ATLAS-CAMPASPE

Mineral Sands Project

ENVIRONMENTAL IMPACT STATEMENT

SECTION 2 › PROJECT DESCRIPTION

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Resource Strategies

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2 PROJECT DESCRIPTION

This section presents a description of the existing/approved Cristal Mining operations in western NSW, the history of statutory approvals and a description of the Project.

2.1 APPROVALS HISTORY AND EXISTING/APPROVED CRISTAL MINING OPERATIONS IN WESTERN NSW

2.1.1 Broken Hill MSP

The potential environmental impacts associated with the development of the MSP and processing of mineral concentrates from the Ginkgo Mine (Section 2.1.2) were assessed in the *Broken Hill Mineral Separation Plant Environmental Impact Statement* (Bemax, 2001a). The MSP was approved by the NSW Minister for Planning in May 2002 (Development Consent DA 345-11-01).

Prior to construction and commissioning of the MSP in 2006, a modification to facilitate alterations to the MSP as a result of the detailed design process and feasibility studies was assessed via the *Broken Hill Mineral Separation Plant August 2005 Modification Statement of Environmental Effects* (Bemax, 2005). The modification to DA 345-11-01 was approved in February 2006.

Following approval of the Snapper Mine in 2007 (described below), a modification to enable the processing and separation of mineral concentrates from the Snapper Mine, including increased processing and production rates and revision of process staging at the MSP was assessed via the *Broken Hill Mineral Separation Plant February 2007 Modification Statement of Environmental Effects* (Bemax, 2007a). The modification to DA 345-11-01 was approved in July 2007.

The currently approved MSP process flow sheet is shown on Figure 2-1.

In summary, the MSP is currently approved to:

- have an operational life of approximately 19 years (i.e. to 2025);
- receive up to approximately 735,000 tpa of mineral concentrates (combined) via road haulage from the Ginkgo and Snapper Mines;
- process up to 650,000 tpa of mineral concentrates (combined) from the Ginkgo and Snapper Mines;
- backload and transport up to 300,000 tpa (combined) MSP process wastes to the Ginkgo and Snapper Mines; and
- rail to market up to 3,200 tonnes (t) of mineral products from the MSP per train (i.e. leucoxene, non-magnetic concentrate, rutile[1], zircon[1], unroasted and roasted ilmenite[2]), with a maximum of six train movements per week.

The currently approved mineral concentrate and MSP process wastes transport routes are shown on Figure 1-1.

Further details of the specific components of the approved MSP relevant to the Project are described in Sections 2.6.6 and 2.8. Upgrades and extensions to the existing/approved MSP to enable receipt and processing of mineral concentrates from the Project would be subject to separate State assessment and State approval.

2.1.2 Ginkgo Mine

The Ginkgo Mine was assessed in the *Ginkgo Mineral Sands Project Environmental Impact Statement* (Bemax, 2001b) and was approved by the NSW Minister for Planning in January 2002 (Development Consent DA 251-09-01).

The Ginkgo Mine commenced construction and was commissioned in 2005.

Since commencement of construction of the Ginkgo Mine, DA 251-09-01 has been modified on eight occasions. In 2010, an application to increase the total ore mined at the Ginkgo deposit, increase the life of mine, and receive ore and HMC from the Snapper Mine for processing was assessed via the *Snapper Mineral Sands Mine & Ginkgo Mineral Sands Mine April 2010 Modification Environmental Assessment* (Bemax, 2010). This latest modification was approved in October 2010.

In summary, the Ginkgo Mine is currently approved to:

- have an operational life of approximately 14 years (i.e. to 2016);
- extract a total of 145 Mt of mineral sands ore from the Ginkgo deposit;

[1] Separated products not produced until addition of the rutile and zircon circuits at the MSP.

[2] Separated products not produced until addition of the ilmenite circuit at the MSP.

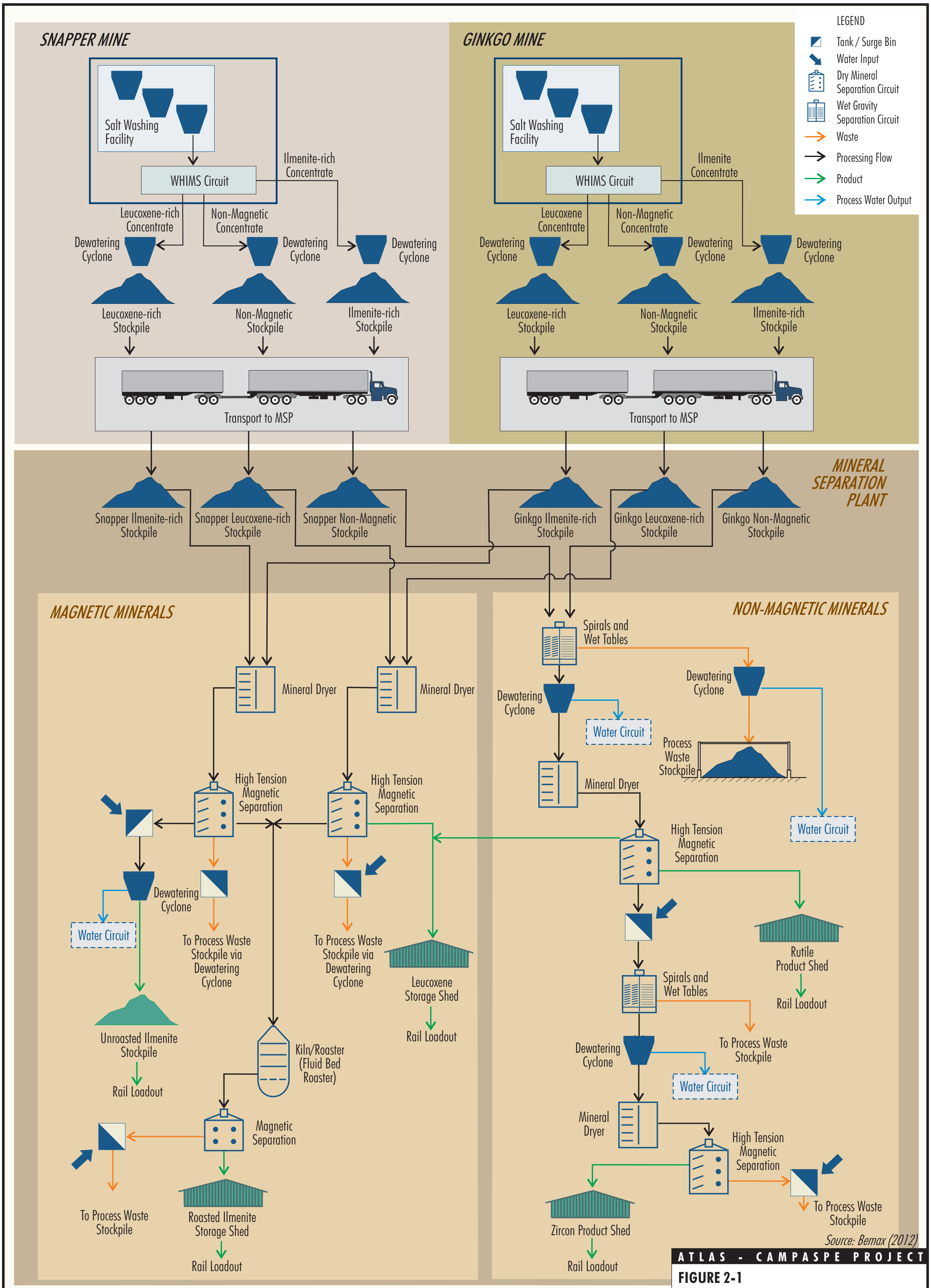

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FIGURE 2-1
Currently Approved MSP Process Flow Sheet

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- extract up to 13 Mtpa of mineral sands ore, producing a maximum 576,000 tpa of mineral concentrates for processing at the MSP; and
- receive backloaded MSP process wastes for designated stockpiling, prior to depositing on the sand residue beach and/or with overburden and covered with overburden (in accordance with conventional practice, monazite from the Ginkgo deposit would be separated from the other heavy minerals at the MSP, diluted with silica waste products and returned to the Ginkgo Mine for disposal above the groundwater table and under a minimum cover depth of 10 m of overburden).

Further details of the specific components of the approved Ginkgo Mine relevant to the Project are described in Sections 2.6.6 and 2.8.3. If required, modification to the existing/approved Ginkgo Mine to allow for continued receipt of MSP process wastes (including the Project) would be subject to separate State assessment and State approval.

2.1.3 Snapper Mine

The Snapper Mine was assessed in the *Snapper Mineral Sands Project Environmental Assessment* (Bemax, 2007b) and was approved by the NSW Minister for Planning in August 2007 (Project Approval [PA] 06_0168).

Construction and development of the Snapper deposit began in August 2008. Since commencement of construction at the Snapper Mine, PA 06_0168 has been modified on three occasions. In 2010, an application to increase the total ore mined at the Snapper deposit, increase the maximum annual production of HMC, reduce the life of mine, and continue trucking of an additional 2 Mt of high-grade ore from the Snapper Mine to the Ginkgo Mine[3] was assessed via the *Snapper Mineral Sands Mine & Ginkgo Mineral Sands Mine April 2010 Modification Environmental Assessment* (Bemax, 2010). The latest modification was approved in October 2010.

In summary, the Snapper Mine is currently approved to:

- have an operational life of approximately 15 years (i.e. to 2025);
- extract up to 9.1 Mtpa of mineral sands ore, producing a maximum 621,000 tpa of mineral concentrates for processing at the MSP;
- process high-grade ore in the WHIMS circuit at a rate capacity of up to approximately 844,000 tpa;
- truck HMC to or from the Ginkgo Mine, dependent on the location of the HMC treatment facility, with disposal of HMC treatment wastes at the Snapper Mine; and
- receive backloaded MSP process wastes for designated stockpiling, prior to depositing on the sand residue beach and/or with overburden and covered under a minimum of 10 m (and up to 35 m) of overburden.

Further details of the specific components of the approved Snapper Mine relevant to the Project are described in Sections 2.6.6 and 2.8.3. If required, modification to the existing/approved Snapper Mine to allow for continued receipt of MSP process wastes (including the Project) would be subject to separate assessment and approval.

2.2 MINERAL DEPOSITS AND EXPLORATION ACTIVITIES

The Murray-Darling basin is a large sedimentary basin covering approximately 300,000 square kilometres (km^2) extending across the borders of NSW, Victoria, Queensland and South Australia. The basin contains mineral sands deposits within the Loxton-Parilla Sands host unit, a sequence of weakly consolidated, near horizontally bedded sands that were deposited during marine transgressions and regressions in the Late Miocene to Late Pliocene period.

The Lower Loxton-Parilla Sands are typically overlain by barren sand of the Upper Loxton-Parilla Sand unit. The Shepparton Formation overlies the Upper Loxton-Parilla Sands and is a sandy clay unit with thick layers of clay. The Shepparton Formation can outcrop in places but is generally overlain by a thin layer of the Woorinen Formation consisting of very fine to coarse sand, silty sand, sandy clay and minor calcrete. The stratigraphic section described above is shown conceptually on Figure 2-2.

The Atlas and Campaspe deposits both occur within the Loxton-Parilla Sands host unit and consist of fine to medium grained quartz sands which are generally unconsolidated, well sorted and contain little clay. A description of each mineral deposit is provided below.

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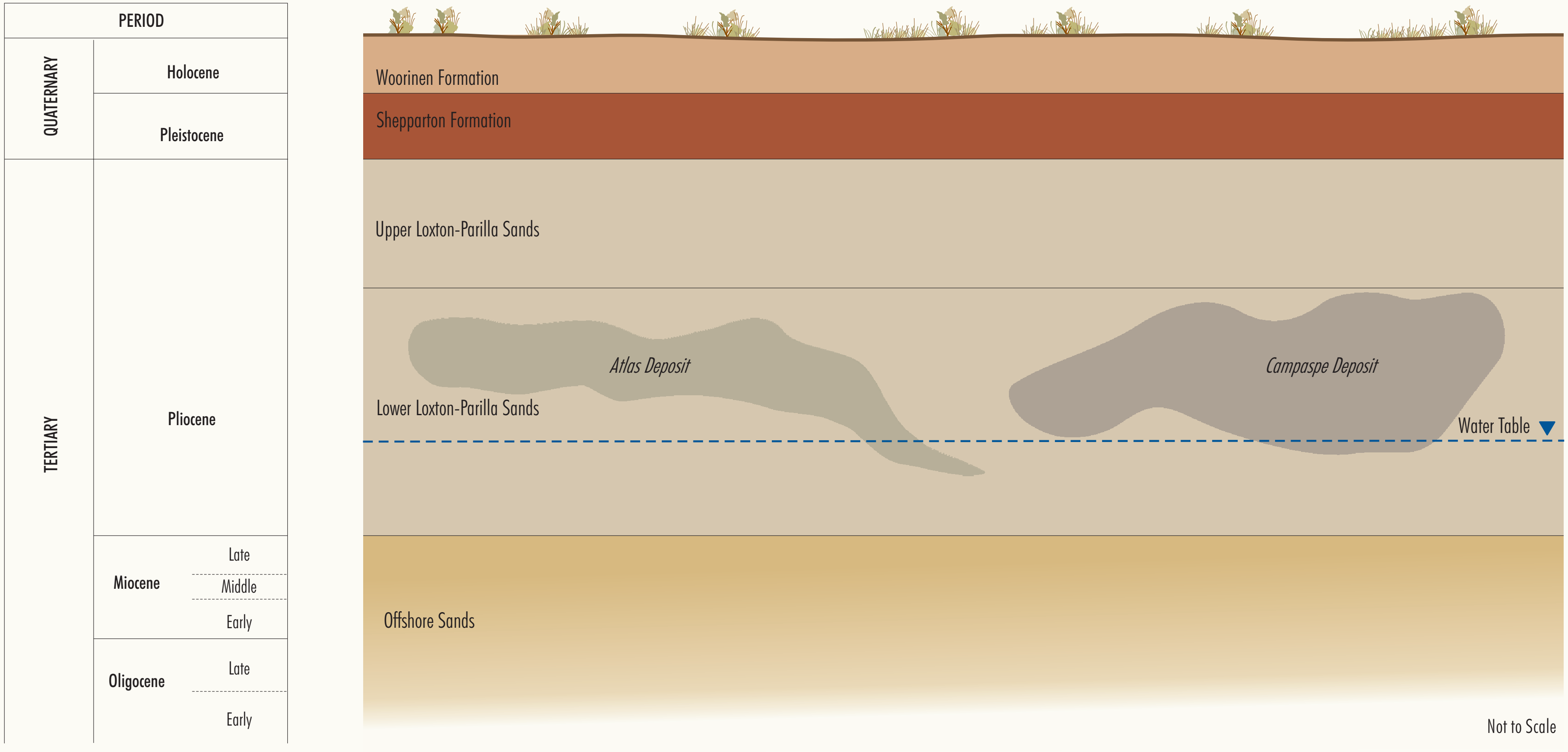
[3] Until December 2011.



Source: NSW Department of Mineral Resources - Poonarie Geological Map 250 k (1996) and Bemax (2012)

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FIGURE 2-2
Conceptual Stratigraphic Section and Deposits

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Atlas Deposit

The Atlas deposit is a continuous body of mineralisation approximately 15 km long and up to 150 m wide, with an average thickness of approximately 6 m. The economic viability of the Atlas deposit decreases in the north-western section of the Atlas deposit. A 12 km section of the Atlas deposit, typically less than 100 m wide, is proposed to be mined by the Project.

Overburden at the Atlas deposit is on average approximately 26 m thick, and increases at the north-western end of the deposit. The removal and handling of overburden at the proposed Atlas-Campaspe Mine is described in Section 2.7.

The Atlas deposit is located predominantly above the existing regional watertable with the exception of a small portion, which would require dewatering during the life of the Project (Section 2.9.4).

The indicated resource for the Atlas deposit comprises approximately 11 Mt of ore at a grade of approximately 15.4% heavy minerals (Bemax, 2012a). This represents some 1.4 Mt of heavy minerals comprising ilmenite, altered ilmenite, leucoxene, rutile and zircon (Bemax, 2012a).

Campaspe Deposit

The Campaspe deposit is a continuous body of mineralisation approximately 18.5 km long, 410 m wide on average, and with an average thickness of approximately 12 m. Similar to the Atlas deposit, the economic viability decreases in the north-western section of the Campaspe deposit. A 14 km section of the Campaspe deposit, typically less than 300 m wide, is proposed to be mined by the Project.

Overburden thickness at the Campaspe deposit varies from less than 10 m at the south-eastern end to greater than 40 m at the north-western end of the deposit. The removal and handling of overburden at the proposed Atlas-Campaspe Mine is described in Section 2.7.

Similar to the Atlas deposit, the Campaspe deposit is located predominantly above the existing regional groundwater table with the exception of a small portion which would require dewatering during the life of the Project (Section 2.9.4).

The indicated resource for the Campaspe deposit comprises approximately 97 Mt of ore at a grade of approximately 4.7% heavy minerals (Bemax, 2012a). This represents some 4.6 Mt of heavy minerals comprising ilmenite, altered ilmenite, leucoxene, rutile and zircon (Bemax, 2012a).

Based on the planned maximum production rate, the total mineable reserve for the Project (both Atlas and Campaspe deposits combined) is approximately 109 Mt of mineral sands ore.

During the life of the Project, mine exploration activities would continue to be undertaken in the Development Application area within the Atlas and Campaspe footprints and would be used to investigate aspects such as ore grade and overburden characteristics as input to detailed mine planning and feasibility studies.

2.3 PROJECT GENERAL ARRANGEMENTS

The proposed life of the Project is approximately 20 years, commencing approximately 1 July 2013 or upon the grant of all required approvals.

The Project general arrangements and activities associated with the two main development components of the Project are described in the following sub-sections.

2.3.1 Atlas-Campaspe Mine

The main activities associated with the development of the Atlas-Campaspe Mine would include:

- ongoing exploration activities;
- sequential development and operation of two separate mineral sands ore extraction areas within the MLA 1 area;
- use of conventional mobile equipment to mine and place mineral sands ore into DMUs[4] at a maximum ore production rate of up to 7.2 Mtpa;
- mineral processing infrastructure including the primary gravity concentration unit, salt washing facility and a WHIMS circuit;
- mineral concentrate stockpiles and materials handling infrastructure (e.g. towers and stackers);
- progressive backfilling of mine voids with overburden behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path;

[4] Mining would use conventional open pit methods and would not involve dredge mining.

- placement of sand residues and coarse rejects (and MSP process wastes[5]) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams;
- development of a groundwater borefield at the Atlas deposit and localised dewatering systems (bores, spearfields and trenches) at both the Atlas and Campaspe deposits, including associated pump and pipeline systems;
- RO plant to supply the salt washing facility and potable water;
- progressive development of water storage dams, sediment basins, pumps, pipelines and other water management equipment and structures;
- administration/office buildings, car parking facilities, workshop and stores;
- on-site accommodation camp;
- sewage treatment plant;
- diesel powered generators, electricity distribution station and associated internal ETLs;
- site access road, internal access roads and haul roads;
- roadworks along the proposed mineral concentrate transport route to the Ivanhoe Rail Facility;
- transport of mineral concentrates along the mineral concentrate transport route to the Ivanhoe Rail Facility;
- road transport of MSP process waste[6] in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for subsequent unloading, stockpiling and placement behind the advancing ore extraction areas;
- development of soil stockpiles and laydown areas;
- monitoring and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

The Project general arrangement of the Atlas-Campaspe Mine is provided on Figure 2-3. The indicative general arrangements for Years 2, 5, 6, 16 and 20 are shown on Figures 2-4 to 2-8, respectively.

The general arrangements are based on planned maximum production and mine progression. The mining layout and sequence shown on Figures 2-4 to 2-8 may vary to take account of localised geological features, market volume and quality requirements, mining economics and Project detailed engineering design.

The detailed mining sequence over any given period would be documented in the relevant Rehabilitation and Environmental Management Plan (REMP) or Mining Operations Plan (MOP) as required by the DRE (within the DTIRIS).

2.3.2 Ivanhoe Rail Facility

The Project general arrangement of the Ivanhoe Rail Facility is provided on Figure 2-9. The main activities associated with the construction and operation of the Ivanhoe Rail Facility located approximately 4.5 km south-west of Ivanhoe, would include:

- development of a rail siding for:
  - loading of train wagons with mineral concentrate for rail transport to the MSP via the Orange – Broken Hill railway; and
  - unloading of MSP process waste in sealed storage containers (transported via the Orange – Broken Hill railway) from train wagons[6];
- site access road and internal haul roads/pavements;
- hardstand areas for mineral concentrate and MSP process waste[6] unloading, stockpiling/sealed container storage and loading;
- a retention basin, drains, pumps, pipelines and other water management equipment and structures;
- site office and car parking facilities;
- extension to existing 11 kV powerline;
- monitoring, landscaping and rehabilitation; and
- other associated minor infrastructure, plant, equipment and activities.

5 Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

6 Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

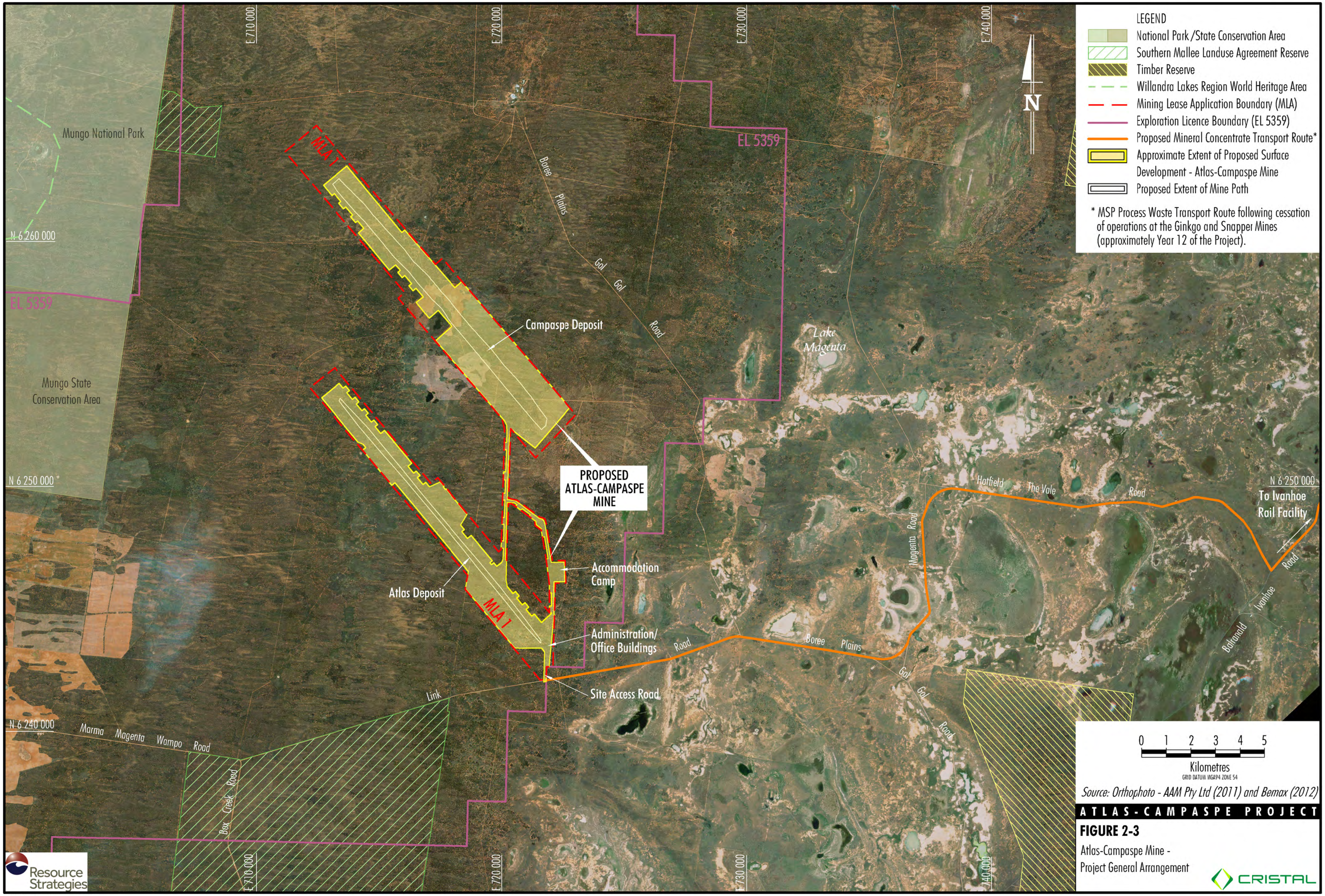

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FIGURE 2-3

Atlas-Campaspe Mine - Project General Arrangement

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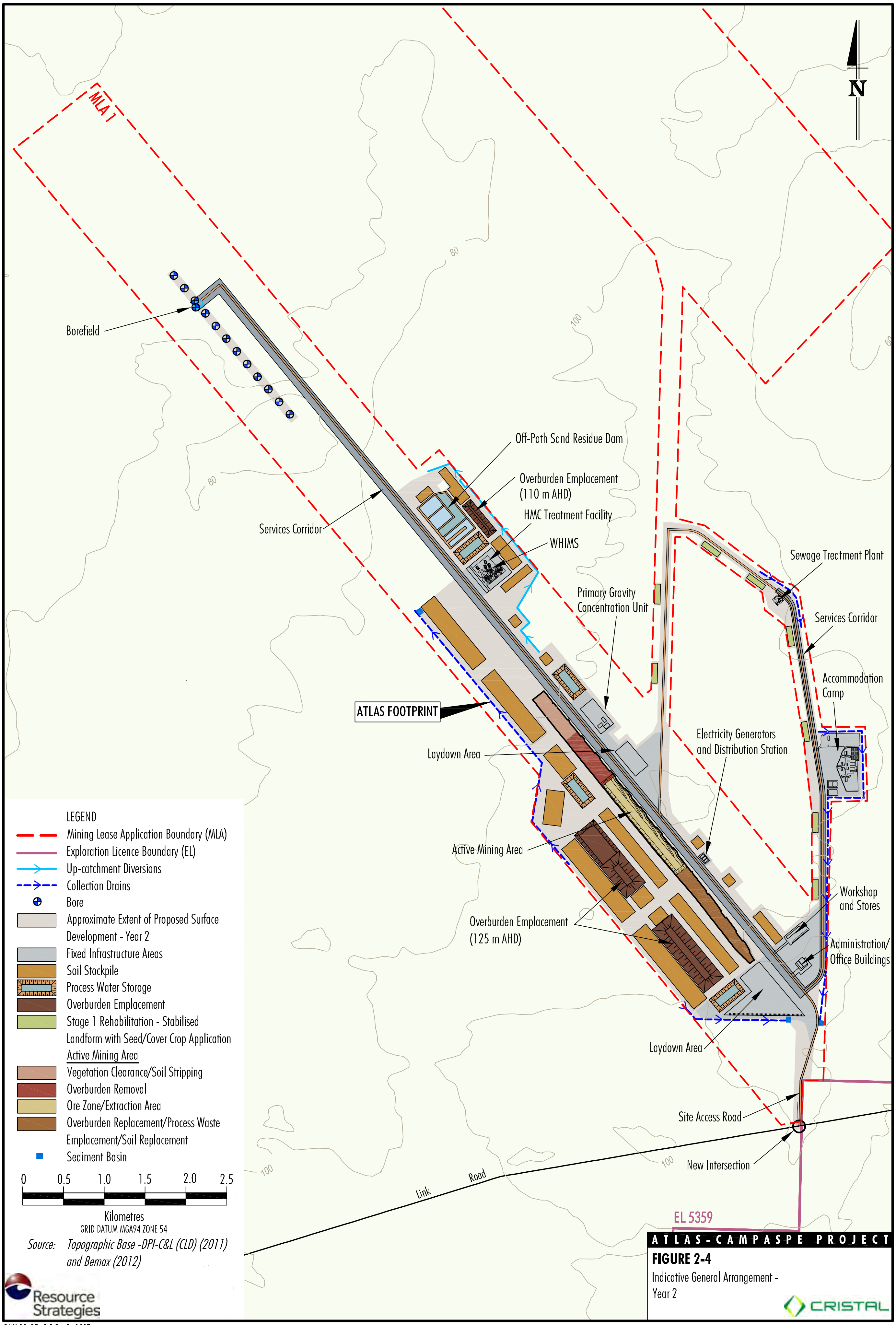

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FIGURE 2-4

Indicative General Arrangement - Year 2

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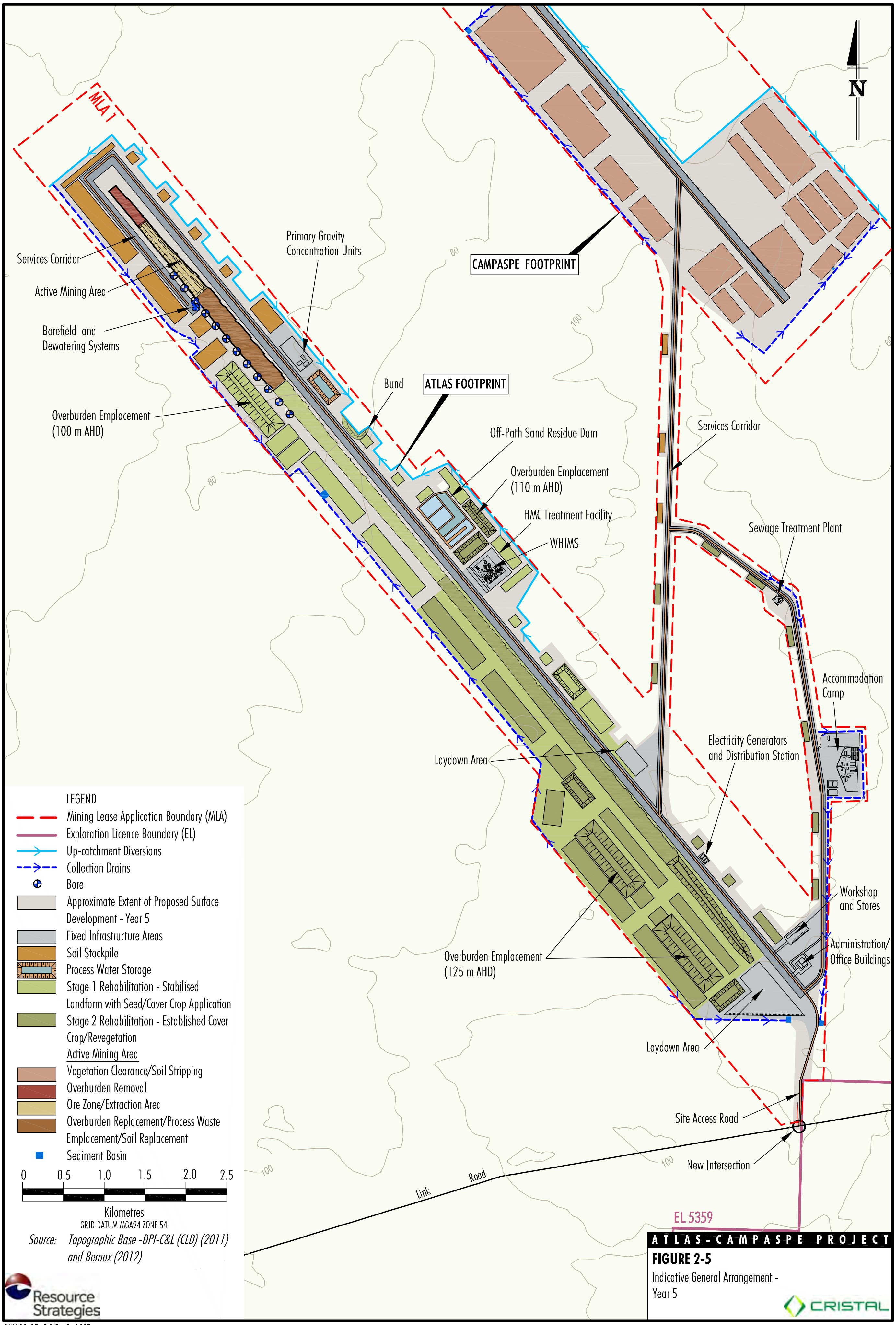

FIGURE 2-5
Indicative General Arrangement - Year 5

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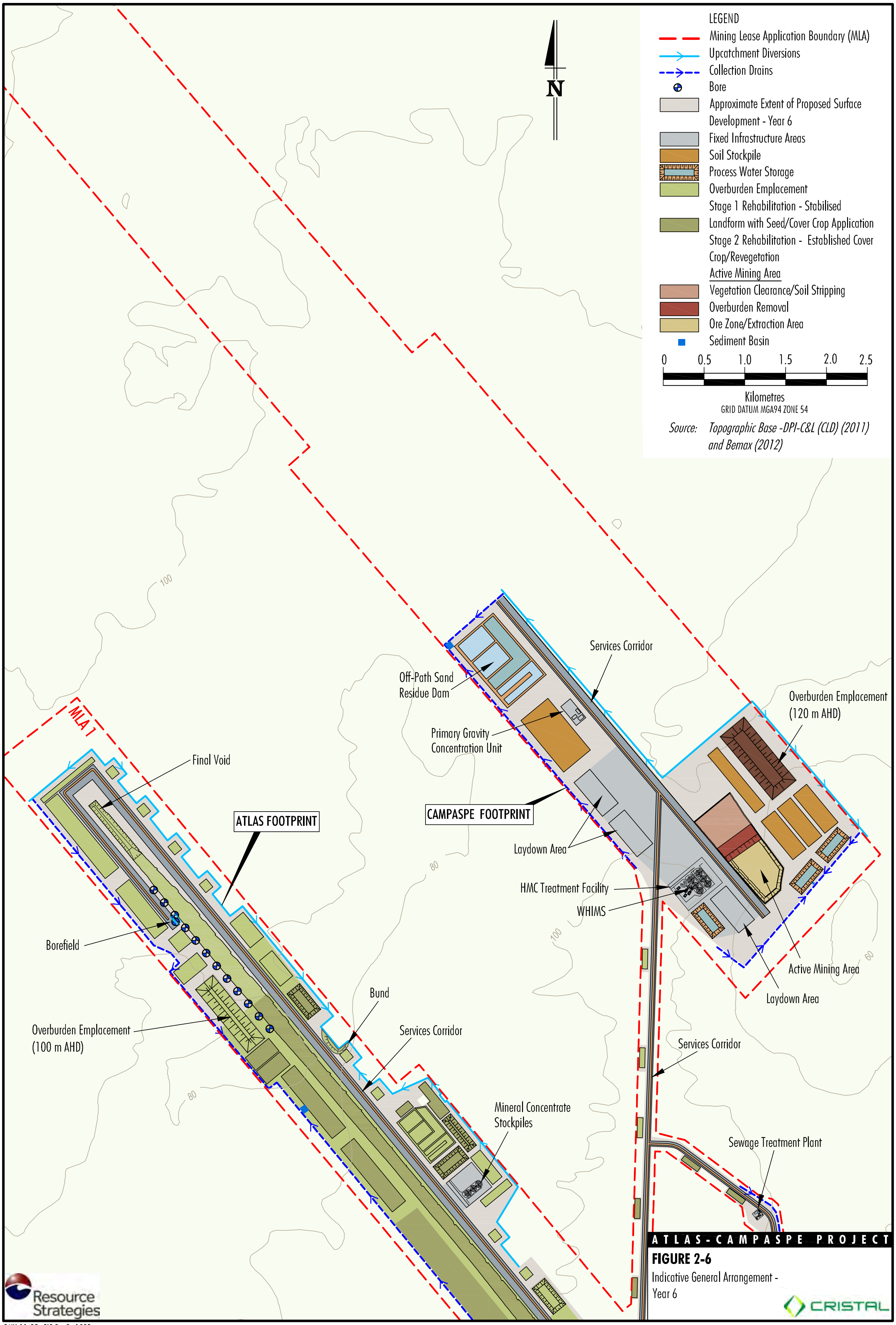

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FIGURE 2-6

Indicative General Arrangement - Year 6

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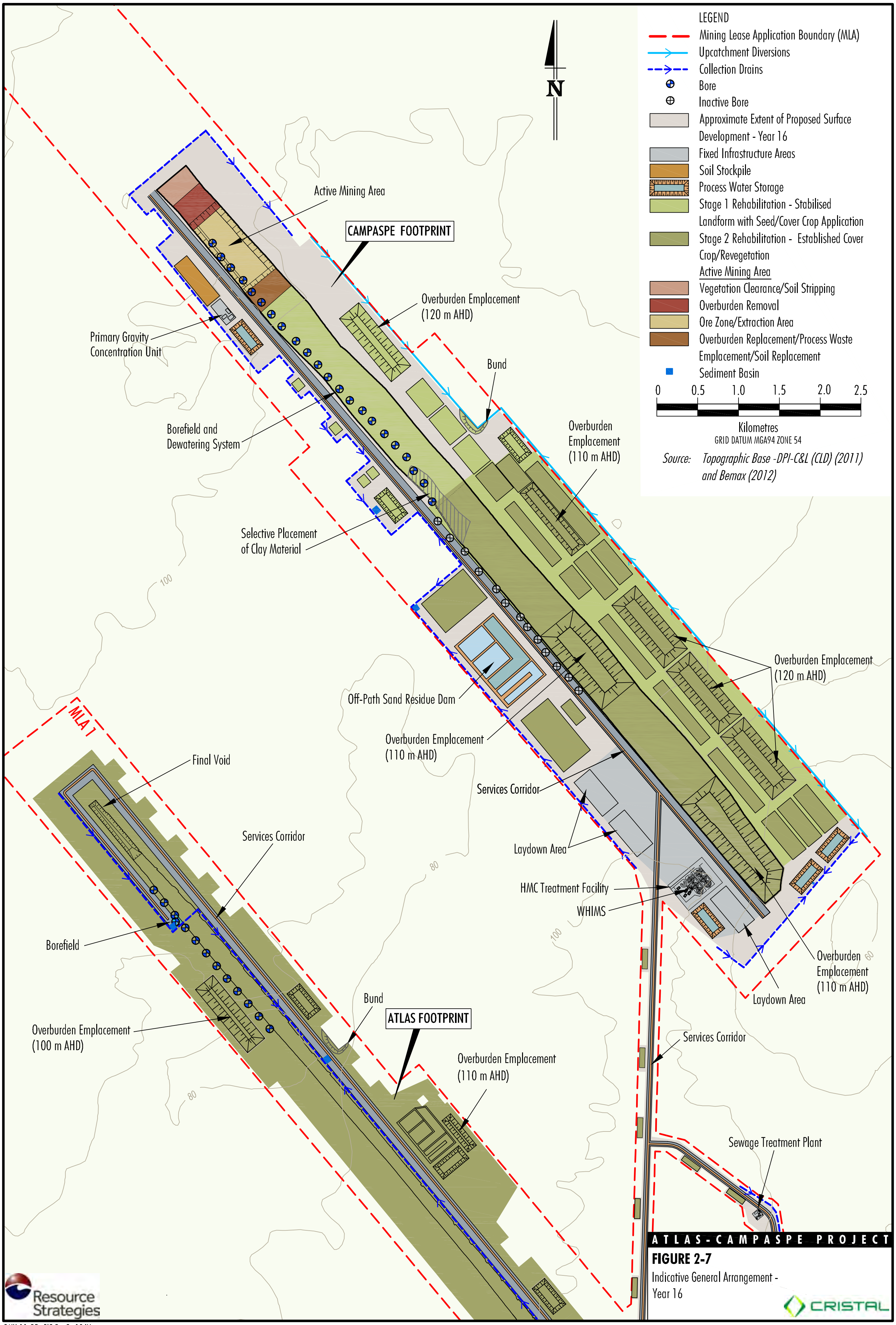

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FIGURE 2-7

Indicative General Arrangement - Year 16

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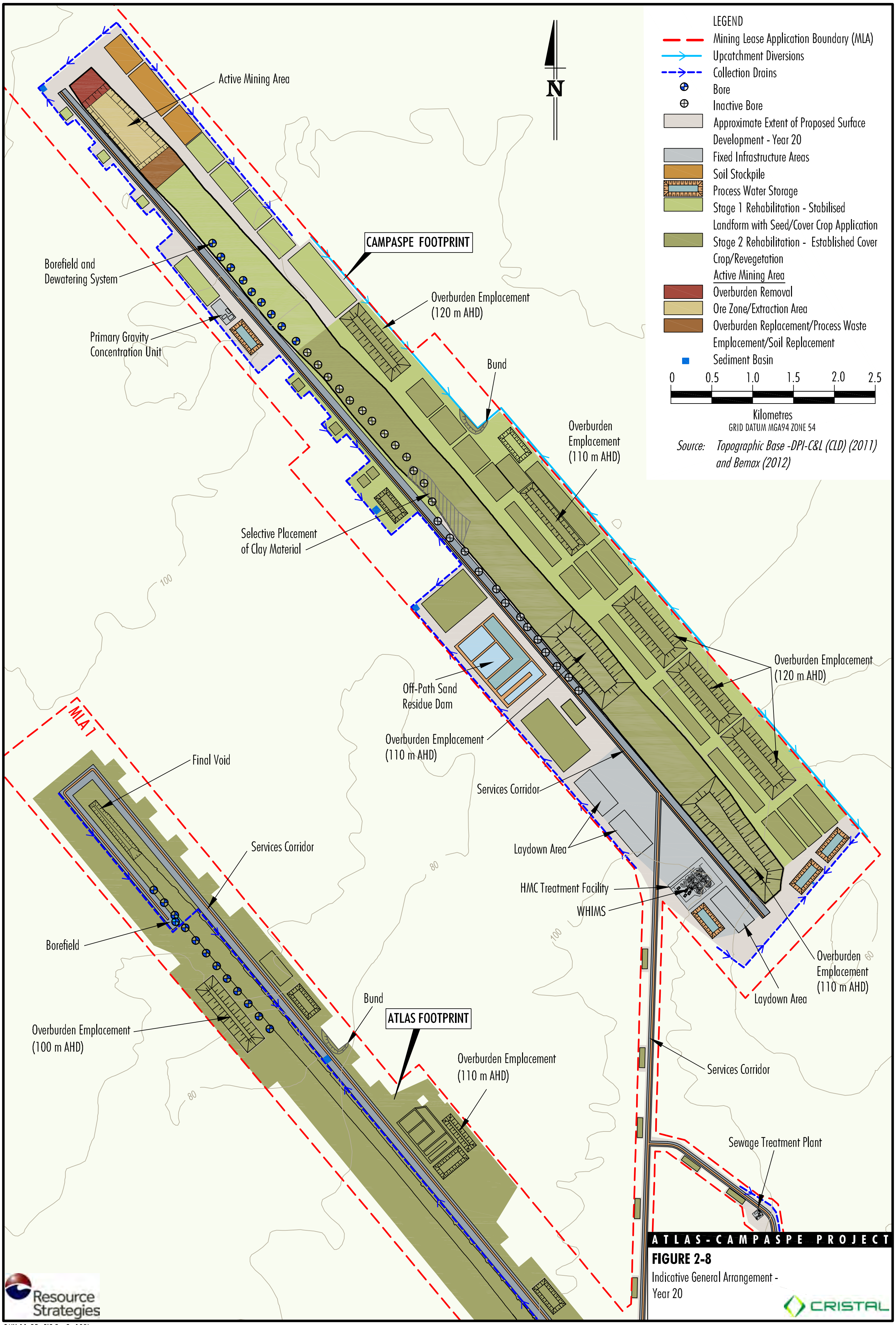

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FIGURE 2-8

Indicative General Arrangement - Year 20

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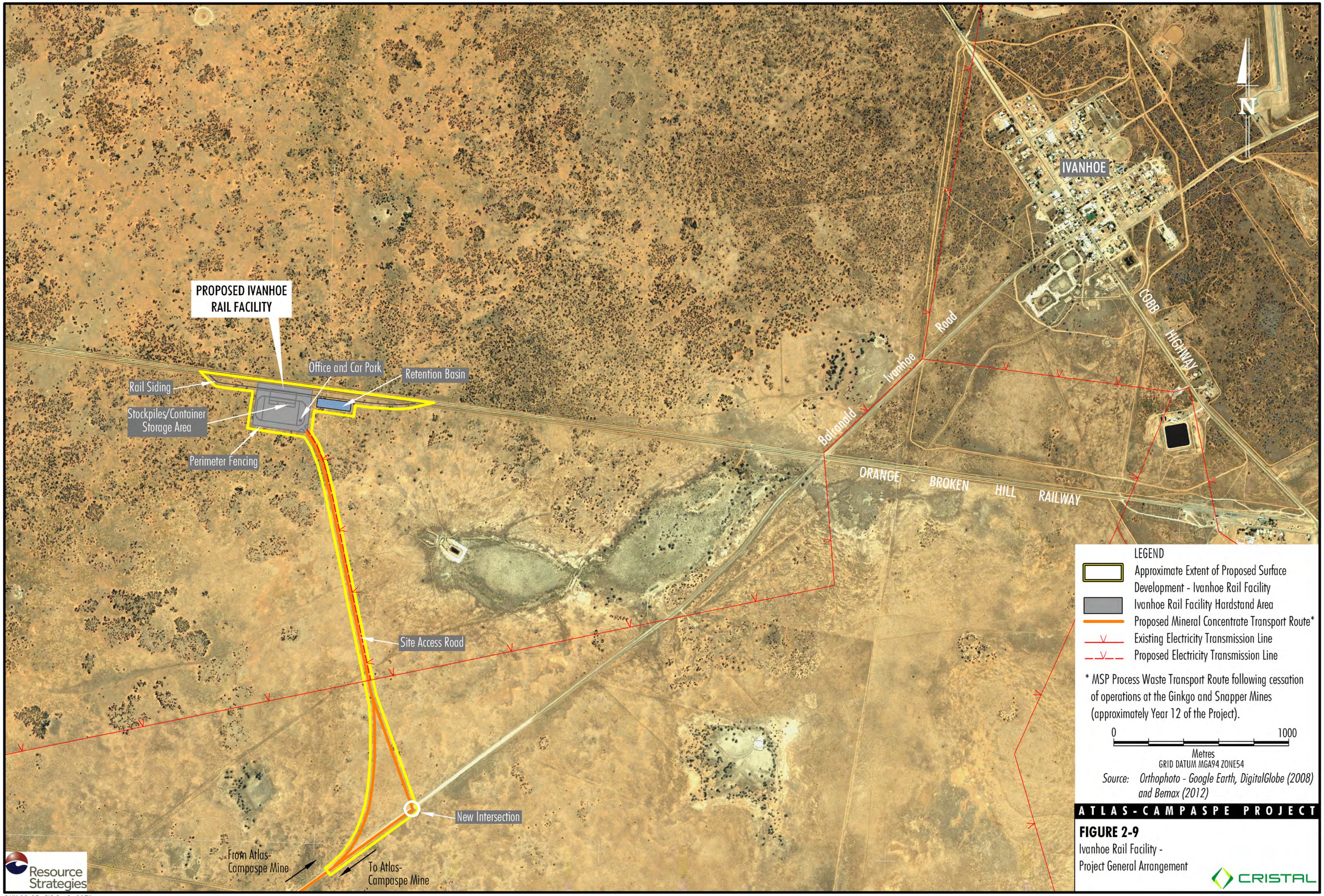

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FIGURE 2-9

Ivanhoe Rail Facility - Project General Arrangement

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2.4 PROJECT CONSTRUCTION AND OTHER DEVELOPMENT ACTIVITIES

Initial construction activities would be undertaken 24 hours per day, seven days per week. The initial construction period (Year 1 of the Project) would be focussed on the development of the following Project infrastructure components:

- site access roads and internal access roads at the Atlas-Campaspe Mine and Ivanhoe Rail Facility;
- on-site accommodation camp and sewage treatment plant at the Atlas-Campaspe Mine;
- water supply infrastructure (including groundwater borefield, RO plant and associated pump and pipeline systems);
- power supply infrastructure (including diesel generators, electricity distribution station and transmission lines);
- fixed infrastructure areas (including administration/office buildings and car parking facilities, workshop and stores, services corridor and laydown areas);
- DMU assembly;
- mineral processing infrastructure (including primary gravity concentration unit, salt washing facility and WHIMS);
- materials handling infrastructure (including pumps and pipelines for mineral sands ore, HMC and process wastes, and towers and stackers for stockpiling mineral concentrates);
- off-path sand residue dams and process water storages;
- roadworks along the mineral concentrate transport route; and
- Ivanhoe Rail Facility.

Where necessary, Cristal Mining would obtain a construction certificate for the works listed above via the consent authority or an accredited private certifier.

The above construction and development activities (including those required to support the Project in parallel with mining operations) are described in more detail below.

2.4.1 Site Access Roads and Internal Access Roads

Access to the Atlas-Campaspe Mine site would be provided from the south via an unsealed two-lane access road off Link Road (Figure 2-3).

The new intersection with Link Road would be constructed in accordance with the *Road Design Guide* (NSW Roads and Traffic Authority [RTA], 1996) and in consultation with the Balranald Shire Council (BSC).

Access to the Ivanhoe Rail Facility would be provided from the south via an unsealed two-lane access road off Balranald-Ivanhoe Road, approximately 3 km south of the Orange – Broken Hill railway crossing (Figure 2-9).

The new intersection with Balranald-Ivanhoe Road would be constructed in accordance with the *Road Design Guide* (RTA, 1996) and in consultation with the Central Darling Shire Council (CDSC).

Warning and restricted access signs would be posted at intervals along the site access roads.

The site access roads would form part of the proposed mineral concentrate transport route (Section 2.6.6).

Internal access roads would be progressively constructed, including link roads within the services corridor.

2.4.2 Accommodation Camp and Sewage Treatment Plant

The accommodation camp at the Atlas-Campaspe Mine would accommodate the peak construction workforce (up to approximately 300 people) and would be reduced in size for Project operations to accommodate approximately 200 people (Section 2.13).

The accommodation camp would be located to the east of the Atlas deposit and immediately north of the site access road (Figure 2-4). Facilities at the accommodation would include:

- up to 300 single quarters/rooms;
- mess area (including stores, kitchen and wet mess);
- office building;
- laundry facilities;
- ablution facilities; and
- garden/recreation area.

An on-site sewage treatment plant would also be constructed to service the Atlas-Campaspe Mine for the life of the Project (Figure 2-4). The sewage treatment plant would be designed and installed in accordance with the requirements of the NSW Environment Protection Authority (EPA) and BSC.

The management of treated sewage and wastewater is described in Section 2.12.

2.4.3 Water Supply Infrastructure

Groundwater Borefield

A groundwater borefield would initially be developed at the Atlas-Campaspe Mine (Figure 2-4) to supply water for construction (e.g. moisture conditioning of earthworks and dust suppression) and for potable water supply (via treatment at the RO plant).

Upon commencement of mining and processing operations at the Atlas-Campaspe Mine, the borefield would be expanded progressively (e.g. installation of additional production bores) to supply the DMUs, primary gravity concentration units and HMC treatment facility.

At full development, up to 13 production bores would be installed with each operated to produce up to approximately 50 litres per second (L/s). The total number of bores in use would vary over the life of the Project and would be dependent on the yield of each individual production bore and localised temporary dewatering requirements.

Therefore, the total number of bores and the operational management requirements of the groundwater borefield to meet the water supply make-up requirements for the Project would be determined during the detailed design of the water supply system.

Each production bore would be fitted with an electric submersible pump to extract groundwater from the Lower Loxton-Parilla Sands. Electricity supply to the borefield would be provided by an ETL within a services corridor from the site electricity generators/distribution system (Section 2.4.4).

Water extracted from the borefield would be reticulated by pump and pipeline systems via services corridors to the DMUs, primary gravity concentration units, HMC treatment facility (including the RO plant). The pump and pipeline systems would be constructed progressively throughout the Project life and would be located either above or below ground within the proposed surface development areas (Figures 2-4 to 2-8).

RO Plant

The RO plant infrastructure would be transported in component parts and assembled on-site. The RO plant would be installed at the HMC treatment facility (Figure 2-4) and would be utilised to supply desalinised process water and potable water requirements (Sections 2.9.2 and 2.10.6).

Potable water would be reticulated via pump and pipeline systems within the services corridor from the RO Plant to the administration/office buildings (including ablutions) and accommodation camp at the Atlas-Campaspe Mine.

2.4.4 Power Supply Infrastructure

On-site diesel-powered electricity generators would be installed and used to supply power from an electricity distribution station at the Atlas-Campaspe Mine (Figure 2-4).

Power would be transferred from the on-site diesel-powered electricity generators either by overhead or underground cables at 22 kV within the services corridor.

A relocatable step-down substation would be located adjacent to the active mining areas as mining advances. Further details are provided in Section 2.10.4.

2.4.5 Fixed Infrastructure Areas

A number of other fixed infrastructure areas would be developed during the initial construction phase at the Atlas-Campaspe Mine including:

- administration/office buildings and car parking facilities (Section 2.10.1);
- workshop and stores (Section 2.10.2);
- a 150 m wide services corridor (including internal access roads, ETLs, water supply infrastructure and drainage works); and
- laydown areas for mine fleet and equipment.

2.4.6 Dry Mining Unit Assembly

Assembly of the first DMU would occur at the south-eastern end of the Atlas footprint and would take approximately 18 weeks to complete. Component parts would be transported to the Atlas-Campaspe Mine and assembled on-site.

A second DMU would be assembled at the south-eastern end of the Campaspe deposit in approximately Year 5 of the Project. After completion of mining at the Atlas deposit, the first DMU would be relocated to the Campaspe footprint (approximately Year 6 of the Project).

2.4.7 Mineral Processing Infrastructure

Construction of the mineral processing infrastructure (including primary gravity concentration units, salt washing facility and WHIMS) would take approximately six months. The mineral processing infrastructure would be transported in component parts and assembled on-site.

The primary gravity concentration units would be initially located adjacent to and approximately one-quarter of the way along the Atlas mine path. As mining advances further to the north-west, the units would be relocated approximately three-quarters of the way along the Atlas mine path (Figures 2-4 and 2-5).

Similarly, the primary gravity concentration units would be relocated adjacent to and approximately one-quarter of the way along the Campaspe mine path upon cessation of mining operations at the Atlas mine path (approximately Year 5). As mining advances further to the north-west, the units would be relocated approximately three-quarters of the way along the Campaspe mine path (Figures 2-6 to 2-8).

The HMC treatment facility (including salt washing facility, WHIMS and RO plant) would be initially located adjacent to and approximately halfway along the Atlas mine path, and upon cessation of mining operations (approximately Year 5) would be relocated to the south-eastern end of the Campaspe footprint (Figures 2-4 to 2-8).

2.4.8 Materials Handling Infrastructure

Pump and pipeline systems would be constructed progressively throughout the Project life for the handling of mineral sands ore and process wastes adjacent to the mine paths and within the proposed services corridors and/or surface development areas (Figures 2-4 to 2-8).

Towers and stackers for stockpiling mineral concentrates would also be constructed adjacent to the HMC treatment facility.

Prior to the receipt of MSP process waste[7], a MORT[8] unit and associated pump and pipeline system would be installed to slurry MSP process waste prior to mixing with sand residues and coarse rejects at the Atlas-Campaspe Mine (Section 2.8.3).

2.4.9 Off-Path Sand Residue Dams and Process Water Storages

A number of off-path sand residue dams and process water storages would be constructed adjacent to the mine path over the life of the Project (Figures 2-4 to 2-8).

Further description of the management of sand residues and process water at the Atlas-Campaspe Mine is provided in Sections 2.8.2 and 2.9, respectively.

2.4.10 Roadworks along Mineral Concentrate Transport Route

With the exception of approximately 37 km of existing unsealed roads between the Atlas-Campaspe Mine site access road and the intersection with the sealed Balranald-Ivanhoe Road (Figure 2-10), the remaining section of the approximate 175 km long proposed mineral concentrate transport route is approved to accommodate road trains (Appendix D).

Roadworks along the 37 km section would therefore be required during construction of the Project and would include (Figure 2-10):

- upgrade of the intersection at Hatfield-The Vale Road and Balranald-Ivanhoe Road;
- road widening and associated drainage works (up to approximately 23 m total width) along a 14.5 km section of Hatfield-The Vale Road to accommodate an unsealed two-lane road;
- new intersections at Hatfield-The Vale Road and Magenta Road;
- a new unsealed two-lane road formation (approximately 2 km long and up to approximately 23 m total width) between the new intersections at Hatfield-The Vale Road and Magenta Road;
- road widening and associated drainage works (up to approximately 23 m total width) along two sections (approximately 2 km and 1 km, respectively) of Magenta Road to accommodate an unsealed two-lane road;
- sealing and associated drainage works (up to approximately 21 m total width) along a 2 km section of Magenta Road to accommodate a two-lane road;
- new intersections at Magenta Road and Boree Plains-Gol Gol Road;

[7] Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

[8] MORT = Monazite Return Tailings.

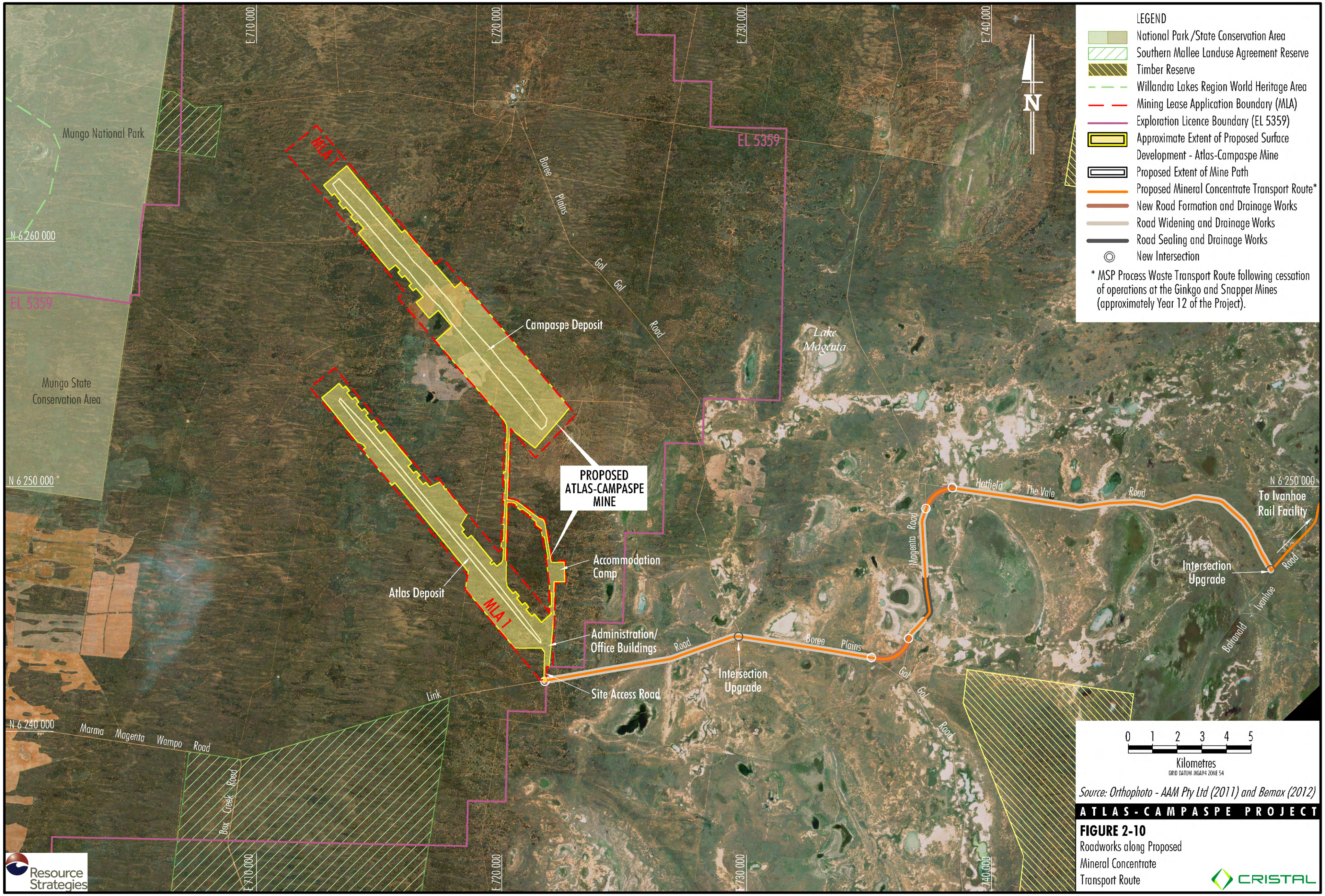

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FIGURE 2-10
Roadworks along Proposed Mineral Concentrate Transport Route

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- a new unsealed two-lane road formation (approximately 2 km and up to approximately 23 m total width) between the new intersections at Magenta Road and Boree Plains-Gol Gol Road;
- road widening and associated drainage works (up to approximately 23 m total width) along a 5.5 km section of Boree Plains-Gol Gol Road to accommodate an unsealed two-lane road;
- road widening and associated drainage works (up to approximately 23 m total width) along a 8 km section of Link Road to accommodate an unsealed two-lane road; and
- a new intersection at Link Road and the Atlas-Campaspe Mine site access road.

The roadworks would be undertaken in consultation with the BSC and in accordance with the requirements of the *Road Design Guide* (RTA, 1996). Cristal Mining would submit relevant concept plans to BSC and the Roads and Maritime Services (RMS) for the roadworks.

In addition to the above, a new intersection would be required for the Ivanhoe Rail Facility site access road off Balranald-Ivanhoe Road.

The new intersection would be designed and constructed in accordance with the requirements of the *Road Design Guide* (RTA, 1996) and in consultation with the CDSC. Cristal Mining would submit relevant concept plans to CDSC and RMS for the new intersection.

Minor quantities of construction materials (e.g. gravel and bitumen) required for the roadworks would be sourced from a licensed supplier. If necessary, Cristal Mining would seek separate approvals from the BSC and/or CDSC for gravel supply.

2.4.11 Ivanhoe Rail Facility

The Ivanhoe Rail Facility would be constructed approximately 4.5 km south-west of the Ivanhoe township to facilitate the transport of mineral concentrates from the Atlas-Campaspe Mine to the MSP (Figure 2-9).

Construction of the Ivanhoe Rail Facility would be undertaken during the Project initial construction phase and take approximately 12 months. The Ivanhoe Rail Facility would comprise:

- a rail siding;
- site access road and internal haul roads/pavements;
- hardstand areas, including stockpiles/container storage areas;
- a retention basin, drains, pumps, pipelines and other water management equipment and structures;
- site office, ablutions and car parking facilities;
- perimeter fencing;
- night-lighting;
- extension to existing 11 kV powerline; and
- landscaping, including retention of existing vegetation along the site access road.

The design and construction of the rail siding would be undertaken in accordance with the requirements of the Australian Rail Track Corporation (ARTC).

Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project), MSP process waste in sealed storage containers would also be temporarily stored on-site prior to being loaded onto trucks and returned to the Atlas-Campaspe Mine.

2.5 MINE OPERATIONS

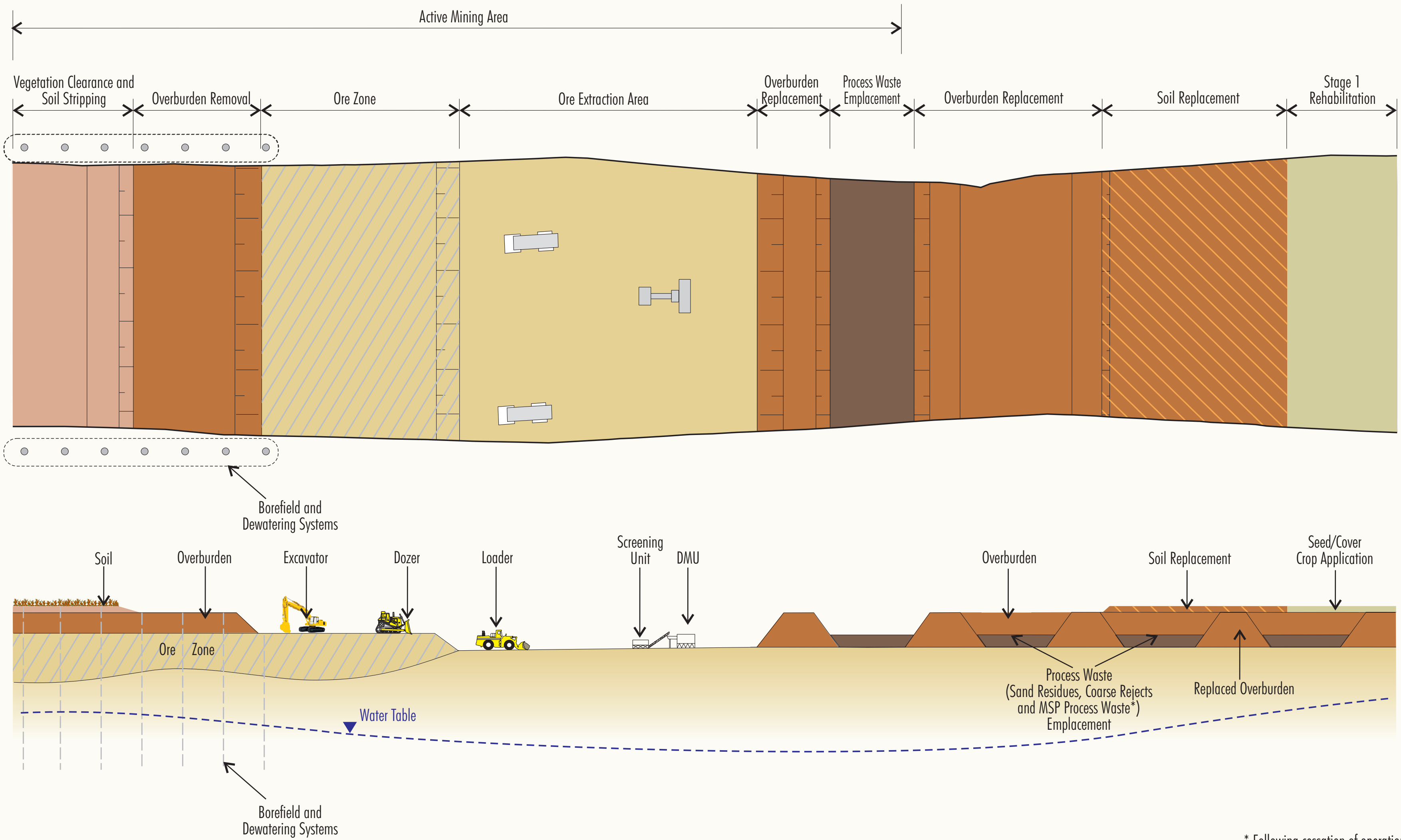
2.5.1 Mining Sequence

Mining at the Atlas-Campaspe Mine would commence with the development of an initial excavation at the south-eastern end of the Atlas deposit and then progress in a north-westerly direction during Years 2 to 5 of the Project (Figures 2-4 and 2-5).

Mining of the Campaspe deposit at the Atlas-Campaspe Mine would commence once mining within the Atlas footprint is complete. Initial development would commence at the south-eastern end of the Campaspe deposit in approximately Year 5 (Figure 2-5) and mining would progress in a north-westerly direction during Years 6 to 20 (Figures 2-6 to 2-8).

The general sequence of mining operations would be as follows (Figure 2-11):

1. Vegetation clearance and soil stripping (Section 2.5.2).
2. Overburden removal ahead of ore extraction areas using conventional truck and shovel methods (e.g. excavators and haul trucks) (Section 2.5.3).



* Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project)

Not to Scale

Source: Bemax (2012)

ATLAS - CAMPASPE PROJECT

FIGURE 2-11

Mining Operations
Conceptual Plan and Section

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3. Mineral sands ore extraction and placement in a DMU using conventional dry mining equipment (e.g. dozers and loaders) (Section 2.5.4).
4. Overburden replacement including progressive backfilling of mine voids behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path (Sections 2.5.3 and 2.7).
5. Placement of process wastes (i.e. sand residues, coarse rejects and MSP process waste[9]) following mineral processing to either the active mining area (behind the advancing ore extraction area) or in sand residue dams (Section 2.8).
6. Overburden and soil replacement including profiling of the final landform in preparation for rehabilitation activities (Sections 2.7 and 5).
7. Progressive rehabilitation behind the advancing mining operation (Section 5).

2.5.2 Vegetation Clearance and Soil Stripping

Vegetation would be progressively cleared over the life of the Project ahead of overburden removal and ore extraction areas (Figures 2-4 to 2-8). Specific vegetation clearance procedures (generally consistent with existing procedures at the Ginkgo and Snapper Mines) would be developed for the Project as described in Section 4.6.3.

Where stripped soils cannot be used directly for progressive rehabilitation, the soil would be stockpiled separately and seeded with grasses to maintain soil viability.

Specific soil management, stockpiling and re-application procedures (generally consistent with existing procedures at the Ginkgo and Snapper Mines) would be developed for the Project as described in Section 5.

A fleet of dozers, scrapers and water trucks would typically be used for vegetation clearing and soil stripping activities.

9 Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

2.5.3 Overburden Removal and Handling

Excavators, dozers and front end loaders would be used to remove overburden ahead of the advancing ore extraction areas (Figure 2-11). Haul trucks would be used to transport the overburden to either behind the advancing ore extraction areas or in overburden emplacements adjacent to the mine path.

Overburden would be used to construct a series of cells behind the ore extraction areas for placement of process wastes (Figure 2-11).

There would, however, be periods during mining when there is insufficient capacity to place all overburden behind the ore extraction areas (e.g. the initial stages of mining at the Atlas and Campaspe deposits [i.e. Years 2 and 6]). The overburden would be placed in overburden emplacements (Figures 2-4 and 2-6) during these periods.

Further information regarding overburden management is provided in Section 2.7.

2.5.4 Mineral Sands Ore Extraction and Handling

Approximately 109 Mt of mineral sands ore would be mined from the Atlas and Campaspe deposits during the life of the Project. Mining would typically involve conventional dry mining equipment (e.g. dozers and loaders) placing mineral sands ore in a DMU located in the ore extraction area (Figure 2-11).

Ore would be placed in the DMU at a rate of approximately 500 tonnes per hour (tph). A second DMU would be used for mining of the Campaspe deposit to increase the total ore feed rate to approximately 1,000 tph.

At the DMU, the mineral sands ore would be slurried, screened and pumped to the primary gravity concentration unit for on-site processing (Section 2.6.3).

2.5.5 Indicative Mine Schedule

The staging of the development of the Atlas-Campaspe Mine, as described in Section 2.6.1, would be determined by the requirements of the market and product specification for customers. As these requirements are likely to vary over the life of the Project, the mineral sands ore extraction rates may also vary.

An indicative mine schedule for the Project is provided in Table 2-1.

Table 2-1
Indicative Mine Schedule

Project Year	Mineral Sands Ore Extraction (Mtpa)		
	Atlas Deposit	Campaspe Deposit	Project Total
1*	-	-	-
2	1.2	-	1.2
3	3.5	-	3.5
4	3.3	-	3.3
5	3.3	-	3.3
6	-	6.2	6.2
7	-	6.6	6.6
8	-	6.7	6.7
9	-	6.8	6.8
10	-	6.8	6.8
11	-	7.2	7.2
12	-	6.6	6.6
13	-	7.0	7.0
14	-	6.9	6.9
15	-	7.0	7.0
16	-	6.5	6.5
17	-	7.0	7.0
18	-	6.9	6.9
19	-	6.7	6.7
20	-	2.5	2.5
Total	**11.3**	**97.4**	**108.7**

Source: Cristal Mining (2012a).
* Assumed Project commencement date is 1 July 2013.

2.5.6 Mine Fleet

The mine fleet at the Atlas-Campaspe Mine would vary according to the equipment requirements associated with the advancing mining operations.

An indicative mine fleet is provided in the Noise Assessment (Appendix J). In summary, the mine fleet would include:

- one road roller/compactor;
- nine scrapers;
- one scraper/water cart;
- two graders;
- six front end loaders;
- four dozers;
- four excavators;
- 12 haul trucks;
- one fuel truck;
- two water trucks; and
- one crane.

Other mining equipment and plant used to support the mine fleet would include diesel-powered generators, a bobcat, two buses, a garbage truck, service and maintenance vehicles and lighting plant.

Some additional plant items (e.g. one backhoe, one road roller/compactor and three cranes) would also be required during construction periods.

2.6 ON-SITE PROCESSING AND MINERAL CONCENTRATE STOCKPILING, LOADING AND TRANSPORT

2.6.1 Indicative Processing and Mineral Concentrate Production Schedule

Based on the indicative mine schedule for the Project (Table 2-1), the on-site processing and production rates for the Project are provided in Table 2-2.

2.6.2 On-site Processing Hours of Operation

Processing of mineral sands ore would operate at the Atlas-Campaspe Mine up to 24 hours per day, seven days per week.

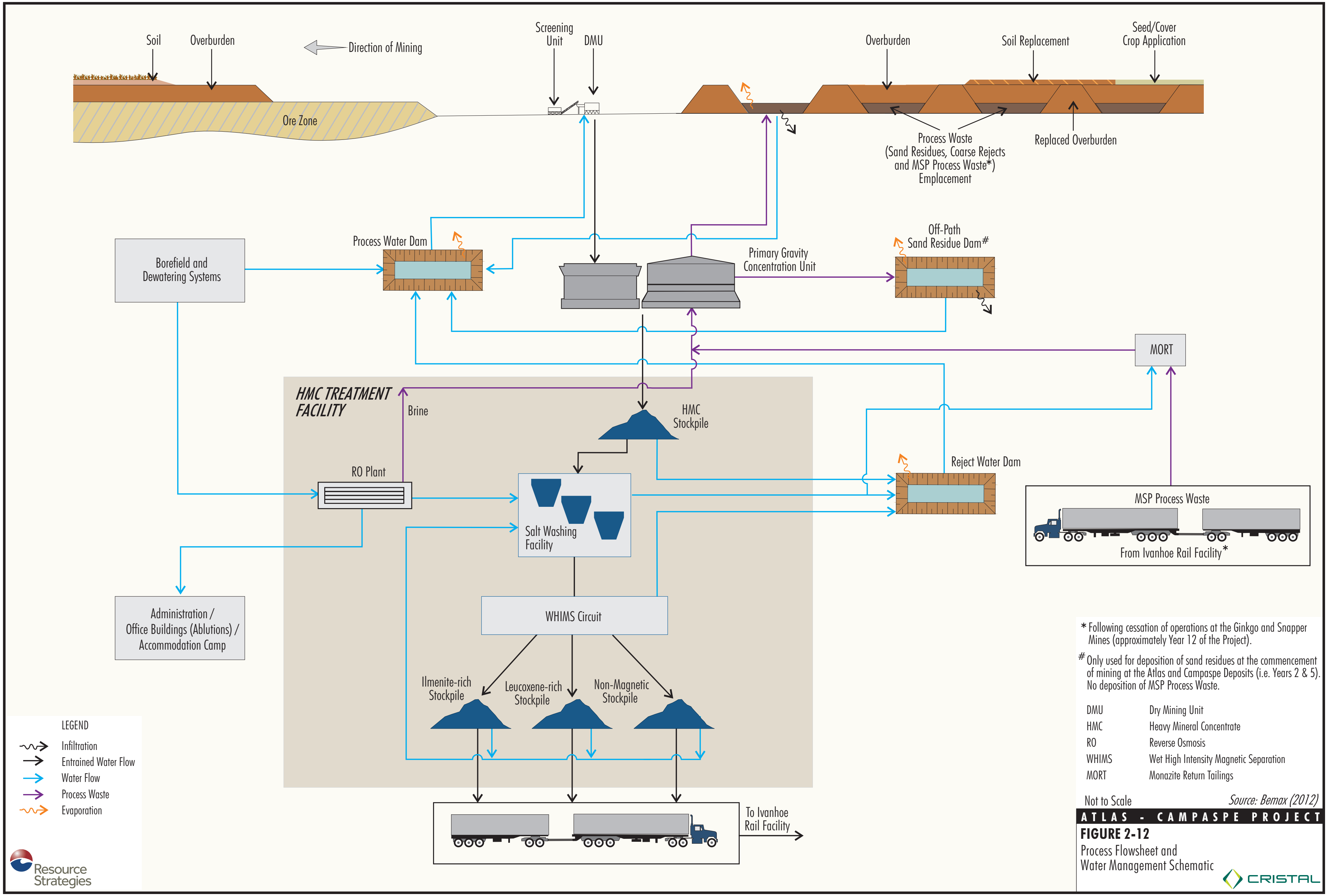
A description of the on-site processing operations at the Atlas-Campaspe Mine is provided in the following sub-sections. A process flow sheet schematic is provided on Figure 2-12.

2.6.3 Primary Gravity Concentration Unit

Primary separation of the valuable minerals from ore would occur in the primary gravity concentration unit. No chemical reagents are used in the separation process. The primary gravity concentration unit would be relocated during the Project life to remain adjacent the advancing mining operation (Figures 2-4 to 2-8).

The ore slurry would be pumped from the DMU to the primary gravity concentration unit. The ore slurry feed material would be approximately 45% solids and comprise unconsolidated sands with 2 to 3% very fine particle content (e.g. clays) and minor amounts of coarse reject material.

The ore would initially report to a surge bin so that a consistent feed rate and pulp density can be maintained to the subsequent concentration circuits. A screen above the surge bin would separate coarse reject material (greater than 3 millimetres [mm]) to a reject bin.



* Following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project).

\# Only used for deposition of sand residues at the commencement of mining at the Atlas and Campaspe Deposits (i.e. Years 2 & 5). No deposition of MSP Process Waste.

DMU	Dry Mining Unit
HMC	Heavy Mineral Concentrate
RO	Reverse Osmosis
WHIMS	Wet High Intensity Magnetic Separation
MORT	Monazite Return Tailings

Not to Scale

Source: Bemax (2012)

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FIGURE 2-12
Process Flowsheet and Water Management Schematic

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Table 2-2
Indicative On-site Processing and Mineral Concentrate Production Schedule

Project Year	Mineral Sands Ore Extraction/ Processed^ (Mtpa)	Sand Residues and Coarse Rejects (Mtpa)	HMC Processed/ Production~ (ktpa)	Mineral Concentrates Stockpiled (kt)		Mineral Concentrates# Transported to MSP (ktpa)
				Atlas Footprint	Campaspe Footprint	
1*	-	-	-	-	-	-
2	1.2	1.0	176	104	-	72
3	3.5	3.0	529	418	-	215
4	3.3	2.8	546	646	-	318
5	3.3	2.8	491	687	-	450
6	6.2	5.9	293	413	117	450
7	6.6	6.3	295	247	128	450
8	6.7	6.4	281	17	189	450
9	6.8	6.5	252	-	8	450
10	6.8	6.5	238	-	-	246
11	7.2	6.9	279	-	-	279
12	6.6	6.4	247	-	-	247
13	7.0	6.7	268	-	-	268
14	6.9	6.6	275	-	-	275
15	7.0	6.7	314	-	-	314
16	6.5	6.2	320	-	-	320
17	7.0	6.7	345	-	-	345
18	6.9	6.5	434	-	-	434
19	6.7	6.3	434	-	-	434
20	2.5	2.3	184	-	-	184
Total (Mt)	**108.7**	**102.5**	**6.2**	**-**	**-**	**6.2**

Source: Cristal Mining (2012a).

* Assumed Project commencement date is 1 July 2013.
^ Including separation in the primary gravity concentration unit.
~ Including separation in the HMC treatment facility.
\# Including leucoxene, ilmenite and non-magnetic concentrates.
ktpa = kilotonnes per annum
kt = kilotonnes.

The ore slurry would then be pumped from the surge bin to gravity separation circuits within the primary gravity concentration unit to separate valuable minerals from sand residues (including clays). The gravity separation circuits would consist of a series of spiral separators.

The gravity separation circuits would produce HMC comprising approximately 94% valuable heavy minerals (principally ilmenite, leucoxene, rutile and zircon).

The HMC recovered by the primary gravity concentration unit would be processed further at the HMC treatment facility.

Sand residues (including clays) separated by the gravity separation circuits would be deposited to a reject bin.

Sand residues and coarse reject materials would be pumped directly from the primary gravity concentration unit to either the active mining area (behind the advancing ore extraction area) or in sand residue dams (Figure 2-12).

As described in Section 2.8.3, following cessation of operations at the Ginkgo and Snapper Mines (approximately Year 12 of the Project), MSP process waste would also be slurried in a designated hopper (MORT) and pumped to the primary gravity concentration unit where it would be mixed with the sand residues and coarse materials in the reject bin (Figure 2-12).

Further information regarding MSP process waste management is provided in Sections 2.6.6 and 2.8.

2.6.4 HMC Treatment Facility

As described in Section 2.4, the HMC treatment facility would include:

- a salt washing facility;
- WHIMS circuit; and
- RO plant.

The HMC treatment facility would be initially located adjacent to and approximately halfway along the Atlas mine path, and upon cessation of mining operations (approximately Year 5) would be relocated to the south-eastern end of the Campaspe footprint (Figures 2-4 to 2-8).

The HMC recovered by the primary gravity concentration unit would be pumped as a slurry to the HMC treatment facility for further processing. The components of the HMC treatment facility are described below.

Salt Washing Facility

Due to the saline nature of groundwater from the borefield (Appendix F) used for the slurrying of ore from the Atlas and Campaspe deposits, HMC pumped from the primary gravity concentration unit would have a high salt content.

The residual salt in the HMC would inhibit the efficiency of the separation process in the WHIMS circuit which, in part, involves electrostatic separation. The HMC would therefore be washed with desalinated water prior to processing in the WHIMS. The salt washing facility would source desalinated water from the proposed on-site RO plant.

Following salt washing, the HMC would be pumped to the WHIMS circuit (Figure 2-12).

WHIMS Circuit

The WHIMS circuit is a preliminary treatment stage which separates the HMC into ilmenite-rich, leucoxene-rich and non-magnetic (containing rutile-rich and zircon-rich) mineral concentrates.

The WHIMS circuit relies on magnetic separation and requires no chemical reagents. The WHIMS circuit consists of primary and secondary magnetic separators to separate the magnetic and non-magnetic mineral concentrates and product de-watering cyclones.

The water requirements for the WHIMS circuit are described in Section 2.9.2, and would source desalinated water from the proposed on-site RO plant.

The mineral concentrates from the WHIMS circuit would be stockpiled in the mineral concentrate stockpile areas at the Atlas-Campaspe Mine by product stackers.

RO Plant

An RO plant would supply desalinated water to the salt washing facility and the WHIMS circuit. Potable water supply for the Atlas-Campaspe Mine would also be sourced from the RO plant.

The groundwater borefield (Section 2.4.3) would supply feed water to the RO plant for the Project.

Wastewater (i.e. brine) from the RO plant would contain approximately 60,000 milligrams per litre (mg/L) of total dissolved solids (TDS) (Appendix F). The management and disposal of wastewater from the RO plant is described in Section 2.9.

2.6.5 Mineral Concentrate Stockpiles and Loading

The mineral concentrates would be stockpiled in the HMC treatment facility at the Atlas-Campaspe Mine (Figures 2-4 to 2-8).

Prior to loading and transport to the MSP, the mineral concentrate stockpiles would be dewatered to approximately 6% water content. Once dewatered, front end loaders would be used to load mineral concentrates from the stockpiles direct to haulage vehicles.

Haulage vehicles would be fitted with side tipping trays to minimise the potential for spillage during loading. Once loaded, the haulage vehicle load would be covered to minimise the potential loss of mineral concentrates during transport.

As shown on Figures 2-4 to 2-8, and provided in Table 2-2, mineral concentrate would be stockpiled within the HMC treatment facility adjacent to both the Atlas and Campaspe mine paths during the life of the Project.

In consideration of the MSP processing schedule (including Ginkgo and Snapper Mines), the total mineral concentrate transported from the Atlas-Campaspe Mine to the MSP has been assessed at up to approximately 0.45 Mt in any one year. Given the planned maximum production rate in Years 3 to 5 from the Atlas mine path is greater than 0.45 Mtpa, mineral concentrate would need to be stockpiled during this time.

The mineral concentrates stockpiled would be progressively reclaimed following cessation of mining at the Atlas deposit and would continue to be transported during mining operations within the Campaspe footprint until the stockpiles are depleted.

2.6.6 Mineral Concentrate and MSP Process Waste Transport

Road Transport

Mineral concentrate would be hauled via road approximately 175 km from the Atlas-Campaspe Mine to the Ivanhoe Rail Facility. The mineral concentrate would be transported in road trains[10]. The Balranald-Ivanhoe Road is an approved route for road trains.

The proposed mineral concentrate transport route to the Ivanhoe Rail Facility is shown on Figure 1-1. The road haulage route would comprise sections of the following public roads (Figure 2-10):

- Link Road;
- Boree Plains-Gol Gol Road;
- Magenta Road;
- Hatfield-The Vale Road; and
- Balranald-Ivanhoe Road.

The proposed mineral concentrate transport route would not cross the Orange – Broken Hill railway nor pass through the township of Ivanhoe (Figure 2-9).

Road transport of mineral concentrate would be undertaken 24 hours per day, seven days per week.

Based on the planned maximum production rate (Table 2-2), up to a maximum 24 haulage vehicle trips (i.e. 48 haulage vehicle movements) per day would be required, with approximately 19 haulage vehicle trips (i.e. 38 haulage vehicle movements) per day on average over the life of the Project.

Up until cessation of the Ginkgo and Snapper Mine operations (approximately Year 12 of the Project), the transport of MSP process waste would be undertaken in accordance with existing/approved Transport Management Plan required under PA (06_0168) for the Snapper Mine and Traffic Code of Conduct and Transport of Hazardous Materials Plan required under Development Consent (DA 251-09-01) for the Ginkgo Mine, or as otherwise modified subject to separate State assessment and State approval.

From approximately Year 12 of the Project, MSP process waste in sealed containers would be unloaded from trains at the Ivanhoe Rail Facility, and temporarily held in a designated area prior to loading onto haulage vehicles for the return trip to Atlas-Campaspe Mine. Therefore no additional haulage movements for the MSP process waste, in addition to the mineral concentrate haulage vehicle movements, would be required for the Project. The management of MSP process waste is described further in Section 2.8.3.

In the event of road closures along the mineral concentrate transport route by relevant authorities (e.g. due to a significant rainfall event/ flooding), the transport of mineral concentrate would temporarily cease until the mineral concentrate transport route is re-opened.

Ivanhoe Rail Facility

A description of the Ivanhoe Rail Facility is provided in Section 2.4.11 and general arrangement shown on Figure 2-9. A summary of the unloading, stockpiling and rail loading operations is provided below.

Unloading and Stockpiling

Haulage vehicles would enter the Ivanhoe Rail Facility via the access road off the Balranald-Ivanhoe Road. A turn-around loop at Ivanhoe Rail Facility would enable the haulage vehicles to turn-around, unload and exit using the same access road.

Mineral concentrate emptied from the haulage vehicles would be dumped directly onto a mineral concentrate stockpiles within the hardstand area.

Loading of Train Wagon Containers

A front end loader would be used to reclaim mineral concentrate from the stockpiles at the Ivanhoe Rail Facility and load directly into containers on train wagons. A forklift would be used to remove and replace covers on the train wagons.

Rail Transport

Mineral concentrates would be railed from the Ivanhoe Rail Facility to the MSP via the Orange – Broken Hill railway. Based on the planned maximum production rate, the total quantities of mineral concentrates required for rail transport over the life of the Project is provided in Table 2-2.

[10] Type 1 road train as defined by RMS, 2012.

Based on train lengths of up to 600 m, the Project would require a maximum of three trains per week over the life of the Project. No more than one train load of mineral concentrate from the Atlas-Campaspe Mine would be railed to the MSP in any 24 hour period. Rail transport movements would be scheduled to occur at any time once loading is completed (i.e. 24 hours per day, seven days per week).

Cristal Mining has entered into long-term arrangements with the ARTC for rail track access from the Ivanhoe Rail Facility to the MSP. These arrangements provide Cristal Mining with the rail capacity required for its long-term mineral concentrate production.

From approximately Year 12 of the Project, MSP process waste in sealed containers would be unloaded from trains at the Ivanhoe Rail Facility prior to returning to the Atlas-Campaspe Mine. No additional rail movements for MSP process waste would be required for the Project. The management of MSP process waste is described further in Section 2.8.3.

2.7 OVERBURDEN MANAGEMENT

2.7.1 Overburden Quantities

Approximately 230 million bank cubic metres (Mbcm) of overburden would be mined over the life of the Project.

Up to a maximum of approximately 21.6 Mbcm of overburden would be removed per annum. The average monthly volumes of overburden removed at the Atlas and Campaspe footprints would be approximately 1.2 Mbcm per month and approximately 1.05 Mbcm per month, respectively.

2.7.2 Overburden Geochemistry

An assessment of the geochemical characteristics of the overburden material associated with the development of the Project is provided in the *Atlas-Campaspe Mineral Sands Project Assessment of Overburden Acid-Generating Potential* (Appendix G) prepared by Cristal Mining (2012b). A summary of the assessment is provided below.

Testwork was conducted on 29 overburden samples from 21 drill holes distributed across the Atlas and Campaspe mine paths. The testwork included pH, electrical conductivity (EC) and sulphur analysis.

The testwork results showed:

- Overburden materials would typically be alkaline, however, would range from weakly acidic to strongly alkaline.
- Overburden materials would typically be non-saline to moderately-saline.
- Total sulphur content of the overburden materials is very low and the sulphate sulphur content averaged approximately 50% of the total sulphur.

Based on the testwork results, the acid-generating potential of overburden materials was considered to be very low (Appendix G).

2.7.3 Overburden Emplacement Strategy

Overburden would be used to construct a series of cells behind the ore extraction areas for placement of process wastes (Figure 2-11). Overburden would generally be used to reinstate the natural ground surface behind the advancing ore extraction areas. However, overburden would be mounded to approximately 10 m above the natural ground surface at the south-eastern end of each deposit (Figures 2-5 and 2-7).

In addition, there would be periods during mining when there is insufficient capacity to place all overburden behind the ore extraction areas (e.g. the initial stages of mining at the Atlas and Campaspe deposits [i.e. Years 2 and 6]). The overburden would be placed in overburden emplacements (Figures 2-4 and 2-6) during these periods.

The overburden emplacements would be constructed to a maximum height of approximately 20 m above the natural ground surface.

2.8 PROCESS WASTE MATERIALS MANAGEMENT

Process waste materials consist of coarse rejects, sand residues and MSP process waste.

Overburden would be used to construct a series of walls and cells behind the ore extraction areas for placement of process wastes (Figure 2-11).

A description of the management of the process waste materials is provided in this section.

2.8.1 Coarse Rejects

Quantities and Management Strategy

Coarse reject material (greater than 3 mm) from the mineral sands ore would be screened prior to reporting to the surge bin and subsequent concentration circuits at the primary gravity concentration units.

Only minor quantities of coarse rejects would be produced over the life of the Project, and would be combined with sand residues in the reject bin for disposal (Section 2.8.2).

2.8.2 Sand Residues

Quantities and Management Strategy

Sand residues (including clays comprising approximately 2 to 3% very fine particle content) from the mineral sands ore are separated by the gravity separation circuits at the primary gravity concentration units.

Approximately 102.5 Mt of sand residues (including minor quantities of coarse rejects) would be produced over the life of the Project (Table 2-2).

Sand residues (and coarse rejects) would be pumped from the reject bin at the primary gravity concentration units to either the process waste emplacement cells behind the advancing ore extraction area (Section 2.7.3) or in off-path sand residue dams.

Off-path sand residue dams would be constructed adjacent to the mine paths to contain sand residues (and coarse rejects) that cannot be placed behind the advancing ore extraction area (e.g. during initial development of the Atlas and Campaspe deposits).

The embankments of the off-path sand residue dams would be constructed with run-of-mine (ROM) overburden materials and lined with clay to minimise water losses (Figure 2-13).

The sand residues (and coarse rejects) in the process waste emplacement cells and the off-path sand residue dams would be covered with a minimum 1 m of overburden and 0.4 m of soil for rehabilitation purposes.

2.8.3 MSP Process Wastes

Waste Characterisation and Classification

As discussed in Section 2.2, and similar to Ginkgo and Snapper Mines, the Atlas and Campaspe mineral sands deposits both occur within the Loxton-Parilla Sands host unit in the Murray-Darling basin. Therefore, the MSP process waste produced by the Project is expected to have similar physical and chemical properties to the MSP process wastes currently produced from the Ginkgo and Snapper Mines.

MSP process wastes currently produced comprise silica, quartz, monazite[11], silicate minerals and ash waste by-products[12] and combined are classified as "**hazardous waste**" (Bemax, 2008).

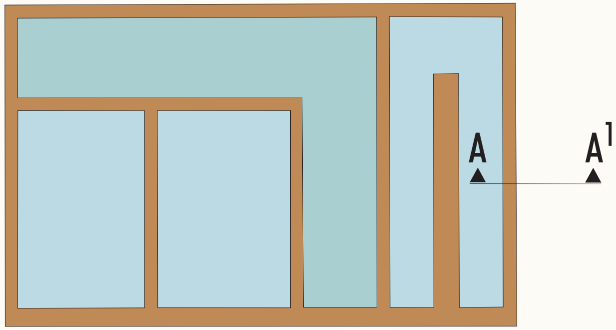
Based on the results of a pilot plant study and metallurgical analysis conducted for the Project, the MSP process wastes have also been characterised and classified in a Mineral Concentrate and Process Waste Materials Assessment (Appendix L) prepared by Radiation Advice & Solutions (2012).

A summary of the assessment findings is provided below:

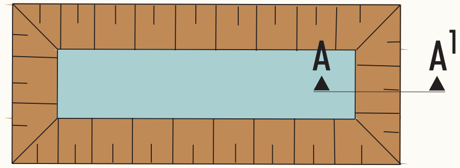
- The Atlas and Campaspe deposits contain very low levels of monazite, which is insufficient to warrant its commercial recovery.
- Monazite would concentrate in the MSP process waste streams along with other minerals that have similar specific gravities, magnetic and conductivity properties.
- The specific activity for the MSP process waste produced from the Atlas-Campaspe Mine would be approximately 335 becquerels per gram (Bq/g).
- When combined with other process waste streams (e.g. sand residues and coarse rejects) at the Atlas-Campaspe Mine, the blended process waste produced by the Project would have a specific activity of approximately 2.5 Bq/g.

[11] Monazite contains cerium, lanthanum and neodymium and is a source of the radioactive element thorium (Bemax, 2007b).

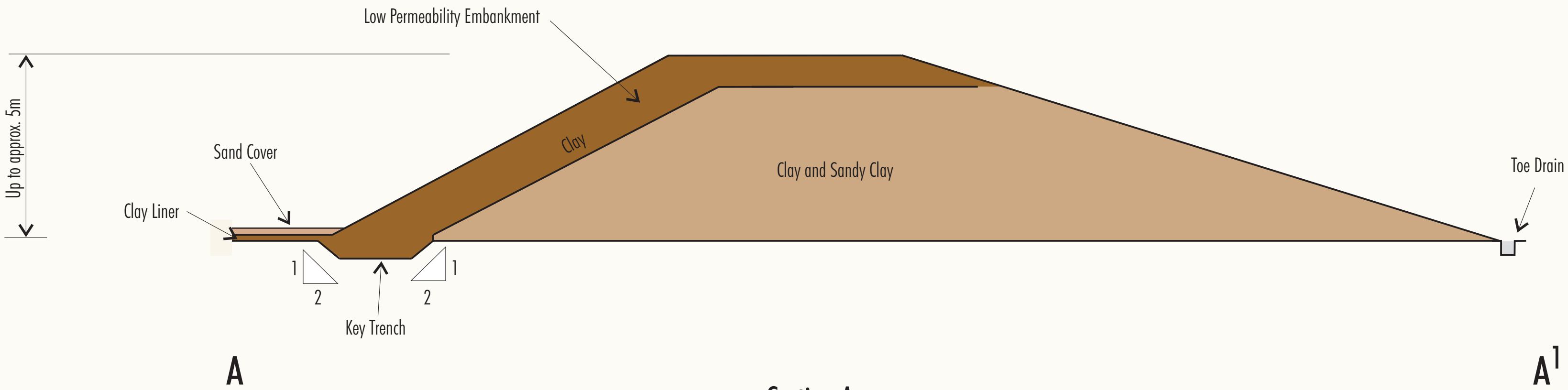
[12] Ash waste by-products are produced by the combustion of coal at the MSP.



Off-Path Sand Residue Dam



Process Water Storage



Section A

Conceptual Off-Path Sand Residue Dam / Process Water Storage

Not to Scale

Source: Bemax (2012)

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FIGURE 2-13

Conceptual Design of Off-Path Sand Residue Dams and Process Water Storage Embankments

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Radiation Advice & Solutions (2012) concluded that:

- The MSP process waste from the Project would likely be classified as "**hazardous**" in accordance with the *Waste Classification Guidelines Part 3: Waste Containing Radioactive Material* (DECC, 2008b).
- The MSP process waste from the Project would likely be classified as a "**radioactive substance**" under the NSW *Radiation Control Act, 1990*.

The blended process waste would likely be classified as "**restricted solid waste**" in accordance with the *Waste Classification Guidelines Part 3: Waste Containing Radioactive Material* (DECC, 2008b).

Quantities and Management Strategy

Up to approximately 50,000 tpa of MSP process waste would be produced by the Project and require disposal. The additional MSP process wastes produced by the Project would be combined with the existing/approved MSP process wastes produced from the Ginkgo and Snapper Mines (Figure 2-1) and continue to be transported to the Ginkgo and Snapper Mines in accordance with existing/approved operations (Section 2.1) up until cessation of those operations (approximately Year 12 of the Project).

From approximately Year 12 of the Project, MSP process waste containers (transported via the Orange – Broken Hill railway) would be unloaded from trains at the Ivanhoe Rail Facility, and temporarily held (i.e. less than a day) in a designated area prior to loading onto haulage vehicles for the return trip to Atlas-Campaspe Mine (Figure 1-1). It is expected that approximately one truck per day would return from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine with MSP process waste.

MSP process waste would be transported via road in sealed storage containers from the Ivanhoe Rail Facility to the Atlas-Campaspe Mine for subsequent unloading, short-term stockpiling and placement behind the advancing ore extraction areas.

The MSP process waste would be transported in accordance with the *Code of Practice for the Safe Transport of Radioactive Material* (Australian Radiation Protection and Nuclear Safety Agency [ARPANSA], 2008), similar to the Snapper and Ginkgo Mines. In the unlikely event of a spill, the spill would be managed in accordance with the Pollution Incident Response Management Plan.

The contracting transport company drivers would be licensed to transport radioactive material. In addition, truck drivers would be required to undergo a site induction prior to commencing their employment and would be briefed upon company protocols for the transport of radioactive material.

Cristal Mining site emergency response personnel would have a Certificate III in Mine Emergency Response which would include HAZMAT training.

At the Atlas-Campaspe Mine, MSP process waste would be unloaded from storage containers and placed in a designated hopper (MORT), mixed with waste water from the salt washing facility, then transported to the primary gravity concentration unit via a slurry pipe, where it would be combined in the reject bin with sand residues and coarse rejects (Figure 2-12). Intermittently, MSP process waste may need to be held in short-term designated stockpiles at the Atlas-Campaspe Mine.

The combined sand residues, coarse rejects and MSP process waste slurry would then be pumped and deposited in the process waste emplacement cells. Blended MSP process waste would be:

- placed above the groundwater table;
- placed no closer than 10 m from the natural ground surface; and
- covered under a minimum of 10 m of overburden and soil, such that the radiation level at the surface of the rehabilitated process waste emplacement cells would be equivalent to the natural background radiation level.

No MSP process wastes would be placed in off-path sand residue dams at the Atlas-Campaspe Mine.

2.9 WATER MANAGEMENT

2.9.1 Mine Water Management System

Figure 2-12 provides a schematic for the Atlas-Campaspe Mine water management system.

A description of the on-site water management system is provided in the Hydrogeological and Water Supply Assessment (Appendix F) prepared by GEO-ENG (2013) and Surface Water Assessment (Appendix G) prepared by Evans & Peck (2012).

The objectives of on-site water management throughout the Project life would be to:

- maintain separation between runoff from areas undisturbed by mining and water generated within active mining areas;
- collect and preferentially re-use surface water runoff from disturbed areas for dust suppression or processing make-up requirements (when available);
- capture and contain on-site any potentially contaminated mine site water; and
- provide a reliable source of water to meet Project requirements.

To meet these objectives, the water management system would be developed progressively over the life of the Project. The progressive development of the mine water management system is described in Appendices F and G.

A predictive assessment of the performance of the mine water management system (i.e. reliability of water supply) is presented in Appendix F.

The post-mining water management strategy would incorporate some aspects of the operational mine water management system and is described further in Section 5.

Up-catchment Runoff Control

Both temporary and permanent up-catchment diversion bunds/drains would be constructed over the life of the Project to divert runoff from undisturbed areas around the mine path, overburden emplacements, soil stockpiles, off-path sand residue dams, process water storages and other fixed infrastructure areas.

The design capacity of up-catchment diversion works would depend on the size of the catchment, the design life of the up-catchment diversion and the potential consequences of a breach.

Up-catchment diversions would be designed to be stable (non-eroding) at the design flows. Stabilisation of the upslope diversion works would be achieved by design of appropriate channel cross-sections and gradients and the use of channel lining with grass or rock fill.

Sedimentation Control

Drainage from disturbance areas within the Atlas-Campaspe Mine footprint would be directed to the evaporation/sediment sumps for containment.

Evaporation/sediment sumps would be designed, constructed and operated in accordance with the relevant requirements of *Managing Urban Stormwater: Soils & Construction* (DECC, 2008a).

Waters collected in evaporation/sediment sumps would be utilised for dust suppression at the mine site or allowed to evaporate.

Off-Path Sand Residue Dams

As described in Section 2.4.9, a number of off-path sand residue dams would be constructed adjacent the mine path over the life of the Project.

The off-path sand residue dams would be designed and constructed with consideration of the outcomes of geotechnical studies conducted during detailed mine planning and in accordance with the requirements of the Dam Safety Committee.

To minimise the potential for seepage from the sand residue dams, the following seepage control measures would be implemented:

- Compaction of a clay liner in the base of the dam and coverage with clean sand material (track rolled) to prevent cracking or drying out of the liner prior to deposition of sand residues.
- Construction and compaction (to optimise the permeability outcome) of a low permeability embankment with clay, sandy clay, gravely clay and selected stockpiled material and placement in layers (Figure 2-13).
- Construction of a toe drain/trench on the downstream face of the embankment to collect runoff and/or seepage.

The off-path sand residue dams would be inspected periodically during operations by an appropriately qualified and experienced geotechnical engineer.

In addition to storage of sand residues, the off-path sand residue dams would be used to facilitate the settling and removal of fines material from the process water. The off-path sand residue dams would be constructed with compartment cells which would be used on a rotational basis to allow for continual treatment (including flocculant addition to enhance particle coagulation and minimise settling times) and filled with process water to a depth of up to approximately 3 m.

Process Water Storages

As described in Section 2.4.9, a number of process water storages would be constructed adjacent the mine path over the life of the Project. The process water storages would be used to manage and buffer process water supply. Similar seepage control measures to those proposed for off-path residue dams would be implemented.

Process water storages would also be constructed within the mine path behind the advancing mining operation for the settling and removal of fines material from the process water. The number of process water storages required would be dependent on the volumes and settling properties of the fines material in the process water encountered during mining.

Water Disposal Dams

As described in Section 2.2, it would be necessary at times during mining to dewater the mine path where the orebody lies below the groundwater table. If during the life of the Project, the water balance indicates that excess water would be derived above the requirement for processing and the volumes of process water storages, then a water disposal dam (within the mine path) would be constructed. The concept of the water disposal dam is shown in Figure 2-14. On completion of mining, and once the dam has been drained, it would be decommissioned and rehabilitated.

2.9.2 Mine Water Consumption

Processing Supply

The processing make-up water demand rate is related directly to the rate of slurry feed to the primary gravity concentration units. Based on a feed slurry of 45% solids, approximately 170 L/s is required for the slurry feed during mining of the Atlas deposit, and up to 340 L/s during mining of the Campaspe deposit (Appendix F). Accounting for re-use of process water, the make-up water demand from the groundwater borefield has been determined as part of the site water balance (Section 2.9.5).

RO Plant

The RO plant would supply desalinised process water requirements. The RO plant would produce approximately 20 L/s of desalinated water for the salt washing facility and WHIMS circuit.

Brine from the RO plant would be disposed with process wastes behind the advancing mining operations. Wastewater from the salt washing facility would be piped to the reject water pond for process water re-use.

Dust Suppression and Road Maintenance Works

Project haul road dust suppression and road maintenance works demand was based on experience at the Ginkgo and Snapper Mines to be approximately 5 to 10 L/s (Appendix F).

2.9.3 Groundwater Borefield

As described in Section 2.4.3, the groundwater borefield would be expanded progressively (e.g. installation of additional production bores) to supply the DMUs, primary gravity concentration units and HMC treatment facility.

At full development, up to approximately 13 production bores would be installed with each operated to produce up to approximately 50 L/s (Appendix F). The total number of bores in use would vary over the life of the Project and would be dependent on the yield of each individual production bore. Where dewatering systems (e.g. bores, spearfields and trenches) are installed, they would reduce the requirements for water supply from the production bores.

Water extracted from the borefield would be reticulated by pump and pipeline systems via services corridors to the DMUs, primary gravity concentration units, HMC treatment facility and RO plant.

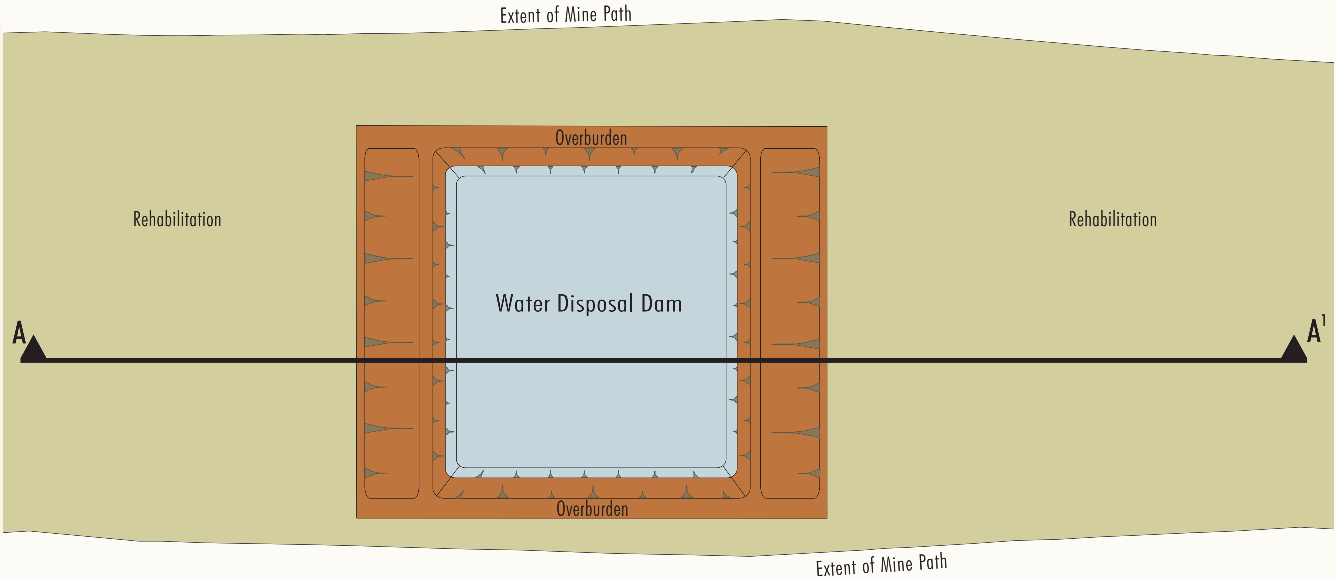
Licensing of groundwater extracted from the borefield is assessed and discussed in Sections 4.4.4 (Table 4-3) and 6.4.1 and Attachment 5.

2.9.4 Mine Dewatering

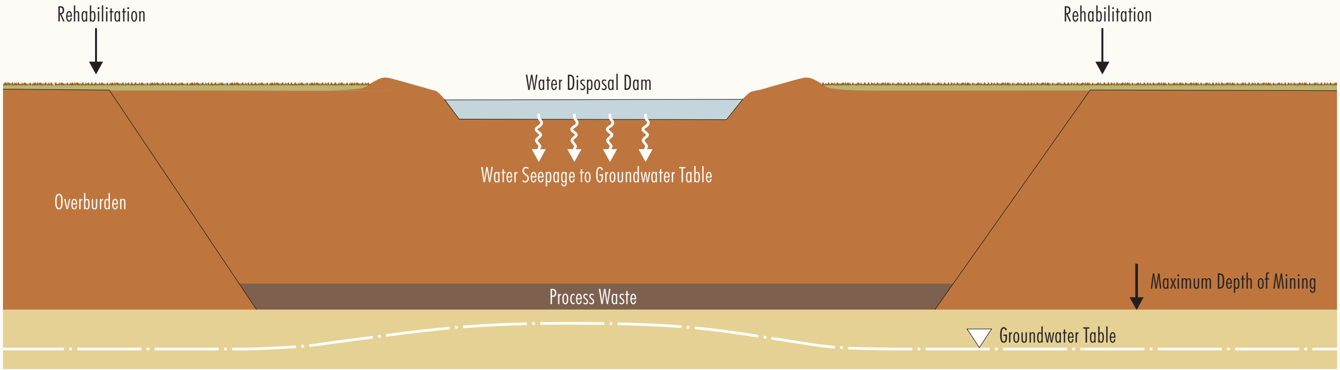
Water captured in the ore extraction areas comprising incident rainfall and runoff and infiltration from active mining areas (and groundwater inflows), would be allowed to settle in an in-pit collection sump for dewatering and re-use by pumping to process water storages.

As described in Section 2.4.3, localised dewatering systems (including bores, spearfields and trenches) would also be used to dewater the orebody where it lies below the groundwater table.

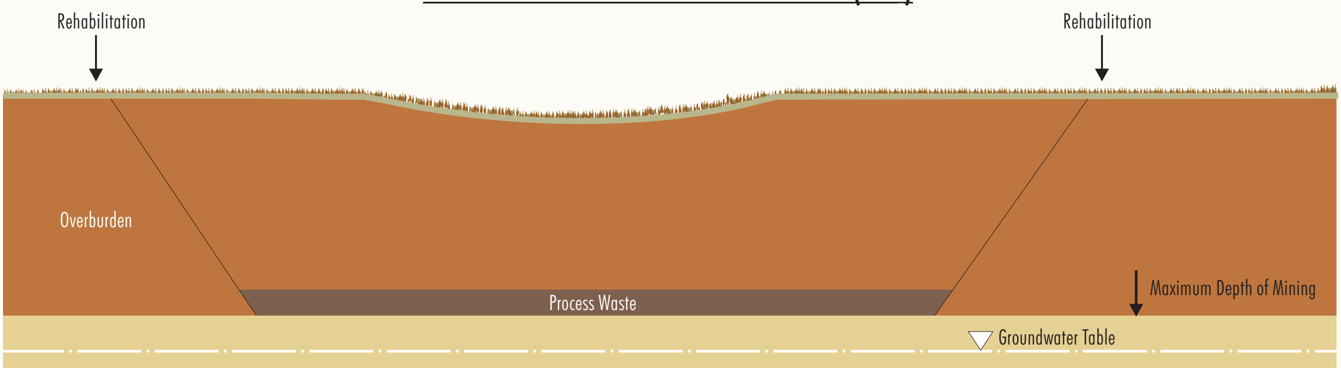
WATER DISPOSAL DAM - PLAN VIEW



WATER DISPOSAL DAM - CONCEPTUAL PROFILE (A-A1)



REHABILITATION - CONCEPTUAL PROFILE (A-A1)



Not to Scale

Source: Bemax (2012)

ATLAS - CAMPASPE PROJECT

FIGURE 2-14

Conceptual Water Disposal Dam

Resource Strategies

CRISTAL

BMX-11-25 EIS Sect2_006E

Licensing of groundwater extracted via mine dewatering for the Project is assessed and discussed in Sections 4.4.4 (Table 4-3) and 6.4.1 and Attachment 5.

2.9.5 Simulated Performance of the Water Management System (Water Supply Reliability)

A site water balance prepared by GEO-ENG as a component of the Hydrogeological and Water Supply Assessment (Appendix F) has been used to determine the performance of the water management system (i.e. water supply reliability).

The site water balance considered the following inputs and outputs to the water management system:

- water required for the DMUs (for slurry);
- water retained in the process wastes (i.e. sand residues including clays);
- water seepage (to groundwater table);
- water consumed in the HMC treatment facility including RO plant feed and moisture transported off-site in mineral concentrate;
- dust suppression and road maintenance works; and
- water gained from the direct rainfall and lost to evaporation.

Based on results of the site water balance, the water supply requirement from the groundwater borefield would be up to approximately 115 L/s during mining of the Atlas deposit and up to approximately 180 L/s during mining of the Campaspe deposit (Appendix F).

Given the conservative nature of the site water balance, the assessment indicates a very low operational risk of water supply deficit over the life of the Project (Appendix F).

2.9.6 Final Voids

At the cessation of mining, a final void would remain at the north-western extent of both the Atlas and Campaspe footprints (Section 5.3.2). The final voids would be partially backfilled with overburden material pushed down from the void batters and adjacent overburden replacement areas within the mine path.

The depths of the final voids would remain above the groundwater table (i.e. a permanent water body would not be formed in the void), however, incident rainfall and local surface water runoff following rainfall events would temporarily pond in the void prior to evaporating or infiltrating to the groundwater table. The Atlas and Campaspe final voids would be approximately 10 to 15 m deep and 15 to 20 m deep, respectively.

The surface catchment of the final voids would be reduced to a practicable minimum by maximising backfilling with overburden material pushed down from the void batters and adjacent overburden replacement areas within the mine path and the use of upslope diversions and contour drains around their perimeter.

2.9.7 Mineral Concentrate Transport Route

Sedimentation Control

During roadworks along the mineral concentrate transport route, temporary sedimentation controls (e.g. evaporation/sediment sumps and silt fences) would be installed for sediment containment.

Drainage Controls

Table drains and culverts would be installed as part of the roadworks along the mineral concentrate transport route (Section 2.4.10). The final locations and dimensions of drainage controls would be determined as part of the detailed road design.

2.9.8 Ivanhoe Rail Facility

A description of the Ivanhoe Rail Facility water management system is provided in the Surface Water Assessment (Appendix G) prepared by Evans & Peck (2012).

Sedimentation Control

During construction of the Ivanhoe Rail Facility, temporary sedimentation controls (e.g. evaporation/ sediment sumps and silt fences) would be installed for sediment containment.

Retention Basin

A retention basin (Figure 2-9) would be constructed within the footprint of the proposed Ivanhoe Rail Facility to collect rainfall runoff from hardstand and infrastructure areas during operations.

The retention basin would be designed, constructed and operated in accordance with the relevant requirements of *Managing Urban Stormwater: Soils & Construction* (DECC, 2008a).

Waters collected in the retention basin would be utilised for dust suppression of mineral concentrate stockpiles at the Ivanhoe Rail Facility or allowed to evaporate.

2.10 INFRASTRUCTURE AND SERVICES

2.10.1 Administration/Office Buildings and Car Parking Facilities

Atlas-Campaspe Mine

The administration/office buildings would be located at the entry to the Atlas-Campaspe Mine (Figure 2-3). Buildings would be pre-fabricated and of demountable design for removal following cessation of mining operations.

A car park for employees and visitors would be provided adjacent the buildings. Parking facilities would be constructed to meet the requirements of the BSC.

Ivanhoe Rail Facility

The site office would be located upon entry to the Ivanhoe Rail Facility, adjacent to the site access road (Figure 2-9). The office building would be prefabricated and of demountable design for removal following cessation of operations.

A car park for employees and visitors would be provided adjacent the buildings. Parking facilities would be constructed to meet the requirements of the CDSC.

2.10.2 Workshop and Stores

Atlas-Campaspe Mine

Workshop and stores would be located at the Atlas-Campaspe Mine during the Project and would provide for servicing of mobile equipment, DMU and primary gravity concentration unit components and storage of hydrocarbons and other consumables.

The buildings would be steel framed, metal clad and the maintenance offices would be air-conditioned.

2.10.3 Site Access Road and Internal Access Roads

Atlas-Campaspe Mine

As described in Section 2.4.1, access to the Atlas-Campaspe Mine would be via a site access road off Link Road.

Internal access roads would be progressively constructed as the mining operations advance. The use of internal access roads would be restricted to mine personnel.

As described in Section 2.9.2, water would be used for dust suppression purposes. Dust from internal haul roads within the active mining area and site access road (i.e. with high dust generation potential) would be suppressed by routinely spraying water sourced from the groundwater supply borefield (i.e. naturally saline) or from sumps which collect mine runoff water at the Atlas-Campaspe Mine.

In addition, as part of ongoing road maintenance works (i.e. for road conditioning and safety purposes), saline water would be applied as required to the internal access roads at the Atlas-Campaspe Mine.

Roadworks along Mineral Concentrate Transport Route

As part of ongoing road maintenance works (i.e. for road conditioning and safety purposes) saline water would be applied as required to the unsealed sections of the mineral concentrate transport route following completion of the roadworks (i.e. in the order of once a week).

Ivanhoe Rail Facility

As described in Section 2.4.1, access to the Ivanhoe Rail Facility would be via a site access road off Balranald-Ivanhoe Road. Access to the Ivanhoe Rail Facility would be restricted to authorised personnel only.

2.10.4 Electricity Supply and Distribution

Atlas-Campaspe Mine

Electricity at the Atlas-Campaspe Mine would be supplied by four 1,000 kVA diesel generator sets. The estimated diesel consumption to meet the maximum Project electricity supply requirements would be up to approximately 6.7 megalitres per annum (ML/annum).

An electricity distribution station would be located at the Atlas-Campaspe Mine (Figure 2-4). Power would be reticulated at 22 kV. A relocatable step-down substation would then be located adjacent to the active mining area as mining advances.

Power would be transferred from the on-site diesel-powered electricity generators either by overhead or underground cable where necessary. Standard electrical safety laws and practices (including vehicle clearance considerations) would apply.

Ivanhoe Rail Facility

Electricity at the Ivanhoe Rail Facility would be supplied by the local network. An extension to the existing 11 kV powerline would be constructed along the easement for site access and powerline (Figure 2-9).

2.10.5 Site Security

Access to the Atlas-Campaspe Mine and Ivanhoe Rail Facility would be restricted to authorised personnel only to maintain public safety and site security.

All visitors would be required to report to the administration/office buildings upon entry on-site.

2.10.6 Potable Water

Atlas-Campaspe Mine

Potable water would be supplied by the RO Plant (<1 L/s) and reticulated via pipeline to the administration/office buildings (including ablutions) and accommodation camp at the Atlas-Campaspe Mine.

Ivanhoe Rail Facility

Potable water would be provided from either the Ivanhoe town water supply or the Atlas-Campaspe Mine water supply and delivered by truck for use at the site office buildings.

2.11 MANAGEMENT OF DANGEROUS GOODS

The transportation, handling and storage of all dangerous goods at the Project would be conducted in accordance with the requirements of the *Storage and Handling of Dangerous Goods – Code of Practice 2005* (WorkCover, 2005).

Transport

Consistent with existing Cristal Mining operations in the region, dangerous goods required for the Project would be transported in accordance with the appropriate State legislation.

Dangerous goods required for the Project would be transported in accordance with the appropriate regulations under the NSW *Dangerous Goods (Road and Rail Transport) Act, 2008.* These regulations apply the *Australian Code for the Transport of Dangerous Goods by Road and Rail* (ADG Code) approved by the Australian Transport Council, as amended from time to time (National Transport Commission, 2007).

Hydrocarbon Storage

Hydrocarbons used for the Project at the Atlas-Campaspe Mine would include fuels (e.g. diesel and petrol) and other workshop lubricants (e.g. oils, greases, degreaser and kerosene). Minor quantities of hydrocarbons would also be stored and used at the Ivanhoe Rail Facility.

Two 60,000 litre (L) capacity diesel storage tanks would be located at the Atlas-Campaspe Mine adjacent the mineral concentrate stockpiles. A 1,000 L diesel storage tank would also be located at the Ivanhoe Rail Facility. Workshop lubricants would be stored within bunded areas.

Construction of hydrocarbon storage facilities would be undertaken in accordance with Australian Standard (AS) 1940:2004 *The Storage and Handling of Flammable and Combustible Liquids* and the *Operational Health and Safety Act, 2000*.

Hydrocarbon storage facilities would be operated in accordance with the requirements of AS 1940:2004.

On-site petrol usage at Atlas-Campaspe Mine would be minor (i.e. 1,000 L petrol storage tank) with the majority of petrol engine vehicles fuelled off-site at local service stations.

Procedures would be developed for the handling, storage, containment and disposal of workshop hydrocarbons (i.e. oils, greases, degreaser and kerosene) for the Project.

Waste hydrocarbons would be collected, stored and removed by licensed contractors on a periodic basis.

Bunding and spill management for the Project would be implemented in consideration of the relevant EPA guidelines to manage environmental risks associated with the storage and handling of liquid substances, including:

- *Storing and Handling Liquids: Environmental Protection – Participant's Manual* (DECC, 2007a); and

- *Environmental Compliance Report: Liquid Chemical Storage, Handling and Spill Management – Part B Review of Best Practice and Regulation* (NSW Department of Environment and Conservation [DEC], 2005a).

Spill kits would be maintained on-site at the Atlas-Campaspe Mine and Ivanhoe Rail Facility.

Other Consumables

Due to the nature of the mineral sands mining operation (i.e. no blasting or explosives required) and processing (i.e. very limited chemical requirements for water treatment and minerals separation), only minor quantities of other consumables would be required for the Project.

The management and storage of chemicals (including separation according to chemical type) would be conducted in accordance with the relevant Australian Standards and codes.

Material Safety Data Sheets and Inventory Registers

No chemicals or hazardous material would be permitted on-site at the Atlas-Campaspe Mine or Ivanhoe Rail Facility unless a copy of the appropriate Material Safety Data Sheet (MSDS) is available on-site or, in the case of a new product, it is accompanied by an MSDS.

All chemicals would be recorded in inventory registers which would identify the type of product, dangerous goods class, liquid class, hazchem class and the quantity held on-site at the Atlas-Campaspe Mine and Ivanhoe Rail Facility. The inventory registers would also identify the compatibility of materials and the emergency response procedures in the event of a spill.

2.12 WASTE MANAGEMENT

The Project would generate waste streams that would be similar in nature to the existing Cristal Mining operations at the Ginkgo and Snapper Mines. The key waste streams would comprise:

- overburden from active mining areas (as described in Section 2.7);
- sand residues (including a small proportion of clays) and coarse reject materials from on-site processing (as described in Sections 2.8.1 and 2.8.2);
- MSP process waste (as described in Section 2.8.3);
- brine from the RO Plant (as described in Section 2.9.2);
- recyclable and non-recyclable general wastes from the Atlas-Campaspe Mine and Ivanhoe Rail Facility;
- sewage and wastewater from on-site ablution facilities; and
- other wastes from mining and workshop related activities (e.g. used tyres, scrap metal, waste hydrocarbons and oil filters).

General waste minimisation principles (i.e. reduce, re-use and recycle) would be applied for the Project. Where waste cannot be recycled, it would be treated and disposed of as described further below. Recycling facilities would be available at the Atlas-Campaspe Mine and Ivanhoe Rail Facility. Site inductions would be used to inform employees of the relevant recycling and waste management for the Project.

All general domestic waste (e.g. general solid [putrescibles] waste and general solid [non-putrescible] waste as defined in *Waste Classification Guidelines Part 1: Classifying Waste* [DECC, 2008c]) and general recyclable products would be collected from the Atlas-Campaspe Mine and Ivanhoe Rail Facility by an appropriately licensed contractor. Grease trap waste is disposed on-site in accordance with *Environmental Guidelines: Composting and Related Organics Processing Facilities* (DEC, 2004a).

A register of waste collected by contractors would be maintained. Where licensed contractors handle waste, those contractors would be required to comply with their own licence agreements with the EPA. Waste would be disposed of at an EPA approved waste facility that is licensed under the NSW *Protection of the Environment Operations Act, 1997* (PoEO Act). This could include licensed landfills within the BSC and/or CDSC LGAs. Where this is the case, an agreement would be entered into for the disposal of landfill.

Waste tyres would be stockpiled (and/or re-used as delineators on-site), prior to collection by contractors and removal from site.

Scrap metal produced at the workshops during the life of the Project would be collected by a scrap metal merchant for recycling.

Sewage and wastewater from on-site ablution facilities would be treated in an on-site sewage treatment plant at the Atlas-Campaspe Mine. The sewage treatment plant would be designed and installed in accordance with the requirements of the EPA and BSC. Treated water would be irrigated on vegetated and garden areas around office facilities and would conform to the *Environmental Guideline for the Utilisation of Treated Effluent* (DEC, 2004b). The sewage treatment plant would be operated in accordance with the *National Water Quality Management Strategy: Guidelines for Sewerage Systems – Effluent Management* and the *National Water Quality Management Strategy: Guidelines for Sewerage Systems – Use of Reclaimed Water*. The sewage treatment plant would be serviced by a licensed waste disposal contractor on an as-needs basis and managed in accordance with the relevant waste-related guidelines including *Environmental Guidelines: Use and Disposal of Biosolids Products* (EPA, 2000a); and/or *Environmental Guidelines: Solid Waste Landfills* (EPA, 1996).

Sewage and waste water from on-site ablution facilities at the Ivanhoe Rail Facility would be directed to an on-site septic system and serviced by a licensed waste disposal contractor on an as-needs basis. The on-site septic system would be designed and installed in accordance with the requirements of the CDSC.

Waste hydrocarbons and oil filters would be collected, stored and removed by licensed contractors. Workshop hydrocarbon spills and leaks, and truck washdown areas would be contained by purpose-built oil/water separator systems which would be inspected and maintained regularly.

2.13 WORKFORCE

2.13.1 Construction

As described in Section 2.4, initial construction activities would be associated with the development of the Atlas footprint and supporting infrastructure at the Atlas-Campaspe Mine and construction of the Ivanhoe Rail Facility. It is expected that construction activities would peak during Year 1 of the Project, requiring a short-term peak construction workforce of up to 300 people (total)[13] for approximately 2 to 3 months, but averaging at approximately 150 people during the initial construction phase. Construction works associated with roadworks along the proposed mineral concentrate transport route would also be undertaken during this time.

Construction activities associated with the initial development of the Campaspe footprint at the Atlas-Campaspe Mine would also be required during the life of the Project (approximately Year 5), and would require a short-term construction workforce averaging approximately 100 people. Construction would be undertaken up to 24 hours per day, seven days per week. Employees would generally work 12 hour shifts, starting at 7.00 am or 7.00 pm.

The majority of the construction workforce would utilise the proposed accommodation camp at the Atlas-Campaspe Mine (Section 2.4.2).

A proportion of the construction workforce would include personnel that would go on to form part of the operational workforce for the Project.

2.13.2 Operations

At full development, the proposed Project operational workforce would be approximately 200 people, including a mixture of direct Cristal Mining employees and contractors.

The Project would operate 24 hours per day, seven days per week. Employees would generally work 12 hour shifts, starting at 7.00 am or 7.00 pm.

[13] Including approximately 10 people required for construction of the Ivanhoe Rail Facility. Construction activities associated with Ivanhoe Rail Facility would generally be restricted to daylight hours (i.e. 7.00 am to 6.00 pm).