing of an EA for mining activities and enforcement of the conditions of granted authorities.

The EA imposes environmental management conditions on the mining activities undertaken on the relevant Mining Lease and outline the environmental management requirements that Pembroke must undertake.

The ERAs under Schedule 2A and Schedule 2 of the *Environmental Protection Regulation 2008* proposed to be undertaken as part of the Project are listed in Table 2-12, with corresponding aggregate environmental scores (AES). The Schedule 2 activities are ancillary activities proposed to be carried out as part of the resource activity of mining black coal. The locations and disturbance areas of the ERAs are shown on Figure 2-28.

The EA for the Project would authorise the carrying out of those prescribed ERAs.

Proposed land uses that may result in land becoming contaminated are known as 'Notifiable Activities' and are listed in Schedule 3 of the EP Act. The following Notifiable Activities are relevant to the Project:

- 7 – Chemical storage (other than petroleum products or oil under item 29).
- 15 – Explosives production or storage.
- 24 – Mine wastes.
- 29 – Petroleum product or oil storage.
- 37 – Waste storage, treatment or disposal.

Table 2-12
Environmentally Relevant Activities at the Project

Environmentally Relevant Activity (ERA)		Aggregate Environmental Score (AES)
Schedule 2A		
• ERA 13 – Mining Black Coal		128
Schedule 2		
• ERA 8 – Chemical Storage	8[1][c] 500m^3 or more of chemicals of class C1 or C2 combustible liquids under AS 1940 or dangerous goods class 3	85
• ERA 31 – Mineral Processing	CHPP	148
• ERA 63 – Sewage Treatment	63[1][b][i] operating sewage treatment work, other than no-release works, with a total daily peak design capacity of more than 100 but not more than 1,500EP	27

Notes: m^3 = cubic metres.
EP = equivalent persons.

2.9 WASTE MANAGEMENT

The management of waste (non-mineral) at the Project would be governed by Queensland legislation, including:

- EP Act;
- EP Regulation; and
- WRR Act.

The key waste streams that the Project would comprise, but not be necessarily limited to, the following:

- waste rock;
- CHPP rejects;
- recyclable and non-recyclable wastes;
- sewage and wastewater; and
- other wastes from mining and workshop activities (e.g. used tyres, scrap metal and waste hydrocarbons and oil filters).

The potential impacts caused by waste streams generated by the Project and proposed mitigation measures are assessed in Section 4.14.3 and summarised below.

Queensland's waste and recycling strategy sets out a waste management hierarchy. The waste management hierarchy identifies the most preferred to the lease preferred waste management option:

- avoid or reduce;
- reuse;
- recycle;
- recover energy;
- treat; and
- dispose.

Pembroke would manage the waste produced at the Project in accordance with the waste and resource management hierarchy. If waste must be disposed of, Pembroke would do so in a way that prevents or minimises adverse effects on environmental values.

Waste management is discussed further in Section 4.14.

2.10 PROJECT JUSTIFICATION AND ALTERNATIVES CONSIDERED

2.10.1 Need for the Project

The Project provides an opportunity to develop a greenfield open cut mine metallurgical coal resource in an existing mining precinct for export of coking and PCI coal products to the steel production industry. The Project would produce up to 20 Mtpa of ROM coal over an anticipated operational life of approximately 79 years.

At full development, the Project would sustain an operational workforce of approximately 1,300 people, as well as a peak construction workforce of up to 700 people. The significant employment opportunities provided by the Project would assist in sustaining the prosperity of the local communities and wider region for the life of the Project.

In addition to the direct employment opportunities associated with the construction and operation of the Project, a significant number of indirect employment opportunities would be supported by the Project, through suppliers, contractors, service providers and local business.

Coking and PCI coal produced in the Bowen Basin is in high demand for use in steel production in Asia. The Project provides an opportunity to exploit the demand for high quality coking and PCI coal in the Asian markets, over the significant Project life, and provide long-term economic benefits through Queensland export income, State royalties and Commonwealth tax revenue.

Development of the Project may assist the future development of adjacent coal resources (e.g. the Olive Downs North and Winchester South projects) by improving accessibility to services and infrastructure (e.g. through the development of the Project rail spur, water pipeline and ETL). Further, development of the Project would also improve access to the currently undeveloped coal resources between the Lake Vermont mine and the Project.

Development of the Project would not sterilise any coal resources that would otherwise be accessed by other mining operations.

The Cost Benefit Analysis conducted in the Economic Assessment (Appendix I) indicates that operation of the Project would have net production benefits to Australia of approximately $2 billion (B). As the residual environmental, social and cultural impacts of the Project that accrue to Australia are considered to be valued at less than $2B, the Project can be considered to provide an improvement in economic efficiency and, hence, is justified on economic grounds.

2.10.2 Consideration of Project Alternatives

Mining Method

Coal reserves are typically mined in one of two ways:

- underground methods, whereby the coal seams are accessed by a surface opening to underground mining areas where coal is extracted; or
- open cut methods, whereby mining is conducted from the surface downwards to progressively expose the coal.

The use of underground mining methods is generally employed where thick, contiguous seams are present. Underground methods are not efficient or safe where multiple, thin seams are present, particularly if the structural geology is complex with the presence of faults and other structures, as is the case with the Project coal resource.

As such, the Project would use open cut mining methods to access the coal reserves.

Open Cut Extent

Geological data indicates that the coal resource extends north of Pit ODS1 beneath the Isaac River and beyond. Despite this, Pembroke has set back the crest of the open cut from the bank of the Isaac River by at least 200 m to minimise impacts on ecological and aquatic values and flood characteristics.

Similarly, in response to preliminary flood modelling results, the eastern extent of Pit ODS8 was pulled back by approximately 300 m to minimise changes to flood characteristics of the Isaac River.

These changes have reduced the total coal initially planned for extraction but would result in improved environmental outcomes by minimising changes to flood characteristics.

Waste Rock Emplacement Design

Open cut mining methods require the development of out-of-pit waste rock emplacements, particularly during the initial stages of excavation before sufficient space is available behind the advancing open cut for waste rock to be placed within the mined out open cut.

In consideration of best practice landform design to improve rehabilitation outcomes and minimise slope instability, the out-of-pit waste rock emplacements have been designed with slope angles of approximately 7 degrees (or 1(V):8(H), or 15%) to improve landform stability and improve rehabilitation outcomes.

Adoption of these slopes as design criteria for waste rock emplacements constrains the volume of material that can be emplaced when compared with a landform with steeper slopes and the same footprint. This design constraint, along with the mining tenement boundaries, requires the development of two out-of-pit waste rock emplacements during the initial years of operation (while the box cut is being developed), one to the west of Pit ODS1, and one to the east, on the eastern side of the Isaac River (Figure 2-1).

This development of these two waste rock emplacements increases the footprint of the Project, however, this is considered to be offset by the improved rehabilitation outcomes such as enhanced landform stability that would result from the adoption of these waste emplacement criteria.

Mining Sequence and Final Voids

Pembroke has scheduled the Project to improve environmental outcomes by:

- Completely mining Pits ODS1 and ODS2 early in the mine life, such that they can be completely backfilled. This maximises resource recovery whilst avoiding creation of final voids in close proximity to the Isaac River.
- Hauling waste rock from Pit ODS6 to completely backfill Pit ODS9, to avoid a final void remaining in close proximity to Ripstone Creek.
- Operating Pits ODS7 and ODS8 during daytime hours only to minimise noise and air quality impacts at the nearby privately-owned dwellings.

Final voids are normally left at the conclusion of open cut mining with the size of these voids dictated by the depth of the open cut, final slope design criteria, the extent of waste emplacement within the voids and the mining sequence.

Traditionally, Bowen Basin mining operations generally open up a number of individual open cut pits at any one time and progressively mine the pits over the life of the mine, such that large final voids remain at the completion of mining.

The Project's mine schedule has been optimised to minimise the number and extent of final voids, and in particular, avoid the creation of final voids in close proximity to the Isaac River and Ripstone Creek.

At the cessation of mining, three final voids would remain, within Pits ODS3, ODS7/ODS8 and WIL5 (Section 5.2.3). The volume of all the final voids[1] is estimated to be approximately 1,750 Million bank cubic metres (Section 5.2.3).

These final voids have been minimised within the constraints of the mining sequence. When compared to traditional Bowen Basin mining operations, which generally mine a number of large open cut pits at any one time resulting in large final voids across the entire resource strike, the number and extent of final voids in the Project final landform is considered to be minimised as far as practicable.

The catchment areas of the final voids would be minimised through the construction of upslope drains/bunds to direct runoff around the voids to the surrounding landscape.

Pembroke has analysed the feasibility of backfilling the final voids to ground level. The analysis identified that the cost associated with rehandling waste rock from the out-of-pit emplacements to fill the final voids would be in the order of $5 billion (assuming a rehandling cost of $3 per bcm). This cost would render the Project unfeasible.

Pembroke also considered the cost associated with partial backfill of the final voids, such that saline water bodies would not accumulate over time. To achieve this, the voids would need to be backfilled to a level at least equal to the surrounding water table. As the water table level is in the vicinity of 10 m to 17 m below ground level in the vicinity of the final voids (Appendix D), the vast majority of the voids would need to be almost completely backfilled to prevent the formation of saline water bodies. Accordingly, the cost for such an exercise would be several billion dollars, again, rendering the Project unfeasible.

Although the mine schedule was developed to minimise the number of final voids, and the mine plan was developed to isolate the final voids from the surrounding floodplain, the final voids in Pits ODS3 and ODS7/ODS8 would be located within the extent of the existing Isaac River floodplain (i.e. within the 1:1000 AEP extent). In consideration of this, Pembroke reviewed the mine plan to determine whether a feasible alternative could be scheduled to keep the final voids beyond the extent of the existing floodplain.

The nature of dipping coal seams dictates that an open cut pit targets the shallowest coal first, and then moves to the deeper coal. The coal seams in the Olive Downs South domain generally dip from west to east (i.e. towards the Isaac River).

Scheduling the mine plan to develop final voids in the shallower areas was determined to be unfeasible, as it would prevent the mine from operating at the optimum production rate (given the higher strip ratios that would be encountered sooner in the mine life) it would also result in significantly greater disturbance areas and material handling costs, due to the additional waste rock that would need to be moved further to out-of-pit emplacement areas (rather than placed in-pit).

The only other alternative to avoid the development of the final voids on the floodplain would be to forgo mining the coal resources where the voids would be located on the floodplain and could not be feasibly backfilled.

[1] To the existing ground level.

Pembroke analysed the impact this would have to the mine plan and found that avoiding the development of final voids on floodplains would result in the sterilisation of approximately 55 Mt of ROM coal and foregone royalties of approximately $590M. It would also decrease the life of the Olive Downs South domain by approximately 30 years.

Given the proposed design solutions to isolate the final voids from the surrounding floodplain (i.e. the permanent highwall emplacements described in Section 2.5.3), the significant impact to royalty streams and Project life are not warranted.

Infrastructure Corridor Alignments

A number of alternative alignments for the Project rail, water pipeline and ETL corridors were investigated during pre-feasibility studies.

Although a number of alternative alignments for these corridors were considered, which would cost less because they were a shorter distance or had fewer road crossings, the final alignments were selected as they:

- minimise impacts to other tenement holders, by locating the corridors along tenement boundaries where practicable;
- minimise impact to existing land uses by co-locating the rail spur and part of the water pipeline in the same corridor;
- minimise the impacts to private landholdings by locating the corridors within existing easements and road corridors, where practicable;
- minimise impact to areas of native title;
- minimise impact to existing stock routes; and
- avoid dwellings.

2.10.3 Consideration of not Carrying Out the Project

Were the Project not to proceed, the following consequences are inferred:

- up to 700 construction and up to 1,300 operational jobs and associated flow-on effects would not be created;
- approximately 612 Mt of ROM coal would not be mined;
- a net benefit of approximately $2B would be foregone (Appendix I);
- company tax revenue of approximately $211M from the Project would not be generated (Appendix I);
- royalties to the State of Queensland of approximately $1.1B would not be generated (Appendix I);
- the potential environmental and social impacts described in this EIS would not occur;
- economic and social benefits to the IRC LGA associate with the Project would not be realised; and
- the Project biodiversity offsets would not be established.