Appendix G

Infrastructure and mine options report

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HUNTER VALLEY OPERATIONS

Hunter Valley Operations Continuation Project Mine Plan Options Report

Report prepared:

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1. Project Objective

The project objective was to design the Project to create an economically viable mine plan whilst avoiding and minimising where reasonable and feasible impacts on the environment and community.

2. Executive Summary

Hunter Valley Operations (HVO) is a multi-pit open cut coal mining complex, comprising two mine sites separated by the Hunter River, HVO North and HVO South. HVO is approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW) (refer to Figure 1). While the two mine sites are approved under separate development consents, they are operated as one complex with fully integrated environmental management systems.

Operations first commenced at HVO over 70 years ago, and since then has been producing high quality thermal and semi-soft coking coal suitable for use in domestic and international markets. HVO extracts coal from the Whittingham Coal Measures of the Hunter Coalfield, which is part of the Permian coal basin known as the Sydney basin.

The HVO Continuation Project (the Project) seeks to extend the life of both HVO North and HVO South, to the end of 2050 and 2045 respectively through the mining of an additional approximate 400 million tonnes (Mt) of run of mine (ROM) coal. The Project proposes no increase in annual production volumes or increase in height of overburden emplacement from current approvals, and mines predominately through areas previously disturbed.

This report presents key mine design options considered in development of the Project and discusses the assessment outcomes for each that have been used to inform the proposed mine plan and corresponding conceptual final landform with respect to the Project objectives.

The various mine plan and final landform options were assessed with a view of achieving a balance between optimal resource recovery and financial return and reducing environmental and social impacts through the implementation of appropriate mitigation measures.

Technical aspects that required consideration during mine plan development included:

- Location of current and former open cut and underground workings
- Geotechnical and geological considerations including interaction and influence of regional and localised geological structures
- A deposit featuring many thin coal plies and working sections of varying coal quality
- The volume of recoverable coal underlying the volume of overburden (strip ratio); and
- Health, safety, and legislative requirements.

The outcome of these studies was the selection of the Preferred Mine Plan that is proposed and has been assessed in the Project Environmental Impact Statement (EIS). The Preferred Mine Plan has also been further refined throughout the impact assessment process through consideration of cultural heritage areas and to reduce where practicable air quality and noise impacts on sensitive receptors.

Alternative mine plan options considered during, but not proposed, in the development of the Preferred Mine Plan included:

- No Project – mining ends as per HVO North consent (12 June 2025)
- Maximise resource recovery - mining in several additional locations around and in addition to the Preferred Mine Plan
- No final void remaining at end of Preferred Mine Plan
- Impacting the CM-CD1 heritage site,
- Excluding the existing Lemington Road from the mining footprint; and
- Underground extraction of target seams.

A summary of the outcomes of the mine plan options assessment with regard to economic viability, technical considerations, and management of environmental and social impacts is provided in Table 1.

In addition to the key considerations above, the final landform and final void options investigated for the Preferred Mine Plan have had regard to:

- Surrounding constraints such as topography and property boundaries
- Availability of material post mining for use in rehabilitation activities
- Long term stability and safety; and
- Visual considerations.

The preferred final landform option incorporates natural landform design elements, with progressive filling of the voids as mining progresses. This design process aligns the Project objectives.

At HVO North this landform includes a single final void at the south-eastern end of the pit, an overall reduction in the number of voids currently approved (three) due to mining continuing beneath the existing Carrington Pit.

At HVO South the existing South Lemington Pit 1 (SLP1) void will be backfilled to a free-draining surface, and the progressive filling of the Cheshunt Pit as mining progresses to the west results in a single void at the western end of the pit, with overall number of voids being maintained as per the current HVO South approval.

The option of backfilling the proposed final voids to achieve a free-draining landform was assessed and was not considered practical or economically viable due to:

- The need to disturb significant areas of established mine rehabilitation in order to access the material needed to fill the final voids and the impacts on biodiversity;
- High costs associated with moving the large volume of material needed to back-fill the final voids to a free-draining surface;
- A prolongation of noise and air quality and GHG impacts well beyond the life of the mining operation - up to 18 years at HVO South and 21 years at HVO North; and
- Delay in final rehabilitation and mine closure.

The Preferred Mine Plan provides:

- A balanced outcome that achieves economic viability whilst managing impacts through the implementation of appropriate mitigation measures;
- Continuation of an existing operation resulting in ongoing employment opportunities and economic benefits to the community and State economy, and enables the efficient use of existing infrastructure; and
- Final voids that will act as long-term groundwater sink avoiding impacts on surrounding water quality.

The Preferred Mine Plan as presented and assessed in the Project EIS best meets Project objectives which achieves a balance between mine planning, economic, environmental, and social outcomes.

Table 1: Summary of Mine Plan Options

Option	Schedule Development	ROM tonnes North / South (Mt) Total in bold	Approximate Mine Life North / South (Yrs)[1]	Project Objectives Analysis: Economically Viable (Provides Financial Return)?	Project Objectives Analysis: Technically Achievable?	Project Objectives Analysis: Reasonable and Manageable Environmental, Cultural and Social Impact?	Project Objectives Analysis: Reasonable and Feasible Mine Plan?	Comments
Option 1: Preferred Mine Plan	Detailed schedule	528 / 208 **737**	28 / 23				Yes	• Preferred Mine Plan provides best balance between mine planning, economic, environmental, and social outcomes. • Endorsed for EIS mine plan proposed.
Option 2: No Project ie continue mining as per approved operations until the end of HVO North consent.	Detailed schedule	31 / 22 **52**	2.5 / 2.5				No	• If no Project, then economic benefit of the Project will be lost. • Schedule for this option assumes that HVO South ceases operations when mining operations at HVO North finish on 12 June 2025 as CPP facilities cease approval for use at that time. • Aligns to EIS Economic Assessment base case.
Option 3: Maximise resource recovery **Preferred Mine Plan +**	Detailed schedule	528 / 208 **737**+						• Includes Project coal tonnage plus additional coal tonnage considered but currently excluded from the Project due to various constraints. These constraints include (options 3a – 3f):
• **Option 3a: Northwest of Mitchell Pit**	Qualitative on areas not scheduled	19 / 0	NA				No	• Geotechnical (faulting), accessibility (timing), noise impacts on Jerrys Plains, existing 330 kV transmission lines.
• **Option 3b: Carrington southeast extension**	Qualitative on areas not scheduled	151/ 0	NA				No	• Mine life duration constrained to 2050 to align with Strategic statement on coal exploration and mining in NSW (State of NSW 2020) – this area has further opportunities for development.
• **Option 3c: Option 3b + Alluvium & North Pit Tailings Storage Facility (TSF) impact**	Qualitative on areas not scheduled	215 / 0	NA				No	• Hunter River alluvium, standoff from North Pit TSF, surface water management, insufficient space to construct flood protection levee.
• **Option 3d: Carrington West Wing residual**	Qualitative on areas not scheduled	3 / 0	NA				No	• Geotechnical (faulting) and surface water considerations (Mitchell clean water diversion).
• **Option 3e: CM-CD1 pillar**	Qualitative on areas not scheduled	21/ 0	NA				No	• Aboriginal cultural heritage site CM-CD1. • The ROM tonnage for this option is only the coal excluded from mining that is directly beneath the CM-CD1 site and

Option	Schedule Development	ROM tonnes North / South (Mt) Total in bold	Approximate Mine Life North / South (Yrs)[1]	Project Objectives Analysis: Economically Viable (Provides Financial Return)?	Technically Achievable?	Reasonable and Manageable Environmental, Cultural and Social Impact?	Reasonable and Feasible Mine Plan?	Comments
								associated offset areas, which would otherwise be mined if CM-CD1 impact was not being avoided.
• **Option 3f: SLP1, SLP2 and Riverview SE Extension**	Qualitative on areas not scheduled	0 / 19	NA				No	• Area extensively studied and showed groundwater and ecology sensitivities. • Riverview SE Extension presents land ownership (Hunter Valley Gilding Club and United Wambo Joint Venture (UWJV)) and tenement constraints. The area also overlaps with approved UWJV Golden Highway and transmission line relocations. • EPBC approval difficult for the forecast impacts.
Option 4: Preferred Mine Plan with no final voids	Detailed schedule	528 / 208 **737**	28 + 21 / 23 + 18 (Mine life + closure years)				No	• Economically not viable due to large volume of rehandle. • Prolonged impacts with regards to air and noise by up to 21 years, and additional Scope 1 GHG emissions with extension of mining required to rehandle material. • Delayed mine site rehabilitation and closure to after 2071 with significant economic penalty.
Option 5: Impacting CM-CD1	Detailed schedule	533 / 208 **741**	28 / 23				No	• Unacceptable impacts to CM-CD1 based on further studies and significance.
Option 6: Existing Lemington Road exclusion	Scheduled	502 / 208 **711**	28 / 23				No	• Reduced economic benefit with increased strip ratio. • Added haulage complications to open HVO North southern void and backfill the northern void with potential for increased amenity impact such as increased noise impact at receptors south/southwest of the operation. • Increased impact socially due to ongoing road closures when blasting in proximity to Lemington Rd, and • No upgrade to Lemington Rd and Hunter River bridge providing no ongoing benefit to local community.
Option 7: Underground mining extraction	Qualitative on area not scheduled	**<100**	No schedules generated				No	• Significantly reduced resource recovery for high capital expenditure.

Legend: Key consideration met; Key consideration partially met; Key consideration not met

[1] Mine life assumes Year 1 is 2023

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3. Introduction

3.1 Scope

This report has been prepared to satisfy the Planning Secretary's Environment Assessment Requirements (SEARs) for SSD 11826681 and 11826621 issued 11 March 2021. The SEARs request that:

- *an analysis of final landform options, including the short and long-term cost and benefits, constraints and opportunities of each, and detailed justification for the preferred option*

Specifically the report also has regards to the Resource Regulator Advice dated 20 January 2021 which requests:

- *Where a void is proposed to remain as part of the final landform, include: (i) a constraints and opportunities analysis of final void options, including backfilling, to justify that the proposed design is the most feasible and environmentally sustainable option to minimise the sterilisation of land post-mining.*

This report has also been prepared in accordance with NSW Department of Planning and Environment (DPE) State significant development guidelines – preparing an environmental impact statement (July 2021). These guidelines state:

- *… include an analysis of feasible alternatives considered having regard to the objectives of the development, including the consequences of not carrying out the development17. The analysis of alternatives should explain how the project has ended up in its current form, summarising the key alternatives that have been considered and rejected (e.g. alternative ways of achieving the objectives of the development; and alternative sites, designs, mitigation measures) and the reasons why they were rejected*

3.2 Background

Hunter Valley Operations (HVO) is a multi-pit open cut coal mining complex, comprising two mine sites separated by the Hunter River, HVO North and HVO South. HVO is approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW) (refer to Figure 1). While the two mine sites are approved under separate development consents, they are operated as one complex with fully integrated environmental management systems.

Operations first commenced at HVO over 70 years ago, and since then has been producing high quality thermal and semi-soft coking coal suitable for use in domestic and international markets. HVO extracts coal from the Whittingham Coal Measures of the Hunter Coalfield, which is part of the Permian coal basin known as the Sydney basin.

HVO North, currently approved for a cumulative extraction of up to 22 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until 12 June 2025, comprises the approved mining areas of West Pit, Mitchell/Wilton Pit, Carrington Pit and North Pit as well as the Hunter Valley (HV) and Howick Coal Preparation Plants (CPP) and the HVO North and Howick mine infrastructure areas (MIA). The Newdell Load Point (LP) and Hunter Valley LP train loading facilities are also at HVO North.

HVO South comprises the approved mining areas of Riverview Pit, Cheshunt Pit, Riverview South East (SE) Extension and South Lemington Pits (SLP) 1 and 2, as well as the HVO South MIA, and the Lemington CPP (LCPP) and rail loop (approved but not constructed), mining at an extraction rate of up to 20 Mtpa of ROM coal until 24 March 2030.

Mining is currently carried out at HVO by conventional large-scale open cut methods using a HVO owned and operated mining fleet, comprising of draglines, face shovels, excavators, and rear-dump trucks of various sizes.

HVO is owned by subsidiary companies of Yancoal and Glencore, as participants in the unincorporated HVO Joint Venture (JV). HV Operations Pty Ltd is the appointed manager of the JV.

The HVO Continuation Project (the Project) seeks to extend the life of both HVO North and HVO South, to the end of 2050 and 2045 respectively through the mining of approximately 740 Mt of ROM coal (from Year 1 of the Project) which includes an additional approximate 400 Mt of ROM coal to that in the currently approved extraction footprint. The Project proposes no increase in annual production volumes or increase in height of overburden emplacement areas from current approvals, and mines predominately through areas previously disturbed.

Key aspects of the Project at HVO North include:

- the continuation of mining to Barrett seam from the current West and Mitchell Pits south-east, beneath the existing Lemington Road and the Carrington Pit mining area
- the realignment of a section of Lemington Road and associated telecommunications and transmission services, in-situ preservation of cultural heritage site CM-CD1, MIA and LP upgrades; and
- additional water management works including enlargement of Parnells Dam and flood mitigation levees.

Key aspects of the Project at HVO South include:

- changes to the currently approved mining sequence with a reduction in maximum extraction rates, from 20 Mtpa to 18 Mtpa, resulting in an extended mine life
- retainment of the current approval to construct Lemington CPP, without the currently approved conveyor and short rail loop options
- the removal of coal extraction from SLP1, SLP2 and Riverview SE extension; and
- additional water management works including enlargement of Lake James and flood mitigation levees.

A summary of the key elements of the Project are noted in Table 2.

Table 2: Summary of Key Project Components

Project Element	HVO North	HVO South
Extraction limit	Consolidate and retain total maximum extraction rate of up to 22 Mtpa.	Reduced maximum extraction rate from 20 Mtpa to 18 Mtpa.
Project life	Extension of the life to the end of 2050 – approximately 25 additional years.	Extension of mine life to the end of 2045 – approximately 15 additional years.
Additional ROM extracted	Approximately 400 Mt.	
Mining area	Extension of open cut mining operation to Barrett Seam from West/Mitchell Pits to the south-east, continuing beneath existing Carrington Pit mining area.	Continuation of current mining operation to Bayswater Seam in Cheshunt/Riverview Pits, and excluding SLP1, SLP2 and Riverview SE extension areas.
Mining method	No change to current methods.	
Key mine infrastructure	HVO North MIA upgrades and relocation of access road. Relocation of sections of transmission lines and other service infrastructure as required for mine progression.	
Public infrastructure relocations	Relocation of part of Lemington Road – from Comleroi Road in the south to the existing alignment in the north. Relocation of sections of Ausgrid and AGL transmission lines.	
Coal handling and processing	Use of existing Howick and HVCPP infrastructure with no change to processing limits.	Existing HVO North CPP infrastructure to be used as per current operations.

	Construction of haul road to Ravensworth Operations ROM pad. Upgrade of Newdell train loading facility and construction of a new product stockpile or extension of HVLP product stockpile.	Currently approved LCPP construction to be retained, including long rail loop and coal loader.
Equipment fleet	Use of existing and new mining fleet to reflect length of mine extension.	
Water management System	Integrated water management across the HVO Complex, with water discharges in accordance with the Hunter River Salinity Trading Scheme (HRSTS). Parnells Dam enlargement, refurbishment of existing HRSTS discharge facility, and enlargement of Lake James. Surface water management including additional flood protection levees.	
Overburden, coarse reject, and tailings management	Overburden to be placed in-pit, with emplacement areas not exceeding maximum approved heights. Coarse rejects to be disposed in overburden emplacement areas as per current operations. Tailings disposal strategy includes removal, relocation and/or reprocessing of tailings from the Carrington in-pit TSF.	
Final void	One final void located at HVO North in Carrington area– reduced from three currently approved voids (at West, Mitchell, and Carrington Pits).	One final void at HVO South as per current approval, with potential changes to dimensions due to rescheduling. Current void at SLP1 will be backfilled.
Rehabilitation and final landform	Progressive rehabilitation planned as part of ongoing operations. Rehabilitation for the Project to be in line with current design standards and industry practice.	
Operating hours	No change.	

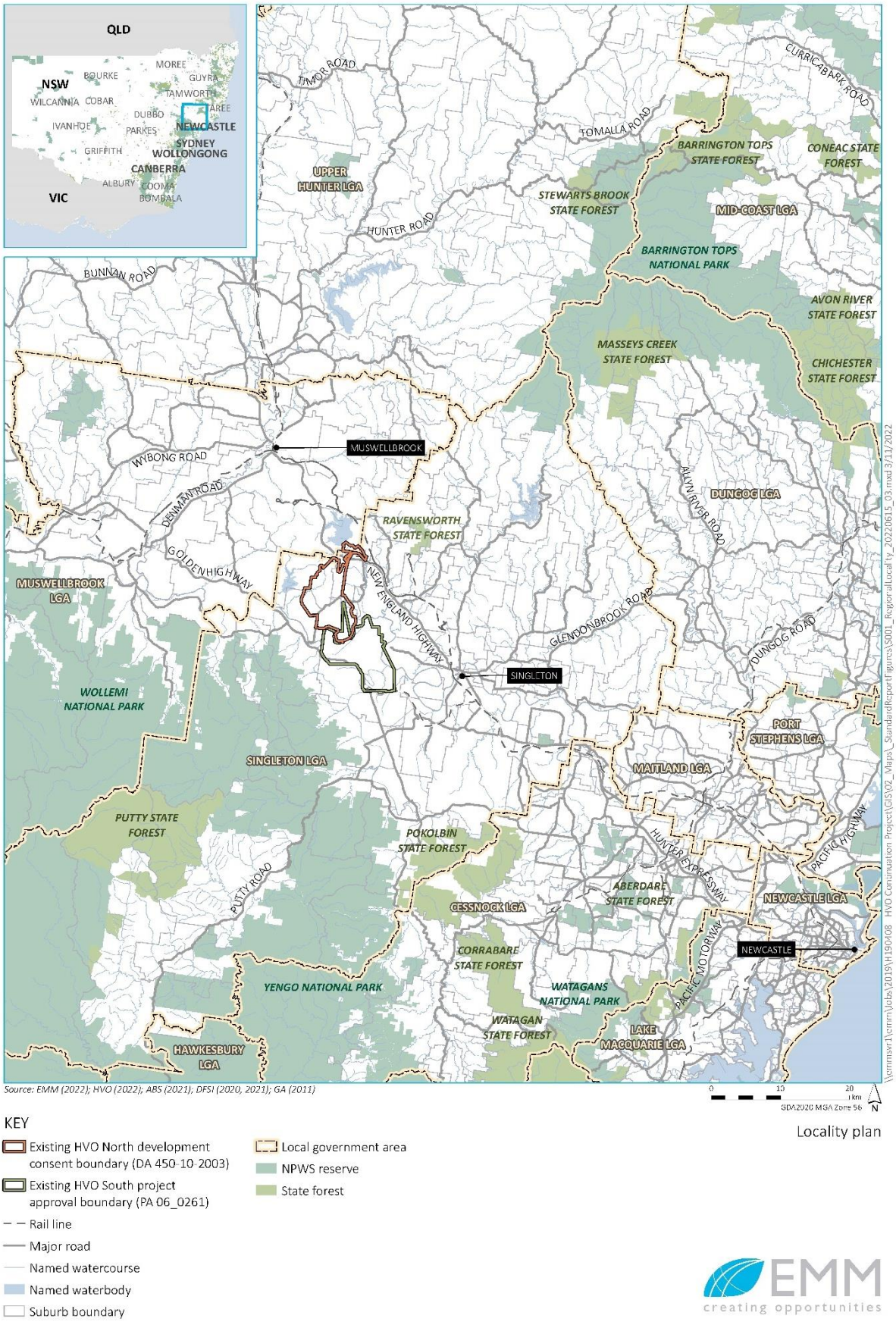

Figure 1: Regional Locality Plan

3.3 Document Structure

This report has been prepared to support the Project EIS and includes:

- An overview of the approach and key drivers and objectives for the mine design for the Project (**Section 4**)
- Assessment of mine plan options and selection of the Preferred Mine Plan which best meets Project objectives (**Section 5**)
- Final landform design overview and final void option assessment for the Preferred Mine Plan (**Section 6**)
- A conclusion and list of key references (**Section 7** and **Section 8**)

4. Mine Design Approach

This section identifies the key factors considered in mine plan development and the key aspects that have been considered in developing the conceptual final landform for the Project in line with the Project objectives.

4.1 Key Mine Design Considerations

4.1.1 Preliminary Project Assessment

The Project has been developed through a thorough internal project assessment process, with progressive and increasing expectations on the mine planning process at each phase that requires increasing definition and refinement of the mine plan and the scope of the Project. It is in the Feasibility Phase that more detailed exploration drilling, and mine planning is completed, the Project's viability is evaluated, and a comprehensive EIS is developed and submitted for assessment.

The Preferred Mine Plan is based on the outcomes of deposit characterisation, constraints analysis, social and environmental impact assessment, and economic analysis. Deposit characterisation considers coal seam structure and coal quality through exploration drilling of open and cored sample holes and analysis of those holes and samples. Constraint analysis considers physical, geotechnical, tenure, tenement, environmental (including heritage and potential amenity impacts) and social constraints. Economic analysis considers inputs such as the mining schedule, workforce levels, coal product quality, capital costs, operational costs, transport costs, taxes, and royalties.

In addition to the consideration of balancing the physical site constraints, environmental, social, geological, safety and legislative requirements, a key driver for the mine design is achieving an economically viable mine plan. All these factors have been considered in the selection and development of the Preferred Mine Plan for the Project.

The following discussion provides further information regarding some of the key mine planning drivers for the Project including mine plan alternatives considered throughout the development of the Preferred Mine Plan.

4.1.2 Geological Setting

The coal seams and overburden layers within the Project area are well known due to experience gained in mining this geology at the HVO Complex and within the greater locality, and through extensive exploration that has occurred over many years with the most recent program occurring between 2019 and 2021. The HVO Complex mined stratigraphy includes 21 seam groups, split into more than 180 plies. Exploration within the Project area has confirmed that the seams planned to be mined are consistent with those within the existing approved HVO Complex and adjacent mining areas with some local variations in quality, thickness, depth, and interval separation.

The coal mined at the HVO Complex are Late Permian Whittingham Coal Measures with the seams of the lower Jerry Plains and Vane Subgroups predominantly within the Project area (from the Glen Munroe to Barrett seams). The typical stratigraphy and target seams within the existing approved operations and Project area is contained in Figure 2.

The structural geology of the Project area is depicted in Figure 3 and includes features such as faults, folds and dykes traversing the area. Several key regional geological features have been considered in the mine design including:

(a) Folding:

  (i) HVO North mining area is located on the eastern flank of the Muswellbrook Anticline. The seams dip two to three degrees north-eastwards towards the centre of the Bayswater Syncline, which has a north-south trending axis 5 – 8 km to the east, intersecting the HVO South mining area. Some localised steep bedding dips occur only near major faulting.

(b) Faulting:

  (i) Fault orientations across the site are generally divided into two main orientations: north-east to south-west and north-west to south-east.

  (ii) Two major east-west striking normal faults are developed at HVO North, namely Parnells Fault, which has a throw of approximately 20 m, and the GRS Fault, which has a throw of up to 50 m.

(iii) The Hunter Valley Fault Zone (HVFZ) is a closely spaced horst and graben structure that extends to depth for several kilometres, across several mine sites including HVO North.

(c) Igneous Intrusions:

(i) Hunter Valley Dyke occurs at HVO North (north of the HVFZ) striking northeast, some 10 – 20 m in thickness.

(ii) Lemington Dyke is a 5 – 10 m wide doleritic dyke that intersects the HVO South mining area.

(iii) Several small-scale igneous dykes have also been intersected throughout the HVO Complex.

(iv) Generally, the identified dykes do not have silling extending into the coal seams beyond 2 m locally.

(d) Paleochannels:

(i) In the HVO North Project area a paleo-channel exists, associated with the Hunter River. This feature has already been intersected by mining in the Carrington Pit and the associated alluvial lands regions. This feature is not expected to have an impact on resources, and limited impact on mining.

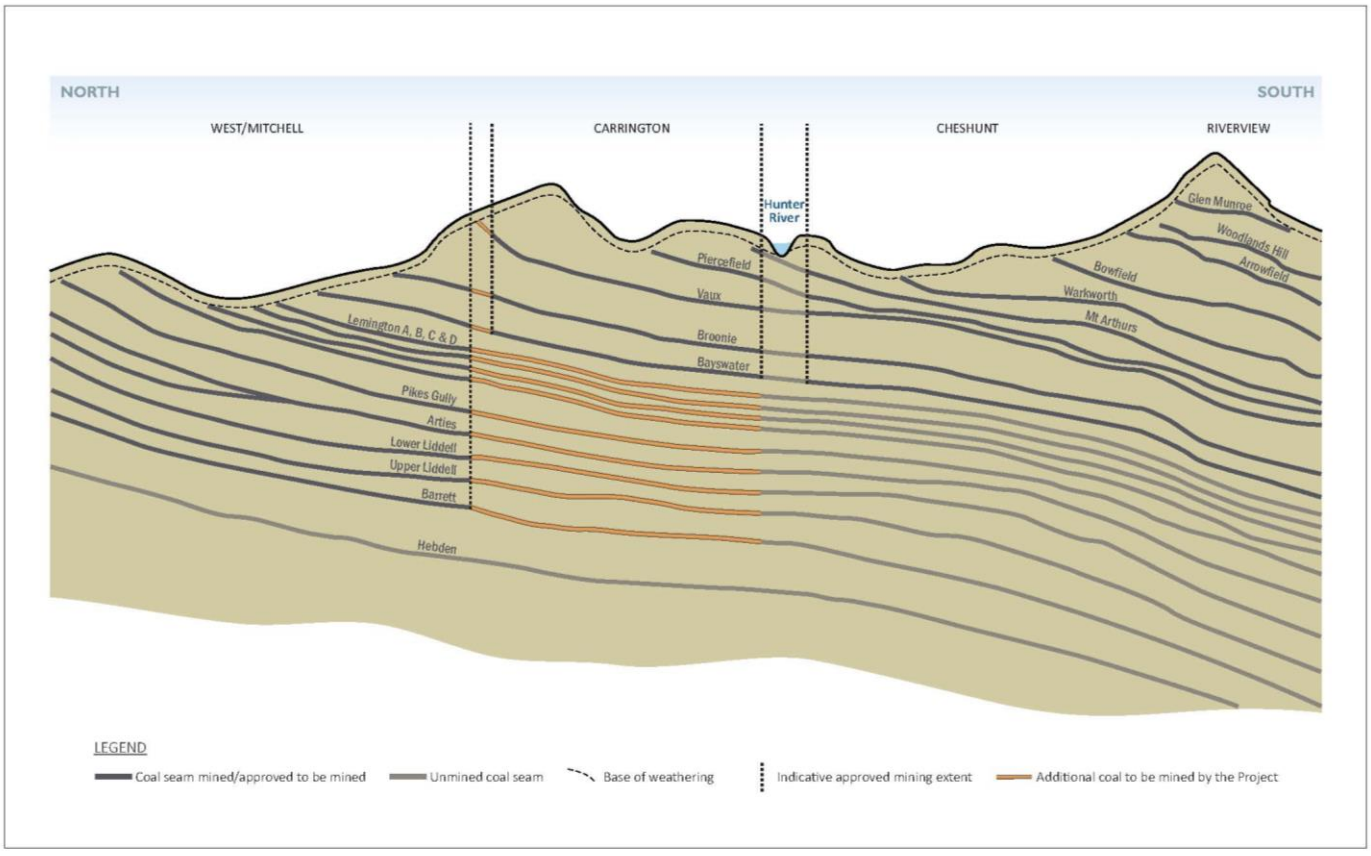

Figure 2: Typical HVO Stratigraphic Profile

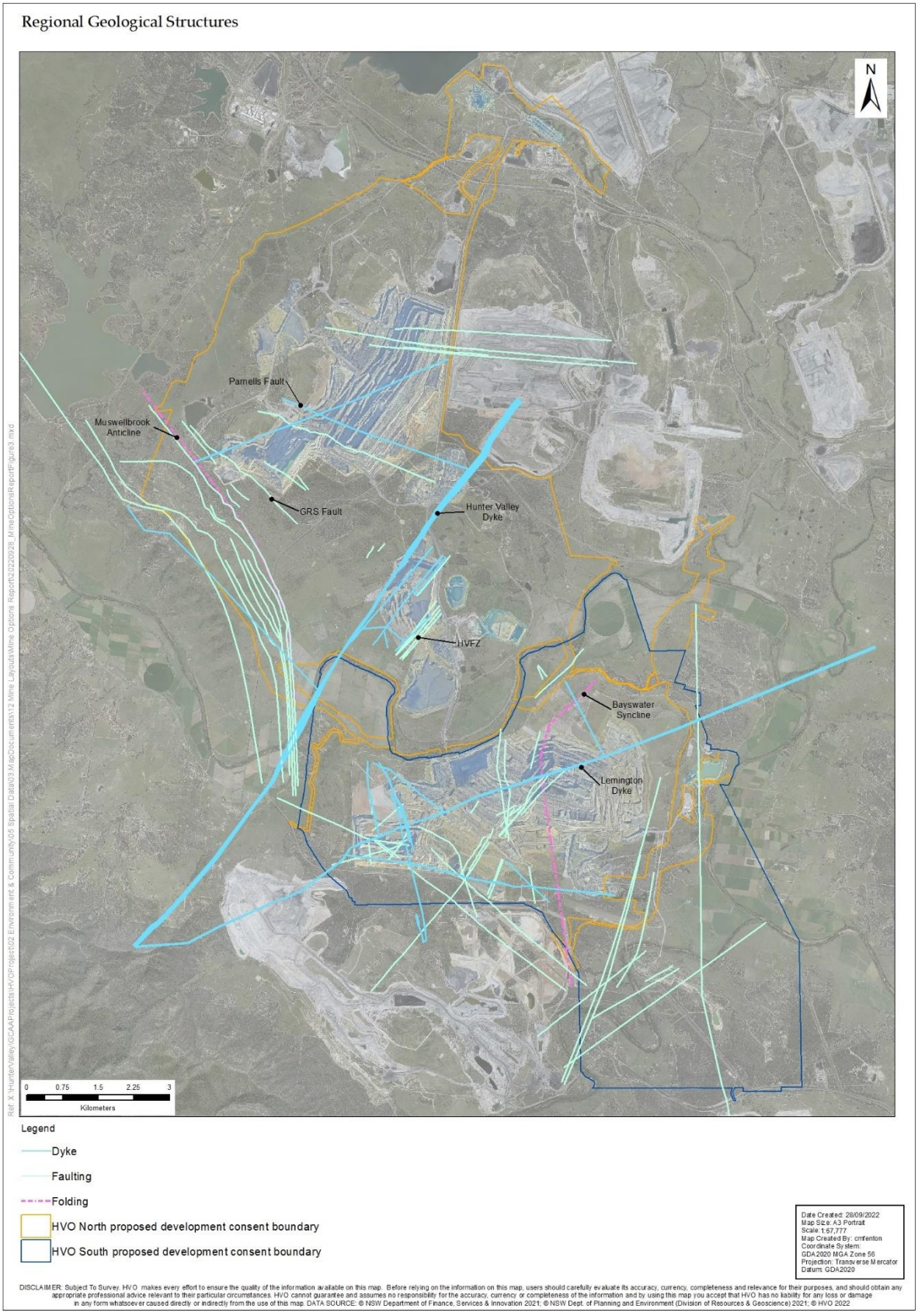

Figure 3: Regional Geological Structures

4.1.3 Mine Plan Considerations

The key drivers in the planning of a mine are to optimise resource recovery whilst balancing mine operation, economic, environmental, and social considerations consistent with the Project objectives. The mine planning studies focussed on selecting the area to be mined, the seams to be mined, the mining method and the direction/progression of the mining operation. Once these key features were determined, further work was then undertaken to refine the mine plan including assessment and consideration of environmental and social constraints.

Technical aspects that required consideration during mine plan development included:

- Location of current and former open cut and underground workings in and around the target area as shown in Figure 4;
- Geotechnical and geological considerations including interaction and influence of regional and localised geological structures discussed in Section 4.1.2 and shown in Figure 3;
- A deposit featuring many thin coal plies and working sections of varying coal quality;
- Variations in the thickness of the different coal seams and differing thicknesses of overburden and interburden material in the area impacting ROM and product strip ratios. Strip ratios, that is the cubic metre volume of overburden required to be removed to recover a tonne of ROM or product coal, is a factor in assessing economic value. The ratio of economic coal to overburden and the product quality of the coal seams are key drivers for determination of mine floor (deepest mined seam); and
- Health, safety, and legislative requirements.

In addition to the technical aspects, the mine plan options considered have had regard to environmental and social factors including:

- Impacts on surface water systems such as the Hunter River and Wollombi Brook, and associated alluvial aquifers, and groundwater systems;
- public serving assets infrastructure such as roads, transmission lines, other utilities;
- Cultural heritage impacts, both Indigenous and European;
- Current land use, ecology, and composition eg. biodiversity, Biophysical Strategic Agricultural Land (BSAL);
- Community impacts such as noise, air quality, blasting, visual and traffic; and
- Final landform and post-mining environment, including land-use considerations and voids.

Other mine planning considerations included:

- Existing operations voids and overburden emplacement areas (eg surrounding dump heights);
- The capacity of the existing infrastructure including CPP facilities;
- The potential for utilisation of existing mining fleet in the most efficient manner both from a productivity perspective and a life cycle perspective; and
- Mobile equipment density in the mining area and optimal coal mining rates.

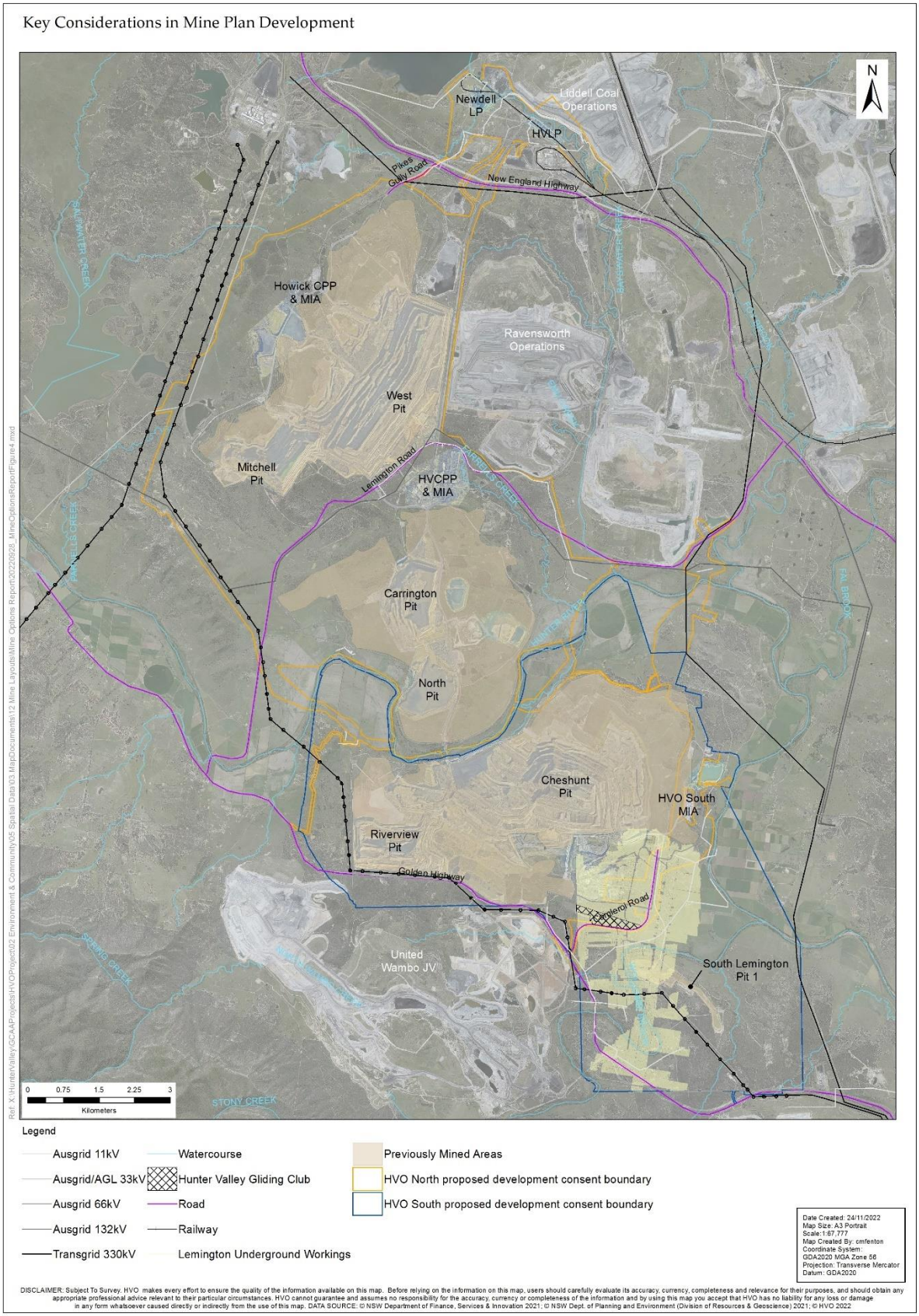

Figure 4: Key Considerations in Mine Plan Development

4.2 Additional Mine Design Considerations

4.2.1 Viability of Underground Mining

The potential option of conducting underground mining was reviewed for the Project. Given that the current HVO Complex mining operation is an existing open cut operation and that the deposit characteristics of the geology within the Project area is such that it includes many thin coal seams, the option for extraction utilising underground mining methods was not considered reasonable and feasible. More detail on the review of underground mining is included in Section 5.8.

4.2.2 Markets and Selection of Target Seams

The targeted coal seams in the Project area are currently mined at the HVO Complex and surrounding operations. Exploration across the Project area and subsequent coal quality analysis indicates that the resource will produce similar types of coal products as are currently being produced from the HVO Complex. The Project ROM coal will be processed to produce both semi-soft coking coal for use in steel manufacture and thermal coal of varying quality for use in coal-fired power stations.

The current HVO South mining operation mines to the floor of the Bayswater seam in the Cheshunt Pit and Bowfield in the Riverview Pit. The Project assumes that mining will progress to the Bayswater seam from the current Cheshunt Pit towards the west, mining under the existing Riverview Pit and emplaced spoil, as per the current approval.

The current HVO North mining operation extracts coal to the floor of Barrett seam in West and Mitchell Pits, north-west of Lemington Rd, and has mined to Bayswater seam in Carrington Pit and Vaux in North Pit/Alluvial Lands area. The Project assumes the mining will progress south-east from the current Mitchell Pit mining area to the Barrett floor, through the current Lemington Road alignment and beneath the previously mined Carrington Pit and spoil.

5. Mine Plan Options

The following section discusses mine plan options investigated and assessed and the Preferred Mine Plan. For several of these mine plan options multiple sub-options were assessed.

5.1 Introduction

The Preferred Mine Plan was chosen as best meets Project objectives as it provides the best balance between optimal resource recovery and economic viability, and reducing environmental and social impacts, through the implementation of appropriate mitigation measures. The Preferred Mine Plan has been refined as further information on the resource has been gained through exploration drilling, and through the completion of environmental and infrastructure studies.

Alternative mine plan options considered during the development of the Preferred Mine Plan included:

- No Project – mining ends as per HVO North consent (12 June 2025);
- Maximise resource recovery - mining in several additional locations around and in addition to the Preferred Mine Plan;
- No final void remaining at end of Preferred Mine Plan;
- Impacting the CM-CD1 heritage site;
- Excluding Lemington Road from the mining footprint; and
- Underground extraction of target seams.

Mine plan options that were not considered reasonable and feasible early in the mine planning phase were developed to a qualitative and/or concept quantitative level only and are provided in this report for comparison purposes only.

5.2 Option 1 - Preferred Mine Plan

The Preferred Mine Plan will extend the life of the HVO Complex by approximately 25 years (to 2050) extracting approximately 700 Mt of ROM coal and providing continued employment opportunities and additional ongoing social and economic benefits, consistent with Project objectives.

This mining schedule has been generated to maximise the economically extractable resource from the HVO mining tenements, including the recently awarded Exploration Lease (EL) 5606. These mining areas considered current operations and mining directions, economic strip ratio, surface and environmental constraints, geotechnical considerations and are reasonable and feasible mine plans.

The Preferred Mine Plan pit shells include:

- Basal seams determined by economic and operational feasibility, with the depth of the pit primarily driven by economic strip ratio considerations - to the Barrett seam at HVO North, and Bayswater seam at HVO South;
- Continuation of current operation from West and Mitchell Pits to the south-east mining to Barrett seam, resulting in the relocation of a section of Lemington Road and associated transmission and telecommunication lines;
- Continuation of mining westward completing Cheshunt Pit and mining under Riverview Pit to Bayswater seam (as per the current approval);
- Mine life proposed to 2050 to align with coal market forecasts described within the Strategic statement on coal exploration and mining in NSW (State of NSW 2020); and
- Final landforms and mining location options that do not preclude further development opportunities.

The proposed mine extents are shown in Figure 5 and bounded by the following constraints:

- HVO tenement and land ownership restrictions
    - Operations assumed within the existing leases, including the assumption that the appropriate mining tenure can be sourced in the areas covered by EL5606 and EL8821 (beneath EL5606).
- Existing operations and associated biodiversity offsets
    - Including prior mining to the planned basal seam such as in West Pit, or where strip ratio increases occur due to the prior mining of upper seams and subsequent spoil emplacement, as in Riverview area.
    - Existing underground operations where mining has already occurred, noting that areas affected by past underground mining activities have been excluded from the proposed mining areas, including the Liddell, Pikes Gully, and Lemington Undergrounds.
- Geology and regional geological structures including the location and orientation of major regional structure, strip ratio and coal quality and geotechnical considerations.
- Environmental considerations such as:
    - Location and potential impact on Hunter River, Wollombi Brook and the associated tributaries and alluvium areas as well as environmentally sensitive areas such as the Carrington Billabong and associated River Red Gums.
    - Mapped BSAL areas.
    - Listed ecological communities such as Warkworth Sands Woodland and Central Hunter Valley Eucalypt Forest and Woodland critically endangered ecological communities (CEEC).
    - Consideration of natural topographical features such as the Wandewoi ridge between HVO and Jerrys Plains.

- Potential amenity impacts (eg noise, air quality, visual, blasting) on local communities (Jerrys Plains, Maison Dieu, Long Point).
- Reasonable avoidance of known cultural heritage sites, eg Aboriginal heritage site CM-CD1.

Other design constraint considerations include existing infrastructure such as transmission lines, major roads (such as the Golden Highway), and CPP/rail load out facilities; existing tailings storage facilities; and required surface water management infrastructure (drains, dams, and levees).

To avoid and minimise noise, blasting, visual and air quality impacts on local communities, various equipment combinations, mining rates and working areas for this mine plan were developed and iteratively refined. The production rate for the Preferred Mine Plan has a steady state of approximately 31 Mtpa, and peaks at 40 Mtpa ROM coal, with the maximum extraction rates of 22 Mtpa at HVO North, and 18 Mtpa at HVO South. At HVO North this maximum extraction rate is the cumulative total of the current approved rates, and the HVO South rate is slightly reduced, down from 20 Mtpa.

Long term tailings management strategy involves tailings emplacement in existing TSFs and an in-pit tailings storage facility in the northern extent of West Pit that will primarily receive tailings from Howick CPP but also acts as an emergency facility for HVCPP.

The majority of the additional disturbance area for the Project has been previously impacted by mining activities, existing infrastructure, and past agricultural land practices, and consists of exotic and derived native grassland communities interspersed with woodland areas.

Table 3: Option 1 Summary Table

Mining Area	ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	528	28	1,277,910
HVO South	208	23	647,593
HVO Complex	737	28	1,925,503

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

The Preferred Mine Plan (the Project) is considered best meets the Project objectives to provide the best balance between environmental and social impacts and associated economic benefits to the residents in the local area and State of NSW. The mine plan options discussed in Sections 5.3 to 5.8 were not considered in the Preferred Mine Plan due to the constraints detailed in these sections.

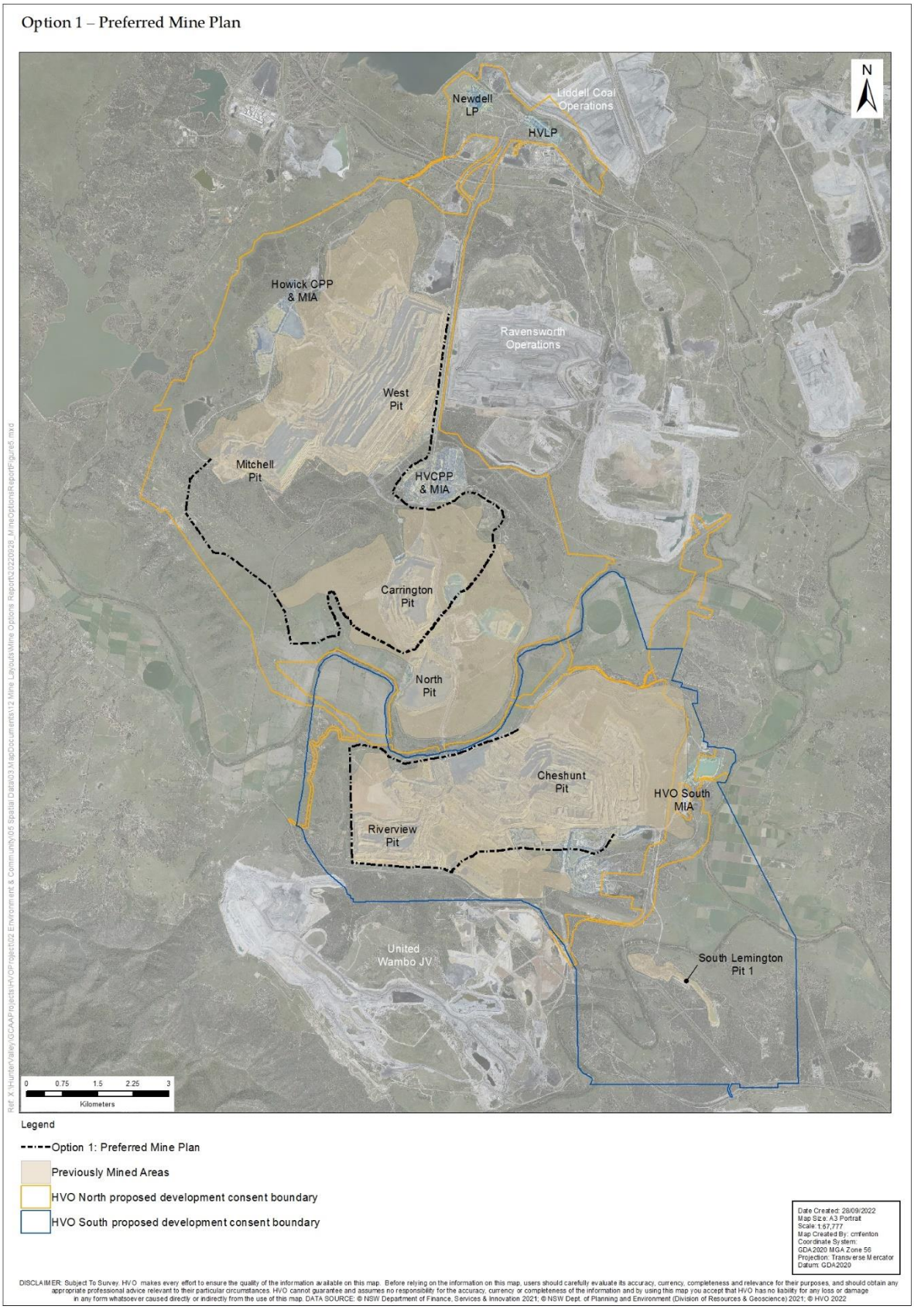

Figure 5: Option 1 – Preferred Mine Plan

5.3 Option 2 - No Project: mining ends as per HVO North consent (June 2025)

The option of not proceeding with the Project was considered. Not proceeding with the Project would mean the cessation of mining at HVO Complex in mid-2025. Currently the HVO South consent allows for mining to continue to 2030, however as HVO South ROM coal is currently processed through HVO North based CPP facilities for this option it assumes that as the CPP facilities cease approval for use when HVO North consents lapses in 2025 then no further coal extraction will occur at HVO South.

There is consideration in the current HVO South consent for the construction of a new CPP facility located south of the pit, however this option considers that construction of this facility would not be feasible to complete prior to mid-2025 to allow continuous operations to occur at HVO South once HVO North stops operating or operate long enough to be economically feasible considering the current consent lapses in 2030.

The current schedule for this option assumes mining progresses as per current operations, with a short ramp down prior to the end of mining in June 2025 and aligns to the economic base case considered in the valuation of the Project (EY 2022). It has also been assumed that the rehabilitation of SLP1 occurs prior to cessation of mining at HVO South to backfill that current void. The projected pit extents for this option can be seen in Figure 6, which also includes the Preferred Mine Plan for comparison.

This option utilises existing infrastructure and does not disturb any additional areas, resulting in no need to relocate Lemington Road, or transmission lines, however as mining has progressed slower and in a differing sequence to that proposed in the current approvals not all the coal from currently approved mining areas will be extracted.

Should the mining operation cease, and the Project not occur, then approximately 685 Mt of ROM coal as proposed in the Project, will remain unmined. This would result in the loss of substantial royalties to the State of NSW, the opportunity for ongoing employment for a workforce of up to around 1,500 personnel will be lost, and the broader economic flow on effects through expenditure with contractor's suppliers and manufacturers who are currently equipped to supply the mining industry with goods and services will not be realised. Not progressing with the Project would have some potential benefits to the local community and environment in terms of avoiding some of the predicted impacts from further approved mining. However, on balance the economic and social benefits of the Project outweigh the environmental benefits of not proceeding with the development.

Table 4: Option 2 Summary Table

Mining Area	ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	31	2.5	212,404
HVO South	22	2.5	156,277
HVO Complex	52	2.5	368,680

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

This option does not meet Project objectives and was not considered reasonable and feasible primarily due to the reduced mine life and considerable lost economic and social benefit.

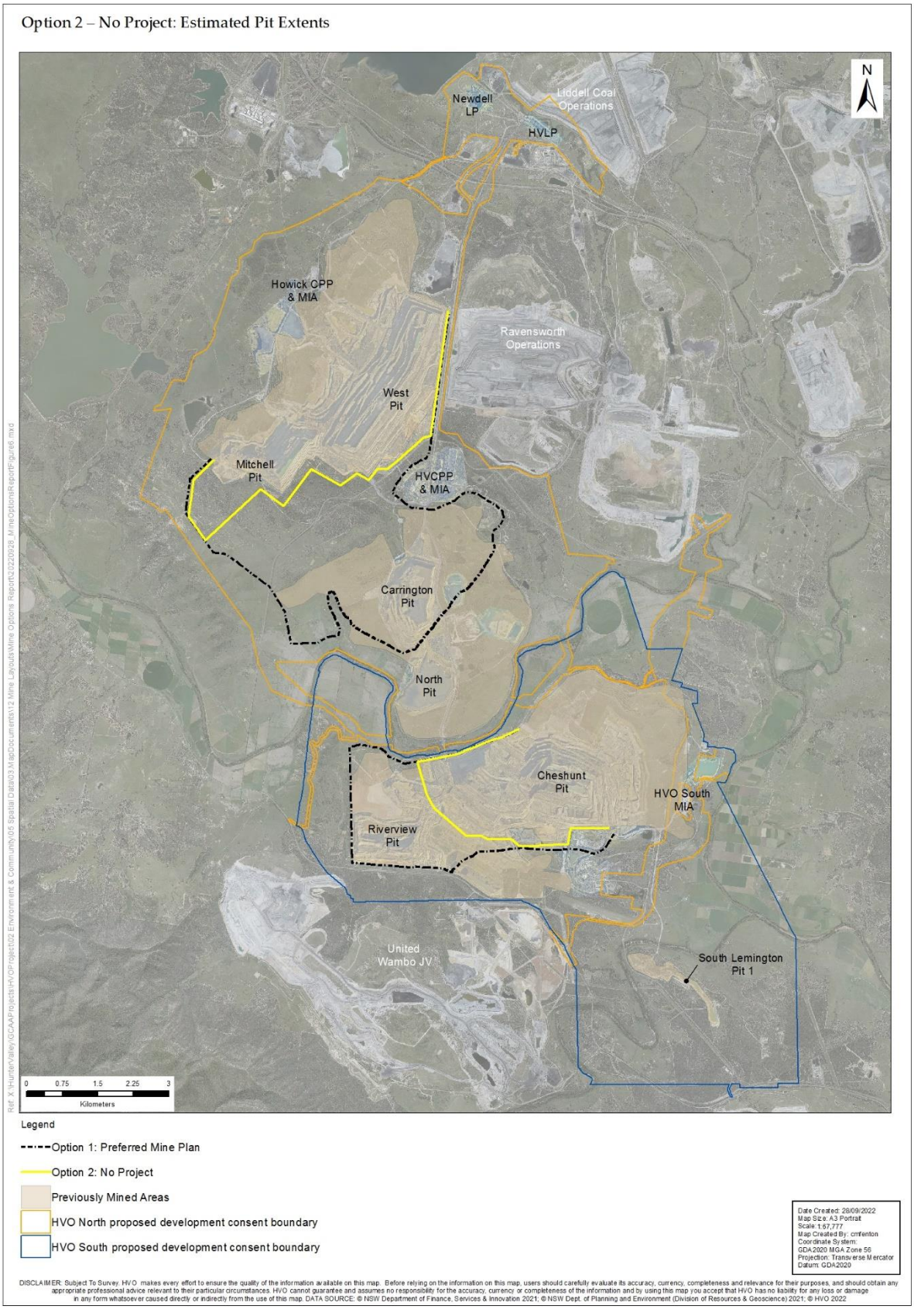

Figure 6: Option 2 – No Project: Estimated Pit Extents

5.4 Option 3 – Maximise Resource Recovery

Coal resources extend throughout the area around the HVO Complex, adjacent to and underlying existing operations and infrastructure, and waterways such as the Hunter River and Wollombi Brook. Various options, in addition to the Preferred Mine Plan, were reviewed as part of the processes of determining the maximum resource recovery achievable while maintaining a reasonable and feasible mine plan meeting Project objectives.

The key alternatives considered are outlined below, including the varying reasons why these options were not selected in the Preferred Mine Plan. Figure 7 shows the locations and extents of the alternative mining areas in relation to the Preferred Mine Plan.

5.4.1 Option 3a – Option 1 + NW of Mitchell Pit

This option considers mining a volume of material that is situated to the north-west of the currently approved Mitchell Pit. Some of the key considerations diminishing the feasibility of this option against the Project Objectives are:

- The proximity and exposure of the location to sensitive receptors, notably the Jerrys Plains locality and potential resultant amenity impacts;
- The technically challenging mining conditions in the faulted zone of the Muswellbrook anticline;
- Proximity to nearby equine critical industry cluster;
- Existing 330 kV transmission lines transecting this location; and
- Accessibility due to approval timing, and associated dump constraint issues.

Due to the location of this option, this material would need to be mined prior to waste emplacement occurring in the Mitchell Pit void, which would have a notable increase in the operational costs and complexity of the required Mitchell Pit mining sequence. The majority of the Mitchell Pit waste material would need to be hauled long distances and possibly dumped higher to maintain access for mining this area. Furthermore, an alternative route for both TransGrid and Ausgrid transmission lines would be needed, increasing the impact of this option, and this couldn't be done until approval had been granted, which would further constrain the overall HVO North dumping and mine sequence.

Preliminary noise modelling done as part of the Project identified mining this area as being sensitive to community receptors, and therefore operations in this area have the potential to be constrained by amenity impact considerations, further impacting pit progression and dump constraints.

Table 5: Option 3a Incremental Summary Table

Mining Area	Additional ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	19	Not scheduled	77,706
HVO South	-	-	-
HVO Complex	19	Not scheduled	77,706

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining in this area was not considered reasonable and feasible due to the considerations, including impacts to community, existing infrastructure, dumping constraints, and potential amenity impacts.

5.4.2 Option 3b – Option 1 + Carrington Southeast Extension

This option assumes all the same constraints and considerations as the Preferred Mine Plan excepting the mine life duration constraint to 2050. The 2050 mine life constraint has been considered in the Preferred Mine Plan (Option 1) to align with the period considered in the Strategic statement on coal exploration and mining in NSW (State of NSW – 2020), in which the NSW Government commits to continue to support the local economy and the responsible development of the state's abundant, high quality coal resources for the benefit of the state. The strategic statement makes it clear that the NSW Government seeks to recognise existing industry investment by continuing to consider responsible applications to extend the life of current coal mines, such as HVO.

There are further development opportunities beyond the period considered in the Statement. In this option mining in this area has been reviewed down to the Barrett seam, continuing south-east towards the Hunter River. This option also includes considerations such as:

- Avoids impact of the North Pit TSF – an in-situ pillar would remain to mitigate the geotechnical considerations of intersecting this void and associated emplaced tailings.
- Offset from the Hunter River, avoiding the impact on the associated alluvial material and restored alluvial lands, and allowing for sufficient space for surface water management requirements including a flood protection levee.

Table 6: Option 3b Incremental Summary Table

Mining Area	Additional ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1]
HVO North	151	Not scheduled	353,303
HVO South	-	-	-
HVO Complex	151	Not scheduled	353,303

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

This option was not considered as part of the Preferred Mine Plan as it did not align with the period considered in the NSW Government's strategic statement.

5.4.3 Option 3c – Option 3b + Alluvium and North Pit TSF Impact

This option is contingent on Option 3b being mined, with additional impacts considered including interactions with the North Pit TSF and alluvial lands adjacent to the Hunter River. Some of the key considerations diminishing the feasibility of this option in consideration of the Project Objective were:

- Intersecting the historic North Pit TSF void (currently being capped), which would involve having to remove the stored tailings in this facility and relocate to an alternate location or reprocess;
- Increases potential for impact on Carrington Billabong and the Hunter River alluvium;
- Requirement for placement of flood protection levee and surface water management; and
- Geotechnical considerations of the final wall in proximity to the Hunter River.

Table 7: Option 3c Incremental Summary Table

Mining Area	Additional ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	215	Not scheduled	443,592
HVO South	-	-	-
HVO Complex	215	Not scheduled	443,592

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining in this area was not considered reasonable and feasible due to interaction with the North Pit TSF and the alluvial lands, and insufficient area for required surface water management including flood protection levees.

5.4.4 Option 3d – Option 1 + Carrington West Wing Residual

This option considered the additional material in the area of the currently approved Carrington West Wing area that is excluded from the Preferred Mine Plan. Some of the key considerations impacting the feasibility of mining the residual western extent of the Carrington West Wing area include:

- the technically challenging mining conditions in the faulted zone of the Muswellbrook anticline;
- the proximity to existing infrastructure – within 100 m of the 330 kV transmission lines; and
- the required space to include the surface water management systems required in the area including the Mitchell clean water diversion and flood protection levee.

Table 8: Option 3d Incremental Summary Table

Mining Area	Additional ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	3	Not scheduled	15,256
HVO South	-	-	-
HVO Complex	3	Not scheduled	15,256

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining in this area was not considered reasonable and feasible due to the geotechnical constraints, existing infrastructure locations and future infrastructure requirements.

5.4.5 Option 3e – Option 1 + CM-CD1 Pillar

This option considered mining the volume of material under the CM-CD1 Aboriginal cultural heritage site. Specifically, the material excluded from the Preferred Mine Plan under the heritage site and associated offset area, solely due to avoidance of CM-CD1 site.

CM-CD1 site (AHIMS 37-2-1877) is a heritage site identified as a buried deposit of miscellaneous small artifacts and is currently protected from disturbance by Schedule 3 Condition 40 of the HVO North DA 450-10-2003. This condition however does not prohibit heritage studies from being undertaken and as part of the Aboriginal Cultural Heritage Assessment (ACHA) being undertaken for the Project, further excavation of CM-CD1 site was completed with the primary aim of collecting samples to confirm the age of the deposits via optically stimulated luminescence (OSL) dating techniques. A total of ten samples were subject to OSL dating, and results support that the CM-CD1 site deposits are of

significant age relating to the early Holocene and late Pleistocene periods (10,000-12,000 years). Considering the rarity of this site type within the known Hunter Valley cultural landscape, CM-CD1 site has been assessed as having high archaeological and cultural significance.

Table 9: Option 3e Incremental Summary Table

Mining Area	Additional ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	21	Not scheduled	89,201
HVO South	-	-	-
HVO Complex	21	Not scheduled	89,201

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining this area did not meet Project objectives to avoid and minimise significant social and environmental impacts and was not considered reasonable and feasible due to the disturbance of the significant CM-CD1 cultural heritage site, and as part of the Project HVO has committed to not disturbing this site through avoidance in the Preferred Mine Plan.

5.4.6 Option 3f – Option 1 + SLP1, SLP2 and Riverview SE Extension

This option considered mining the areas of SLP1, SLP2 and Riverview SE Extension. Mining has previously occurred at SLP1 and to a limited extent in the Riverview SE Extension area, however no prior disturbance has occurred at SLP2 area. The proposed mining areas of SLP1, SLP2 and Riverview SE Extension have State planning approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act) but not all the proposed areas have yet had an application for Federal approval undertaken under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). These mining areas have undergone extensive studies as part of the Project and showed groundwater and ecological sensitivities on which the planned footprints and mining depths would be likely to have a significant impact to the extent that mining in these areas was not considered reasonable and feasible.

Some of the key considerations diminishing the feasibility of this option meeting the Project Objectives were:

- Impacts on listed ecological communities such as Warkworth Sands Woodland and Central Hunter Valley Eucalypt Forest and Woodland CEECs, notably in SLP1 and SLP2 mining areas;
- Potential impact to water resources including Wollombi Brook alluvium, and requirements for water management and flood mitigation requirements
- Existing land ownership and overlapping tenements, eg Riverview SE Extension interacts with the Hunter Valley Gliding Club land, and also overlaps with the approved UWJV Golden Highway and transmission line relocations
- Potential impact to Comleroi Road - by either proximity to operations in SLP2 or requiring realignment when mining in both SLP2 and Riverview SE Extension, with alternatives needed to be assessed, such as changing the alignment to go around the north of these operations, if this option were to proceed; and
- Constrained dumping and haulage considerations from SLP2 and Riverview SE Extension, considering the neighbouring infrastructure, potential amenity impacts, limited access to existing voids and need to source material to backfill these voids as per current approval.

The current HVO South consent includes a commitment to backfill the existing SLP1 void to a free-draining surface, which will be maintained as part of the Project and this commitment has been included in all options considered.

Table 10: Option 3f Incremental Summary Table

Mining Area	Additional ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	-	-	-
HVO South	19	Not scheduled	38,094
HVO Complex	19	Not scheduled	38,094

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining in these areas was not considered reasonable and feasible due to the constraints.

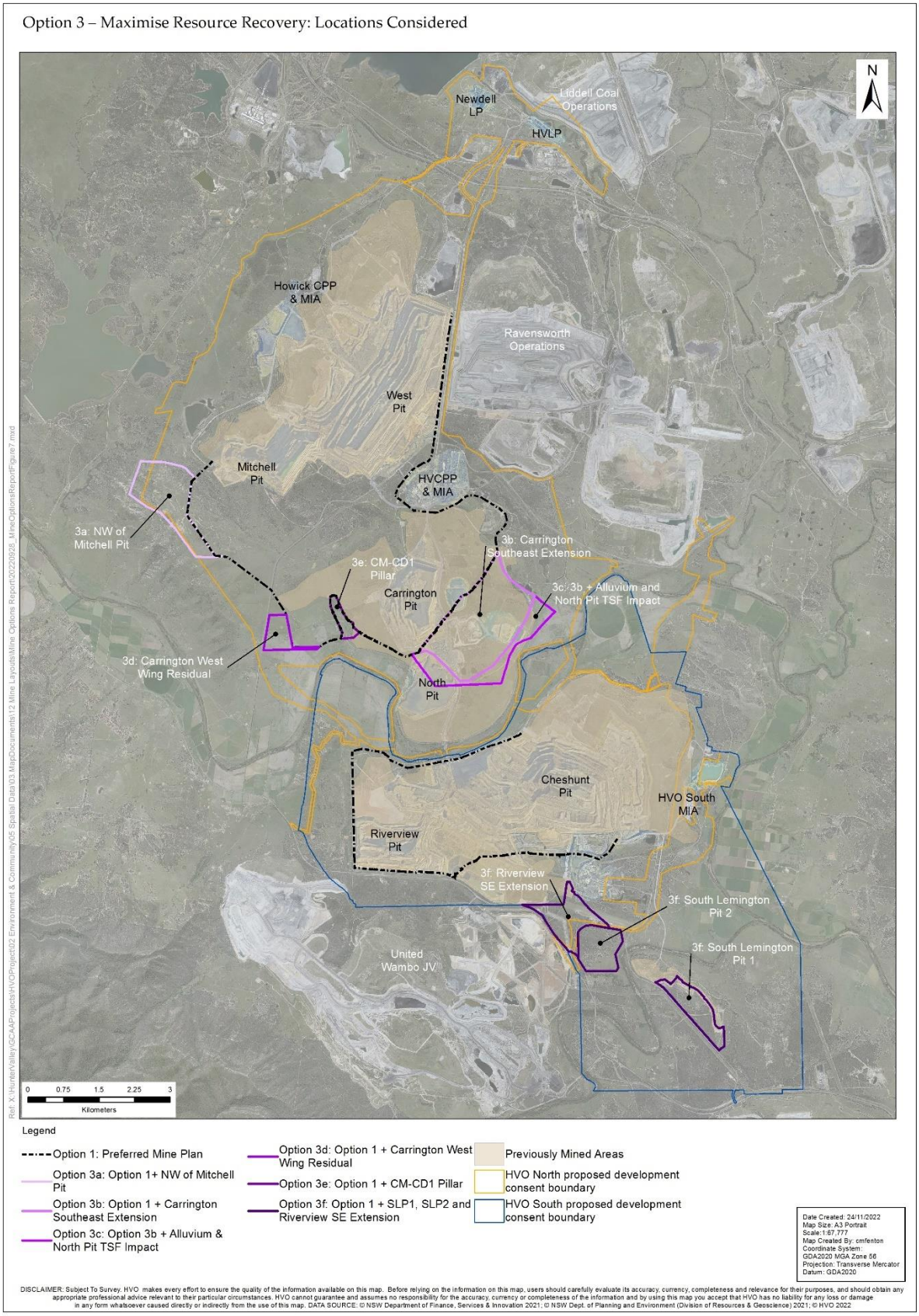

Figure 7: Option 3 – Maximise Resource Recovery: locations considered

5.5 Option 4 – Preferred Mine Plan with no final voids

The Preferred Mine Plan, as summarised in Section 5.2, currently assumes a final void at the cessation of mining in both HVO North and HVO South, however a no-void option was considered in acknowledgement of stakeholder expectations and government direction including the Improving Mine Rehabilitation in NSW Discussion Paper (DPE 2017).

This option considered that the mining voids are progressively backfilled and subsequently rehabilitated as mining progresses as per the proposed mining sequence. However following the cessation of coal extraction, the final voids are backfilled. The volume of material needed to form a free-draining surface at mine closure has been calculated using conventional mining assumptions, as well as identifying sources of material for this process.

The mine schedule generated to achieve this outcome at the end of mining estimated the required additional duration of mining activities and delays to mine closure, and assumed the following considerations:

- Preliminary schedule includes two fleets of 3 x 800 tonne excavators working in existing spoil at HVO North and HVO South, with a fleet of approximately 60 x 300 tonne rear dump trucks; and
- All material needed to generate the concept free-draining surfaces can be sourced from existing waste emplacement in the respective mining areas, eg all material required to backfill the HVO North void can be located within the HVO North emplacement areas, above the immediately surrounding topography.

This option has the following impacts for HVO North:

- Requires approximately 730 million cubic metres of material mined from existing rehabilitated emplacement areas to fill the proposed void at the end of coal extraction to approximately 75 mAHD
- Disturbs more than 1,100 hectares (ha) of rehabilitated land established during the Project
- Approximate 21-year extension of site works post-mining including prolongation of potential air quality and noise impacts, additional Scope 1 greenhouse gas (GHG) emissions and delay in mine site rehabilitation with no economic return; and
- Remaining high wall remnants may be selectively shaped for visual amenity and geotechnical stability reasons.

This option has the following impacts for HVO South:

- Requires rehandle of approximately 610 million cubic metres from existing rehabilitated emplacement areas to fill the proposed HVO South mining void to approximately 70 mAHD
- Disturbs more than 850 ha of rehabilitated land established during the Project
- Approximate 18-year extension of site works post-mining including prolongation of potential air quality and noise impacts, additional Scope 1 GHG emissions and delay in mine site rehabilitation with no economic return; and
- Remaining high wall remnants may be selectively shaped for visual amenity and geotechnical stability reasons.

Table 11: Option 4 Summary Table

Mining Area	ROM Tonnage (Mt)	Est. Mine Life + backfill (Years)	Est. Royalties [1] (A$k)
HVO North	528	28 + 21	1,277,910
HVO South	208	23 + 18	647,593
HVO Complex	737	28 + 21 (49)	1,925,503

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

This option does not meet Project objectives and was not considered reasonable and feasible due to the ongoing noise and dust generation impacts on local communities, significant destruction of established rehabilitation, prolonged Scope 1 GHG emissions, delays in establishing final landform and land use and associated costs which render this option economically unviable.

Figure 8: Option 4 – Preferred Project with no voids: conceptual final landform

Figure 9: Option 4 – Source Material to Backfill Voids Post-mining

5.6 Option 5 – Impacting CM-CD1

Mining through the identified CM-CD1 Aboriginal cultural heritage site was considered as a mine plan alternative and was including in the initial Scoping Report for the Project. Including most of the constraints and assumptions as per the Preferred Mine Plan this option varies in that it assumes that the mine progresses through the location of the CM-CD1 heritage site. As a consequence of mining through the pillar beneath the heritage site, the location of the end-wall differs from the Preferred Mine Plan due to variations in the strip ratio. The strip ratio of the material beneath CM-CD1 site, is 4 bcm/t compared to that in the last few strips of the operation (average 5.5 bcm/t), and within the mine life duration 2050 constraint more coal could be extracted. See Section 5.4.5 Option 3e for more details on CM-CD1 cultural heritage site.

Table 12: Option 5 Summary Table

Mining Area	ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	533	28	1,278,024
HVO South	208	23	644,009
HVO Complex	741	28	1,922,033

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining in this area was not considered reasonable and feasible due to the disturbance of the CM-CD1 site, and as part of the Project HVO has committed to not disturbing this site which is consistent with the Project objectives.

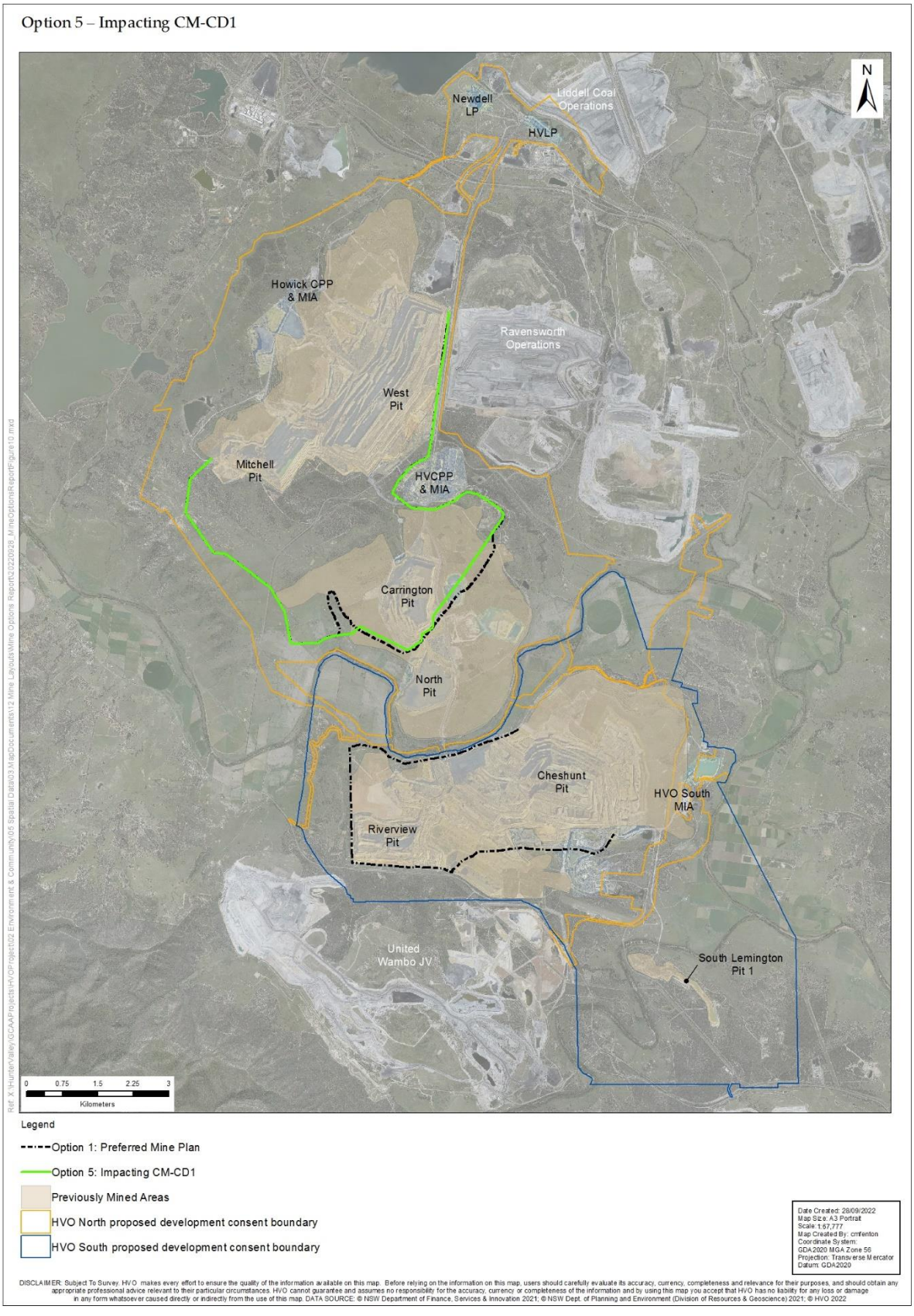

Figure 10: Option 5 – Impacting CM-CD1

5.7 Option 6 – Existing Lemington Road Exclusion

Excluding the existing Lemington Road from the mining footprint at HVO North was considered as an alternative option. A pillar of approximately 150 m width at the crest was assumed, leaving Lemington Road in place and extracting coal on either side as shown in Figure 11. This option requires an additional crossing of Lemington Road to allow for haulage of waste material from the southern void to the northern emplacement areas, to reduce coal sterilisation and minimise final voids, leaving only one void to the south-east of the mining region. The same constraints as in the Preferred Mine Plan were considered in this option, with the addition of the Lemington Road constraint.

Some of the key considerations of this option that do not best meet Project objectives include:

- increase in strip ratio, with additional coal mined from deeper coal seams as the mine progressed further southeast; in the Carrington southeast extension mining area included in Option 3b.
- approximately 65 Mt of ROM coal would be sterilised with dumping adjacent to the pillar on both sides of the road to topography and above;
- impact to haulage being constrained by bridges over Lemington Road to transport material to the north side of the road;
- potential increased amenity impact due to the crossing of Lemington Road at or above topography by haul trucks to backfill the northern void;
- mining proximity to existing infrastructure – blasting impacts, no upgrade to road, visual amenity considerations;
- change to final landform to accommodate not mining through the road; and
- increased complexity of surface water management systems required in the area.

Table 13: Option 6 Summary Table

Mining Area	ROM Tonnage (Mt)	Est. Mine Life (Years)	Est. Royalties [1] (A$k)
HVO North	502	28	1,225,216
HVO South	208	23	646,678
HVO Complex	711	28	1,871,894

1 – Based on the EY Economic Impact Assessment Parameters, NPV in 2022 Australian dollars based on a 7 per cent real discount rate

Mining in this area did not meet Project objectives and was not considered reasonable and feasible due to the considerations. In particular, this option would not include the proposed Lemington Road realignment which would provide for an improved public infrastructure outcome for the community from the upgrade of the road, such as improved flood immunity, which would not be realised.

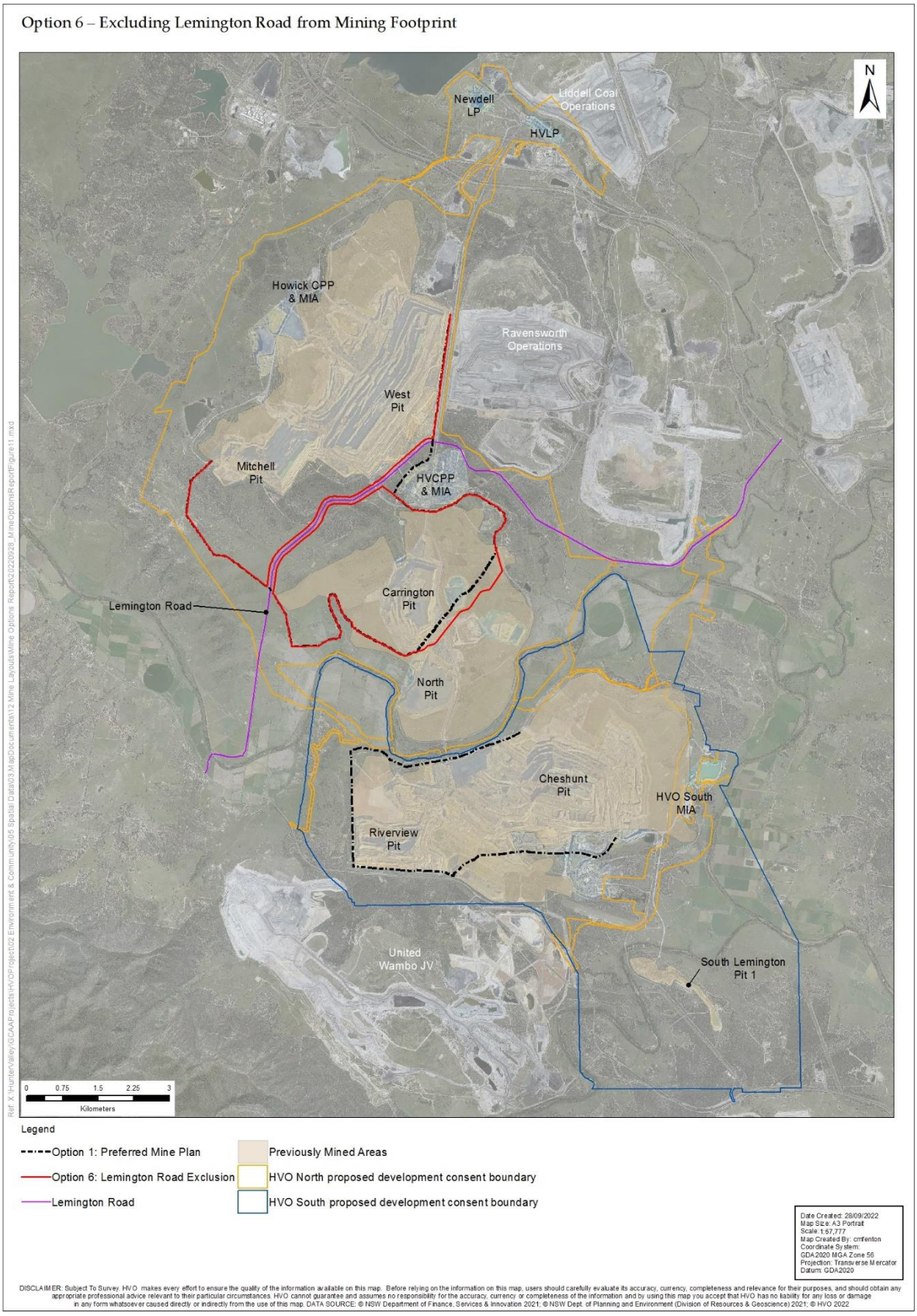

Figure 11: Option 6 – Excluding existing Lemington Road from mining footprint

5.8 Option 7 – Underground Mining Extraction

As an alternative to the open cut mining methodology the extraction of resources in the Project area using underground mining methods was considered. The benefit of this option is that it would reduce the impact on the surface, however underground mining does not meet Project objectives as it is not considered economically viable for resource extraction in the area for the following reasons:

- Coal quality, seam proximity and seam thickness are all significant constraints on minable coal tonnage utilising underground mining methodologies. Considering a minable ROM coal thickness of greater than 2 m, sufficient separation in depth between mined seams to maintain geotechnical stability of potential target and coal quality, only a few seams display potential for underground mining. Initial reviews indicate that this would lead to a significant reduction in resource recovery with less than 15% of the minable tonnage identified in Option 1 being potentially recoverable;
- The presence of regional geological features such as the faulting to the west of HVO North associated with the Muswellbrook anticline, the Hunter Valley Dyke and HVFZ which transects HVO North to the south, and Lemington dyke and numerous faults that influence HVO South would also constrain underground mining;
- There is a high capital cost associated with the establishment of an underground mine and the coal tonnes available for recovery within the resource area are insufficient to ensure the economic viability of the operation;
- Whilst mining does not occur from the surface there are still potential surface subsidence impacts that could influence existing drainage lines and shallow alluvial aquifers. Additionally, subsidence could impose additional stresses on surface infrastructure such as Lemington Road;
- Reduced employment opportunity and continuity due to limited mining reserves, and changes to mining processes; and
- Still have multiple final voids at cessation of mining following the transition from open-cut to underground mining.

For the above financial and technical reasons, underground mining extraction across the resource area is not considered reasonable and feasible and does not meet Project objectives.

6. Final Landform Options

Several post mining final landform and final void concepts were considered for the Preferred Mine Plan. Relevant mine plan design features applicable to establishing the final landform and development of the Preferred Mine Plan include:

- Optimisation of final void including considerations of long-term flood mitigation;
- Capping of completed tailings storage facilities; and
- Establishment of a rehabilitated and stable landform, constituting a mixture of woodland and grassland areas, using natural landform design principles and revegetation techniques.

This section outlines the final landform considerations and the proposed final void arrangement for the Preferred Mine Plan.

6.1 What is a Final Void?

Open cut mining involves the displacement of material to access a resource within the ground which often results in the formation of large pits or 'voids' where that material has been removed. Where a void is left after mining, it is typically referred to as a 'final void' (DPE 2017).

The ‘final void’ is the area within the crest of the final high wall surrounding the predicted long term water recovery level of the pit lake and excluding the low wall. The low wall has been excluded from the definition of a final void due to its reduced slopes and ability for rehabilitation opportunities as described within this report.

It is important to note that not all areas defined as a final void render the land unusable and final voids may have future value beyond the scope of this report.

6.2 Why Are Final Voids Required?

As discussed in Section 4, the Project has been designed to optimise resource recovery and operational efficiencies at the HVO Complex whilst avoiding and minimising environmental and social impacts where reasonable and feasible.

Mining at HVO, both current and proposed, will result in a net volume deficit between the total volume of material excavated from the mining area and the total waste material remaining for emplacement in-pit following the processing and sale of coal. Therefore, it is not possible to reinstate the topography to pre mining levels across all previously mined and future mining areas as discussed in Section 5.5.

At the commencement of mining, “out of pit” overburden emplacement areas were required to provide for the initial start-up operating area before emplacement of mine overburden within the pit void (in-pit) could commence. Additionally, as mining progresses and waste is placed within the void, these emplacement areas are not topographically constrained, but rather constrained by the progress of the mining face, and the increasing depth of the mining area. For the out of pit emplaced material, and material exceeding pre-mining topography, to be put back into the mine shell at the completion of mining it must be rehandled (effectively mined twice). This rehandle of material places a significant financial burden on the mining operation at the completion of mining and would prolong the environmental and social impacts of the mine.

The Preferred Mine Plan will retain a void in the final landform in both HVO South and HVO North. At HVO South this aligns with the currently approved single void, occurring at the same location and with a similar landform. At HVO North this is a reduction in the number of final voids currently approved, however the proposed void is larger and deeper than those included in the current approval.

6.3 Final Landform Design Aspects

HVO undertakes progressive development of rehabilitation works in conjunction with mining activities and is committed to designing sustainable final voids that are safe, stable, and non-polluting through effective mine planning and design. Final landforms are designed to comprise natural landform design elements and include undulating surfaces and drainage lines that are sympathetic with the surrounding natural terrain and the existing rehabilitation in the area.

Throughout the life of the Project the following factors will be considered:

- The ongoing refinement of the life of mine plan to consider final void implications at each stage of planning;
- Recognition that due to the dynamic nature of mining, mine plans may change through time in response to economic, geotechnical, and environmental factors. As such, void positions/size/characteristics may change from that initially envisaged in the proposed mine plans, however, the design of the final voids in each mine plan iteration will meet acceptable outcomes; and
- Final void and rehabilitated landform designs need to consider opportunities for the economic diversification of an area following the cessation of mining and be considered as part of the detailed mine closure planning process.

Overarching commitments for final void design are further described as:

- Safe – associated with safe access and egress into voids by people and animals, and in the case of specific water quality issues, related to safe access and use of that water;
- Stable – associated with control of risk of geotechnical wall failures, slips and similar mass movement or high erosion rates;
- Non-polluting – associated with control of geochemical risks and water quality impacts on important aquifers, drainage lines or surrounding ecosystems with the baseline and existing condition of the receiving waters to be considered when determining acceptable water quality standards;
- Fit for nominated post-mining land use – associated with the ability to remain a stable system that supports nominated post-mining land use, such as native vegetation woodlands or pastural land, and can satisfy the desired outcomes of safety, stability, or that of not polluting into the future; and
- Sympathetic with surrounding landforms – associated with integrated design considerations and utilisation of natural landform design elements for cohesive visual impacts and surface water management.

Initial mining landforms are volumetrically optimised, within proposed height and location limits, to manage operating requirements such as haul distance considerations and allow for progressive construction of the final landform. Then, further design refinement is undertaken to include integrated geomorphic landform design, generally be designed to be self-draining, directing water away from final voids and into the local river catchments, and maintain a reasonable with operational requirements. Once the location and general geometry of the final void developed as part of the Project has been determined, the following established design principles are applied:

- All final void rock slope angles will be determined by geotechnical investigations to ensure they are safe and stable;
- Geomorphic approach to landform design on low-walls ensuring long-term stable landforms that are hydraulically and visually integrated with the down-stream catchments and surrounding natural environment;
- The void slopes and highwall benches will be revegetated where practicable and appropriate; and
- The highwall benches will be revegetated with a suitable native vegetation mix using local species, where appropriate, above the predicted final void water level.

The geometry of the Preferred Mine Plan adds a level of complexity to the final landforms with overburden emplacement constrained due to varying pit widths during mine life, a progressively deepening pit floor in both mining areas, and proximity to features such as the Hunter River, all of which influences the maximum landform heights and final void volumes.

In HVO North there will be a reduction of voids from the three currently approved to one, larger void in all the mine schedule options. The final landform at HVO South maintains one void and a landform similar to that currently approved. At HVO South the focus of the dump sequencing and final landform is to ensure sufficient height on the northern extent of the pit void to meet the spoil heights required adjacent to the Hunter River to manage long-term flood mitigation. The existing SLP1 void at HVO South will be backfilled, using spoil material adjacent to the void which will remove that void from the final landform as per the current approval.

Both proposed final voids are located near the Hunter River, with depths ranging from approximately 200 – 350 m.

The Surface Water Impact Assessment (Engeny 2022) and Groundwater Impact Assessment (AGE 2022) completed for the Project EIS (EMM 2022a) have found that the final pit lake water levels will gradually recover over time until an equilibrium state is reached at approximately -80 mAHD in the HVO North final void (approximately 155 m below natural ground level), and approximately -84 mAHD in the HVO South final void (approximately 160 m below natural ground level).

It is anticipated that the long-term recovery of water levels will fluctuate with time and conditions however are predicted to generally stabilise at a lower level than under pre-mining conditions and will not discharge to the natural creek system. Under this condition, the final voids will act as a long-term groundwater ‘sink’.

The design of the void will be continually reviewed and refined over the life of the mine as mining progresses.

6.4 Landform Options

Integral with the development of the Preferred Mine Plan, an assessment was undertaken to review the landform with a view to reducing the final void size and improving the design of the void that is proposed to remain.

Final void and final landform options assessed for the Project were the preferred option and a no void option. Impacts of the no void option include ongoing noise and dust generation, potential significant destruction of established rehabilitation, delays in establishing final landform and land use, and associated costs that significantly affects the Project’s viability. Note that more details on the no void option can be found in Section 5.5.

The assessment completed on the final void options discussed below have been completed at a concept level to determine their feasibility with consideration of meeting Project objectives and understanding potential impacts and indicative costs. Costs for the no-void option have been estimated assuming cost drivers consistent with the economic assessment for the Project. Additional capital and operating costs for this final landform option are estimated to exceed A$7,000M.

A summary of the final void options considered for both North and South is provided in Table 14 and Table 15 respectively along with concept final landform designs in Figure 12.

Table 14: Summary of Final Void Options HVO North

Mine Plan Option	Void Features
No Project	**No Project Case – Existing Approved Voids** There is an approved final landform including three final voids in the existing HVO North approved mining area (Mitchell, Carrington, and West Pits). Considering the current mining sequence with progressive filling of the void, at cessation of mining in 2025 three final voids will result in the existing approved mining areas, with one void in Carrington Pit and voids in both the Mitchell and West Pit areas.
Preferred Mine Plan - Preferred Void Option	**Preferred Void Option (as included in the EIS)** Progressive filling of the HVO North void, as mining progresses to the south-east; with overall number of voids reduced due to mining continuing beneath existing Carrington Pit. The concept final landform incorporates natural landform design elements with a single final void at the south-eastern end of the mining area. As part of the design considerations erosional stability assessments and materials modelling has been undertaken, with treatment of the proposed final void including: • Battering top layers of weathered strata to improve long term stability of high walls • Design of backfilled low-wall slopes to maximise post mining habitat areas down to the predicted equilibrium water level; and • Softening of internal angles to reduce the geometric form and achieve a more natural form.
Preferred Mine Plan - No Void Option	**Full Backfill - No Void (not practical or economically viable)** Progressive filling of the HVO North void as mining progresses to the south-east, with overall number of voids reduced due to mining continuing beneath existing Carrington Pit. Once coal extraction is complete, the HVO North void would be filled with overburden sourced from adjacent rehabilitated overburden area/s to produce a free-draining surface. This option has the following impacts: • Requires rehandle of approximately 730 million cubic metres from existing rehabilitated mining area/s to fill the proposed mining void to approximately 75 mAHD to achieve a free-draining landform. Note that there is insufficient material available to completely reinstate the post-mining landform to its pre-mining topography. • Disturbs more than 1,100 ha of rehabilitated land established during the Project; and • Approximate 21-year extension of site works post-mining including prolongation of impacts, and delays in mine site rehabilitation and closure. Remaining high walls may be selectively shaped for visual amenity and geotechnical stability reasons.

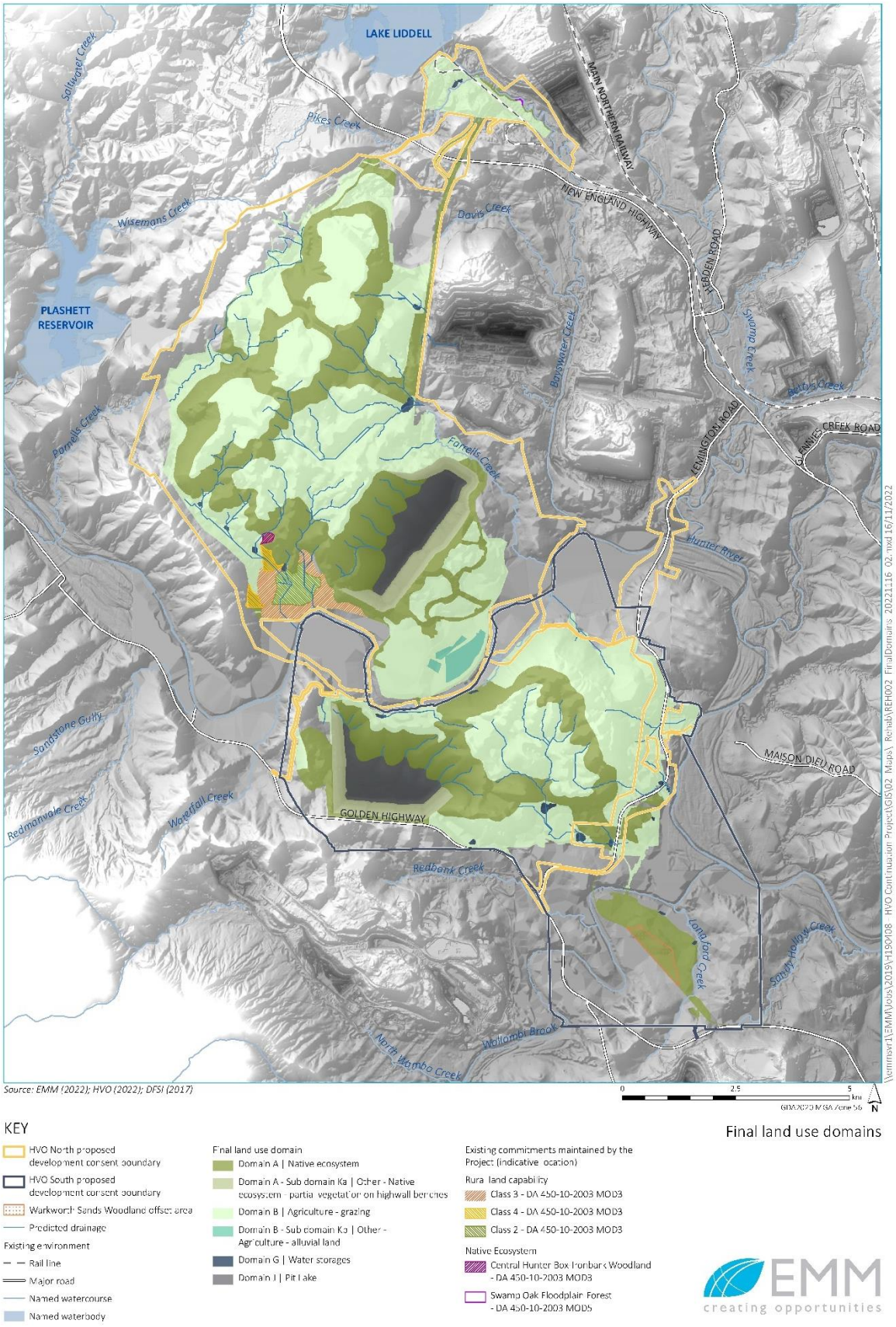

Figure 12: Conceptual Final Landform

Table 15: Summary of Final Void Options HVO South

Mine Plan Option	Void Features
No Project	**No Project Case – Existing Approved Void** There is an approved final landform including a final void in the existing HVO South approved mining area, in Cheshunt Pit, with all other proposed mining areas assumed backfilled to a free-draining topography.
Preferred Mine Plan - Preferred Void Option	**Preferred Void Option (as included in the EIS)** Progressive filling of the HVO South mining area as mining progresses to the west, and backfilling of existing SLP1 void, with overall number of voids being maintained as per current approval, noted above in 'no project case', is generally the same landform and void location. The concept final landform incorporates natural landform design elements with a single final void at the western end of the mining area. As part of the design considerations erosional stability assessments and materials modelling has been undertaken, with treatment of the proposed final void including: • Design of backfilled low-wall slopes to maximise post mining habitat areas down to the predicted equilibrium water level, and • Softening of internal angles to reduce the geometric form and achieve a more natural form.
Preferred Mine Plan - No Void Option	**Full Backfill - No Void (not practical or economically viable)** Progressive filling of the HVO South mining area as mining progresses to the west, and backfill of existing SLP1 void. Once coal extraction is complete, the HVO South void would be filled with overburden sourced from adjacent rehabilitated overburden area/s to produce a free-draining surface. This option has the following impacts: • Requires rehandle of approximately 610 million cubic metres from existing rehabilitated mining area/s to fill the proposed mining void to approximately 70 mAHD to achieve a free-draining landform. Note that there is insufficient material available to completely reinstate the post-mining landform to its pre-mining topography • Disturbs more than 850 ha of rehabilitated land established during the Project; and • Approximate 18-year extension of site works post-mining including prolongation of impacts, and delay in mine site rehabilitation and closure.

6.5 Final Void Options Assessment Outcome

Overburden from the HVO Complex mining activities will be used to fill the existing and progressive void as the proposed mining operations progress. The final landform for the Preferred Mine Plan will include a void at the south-eastern end of the HVO North and western end of HVO South, with depths ranging from approximately 200 – 320 m. The net outcome of this proposed process will be a reduction on the number of approved voids at HVO North, and no change in the number of approved final voids at HVO South.

The progressive rehabilitation will be undertaken as soon as is practicable, with the proposed final landform for the Preferred Mine Plan incorporating natural landform design elements integrated into the current operation's landform. At the completion of mining treatment protocols considered will include battering weathered strata to improve the long-term stability of high walls and the battering of internal backfill slopes to maximise post-mining habitat areas down to the predicted equilibrium pit lake level.

The area and volume of the final landforms has been influenced largely by the geometry of the Preferred Mine Plan including varying pit widths during the mine life, a progressively deepening pit floor in both mining areas, and proximity to features such as the Hunter River, all of which influences the maximum landform heights and final void volumes.

The proposed final landform:

- Provides a balanced outcome that both achieves economic expectations whilst reducing where practicable the size of the final voids;
- Improves the visual appearance of the voids where possible by softening some of the sharper profiles;
- Integrates into the surrounding landscape, with geomorphic design including dendritic drainage and attenuation areas within the landform; and
- Void acts as a long-term groundwater sink, capturing salt and avoiding impacts on surrounding water quality.

A no void final landform option was assessed, however it is not possible to reinstate the topography to pre mining levels across all previously mined areas as following the extraction of coal there is a net deficit of overall material available, and the amount of material that would need to be rehandled to back fill the proposed voids to a free-draining surface following cessation of coal extraction is substantial. As detailed in Section 5.5, the filling of the final voids is not considered practical or economically viable and therefore does not meet Project objectives. Further details regarding the key features of the final landform and rehabilitation strategy are discussed in the Mine Closure and Rehabilitation Strategy (EMM 2022b).

7. Conclusion

Mine planning investigations have been undertaken over a number of years at HVO and have included exploration and geotechnical drilling, and assessment of alternate mine plan options with consideration of technical constraints and risks, economic viability, and potential environmental and social impacts. The outcome of these investigations has been the selection of the Preferred Mine Plan, which forms the basis of the Project, and will provide both direct economic benefits (company tax, royalties, and payroll tax) to the State of NSW and substantial economic flow on effects in the form of spending with suppliers and contractors and associated employment. The Preferred Mine Plan includes:

- Continuation of mining south-east from West/Mitchell Pit to the Barrett seam, through Lemington Road and beneath the existing Carrington Pit area (previously mined to Vaux and Bayswater seams) at HVO North
- Continuation of mining from Cheshunt Pit to Bayswater seam, mining west beneath the existing Riverview Pit at HVO South
- Rehabilitation of SLP1 existing void at HVO South, however no further coal extraction. No planned coal extraction for SLP2 and Riverview SE Extension in variance to the current consent; and
- Impacts to sections of Lemington Road, telecommunications and transmission lines.

Alternate final landform options have been examined for the Preferred Mine Plan with consideration of technical, economic, environmental, and social factors. The preferred final landform option will include final voids at the south-eastern end of the HVO North and western end of HVO South. This will result in no change in the number of approved voids at HVO South, and a reduction of the currently approved three voids to one, albeit larger and deeper, final void at HVO North. It is planned at both mining regions for waste material to be emplaced in-pit with progressive rehabilitation and the final landform will incorporate natural landform design elements to create a safe, stable, non-polluting, and fit for nominated post-mining purpose landform that integrates with the surrounding landscape.

The option of backfilling the proposed void to achieve a free-draining landform was assessed and was not considered practical or economically viable due to:

- The large volume of material needed to fill the voids to a free-draining surface, which has a high cost associated with this rehandled material movement
- The need to substantially disturb areas of established mine rehabilitation (in some areas rehabilitation will have been established for many years) to access the material needed to fill the voids
- Prolongation of impacts well beyond the life of the economic mining operation, and
- Substantial delays in final rehabilitation and mine closure of up to 21 years.

The Preferred Mine Plan and final landform as proposed in the EIS is considered to achieve an appropriate balance between mine planning, economic, environmental, and social outcomes best meeting Project objectives.

8. References

- Australasian Groundwater & Environmental Consultants (AGE) 2022. Hunter Valley Operations Continuation Project – Groundwater Impact Assessment.
- Department of Planning and Environment 2017. Improving Mine Rehabilitation in NSW Discussion Paper November 2017.
- EMM 2022a. HVO Continuation Project Environmental Impact Statement.
- EMM 2022b. HVO Continuation Project Mine Closure and Rehabilitation Strategy.
- Engeny Water Management 2022. HVO Continuation Project Surface Water Impact Assessment.
- Ernst & Young (EY) 2022. Economic Impact Assessment of the Hunter Valley Operations Continuation Project
- State of NSW (Department of Regional NSW) 2020. Strategic Statement on Coal Exploration and Mining in NSW *https://www.regional.nsw.gov.au/__data/assets/pdf_file/0017/1304135/Strategic-Statement-on-Coal-Exploration-and-Mining-in-NSW.pdf*

HUNTER VALLEY OPERATIONS

HVO Continuation Project Infrastructure Options and Avoidance Report

Report prepared:

File Name	HVO Continuation Project Infrastructure Options and Avoidance Report
Last Edited	30/11/2022
Report Status	Final

1. Executive Summary

Infrastructure requirements have been determined over a number of years at HVO, to inform HVO Continuation Project (the Project), and have included detailed engineering design and assessment of alternate options with consideration of technical constraints and risks, economic viability, and potential environmental and social impacts. These investigations have informed infrastructure design ensuring that reasonable and feasible mitigation and avoidance measures are adopted whilst meeting Project objectives.

The outcome of these investigations has been the selection of the preferred infrastructure options, which forms the basis of the Project, and will provide both direct economic benefits (company tax and payroll tax, whilst facilitating ongoing royalties via mining activities) to the State of NSW and substantial economic flow on effects in the form of spending with suppliers and contractors and associated employment.

The infrastructure options considered within this report and assessed against potential alternatives include:

- The realignment of Lemington Road, providing improved continued access between the Golden Highway and the New England Highway with increased flood immunity, whilst minimising impacts to high value biodiversity matters and items of Aboriginal cultural heritage in consultation with Registered Aboriginal Parties (RAPs).
- Realignment of transmission and telecommunication lines, to avoid interaction with proposed mining activities. Proposed easements comprise significant avoidance and mitigation measures to minimise impacts as far as reasonable and feasible.
- Maintain approval for the Lemington Coal Preparation Plant (LCPP), however not retain the approval for the short rail loop option, significantly reducing approved impacts to high value biodiversity matters.
- Improvements to design of product stockpile and train loading facilities, largely within existing disturbance areas whilst maximising the capacity and capability of existing infrastructure.
- Improvements to the existing HVO North MIA, to include a new workshop suitable for ultra-class haul trucks and incorporate modern maintenance facilities.

On determination of the preferred infrastructure options, further assessment of reasonable and feasible avoidance measures was undertaken to reduce potential environmental and social impacts whilst achieving positive Project outcomes.

Key avoidance measures adopted by the Project have resulted in the following outcomes:

- A total of 25.8 ha of direct impacts to ecological communities has been actively avoided through the adoption of reasonable and feasible avoidance measures within the Lemington Road realignment preferred infrastructure option area. Including the direct avoidance of:
    - 7.2 ha of Warkworth Sands Woodland (Endangered Ecological Community (EEC) and Critically Endangered Ecological Community (CEEC));
    - 9.1 ha of Central Hunter Grey Box – Ironbark Woodland (EEC); and
    - 2.6 ha of Hunter Valley Footslopes Slaty Gum Woodland (Vulnerable Ecological Community (VEC)).
- The preferred transmission line realignment paths were carefully considered to avoid areas of higher quality vegetation and habitats, and to provide for maximum vegetation and habitat retention, wherever possible. This was implemented by the effective sighting of transmission line structures within the preferred realignment easements. Resulting in the avoidance of:
    - Within the newly proposed transmission line easement (Management Zone 2)
        - approximately 47 ha of existing native vegetation and *Hunter Valley delma* habitat .
    - Within the wider easement area
        - 21.8 ha of native forest and woodland habitat including 4.6 ha of Central Hunter Grey Box – Ironbark Forest EEC and 0.3 ha of Hunter Floodplain Red Gum Woodland EEC,;
        - 147 ha of *Hunter Valley delma* habitat; and
        - 163.5 ha of native and exotic grassland habitat.

- Surrendering the existing approval for the short rail loop option at LCPP, results in the avoidance of:
    - approximately 26.1 ha of direct disturbance to biodiversity matters within the existing and approved disturbance area, comprising
        - 24.8 ha of Central Hunter Grey Box – Ironbark Woodland EEC (identified as Central Hunter Valley Eucalypt Forest and Woodland CEEC under the Environment Protection and Biodiversity Conservation Act (EPBC Act)); and
        - 1.3 ha of the Hunter Lowland Redgum Forest EEC.

As identified above the determination of the preferred Project infrastructure options and avoidance measures adopted have resulted in significant minimisation of potential environmental and social impacts whilst achieving relevant Project outcomes.

It is noted that a detailed Mine Plan Options Report (MPOR, (HVO 2022)), available in Appendix D of the Environmental Impact Statement (EIS), provides further detail regarding options considered in regard to mine planning and final voids not contemplated in this report.

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2. Introduction

2.1 Background

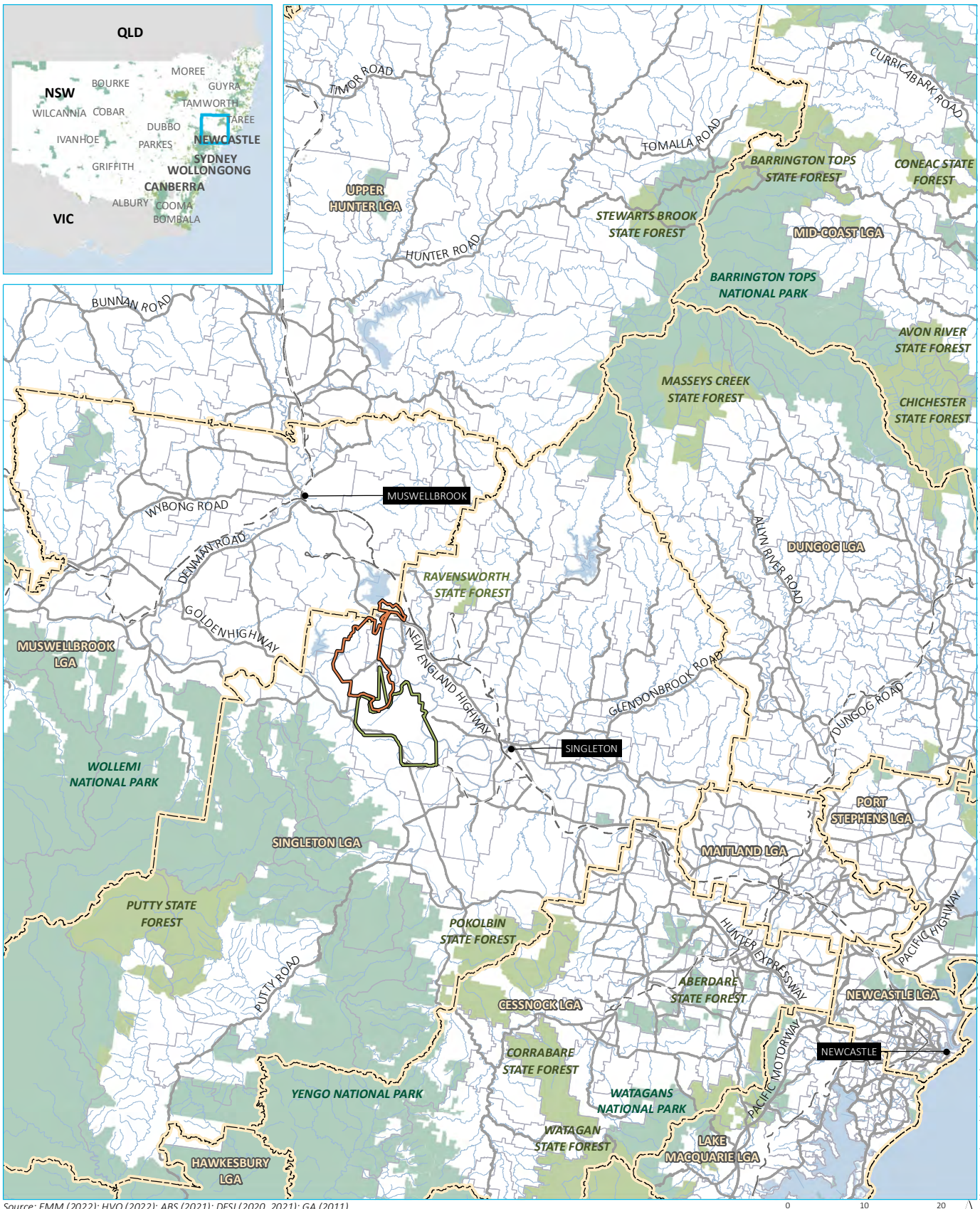
Hunter Valley Operations (HVO) is a multi-pit open cut mining complex approximately 24 kilometres (km) north-west of Singleton in the Hunter Valley of New South Wales (NSW) (Figure 1). HVO comprises two mine sites separated by the Hunter River, HVO North and HVO South. While the two mine sites are approved under separate development consents, they are operated as one complex with fully integrated environmental management systems.

The existing HVO North operation comprises the approved mining areas of West Pit, Mitchell Pit and Carrington Pit, as shown in Figure 2. It operates under development consent DA 450-10-2003 which allows extraction of up to 22 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal until 12 June 2025.

HVO South operates under Project Approval (PA) 06_0261 and comprises the approved mining areas of Riverview Pit and Cheshunt Pit, where mining activities currently take place, and the Riverview South East Extension and South Lemington Pits 1 and 2. PA 06_0261 allows the extraction of up to 20 Mtpa of ROM coal until 24 March 2030.

Mining across HVO is undertaken using dragline and truck and shovel methods. ROM coal from HVO North and South is currently processed at the Hunter Valley (HV) Coal Preparation Plant (CPP) and/or the Howick CPP (both at HVO North), from which product coal is predominantly transported via overland conveyor to the HV load point (HVLP) or Newdell LP and via rail to the Port of Newcastle for export. The Lemington CPP (LCPP) and associated rail loop, which is approved under PA 06_0261 and would process and rail coal from HVO South, is yet to be constructed.

HVO is owned by subsidiary companies of Yancoal and Glencore, as participants in the unincorporated HVO Joint Venture (JV). HV Operations Pty Ltd is the appointed manager of the JV.



Source: EMM (2022); HVO (2022); ABS (2021); DFSI (2020, 2021); GA (2011)

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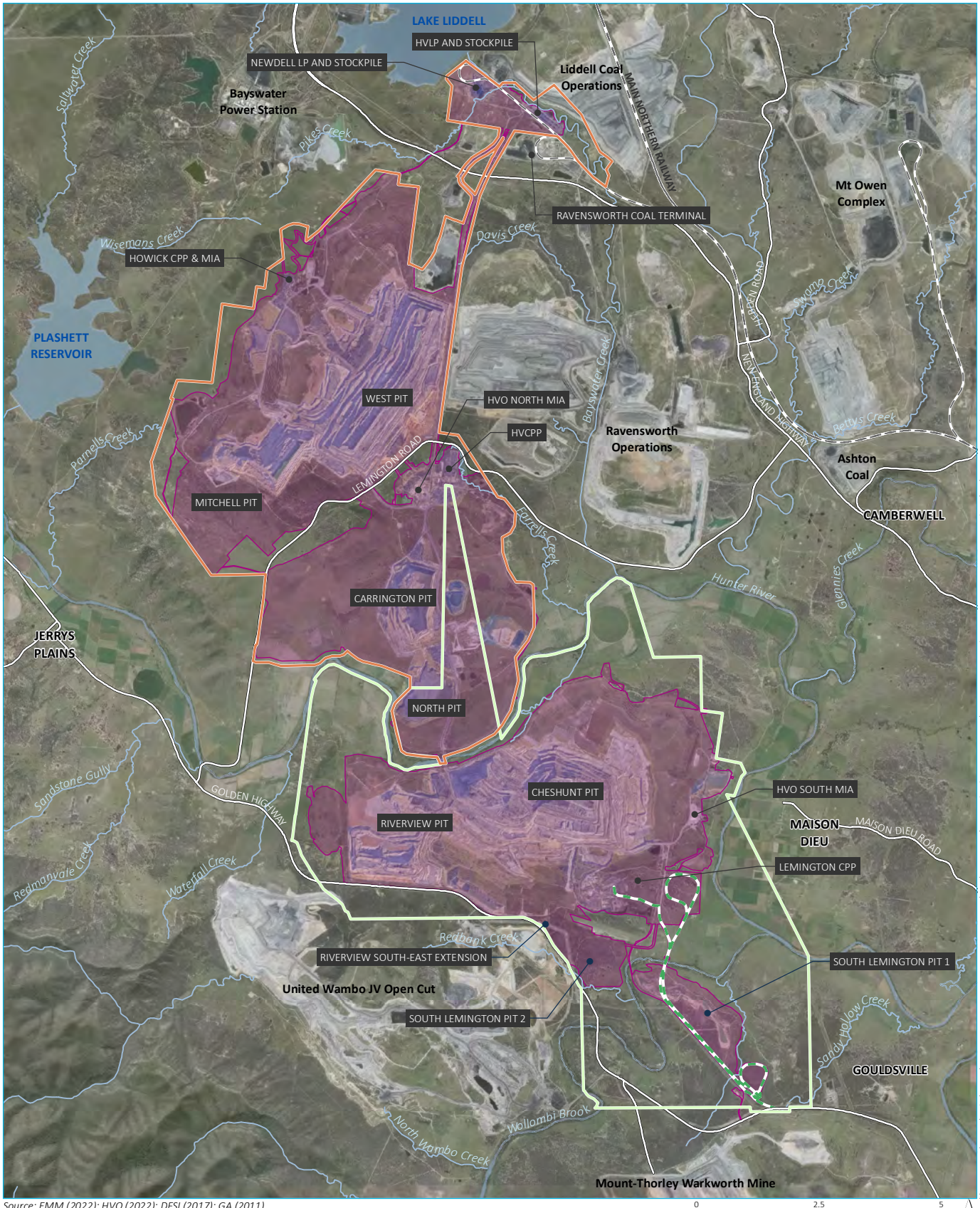
KEY

- Existing HVO North development consent boundary (DA 450-10-2003)
- Existing HVO South project approval boundary (PA 06_0261)
- Rail line
- Major road
- Named watercourse
- Named waterbody
- Suburb boundary
- Local government area
- NPWS reserve
- State forest

Locality plan

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 1

EMM creating opportunities



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Source: EMM (2022); HVO (2022); DFSI (2017); GA (2011)

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N

KEY

- Existing HVO North development consent boundary (DA 450-10-2003)
- Existing HVO South project approval boundary (PA 06_0261)
- Existing and approved disturbance area
- South Lemington Rail Loop and haul route (approved, not yet constructed)

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Local context

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 2

EMM
creating opportunities

2.2 Project overview

The HVO Continuation Project (the Project) broadly comprises the continuation of the life of HVO North and HVO South, from the current approved mining completion dates of 2025 and 2030 respectively, to the end of 2050 at HVO North and 2045 at HVO South. The continuation of mining across the HVO Complex will increase resource recovery from the existing operation, predominantly by mining through previously mined areas and to the extent of existing mining tenements and extracting coal from deeper seams at HVO North.

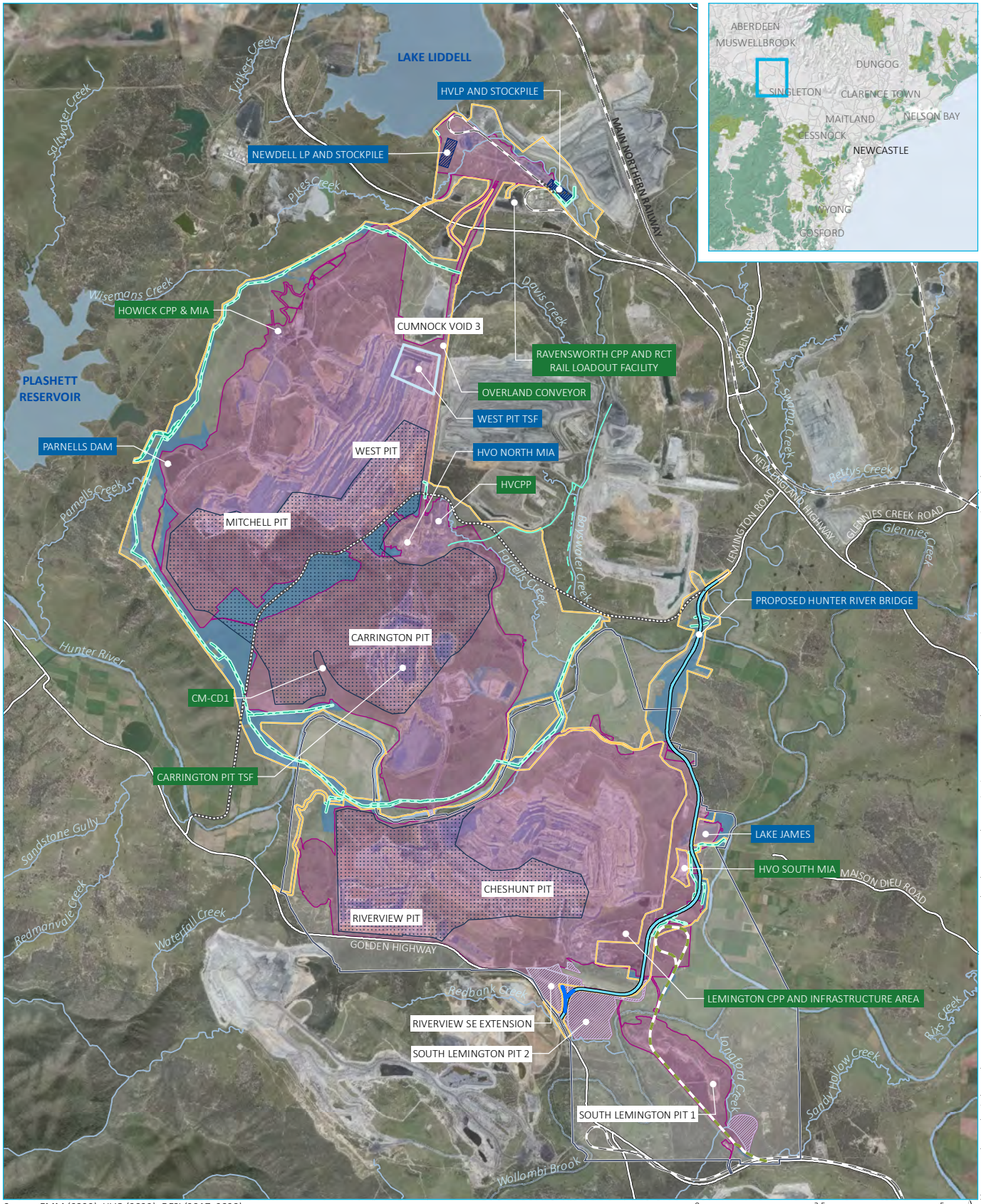
At HVO South an extension to the life of the mine is proposed to facilitate improved mine sequencing outcomes and reduction in mining rate. The Project proposes a reduced mining footprint at HVO South compared to what is approved for extraction, with the previously approved coal extraction in the Riverview South East Extension area and South Lemington Pits 1 and 2 proposed to be removed from mine plan (and future approvals) for the Project. However, some rehabilitation works will be required to be undertaken in the South Lemington Pit 1 area, as part of the mine closure process. The approved shorter rail loop option associated with the LCPP has also been removed from the Project.

A number of infrastructure upgrades and changes are also required to facilitate the Project (and are included as part of it), including realignment of part of Lemington Road, relocation of transmission and telecommunication lines, an upgrade of the Newdell LP including construction of a new product stockpile and train loading bin, an upgrade of the HVLP product stockpile including an extension to the existing coal stockpile, and improvements to Lake James and Parnell's Dam.

To enable the Project to proceed, two new State significant development (SSD) consents are required; one for HVO North and one for HVO South, under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). The Project will seek to maintain separate development consents for HVO North and South, as is currently the case. Given that the two mine sites operate as one complex, one Environmental Impact Statement (EIS) has been prepared to support the two development applications required for the Project.

This Infrastructure Options and Avoidance Report (IOAR) forms part of the EIS and provides a summary of the infrastructure options considered to support the Project and avoidance measures implemented to avoid, minimise and mitigate potential impacts.

The project description is provided in Chapter 4 of the EIS (EMM 2022). The key components of the Project as they relate to HVO North and HVO South are individually listed below. The proposed conceptual layout of the Project, inclusive of both HVO North and South, is provided in Figure 3.



Source: EMM (2022); HVO (2022); DFSI (2017, 2020)

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KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Existing and approved disturbance area
- Previously approved area not retained
- Project related item
- Existing item

Existing HVO elements to be maintained

- South Lemington Rail Loop (approved, not yet constructed)

Proposed HVO Continuation Project elements

- Lemington Road realignment
- Indicative location of public road closure
- Haul route to Ravensworth Operations
- Transmission line relocation
- Alternative Golden Highway intersection
- Proposed mining area
- Product stockpile
- Additional disturbance area
- West Pit TSF

Existing environment

- Rail line
- Major road
- Ravensworth Operations access road
- Named watercourse
- Named waterbody
- NPWS reserve (refer to inset)
- State forest (refer to inset)

Proposed conceptual layout

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 3

EMM creating opportunities

2.2.1 HVO North

The key changes proposed by the Project to the approved HVO North operations include:

- an extension to the life of the mine until the end of 2050;
- extraction of coal to the base of the Barrett seam across the HVO North mining area. Existing operations are approved to extract coal to the base of the Barrett seam in the West Pit; however, are only approved to the base of the shallower Bayswater seam in Carrington Pit;
- extraction of an additional approximate 400 Million tonnes (Mt) of run of mine (ROM) coal through the extraction of coal from deeper seams and a small increase in the mining extent (between the existing West and Mitchell Pits and Carrington Pit);
- infrastructure upgrades, as listed below:
    - realignment of Lemington Road and new bridge over the Hunter River. While the proposed realigned corridor is partly within the HVO South development consent boundary, the realignment is required to enable the progression of mining from the Mitchell and West pits into the Carrington area at HVO North. The works associated with the road realignment therefore form part of the HVO North Project;
    - HVO North site access road relocation off the existing Lemington Road;
    - an increase in the capacity of Parnell's Dam from approximately 1 gigalitres (GL) to 4 GL;
    - realignment of transmission and telecommunication lines that are currently within the proposed mining footprint;
    - HVO North Mine Infrastructure Area upgrade;
    - ancillary activities as required to facilitate operations;
    - access roads to facilitate service provider access;
    - use of demountable/temporary buildings in construction compounds as required;
    - upgrade of the existing Newdell LP train loading facility and construction of a new product stockpile; or
    - extension of the HVLP product coal stockpile, including the closure of a section of Liddell Station Road.
- coal haulage from the HVCPP to the Ravensworth ROM pad, via internal haul roads;
- revised tailings management strategy;
- amendments to the approved final landform;
- progressive rehabilitation throughout the mine life; and
- changes to the development consent boundary to incorporate the changes listed above.

Other than as set out above, all activities that are currently approved under the existing HVO North approval are intended to continue. Key aspects and outcomes of the approved development at HVO North that will remain the same under the Project include the following:

- the maximum allowable annual coal extraction and processing rate;
- annual operational workforce numbers and associated traffic generation;
- approved heights of overburden emplacement areas;
- receipt of ROM coal from HVO South via internal haul roads for processing at all CPP facilities approved for HVO North;
- continued avoidance of the Aboriginal heritage site known as Carrington Mine - Colluvial Deposit 1 (CM-CD1); and
- the ridge between Jerrys Plains and HVO North will remain, continuing to provide an effective amenity barrier.

2.2.2 HVO South

The key changes proposed by the Project to the existing approved operations at HVO South include:

- an extension of the life of the mine until the end of 2045;
- a reduction in the approved maximum ROM coal extraction rate from 20 Mtpa to 18 Mtpa;
- changes to the approved mine sequencing (although noting that mining within the two primary open cut pits; Riverview and Cheshunt, will remain generally within the same footprint as approved);
- removal of coal extraction from the mine plan from the Riverview South East Extension, South Lemington Pit 1 and South Lemington Pit 2 mining areas;
- infrastructure upgrades and changes to that currently approved, as listed below:
    - removal of the LCPP short rail loop option;
    - removal of the approved conveyor from HVO South to the HVCPP at HVO North (the conveyor has not been constructed);
    - construction of the Cheshunt and Riverview flood protection levees;
    - realignment of transmission lines;
    - enlargement of Lake James from approximately 0.7 GL to 2 GL;
    - additional tailings pipelines and pumps;
    - ancillary activities as required to facilitate operations;
    - access roads to facilitate service provider access; and
    - use of demountable/temporary buildings in construction compounds as required.
- revision and implementation of the tailings strategy; and
- amendments to final landform due to rescheduling and or infrastructure relocations, progressive rehabilitation will be undertaken throughout the mine life.

Other than as set out above, all activities that are currently approved under the existing HVO South approval are intended to continue. Key aspects of the approved development at HVO South that will remain the same for the Project include:

- the coal seams to be extracted (ie no increase in the depth of mining);
- the extent of approved mining areas within the Riverview and Cheshunt Pits;
- approved heights of overburden emplacement areas;
- construction of the LCPP and associated rail loop (long rail loop option only);
- transfer of coal from HVO South to HVO North for processing; and
- annual operational workforce numbers and associated traffic generation.

2.3 Project terminology

The following key terms are used throughout this assessment to describe the Project:

- **HVO Complex** – comprises both HVO North and HVO South operations.
- **The Project** – the Project in its entirety, encompassing the continuation of the life of the complex; ie, both HVO North and HVO South, within their respective proposed development consent boundaries, as illustrated in Figure 2.
- **Project area** – The area that is the subject of the two development applications, ie, the proposed development consent boundary for HVO North and the proposed development consent boundary for HVO South.

- **Existing and approved disturbance area** – Areas that are disturbed and/or approved under the NSW EP&A Act to be disturbed under the current development consents that apply to the HVO Complex.
- **Approved mining area** – The areas within the approved disturbance area that have been previously assessed and approved under the NSW EP&A Act for mining operations.
- **Additional disturbance area** – The areas that will be disturbed by the Project that are outside of both the existing and approved disturbance area for the HVO Complex and other neighbouring mines (Ravensworth Operations, United Wambo and Liddell Coal Operations (LCO)).
- **Previously approved areas not retained** - Areas that are disturbed and/or approved to be disturbed under the current development consents that apply to the HVO Complex, that will no longer be disturbed by the Project, such as the LCPP short rail loop, the Riverview South East Extension and South Lemington Pit 2 mining areas, and the approved temporary crossing across the Hunter River between HVO North and South.
- **Proposed mining area, HVO North** – Areas where coal extraction will take place for the Project at HVO North and includes:
    - areas already disturbed by mining that will be re-disturbed to facilitate coal extraction in the deeper Barrett seam;
    - areas not previously approved for mining (eg the area between the Mitchell Pit and Carrington Pit); and
    - areas approved but not yet disturbed (eg the Carrington West Wing area).
- **Proposed mining area, HVO South** – Comprises the Riverview Pit and Cheshunt Pit, where coal extraction will continue under the Project, down to the Bayswater seam. The HVO South proposed mining area does not include the previously approved South Lemington Pit 1, South Lemington Pit 2, or the Riverview South East Extension, as coal extraction is not proposed in these areas as part of the Project. However, rehabilitation activities will be required in some areas and form part of the Project.
- **Transmission line corridors** – Two categories of transmission line corridors have been defined for the purpose of quantifying the extent of disturbance for the Project:
    - realigned transmission lines (ie new transmission line easements) – the extent of disturbance will be limited to transmission line poles/towers and an access road for maintenance along the alignment, as well as vegetation management to maintain safe powerline clearance; and
    - existing transmission line easements to be decommissioned – disturbance will be confined to existing access tracks and cleared areas.
- **Realigned Lemington Road corridor** – The corridor extends from the Comleroi Road intersection with the Golden Highway at the southern end of the new alignment, along the Comleroi Road alignment around the south-eastern side of HVO South, and then extends in a northerly direction to join the existing Lemington Road at a point approximately 2.3 km south of the New England Highway/Lemington Road intersection. The corridor also allows for two options with respect to the connection to the Golden Highway; one assuming that the Golden Highway is realigned by United Wambo as approved under SSD 7142, and a second option that connects with the current alignment of the Golden Highway.
- **Project disturbance area** – this area is a combination of the additional disturbance area and the existing and approved disturbance area, minus the areas not being retained by the Project. If the Project is approved, this will become the 'approved disturbance area' under the new SSD consents.

2.4 Assessment requirements

This IOAR has been prepared in accordance with requirements of the NSW Department of Planning and Environment (DPE). These were set out in the Secretary's Environmental Assessment Requirements (SEARs) for the Project, issued on 11 March 2021. Table 1 lists individual requirements relevant to this IOAR and where they are addressed in this report.

Table 1: Related DPE SEARs

Requirement	Section addressed
• description of the measures that would be implemented to avoid, **minimise**, mitigate and/or offset the likely impacts of the development, and an assessment of: ○ whether these measures are consistent with industry best practice, and represent the full range of reasonable and feasible mitigation measures that could be implemented; ○ the likely effectiveness of these measures; and ○ whether contingency measures would be necessary to manage any residual risks;	Sections 2 and 3
• the **reasons** why the development should be approved, having regard to: ○ feasible alternatives to the development (and its key components), including the consequences of not carrying out the development;	Sections 2 and 3

To inform the preparation of the SEARs, DPE invited other government agencies to recommend matters to be addressed in the EIS. The matters raised are listed in Table 2 and have been taken into account in preparing this assessment, as indicated in the table.

2.5 Study area

The study area of this IOAR directly relates to the specific infrastructure aspects of the Project identified within Section 1.2.

2.6 Document Structure

This report has been prepared to support the Project EIS and includes:

- **Confirmation** of infrastructure options considered and selection of the Project infrastructure options (Section 2).
- **Avoidance** measures implemented in regard to the preferred Project infrastructure options (Section 3).

3. Infrastructure Options

3.1 Approach to infrastructure design

To meet Project objectives, detailed concept and pre-feasibility studies considering mining options and infrastructure arrangements were carried out. Each of these studies evaluated potential environmental and social impacts to inform the Project design, as summarised in Section 1.2 and described in detail within Chapter 4 of the EIS, being the preferred Project.

The following sections summarise the infrastructure options considered that were ultimately found either not to be feasible, or desirable, or able to form part of, the preferred Project design which best met Project objectives. Infrastructure options considered are identified in relation to HVO North and South separately in accordance with the separate development applications proposed to be lodged for the Project.

It is noted that a detailed Mine Plan Options Report (MPOR, (HVO 2022)), available in Appendix D of the EIS, provides further detail regarding options considered in regard to mine planning and final voids not discussed in the report.

3.2 HVO North Infrastructure

3.2.1 Realignment path of Lemington Road

The current Lemington Road alignment passes between the West/Mitchell Pits and the Carrington area at HVO North. As this area is proposed to be mined, the Project seeks to realign part of Lemington Road to the east of the HVO Complex, linking the existing Comleroi Road in the south with the existing Lemington Road in the north approximately 2.3 km south of the New England Highway, as shown in Figure 5.

The preferred Lemington Road realignment presents an opportunity to improve the accessibility and reliability of the road as the primary access joining the Golden Highway and New England Highway between Singleton and Muswellbrook. The realigned road includes the construction of a new bridge over the Hunter River (refer to Figure 5), which will be constructed to meet the requirements of a 1 in 10 average recurrence interval (ARI) flood protection design. This design will provide significantly improved accessibility and safety outcomes in comparison to the existing Moses Crossing, which is a low-level bridge across the Hunter River at the southern end of the existing Lemington Road. Furthermore the preferred Lemington Road realignment present the following additional benefits:

- the existing New England Highway intersection is not required to be upgraded reducing impact to local road users along key regional NSW highways;
- minimal interaction with the proposed or potential future mining operations;
- provide significant flood immunity compared to the existing Moses Crossing over the Hunter River crossing;
- minimal travel time impacts between the Golden Highway and the New England Highway for local residents of Jerrys Plains; and
- reduced visual exposure to the proposed mine workings when compared to the existing Lemington Road alignment and alternative options considered.

Alternative routes considered but determined not reasonable or feasible for the Lemington Road realignment are summarised below.

3.2.1.1 Alternative Option 1 – Lemington Road realignment south of HVO North

This realignment option would involve the realignment of Lemington Road south of HVO North but north of the Hunter River, as shown in Figure 6. It would not require the construction of new intersections with the New England Highway or Golden Highway nor a bridge over the Hunter River; however, safe separation between the public traffic, mining operations and the Hunter River would be difficult to implement. Noting an overpass would be required to separate material haulage from HVO South to HVO North CPP facilities.

Mining would be highly visible from the relocated section of Lemington Road. In addition, this alignment is also partly located over an area of rehabilitated mine overburden, which could present challenging geotechnical conditions and

associated potential construction difficulties. As such this option was not considered reasonable and feasible and did not best meet Project objectives.

Summary of constraints:

- proximity to proposed and currently approved mining activities at HVO North;
- proximity to Hunter River;
- visual impacts experienced by road users;
- sighting of the proposed alignment over rehabilitated mine overburden; and
- requirement of an overpass to separate material haulage HVO South to HVO North CPP facilities.

3.2.1.2 Alternative Option 2 – Pikes Gully Road Extension

This realignment option involves upgrade and extension of the existing Pikes Gully Road along the western side of the HVO Complex and construction of a new Hunter River crossing and Golden Highway intersection in the vicinity of Jerrys Plains, as shown in Figure 6. In addition, the existing Pikes Gully Road intersection with the New England Highway would likely be required to be upgraded. Currently, the land which would be relied upon to facilitate this option between the Hunter River and the Golden Highway intersection is privately owned. This option would require the purchase of private land, and the location of an intersection with the Golden Highway would increase traffic movements in the vicinity of Jerrys Plains Village and the surrounding equine industry.

24% of road uses access or leave Lemington Road from the south of which 8% represent through traffic and the remaining are accessing or leaving either HVO or Ravensworth Operations (WSP 2022). For those accessing HVO or Ravensworth Operations, Option 2 would represent a significant travel impact because travellers would need to travel via New England Highway and Lemington Rd to access or leave the mine sites. Likely most of these users will utilise New England Highway for the entire route rather than Golden Highway. For through users most are travelling from East to West and may benefit from the alignment however that depends on their origin or final destination once on the New England Highway. Moreover, residents of Jerry Plains wishing to travel to the north of Singleton, which was a key concern of local residents noted during Project consultation (EMM 2022a), would experience a longer travel route and time. Option 2 would also result in an increase in through traffic in Jerrys Plains. For reasons of travel time impact Option 2 was not considered as a preferred option.

It is noted that HVO North as approved is authorised to transport product coal by road truck between the Howick CPP and the Newdell LP and HVLP via Pikes Gully Road, this is proposed to continue under the Project. This option would increase the likelihood of interactions between coal trucks and public road users.

As such this option was not considered reasonable and feasible and did not best meet Project objectives.

Summary of constraints:

- requirement of a new intersection in the vicinity of Jerrys Plains and equine industry
- purchase of private land within the vicinity of Jerry Plains village;
- increase through traffic within the Jerrys Plains village;
- improvements to the existing Pikes Gully Road and New England Highway intersection;
- increase in travel times to through traffic and traffic access HVO & Ravensworth Operations from the south; and
- increased interaction between HVO material haulage road vehicles and public traffic.

3.2.1.3 Alternative Option 3 – Close Lemington Road

Approximately 8% of road users rely on Lemington Road to travel between the New England and Golden Highways as a through road (WSP 2022), largely providing a thoroughfare for the community of Jerry Plains to access the north of Singleton. It is noted that, due to the low level of Moses Crossing, Lemington Road is regularly closed as a result of flooding. At the time of drafting this report Moses Crossing has been closed for over 120 days consecutively and over 700 days since January 2010. This is calculated on the basis of river height at the WaterNSW - managed Hunter River - Liddell monitoring station against the Moses Crossing deck height. As such, the total number of days is considered conservative given that it doesn't account for the time necessary for Singleton Council to reopen the road post a flooding event.

Given the high frequency of the closure of Moses Crossing due to flooding events requiring available alternative routes to be used for access between the New England and Golden Highways, it is considered both reasonable and feasible to close the Lemington Road at the intersection with the Golden Highway and west of the HVO North access point. Under this scenario , alternative routes within the road network would be relied upon to support both the community currently relying on Lemington Road as a throughfare and access to HVO and Ravensworth Operations.

However, HVO has determined closing the Lemington Road is not in the best interest of the local community nor workforce members who access either HVO or Ravensworth Operations from the west opting instead to provide a proposed alignment with improved flooding protection.

3.2.1.4 Alternative concepts road alignments

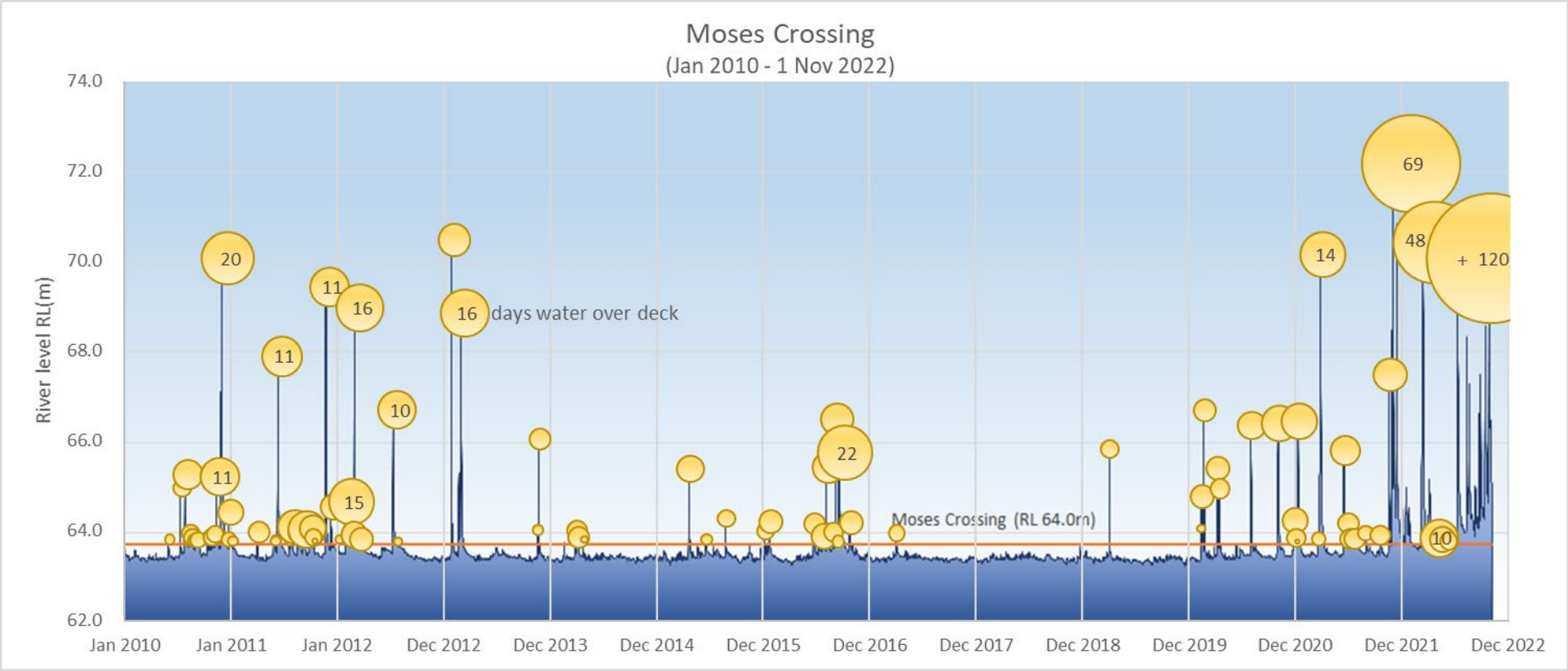
A number of concept road alignments were considered in addition to the preferred Lemington Road realignment presented by the Project and the alternate options discussed above. Concept options were developed in consideration of an unrestricted environment and were reviewed on the basis of reasonable and feasible Project and community outcomes. Following initial reviews and immediate determination that concept road alignments were not appropriate, no further assessment or consideration was undertaken.

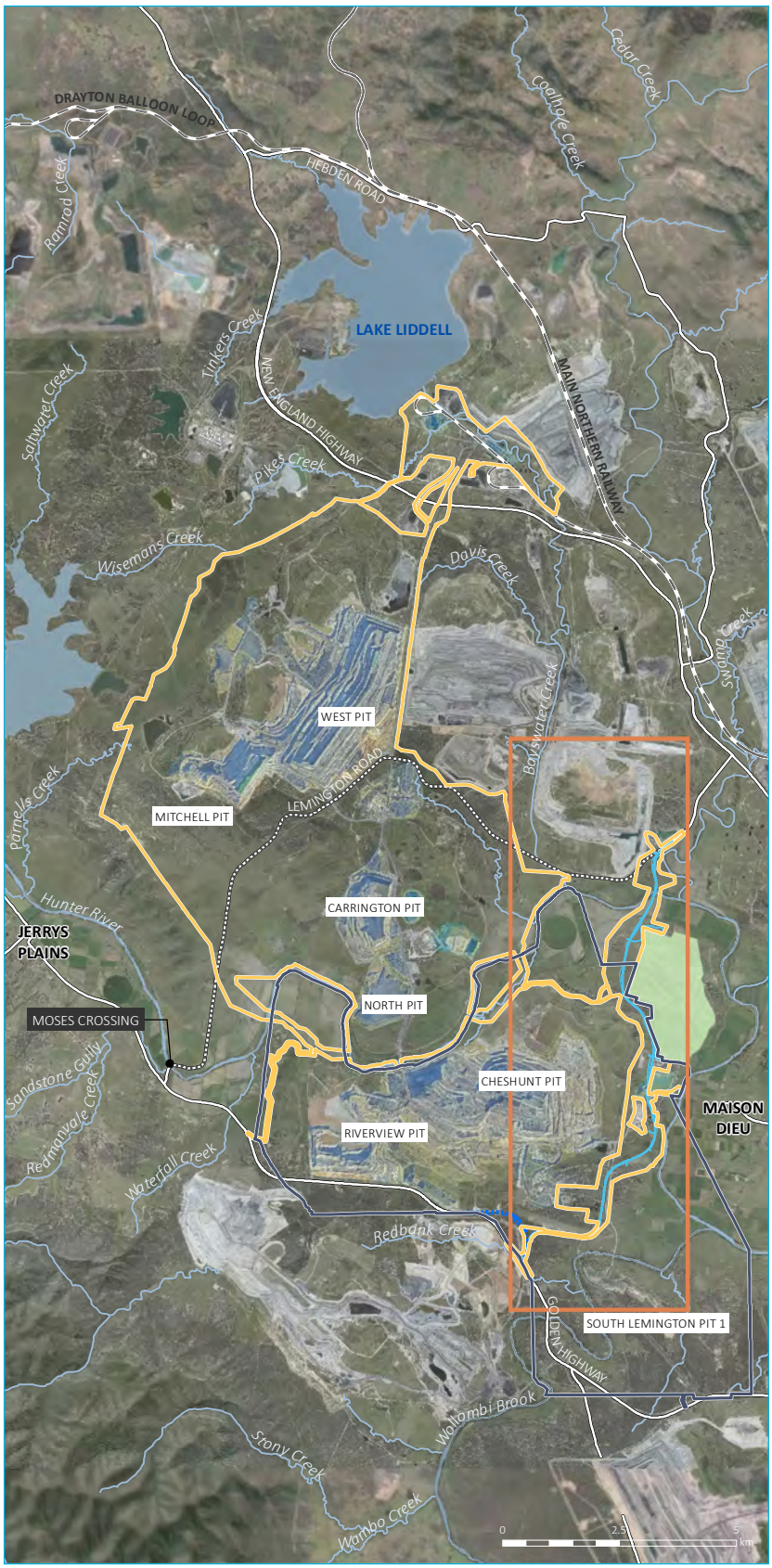
Concept alignments are illustrated in Figure 7, a summary of key constraints in which these concept road alignments were dismissed are identified below:

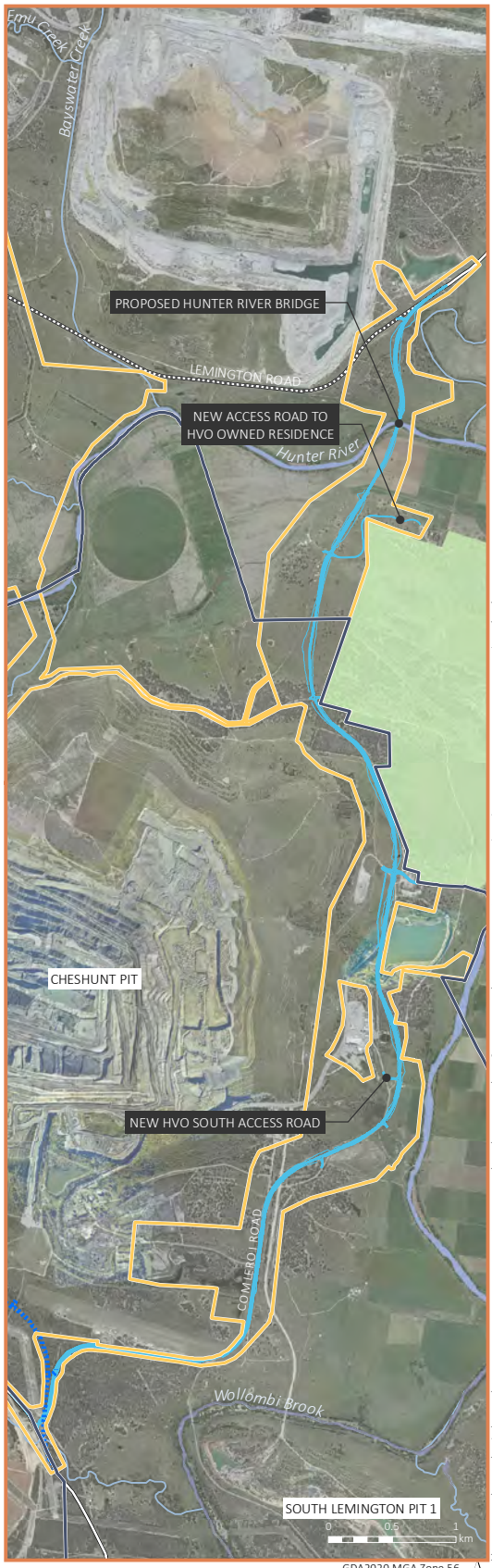
Summary of constraints:

- requirement of new and or improved intersections;
- purchase of private land;
- increase through traffic within the Jerrys Plains village;
- increase in travel times to through traffic;
- disturbance of high value ecological communities; and
- interaction with approved and proposed mining activities.

Figure 4: Moses Crossing flooding impact







\\emmsvr1\emm\Jobs\2019\H190408 - HVO Continuation Project\GIS\02_Maps_Infrastructure\OA008_LemingtonRoadRealignment_20221125_02.mxd 29/11/2022

Source: EMM (2022); HVO (2022); DFSI (2017); GA (2011)

GDA2020 MGA Zone 56

N

KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Biodiversity offset area
- Proposed Lemington Road realignment
- Indicative location of public road closure
- Alternate Golden Highway alignment (as per United Wambo Joint Venture - SSD 7142)

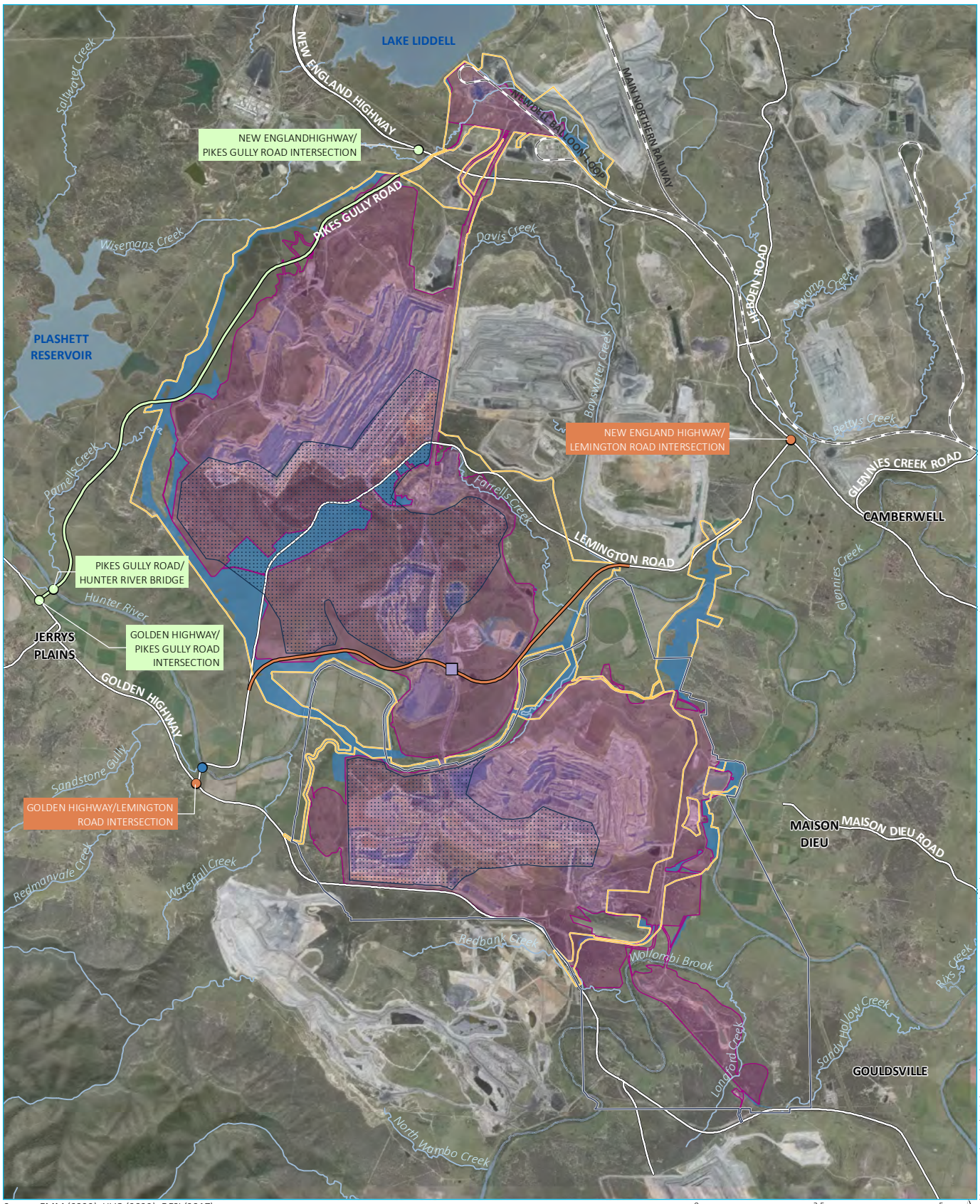
Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Lemington Road realignment

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 5

EMM creating opportunities



Source: EMM (2022); HVO (2022); DFSI (2017)

0 2.5 5 km

GDA2020 MGA Zone 56

N

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KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Existing and approved disturbance area
- Additional disturbance area
- Proposed mining area
- Alternative option 1 - Lemington Road
- Alternative option 2 - Pikes Gully Road

Key intersection

- Lemington Road
- Pikes Gully Road
- Potential overpass
- Moses crossing

Existing environment

- Rail line
- Major road
- Minor road
- Named watercourse
- Named waterbody

Alternative Option 1 and 2 - Lemington Road realingment south of HVO North and Pikes Gully Road extension

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 6

EMM
creating opportunities

Source: EMM (2022); HVO (2022); DFSI (2017); GA (2011)

0 2.5 5 km

GDA2020 MGA Zone 56

N

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KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Proposed mining area
- Key existing intersection
- Moses crossing

Concept alignment

- Lemington Rd - shortened concept
- Lemington Rd - Concept 1
- Lemington Rd - Concept 2
- Lemington Rd - Concept 3
- Lemington Rd - Concept 4
- Lemington Rd - Concept 4 - RN Access
- Lemington Rd - Concept 5
- Lemington Rd - Concept 6
- Lemington Rd - Concept 7
- Lemington Rd - Concept 8
- Lemington Rd - Concept 9
- Pikes Gulley Rd - Concept 1
- Pikes Gulley Rd - Concept 2
- Pikes Gulley Rd - Concept 3
- Pikes Gulley Rd - Concept 4

Existing environment

- Rail line
- Major road
- Minor road
- Named watercourse
- Named waterbody

Concept alignments

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 7

EMM
creating opportunities

3.2.2 Product stockpile and train loading facility upgrades

3.2.2.1 Background – HVO Coal Handling & Processing

As currently approved, coal extracted across the HVO Complex is transported via internal haul roads to one of two CPPs; the HVCPP or the Howick CPP (see Figure 3), where it is crushed to size and either processed to remove impurities or bypassed where coal quality is appropriate. Processing produces saleable coal, along with coarse and fine reject materials. Coarse rejects are disposed of in pit, and fine rejects are placed in a TSF. Each CPP site has storage facilities for raw (unprocessed/ROM) coal and processed (saleable/product) coal.

The HVCPP may process up to a total of 20 Mtpa of ROM coal from the HVO Complex, of which only 16 Mtpa may be received from HVO South. The Howick CPP may process up to 6 Mtpa of ROM coal. Both HVCPP and Howick CPP utilise available processing technologies to process ROM coal.

The HVO South approval authorises the use of the HVCPP and Howick CPP and the HVLP and Newdell LP for coal extracted from HVO South. A CPP was constructed in the Lemington area as part of the initial development of the Lemington mine in 1971; however, it was closed and decommissioned in 1987 with the facilities placed under care and maintenance and finally demolished in 2003. HVO South has approval to construct and operate a new LCPP and to construct a rail loop off the Wambo rail spur, as shown in Figure 3. The construction of this infrastructure has not been required to date and is further discussed in Section 2.3.

3.2.2.2 Product Stockpile & TLO Upgrade

Coal handling infrastructure improvements proposed by the Project, being the preferred Project product stockpile and train loading facility upgrades, include an extension of the HVLP product coal stockpile, or the construction of a new product stockpile and train loading facilities at the Newdell LP, as shown in Figure 3.

The construction of a new product stockpile and train loading facilities at Newdell will require the demolition of parts of the existing Newdell LP facility. The new facility will involve the construction of a new product coal stockpile and train loading bin and an upgrade of elements of the existing stockpile. The area identified for the works is within an area already disturbed and has already historically been an area of coal stockpiles.

If the HVLP upgrade is proceeded with, the HVLP product stockpile will be extended as shown in Figure 3. The extension will involve the removal of vegetation and topsoil from the extended footprint, establishment of a hard stand base and necessary infrastructure such as conveyors, stackers and reclaimers. The extension will also require the closure of a portion of Liddell Station Road. This portion of road is not currently publicly accessible. In addition, the construction of the HVLP stockpile extension requires the realignment of existing transmission lines as shown in Figure 3. Communication lines which interact with the HVLP extension are also required to be realigned.

Upgrades to either the Newdell LP or the HVLP will improve coal handling efficiency across the HVO Complex. Furthermore the preferred Project product stockpile and train loading facility upgrades present the following additional benefits:

- Opportunity to improve existing infrastructure:
    - Newdell LP and stockpile
        - The Newdell LP and stockpile facilities dates back to the original Newdell CHPP facilities built subsequent to the 1949 commencement of operations. It was the subject of upgrades in 2012 by construction of a conveyor linking HVLP and the Newdell stockpile. Thus providing the opportunity to improve existing infrastructure within the largely the same footprint or within previously disturbed area.
        - The existing Newdell stockpile is restricted by its current size, with a capacity of around 300 kt, and has a slow reclaim rate. The existing train loading bin enables reasonable train loading times however this process does not support short intervals between trains and the bin itself is aged and requires significant repairs. Providing an additional stockpile with modern efficient reclaim infrastructure, and a new train loading bin, will provide the most cost effective opportunity to improve product handling for HVO.
    - HVLP stockpile

- The HVLP stockpile extension largely provides the same benefits of that identified for the Newdell LP and stockpile improvements proposed. However will require the realignment of transmission and telecommunications infrastructure.

The preferred Project product stockpile and train loading facility upgrades have been selected on the basis that it represents the most cost effective option that minimises disturbance and interaction with existing infrastructure. It can also readily receive product coal from existing CPPs.

Alternative product stockpile and train loading facility upgrades considered but determined not reasonable or feasible are summarised below.

3.2.2.3 Alternative Option – Additional capacity at HVCPP or Howick CPP

Both HVCPP and Howick CPP have product stockpiles albeit of limited capacity, identified in Figure 3. An alternative option considered was increasing the size of either or both of these two facilities. Increasing the capacity of these two facilities was not reasonable and feasible when compared to the preferred Project product stockpile and train loading facility upgrades on the basis of the following:

- Distance to train loading facilities presenting operational restrictions by way of long overland conveyor and or heavy vehicle material haulage to train loading facilities. Ideally product stockpiles for train loading are as close as possible to the train loading facility;
- As the stockpiles could only receive coal from their respective preparation plants expanding stockpiles at the plants restricts coal blending opportunities;
- Increased capital cost expenditure in comparison to the to the preferred Project product stockpile and train loading facility upgrades as more stockpile space would be required;
- There are also existing environment restrictions at both the HVCPP and Howick CPP:
    - HVCPP
        - Farrells Creek is north and east of the HVCPP and stockpiles restricting potential extension, noting that sections of creek have previously been diverted to allow for the existing HVCPP stockpiles.
        - The existing Lemington Road alignment is north of the HVCPP and stockpiles restricting any increase north. Noting this section of the existing Lemington Road realignment is proposed to be relied upon to facilitate access to the HVO North MIA under the Project.
        - Previously undisturbed vegetation is immediately west of the HVCPP and stockpiles restricting potential extension. Approximately 10 ha of undisturbed vegetation is between the Hunter Valley Conveyor One (HVC1) and the existing HVCPP stockpiles would likely be required to be impacted.
        - The primary Hunter Valley product coal conveyor (HVC1) is west of the existing HVCPP stockpiles restricting extension west of the vegetated area.
        - Previous and proposed mining activities to the south of the HVCPP and stockpiles restricts potential extension.
    - Howick CPP
        - Pikes Gully is east of the Howick CPP restricting potential extension, noting that sections of creek have previously been diverted to facilitate mining activities.
        - Previous and proposed mining activities to the south of the HVCPP and stockpiles restricts potential extension.
        - Pikes Gully Road is north of the Howick CPP restricting potential extension.

3.2.3 Realignment path of transmission and telecommunication lines

The Project requires the realignment of a range of electrical transmission lines, communication infrastructure assets and associated services within the proposed mining area to avoid interaction with proposed activities at HVO North. Services to be relocated include, but are not limited to, sections of Ausgrid's 132 kV, 66 kV and 11 kV transmission infrastructure, as well as 33 kV transmission lines owned by AGL, and some Telstra owned telecommunication lines.

Internal HVO owned electricity and telecommunication infrastructure will also need to be relocated. New maintenance and service accesses to realigned electricity and communication infrastructure will also be established to avoid interaction with mining activities where possible.

As a result of consultation with the infrastructure owners, the transmission and telecommunication infrastructure requiring relocation and not owned by HVO are included as part of the Project, and therefore sit within the Project disturbance area. The realignment works will be completed with agreement with the relative asset owners.

The proposed transmission line realignment paths are illustrated in Figure 8, with disturbance for other electrical and telecommunication infrastructure included within the Project area. The extent of disturbance associated with the new transmission lines and associated establishment of easements will be limited to transmission line pole pads and an access road for maintenance along the alignment, as well as vegetation management to maintain safe powerline clearance. The disturbance associated with decommissioning existing transmission line easements will be confined to existing access tracks and cleared areas.

As part of Project planning, the preferred realignments of services to be relocated has been carefully considered to avoid areas of environmental sensitivity as much as possible and to avoid disruption to electricity and communications distribution, as discussed in Section 3.

An overview of the preferred realignment paths of each individual transmission and telecommunication line is provided in Table 2 and illustrated in Figure 8. Table 2 inclusive of the benefits presented by the preferred alignments.

3.2.3.1 Alignment Design Process

The design process of the realignment routes for transmission and telecommunication linear assets, both 3rd party and HVO owned, has been the same regardless of the asset. The process relied upon to ensure reasonable and feasible mitigation measures have been adopted whilst ensuring Project outcomes is defined below.

1. Identify the Project interaction point with transmission or telecommunication line item;
2. Identify the nearest reasonable connection points each side of the interaction;
3. Identify areas or points of avoidance such as sensitive biodiversity matters, heritage items and or landownership constraints;
4. Understand potential amenity impacts;
5. Plan a minimum length alignment between available connection points whilst recognising outcomes of Steps 3 and 4;
6. Consult with the asset owner on the appropriateness of the alignment
7. Adjust if necessary.

Through this process implementing reasonable and feasible impact avoidance and mitigation whilst achieving Project outcomes, the potential impacts of the Project as it relates to transmission and telecommunication line infrastructure is kept to a minimum.

To this end Table 2 below overviews the primary assets for relocation, describes their function and notes the avoidance or minimisation measures undertake during the design process.

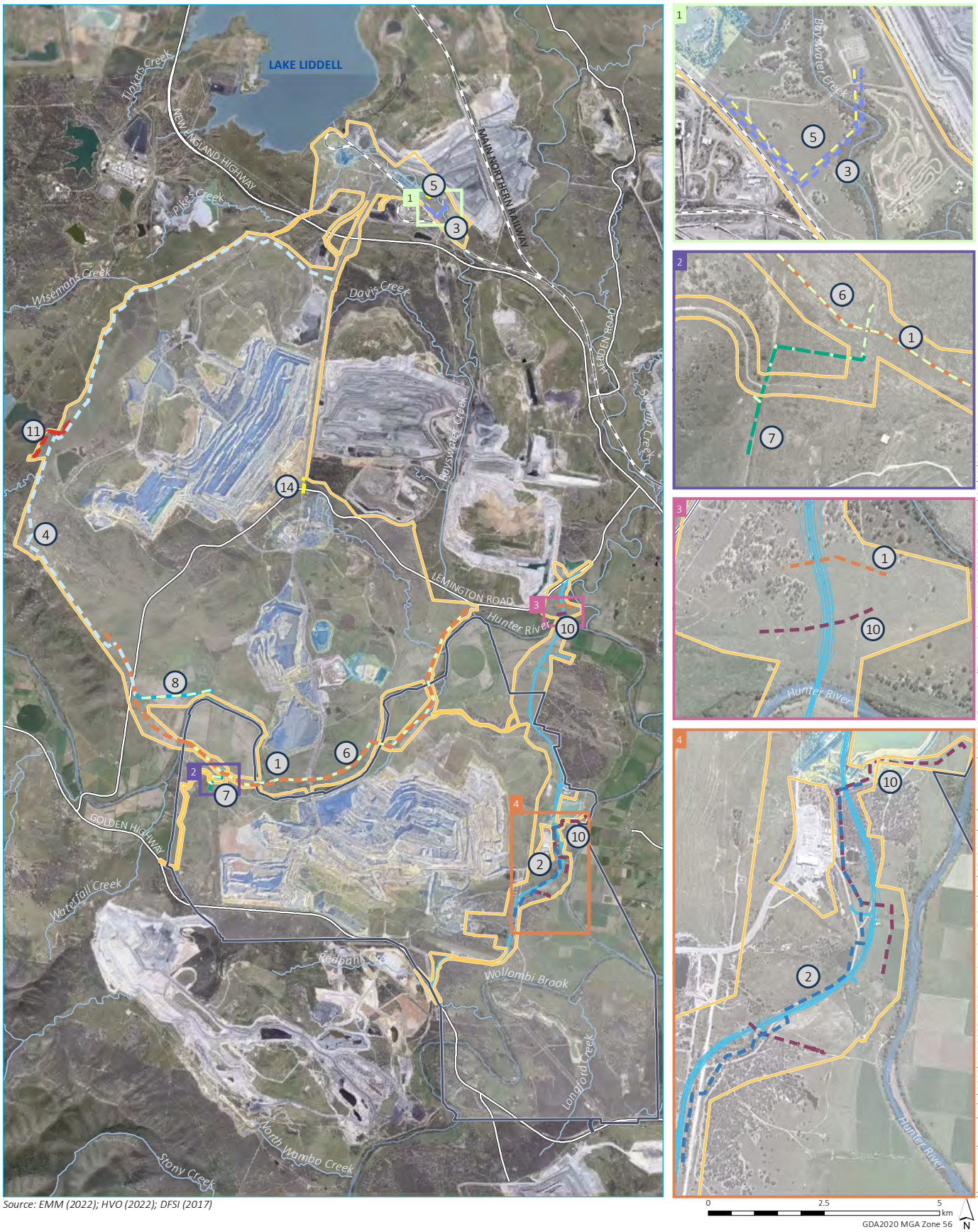
Table 2: Summary of preferred transmission and telecommunication infrastructure realignment paths

ID	Voltage	Asset Owner	Realignment required due to	Service provided by realignment	Impact avoidance and minimisation adopted
1	132 kV	Ausgrid	Existing alignment within HVO North proposed mining area	Ensure continued connection of existing 132 kV transmission line and end users.	• Avoids interaction with proposed and approved mining. • Sighted to avoid visual impacts to local receptors as Wandewoi ridgeline provides shielding to Jerry Plains Village. • Located on land owned by HVO JV or AGL, ensuring no private land is required to be directly impacted or purchased. • Sighted to avoid areas of high ecological values and Aboriginal cultural heritage sites or minimise impact by selection of towers or appropriate structural strength poles. • River crossings aligned to avoid potential native title interaction. • River crossings minimised in consideration of Ausgrid access requirements. • Pole designs through river flood plains designed for flood clearance as per Ausgrid guidelines.
2	66 kV	Ausgrid	Existing alignment within proposed Lemington Road realignment path	Ensure continued connection of existing 66 kV transmission line and end users.	• Located in proximity to existing alignment and largely located within existing and approved disturbance. • Avoids interactions with Lemington Road realignment. • Minimises ecological impact by utilising existing transmission line corridors where possible.
3	66 kV	Ausgrid	Existing alignment within proposed HVLP stockpile extension. Note inclusive of 66 kV sections north and south of proposed HVLP stockpile	Ensure continued connection of existing 66 kV transmission lines to Newdell Zone 66/11kV Substation.	• Avoids interaction with proposed and approved mining. • Sighted to avoid areas of high ecological values and Aboriginal cultural heritage sites or minimise impact by selection of towers or poles. • Highly industrial zone presenting no amenity impacts to local receptors.

ID	Voltage	Asset Owner	Realignment required due to	Service provided by realignment	Impact avoidance and minimisation adopted
4	66 kV	Ausgrid	Existing alignment within HVO North proposed mining area	Ensure continued connection of existing 66 kV ring-main and spur connection to HVCPP Zone Substation.	• Avoids interaction with proposed and approved mining. • Sighted to avoid areas of high ecological values and Aboriginal cultural heritage sites or minimise impact by selection of towers or poles. • Highly industrial zone presenting no amenity impacts to local receptors. • Minimise alignment impact with neighbouring (AGL) land
5	11 kV	Ausgrid	Existing alignment within proposed HVLP stockpile extension	Ensure continued connection of existing 66 kV transmission line to Newdell Zone 66/11 kV Substation.	• Avoids interaction with proposed and approved mining. • Sighted to avoid areas of high ecological values and Aboriginal cultural heritage sites or minimise impact by selection of towers or poles. • Highly industrial zone presenting no amenity impacts to local receptors.
6	11 kV	Ausgrid	Existing alignment within HVO North proposed mining area and levee construction	Ensure continued connection of existing 11 kV transmission line and end users.	• Minor realignment as to ensure towers or poles do not interact with proposed supportive infrastructure footprint. • Located in proximity to existing alignment and largely within an area cleared for agricultural purposes. • Sighted to avoid areas of high ecological values and Aboriginal cultural heritage sites • Alignment with 132kV line where possible to minimise impacts to biodiversity matters.
7	66 kV	Ausgrid	Existing alignment within proposed HVO South supportive infrastructure footprint Riverview flood protection levee	Ensure continued connection of existing 66 kV transmission line and end users.	• Minor realignment as to ensure towers or poles do not interact with proposed supportive infrastructure footprint. • Sighted to avoid areas of high ecological values and Aboriginal cultural heritage sites • Located in proximity to existing alignment and largely located within an area cleared for agricultural purposes

ID	Voltage	Asset Owner	Realignment required due to	Service provided by realignment	Impact avoidance and minimisation adopted
8	66 kV	Ausgrid	Existing alignment within HVO North proposed mining area	Ensures continued connection to Lemington Zone 66/11 kV Substation	• Located in proximity to existing alignment and largely located within existing and approved disturbance. • Highly industrial zone presenting no amenity impacts to local receptors.
9	11 kV	Ausgrid	Existing alignment within proposed Lemington Road realignment path	Ensure continued connection of existing 11 kV transmission line and end users.	• Avoids interactions with Lemington Road realignment. • Avoids impact with Crown land • Utilises existing transmission line corridor where possible to minimise interaction with biodiversity matters.
10	132 kV & 11 kV	Ausgrid	Existing alignment within proposed Lemington Road realignment path. Note this is in regard to the section which interacts with the north end of the proposed Lemington Road realignment.	Ensure continued connection of existing132kV & 11 kV transmission line and end users.	• Minor realignment and height adjustment to ensure towers or poles do not impact the proposed Lemington Road realignment or road construction. • Located in proximity to existing alignment and largely within an area cleared for agricultural purposes
11	33 kV	AGL	Realignment required to minimise impact of realigned Ausgrid 66 kV asset and existing TransGrid 330 kV asset.	Ensure continued connection of existing 33 kV transmission line and end users.	• Located in proximity to existing alignment and largely located within an area cleared for agricultural purposes. • Avoids interaction with the existing TransGrid 330 kV transmission line within a constrained environment with Plashett Reservoir to the west and Parnells Dam construction to the east. •
12	Telstra communications line	Telstra	Existing alignment within HVO North proposed mining area	Ensures continued communications to HVO north infrastructure and Ausgrid Lemington Zone Substation	• Avoids interaction with proposed and approved mining. • Does not interact with proposed supportive infrastructure footprint. • Realignment to ensure not impacted by the proposed HVO North altered mining entrance road realignment or road construction.

ID	Voltage	Asset Owner	Realignment required due to	Service provided by realignment	Impact avoidance and minimisation adopted
13	Telstra Communications	Telstra	Existing alignment within proposed Lemington Road realignment path	Ensures continued connection to existing Hunter River gauging station facilities	• Avoids interactions with Lemington Road realignment.
14	66kV	Ausgrid	Existing alignment within HVO North proposed mining area	Ensures continued connection to Hunter Valley Zone 66/11 kV Substation	• Minor realignment and height adjustment to ensure monopoles do not impact the proposed HVO South altered mining entrance off the Lemington Road realignment or road construction.



Source: EMM (2022); HVO (2022); DFSI (2017)

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0 2.5 5 km

GDA2020 MGA Zone 56

N

KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Proposed Lemington Road realignment

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

Transmission line realignment

- 1 | 132 kV - Ausgrid
- 2 | 66 kV - Ausgrid
- 3 | 66 kV - Ausgrid
- 4 | 66 kV - Ausgrid
- 5 | 11 kV - Ausgrid
- 6 | 11 kV - Ausgrid
- 7 | 66 kV - Ausgrid
- 8 | 66 kV - Ausgrid
- 10 | 132 kV & 11 kV - Ausgrid
- 11 | 33 kV - AGL
- 14 , 66kV, Ausgrid

Proposed transmission and telecommunication lines

HVO Continuation Project
Infrastructure Options and Alternatives Report
Figure 8

EMM
creating opportunities

3.2.4 Improvements to the HVO North MIA

The existing HVO North MIA within the HVO North Project area will be upgraded to include a new workshop suitable for ultra-class haul trucks and incorporate modern maintenance facilities. The proposed improvements to the HVO North MIA are within the existing approved disturbance area of HVO North. The upgrade will also include administration offices, bath house extension and carparking to more appropriately manage and modernise the existing facilities. It will also assist in the transition in workforce away from the Howick MIA facility as mining in HVO North progresses further south-east.

The option to upgrade the HVO North MIA was identified as the most appropriate location for the following reasons:

- it is already the principal HVO facility and works are achievable without additional disturbance;
- the HVO North MIA and HVCPP combined are centrally located without near neighbours and close to mining operations, minimising potential impact to sensitive receivers; and
- as mining progress further south upgrading and or refurbishment of the Howick MIA represents an impractical long term solution.

Noting the above the improvements to the HVO North MIA were determined to be reasonable and feasible options which best meet the Project objectives with no further options considered.

3.3 HVO South Infrastructure

3.3.1 Lemington CPP and associated rail loop

The HVO South approval authorises the use of the HVCPP and Howick CPP and the HVLP and Newdell LP for coal extracted from HVO South. A CPP was constructed in the Lemington area as part of the initial development of the Lemington mine in 1971; however, it was closed and decommissioned in 1987 with the facilities placed under care and maintenance and demolished in 2003.

HVO South has approval to construct and operate a new LCPP and to construct a short and long rail loop off the Wambo rail spur, as shown in Figure 2. The construction of this infrastructure has not been required to date. Construction of the LCPP, and the trucking of ROM coal from the Riverview and Cheshunt Pits for processing there, was approved in an earlier development application for HVO South (PA 06_0261) and remains approved under the current consolidated project approval.

The opportunity to construct the LCPP and rail loop is critical for the continued operations of HVO South. The Project proposes to construct the LCPP in around Year 11-15 when production exceeds the capacity of the HVO North clearance infrastructure and approved processing limits. Moreover, the Lemington facility is critical if, should operational or commercial arrangement require it, the HVO South operation is required to operate independently.

In reviewing the approved LCPP and associated rail loop in consideration of the Project, the following constraints were identified should it be moved outside the existing approved location:

- impacts to identified items of biodiversity value;
- potential amenity impacts, namely to residences of Maison Dieu;
- proximity to the Hunter River and Wollombi Brook and associated flood immunity considerations;
- proximity to mining operations; and
- there are very few alternate locations for the Lemington CPP.

As with the location of the LCPP, the location of the connecting product coal clearance infrastructure is similarly constrained. There is no available corridor for a rail, or even conveyor, to link the Lemington CPP with the HVO rail facilities at the HVLP and Newdell LP. As such the currently approved LCPP was determined to be reasonable and feasible option which best meets the Project objectives. No further new CPP or coal clearance systems alternate options were considered in regard to HVO South.

It is noted that the approved short rail loop option, with a rail balloon loop adjacent to the Wambo rail spur near the Golden Highway, required the disturbance of approximately 26.1 ha of high value biodiversity features discussed in Section 4.3.1. Moreover, neither a conveyor, or a truck haul option, was particularly feasible due to the constraints of the area, the crossing of South Lemington Pit 1 and the adjacent Wollombi Brook. It was therefore realised that the approved long rail option, which is currently approved under PA 06_0261, is the preferred product coal clearance option for the LCPP, and that short rail loop option would not be retained under the Project, further discussed in Section 3.

4. Avoidance measures

4.1 Approach to avoidance

Following determination of the preferred Project design as outlined in Section 1.2 and further discussed in Section 2, detailed design of infrastructure arrangements was carried out. Involving the implementation of engineering design measures into the preferred Project infrastructure items as to avoid and minimise potential environmental and social impacts whilst achieving positive Project outcomes.

Avoidance measures were informed by the outcomes of environmental assessments undertaken to inform the Project design and the EIS, largely in response to biodiversity and Aboriginal heritage assessment findings. The following section summarises the infrastructure avoidance measures considered reasonable and feasible, adopted by HVO whilst achieving positive Project outcomes. It is noted that the following sections includes only infrastructure items where avoidance measures were deemed appropriate, as such not all preferred infrastructure options discussed in Section 2 are considered below.

4.2 HVO North avoidance

4.2.1 Avoidance measures adopted for Lemington Road

The proposed realignment of Lemington Road has been carefully considered to avoid areas of environmental sensitivity, provide improved outcomes for road users and meet required Project outcomes. Avoidance measures implemented to the preferred Lemington Road realignment are summarised below in comparison to the prefeasibility early design.

4.2.1.1 Consideration of biodiversity features

The realignment of Lemington Road intersects areas of high biodiversity value, to minimise this impact HVO engaged an engineering study (WSP 2021) to undertake further engineering design works to reduce the direct disturbance to areas of biodiversity significance. Figure 9 illustrates the proposed disturbance footprint of the Lemington Road realignment, whilst confirming areas in which complete avoidance has been achieved via engineering design and the associated biodiversity features located within.

Avoidance areas were included within the prefeasibility disturbance area of the Lemington Road realignment prior to identification of areas of high biodiversity value. A total of 25.8 ha of direct impacts to ecological communities has been actively avoided through this process, as illustrated in Figure 9. Further information in regard to ecological communities proposed to be impacted by the Project is available within the Biodiversity Development Assessment Report (Umwelt 2022), see Appendix L of the EIS.

Table 3 below confirms the total area avoided via engineering design, in comparison to early prefeasibility design works and the total reduction of direct impacts to biodiversity features.

Table 3: Impacts avoided following Lemington Road realignment design refinement

Biodiversity Feature	Area (ha) Avoided^
Native forest and woodland habitat	19.5 ha
Native and exotic grasslands	6.3 ha
BC Act-Listed Features	
Warkworth Sands Woodland EEC	7.2 ha
Central Hunter Grey Box – Ironbark Woodland EEC	9.1 ha
Hunter Valley Footslopes Slaty Gum Woodland VEC	2.6 ha
EPBC Act-Listed Features	
Warkworth Sands Woodland in the Hunter Valley CEEC	7.2 ha
Central Hunter Valley Eucalypt Forest and Woodland CEEC	10.6 ha

^Areas not cumulative

As identified Section 3.1, significant engineering works have been undertaken to minimise impacts to items of biodiversity value. Direct impacts to items of biodiversity value, including impacts to Warkworth Sands Woodland EEC and Central Hunter Grey Box – Ironbark Woodland EEC, have been avoided as much as is reasonable and feasible due to the location of the existing mining operations and established biodiversity offsets areas in proximity of the proposed alignment, as identified in Section 2.2.1.

HVO has conducted substantial consideration of the alignment within the area of WSW to reduce the overall disturbance required whilst meeting relevant road design parameters. This has resulted in the avoidance of approximately 7.2 ha of WSW by the proposed alignment. These avoidance measures will increase road construction cost but minimise impacts to WSW and other ecological features as much as possible.

It is noted that under the Project, HVO propose to implement a WSW offset strategy in which a 50 ha area will be relied upon to develop the South Lemington Offset to mitigate potential impacts of the Project on WSW. The South Lemington Offset is further discussed within the BDAR (Umwelt 2022), see Appendix L of the EIS.

Noting the above the avoidance measures proposed by HVO, ensure direct impacts are minimised as far as reasonable and feasible whilst ensuring Project and community outcomes are achieved.

4.2.1.2 Consideration of Aboriginal cultural heritage matters

Two Aboriginal scarred trees, HVOCP TR212-ST1 (AHIMS #37-3-1629) and HVOCP TR216-ST1 (AHIMS #37-3-1635), are located within the Project disturbance area associated with the proposed Lemington Road realignment, as shown in Figure 10. HVO commissioned an engineering study (WSP 2021) to review the road design and investigate options whereby avoidance of harm to these sites could be avoided.

Considerations of the road design needed to consider the below listed items, and where appropriate identified in Figure 10:

- avoidance of existing 330 kV transmission lines and maintaining safe vertical clearance for construction and ongoing road use;
- maintained access to existing residences;
- avoidance or minimisation of impacts to endangered ecological communities including WSW EEC and Central Hunter Grey Box – Ironbark Woodland EEC and other native forest and woodland habitat, as well as the Warkworth Northern Biodiversity Area (NBA) Offset located to the immediate east of the proposed alignment;

- alignment of the road to maintaining a 100 km/h speed limit and a perpendicular crossing of the Hunter River to meet the requirements of flood protection design; and
- minimisation of disturbances including those associated with cut and fill.

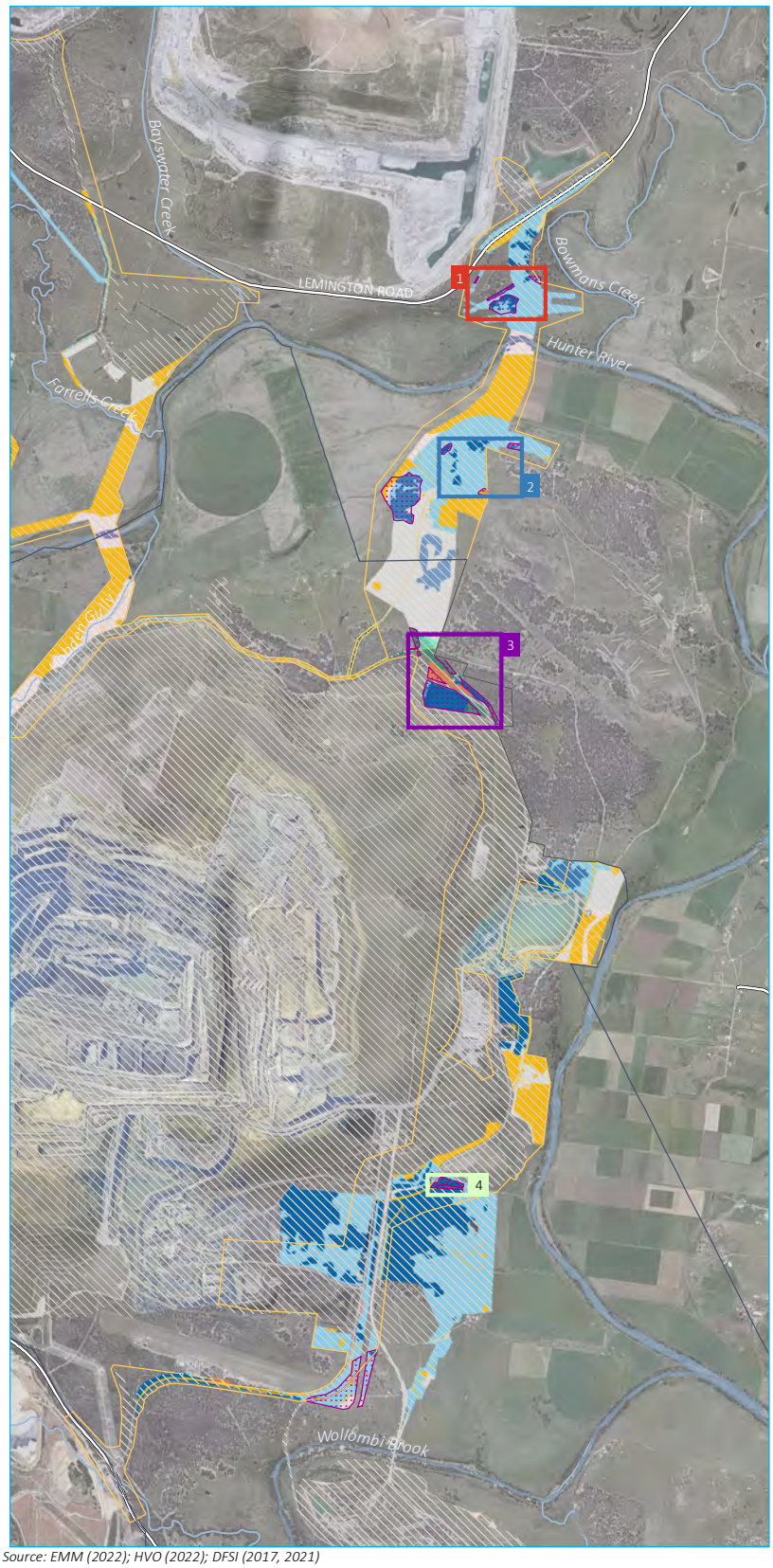
Due to an extremely constrained alignment path as a result primarily of local topology and established Warkworth NBA Offset in proximity of the items, avoidance of direct impacts to the two scarred trees has not been achievable.

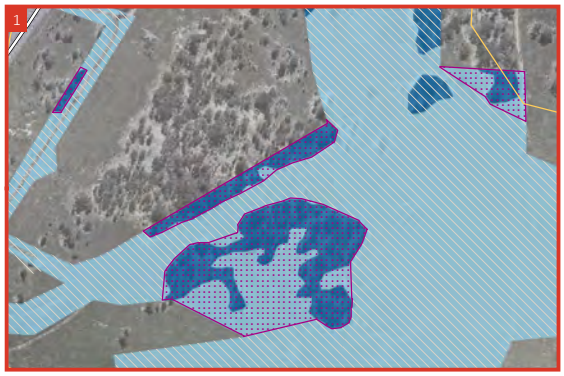
Consultation was undertaken with Registered Aboriginal Parties (RAPs) in regard to the proposed impact to the two scarred trees. A key outcome of consultation with RAPs was agreement regarding the appropriateness of salvage of the culturally scarred portions of the trees due to their poor and increasingly degrading condition, and preference for long-term management being for the salvaged portions to be kept near to their original location or at an established keeping place. Salvage and the long-term management of the scarred trees is further discussed within the Aboriginal Cultural Heritage Assessment Report (ACHAR, (EMMb 2022)), see Appendix N of the EIS.

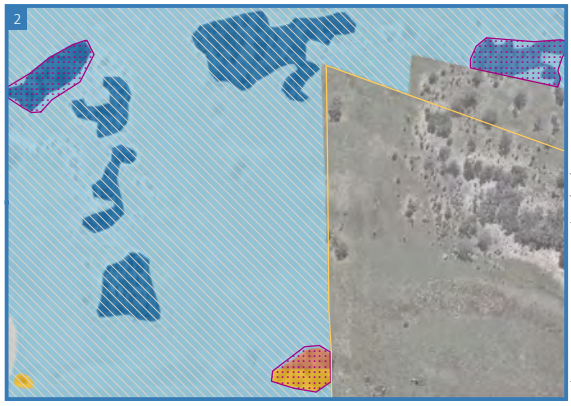
An alternative road alignment option considered to avoid direct impacts to the scarred trees is identified in Figure 10. This alternative road realignment option was determined to not be reasonable and feasible or best meet required Project outcomes on the basis of the following:

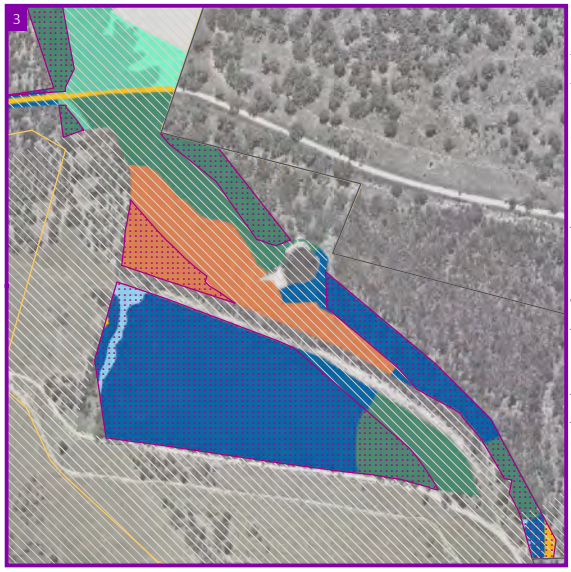
- Clearance under the existing 330 kV transmission line, due to local topology, is limiting to the safe construction of the road and ongoing public for the safe road construction and operation;
- Insufficient clearance between the alternative road alignment and the Warkworth NBA Offset to provide suitable road access to existing residents;
- Insufficient clearance to scarred tree HVOCP TR216-ST1;
- The southern bridge under the alternative road alignment would require to be longer with a steeper elevation to that under the proposed alignment; and
- Significant further earthworks would be required in comparison to the preferred alignment.

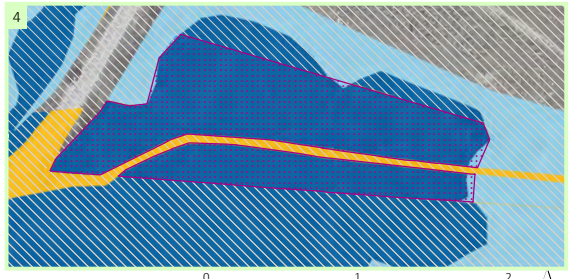
For the reasons outlined above the proposed Lemington Road realignment is considered reasonable and feasible whilst resulting in direct impacts to HVOCP TR212-ST1 and HVOCP TR216-ST1. Consultation with RAPs has determined that salvage of the culturally scarred portions of the trees is acceptable. It is therefore considered that the preferred alignment represents the best Project outcome for both HVO and RAPs, whilst ensuring the preservation of cultural items.











Source: EMM (2022); HVO (2022); DFSI (2017, 2021)

0 1 2 km

GDA2020 MGA Zone 56

N

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KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Project disturbance area
- Avoidance area

Vegetation community | Condition

- Category 1 - Exempt Land

PCT 42
- Cooba woodland
- Moderate
- Low to moderate
- Derived native grassland
- Exotic grassland

PCT 485
- Moderate

PCT 1655
- Moderate
- Thinned

PCT 1658
- Moderate
- Low to moderate
- Regeneration
- Exotic grassland
- Disturbed

PCT 1691
- Cooba woodland
- Woodland with exotic understory
- Thinned woodland
- Moderate
- Plantation
- Scattered regeneration
- Poor condition derived native grassland
- Exotic grassland

PCT 1692
- Moderate

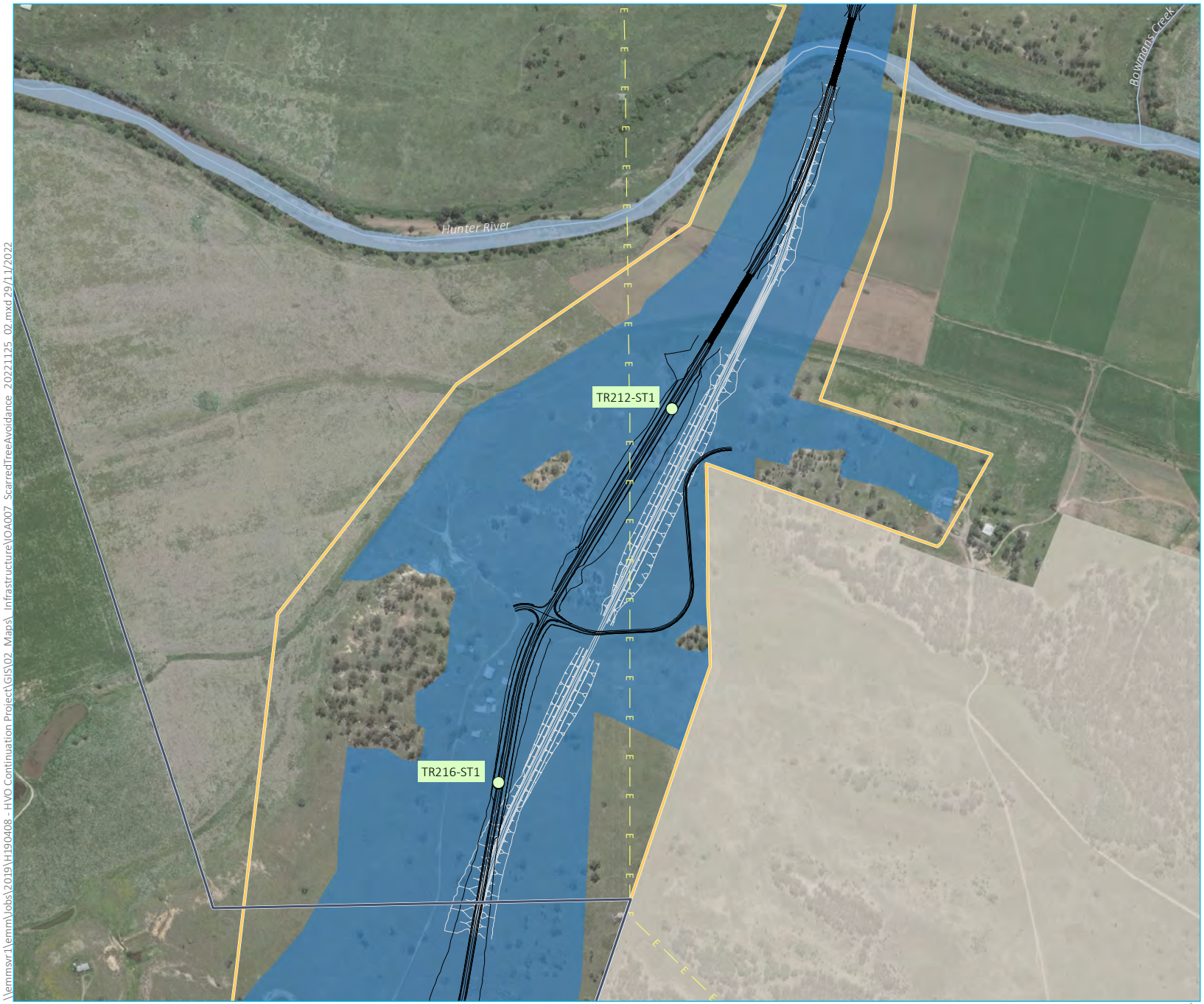
PCT 1731
- Moderate

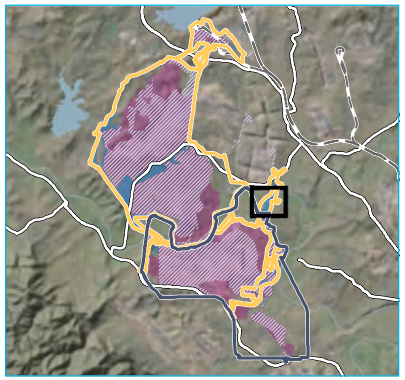
Existing environment
- Major road
- Named watercourse
- Named waterbody

Lemington Road - biodiversity avoidance

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 9

EMM
creating opportunities





KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Existing and approved disturbance area (refer to inset)
- Additional disturbance area
- Area of redisturbance (refer to inset)
- Mt Thorley offset area
- Lemington Road preferred alignment
- Scarred tree avoidance alignment
- Existing 330 kV transmission line
- Scarred tree
- Rail line
- Named watercourse
- Named waterbody

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Source: EMM (2022); HVO (2022); DFSI (2017); DPI (2013)

0 250 500 m

GDA2020 MGA Zone 56

N

Lemington Road - Scarred tree avoidance

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 10

EMM creating opportunities

4.2.2 Avoidance measures adopted for transmission lines

As noted in Section 2.2.3, due to the nature of the majority of transmission and telecommunication line realignments, only a single option, being the preferred realignments identified in Table 2, was determined to be reasonable and feasible options which best meet the Project objectives. Avoidance measures enacted by the Project in relation transmission lines are identified in the following sections.

4.2.2.1 Consideration of biodiversity features

Consideration of overall impact minimisation of transmission line easements

As part of the Project design phase, the preferred transmission realignment paths were carefully considered to avoid areas of higher quality vegetation and habitats, and to provide for maximum vegetation and habitat retention, wherever possible. This was implemented by the effective sighting of transmission line structures within the preferred realignment easements.

As such, impacts associated with transmission lines have been considered in accordance with the following level impact and or management, which are illustrated in Figure 11:

- Management Zone 1 (MZ1) – full clearance assumed, relating to transmission line pole structures and access tracks.
- Management Zone 2 (MZ2) – newly proposed transmission line easement vegetation maintenance (i.e. areas within the new transmission line easement under transmission lines will be managed to remove canopy and shrub species and retain understorey/grassland species).
- Wider Easement Area – wider transmission line easement. Not currently identified for impact, however the location of the transmission line is indicative only and subject to final design hence the area's inclusion in the Project disturbance area.

Table 4 outlines the impacts and avoided areas within the proposed easement corridors. These areas are illustrated in Figure 11.

Table 4: Impacts and avoidance of impact in transmission line realignment design

Impact	Description of impacts and vegetation management	Vegetation and habitat impacts avoided
MZ1	• Complete disturbance assumed for transmission line poles/towers (10 m buffer around each pole) • Complete disturbance assumed for 6 m wide access tracks for construction and operational maintenance	• N/A
MZ2	• No impact to grassland vegetation within easements unless impacted by access tracks/pole pads as above (MZ1). • Any woody vegetation zones will be retained as grassland in accordance with ISSC 20 Guideline for the Management of Activities within Electricity Easements and Close to Electricity Infrastructure (ISSC 2012).	• 47 ha of existing native vegetation (grassland, woodland and shrubland) to be maintained as grassland during operational phase. No impact to Hunter Valley delma in these areas. • Targeted avoidance of river red gum stands through careful placement of pole locations where possible along the Hunter River.

Impact	Description of impacts and vegetation management	Vegetation and habitat impacts avoided
Wider easement area	• No impact currently proposed, however changes to the final easement alignment may result in minor changes and impacts.	• 147 ha of Hunter Valley delma habitat avoided. • Avoidance of 21.8 ha of native forest and woodland habitat including 4.6 ha of *Central Hunter Grey Box – Ironbark Forest EEC* and 0.3 ha of *Hunter Floodplain Red Gum Woodland EEC* • Avoidance of 163.5 ha of exotic and native grassland habitat.

Consideration of the River Red Gum Additional Disturbance Area

The River Red Gum Additional Disturbance Area, see Figure 12, is an area within the existing HVO South Project Approval (PA 06_0261) adjacent to the Hunter River where minor impacts to the river red gum (*Eucalyptus camaldulensis*) endangered population and *Hunter Floodplain Red Gum Woodland EEC* are expected to occur because of the proposed transmission line relocation.

While this area is within the existing and approved disturbance area at HVO North, Condition 31 of PA 06_0261 states that *"The Applicant must protect all stands of the Hunter Lowland Red Gum Forest (also identified as Hunter Floodplain Red Gum Woodland Complex in the EA) endangered ecological community within the site, and adjacent lands under the control of the Applicant, as shown in Appendix 8, to the satisfaction of the Planning Secretary."*

This area includes part of a stand (Stand C) of river red gums identified in Appendix 8 of the Project Approval where Condition 30 of PA 06_0261 requires a River Red Gum Strategy to be implemented, which conserves and restores the river red gums identified. While the location of the proposed transmission line relocation is indicative, following the identification of river red gums and *Hunter Floodplain Red Gum Woodland EEC* in this area, the footprint of the transmission line was designed to minimise impacts on these threatened entities.

Ecological surveys undertaken to inform the Project of the River Red Gum Additional Disturbance Area identified 5.9 hectares of *Hunter Floodplain Red Gum Woodland EEC* and 269 individual river red gums ranging from saplings to mature trees (refer to Figure 12).

Early prefeasibility designs for the AusGrid 132 kV transmission line interacted with River Red Gum Additional Disturbance Area. Changes to the proposed alignment (see Figure 12) have avoided 5.8 ha of *Hunter Floodplain Red Gum Woodland EEC* and 255 river red gums. To ensure impacts will be avoided and minimised the following measures are proposed to be implemented by the Project:

- Pre-clearance surveys and clear delineation of easement boundaries avoiding river red gums during construction.
- Information signage to assist long-term management of the easement without impacting surrounding river red gums.
- Ongoing monitoring of river red gum in this area as outlined in the HVO River Red Gum Rehabilitation and Restoration Strategy (HVO 2020) with a recommendation to change this area from a low priority site to a 'Priority site'.

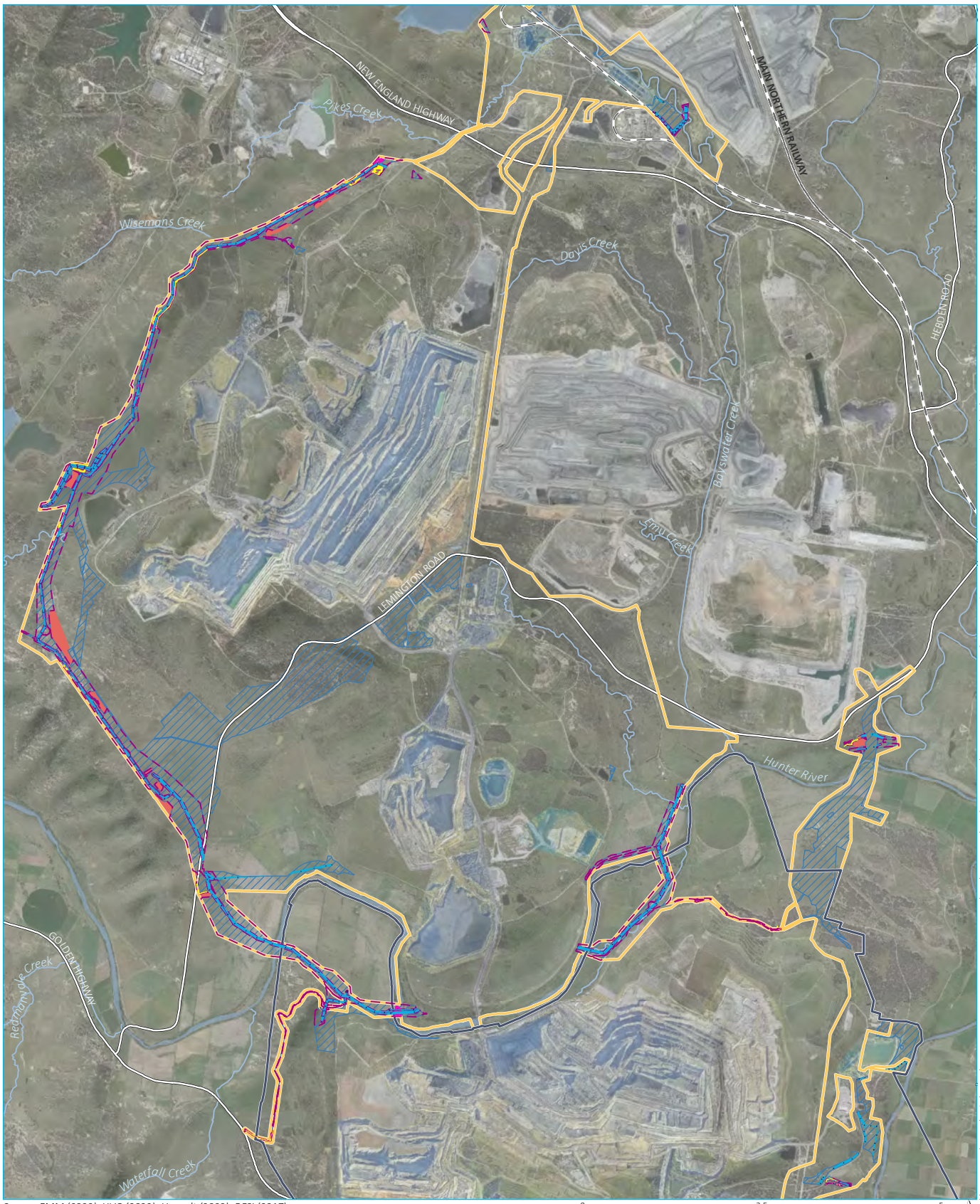
4.2.2.2 Consideration of Aboriginal cultural heritage matters

Aboriginal scarred tree TR178-ST1 is within the Project disturbance area associated with the 132 kV Ausgrid transmission line realignment, see Figure 10. Direct impacts to the scarred tree are proposed to be avoided by sighting of transmissions line structures approximately 30 m away. As such total avoidance of TR178-ST1 is considered reasonable and feasible whilst meeting required Project outcomes.

4.2.2.3 Consideration of historic heritage matters

The Historic Heritage Assessment (HHA, EMMc 2022), see Appendix O of the EIS, identified the remnant foundations within the proposed Ausgrid 132 kV transmission line alignment, see Figure 13. The HHA concludes that the remnant foundations maintains historic significance at the local level.

Direct impacts to the remnant foundations are proposed to be avoided by sighting of transmissions line structures and access tracks away from the heritage item. As such total avoidance of the remnant foundations are considered reasonable and feasible whilst meeting required Project outcomes.



Source: EMM (2022); HVO (2022); Umwelt (2022); DFSI (2017)

0 2.5 5 km

GDA2020 MGA Zone 56

N

KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Additional disturbance area
- Avoided vegetation area
- Telecommunication easement
- New pole pad (MZ1) - indicative only
- Easement vegetation maintenance (MZ2) - indicative only
- BC Act TEC mapping
- EPBC Act TEC mapping

Existing environment

- Rail line
- Major road
- Named watercourse
- Named waterbody

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Minimisation of impacts in transmission easements

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 11

EMM creating opportunities

Source: EMM (2022); HVO (2022); Umwelt (2022); DFSI (2017)

0 250 500 m

GDA2020 MGA Zone 56

N

KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Additional disturbance area
- New pole pad (MZ1) - indicative only
- Easement vegetation maintenance (MZ2) - indicative only
- River Red Gum additional disturbance area
- Hunter Floodplain Red Gum Woodland EEC
- Impacted River Red Gums' and impacted Hunter Floodplain River Red Gum Woodland EEC

NSW Bionet Atlas threatened species records (2022)

- *Eucalyptus camaldulensis* (River Red Gum)

Umwelt threatened species records (2020-2022)

- *Eucalyptus camuldulensis* (River Red Gum)
- Named watercourse
- Named waterbody

Avoidance of River Red Gums and Hunter Floodplain River Red Gum Woodland EEC in the River Red Gum additional disturbance area

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 12

EMM creating opportunities

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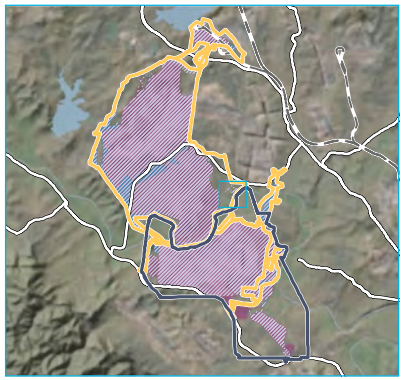

KEY

- HVO North proposed development consent boundary
- HVO South proposed development consent boundary
- Existing and approved disturbance area (refer to inset)
- Additional disturbance area
- Area of redisturbance
- Assessed scarred tree
- Rail line
- Named watercourse
- Named waterbody

Source: EMM (2022); HVO (2022); DFSI (2017); DPI (2013)

GDA2020 MGA Zone 56

0 100 200 m

N

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Transmission line - Scarred tree and histoiric heritage avoidance

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 13

EMM
creating opportunities

4.3 HVO South avoidance

4.3.1 Lemington CPP and associated rail loop

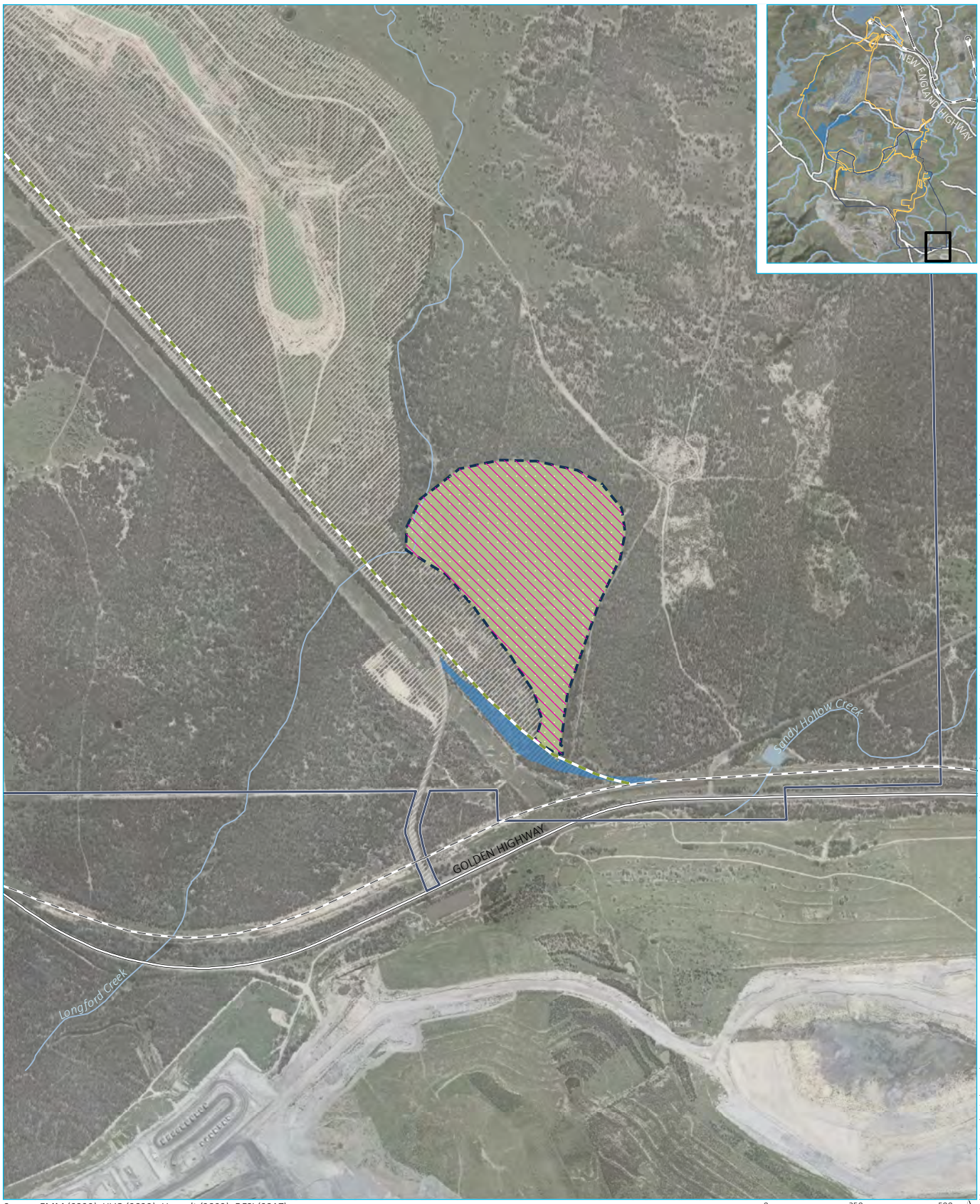
As noted in Section 2.2, under PA 06_0261, HVO maintains approval to construct and operate the LCPP and to construct a rail loop off the Wambo rail spur, as shown in Figure 2. The construction of this infrastructure has not been required to date. Under the Project, HVO propose to maintain approval for the LCPP and the long rail loop however approval for the short rail loop option is not proposed to be retained, as illustrated in Figure 3.

The surrendering of the approval for the short rail loop option, was informed because of the approximate 26 ha of high biodiversity features located within the existing and approved disturbance area, see Figure 14. Table 5 confirms the total biodiversity features which will be avoided by no longer retaining approval of the short rail loop. It is noted that under PA 06_0261 this area is approved to be disturbed as such, this represents an approximate net 26 ha reduction to the existing and approved disturbance area at HVO South.

Table 5: Short rail loop – Biodiversity area avoidance

Biodiversity feature	ha^
Native forest and woodland habitat	26.1
BC Act-Listed Features	
Central Hunter Grey Box – Ironbark Woodland EEC	24.8
Hunter Lowland Redgum Forest EEC	1.3
EPBC Act-Listed Features	
Central Hunter Valley Eucalypt Forest and Woodland CEEC	24.8

^Areas not cumulative



Source: EMM (2022); HVO (2022); Umwelt (2022); DFSI (2017)

0 250 500 m

GDA2020 MGA Zone 56

N

KEY

- South Lemington Rail Loop (approved, not yet constructed)
- Existing rail line
- HVO North proposed development consent boundary (refer to inset)
- HVO South proposed development consent boundary
- Additional disturbance area
- Project disturbance area
- Short rail loop
- EPBC Act TEC mapping
- BC Act TEC mapping
- Native forest and woodland habitat
- Major road
- Named watercourse
- Named waterbody

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Short rail loop impact avoidance

HVO Continuation Project
Infrastructure Options and Avoidance Report
Figure 14

EMM creating opportunities

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