VICKERY EXTENSION PROJECT

RESPONSE TO INDEPENDENT PLANNING COMMISSION POINTS OF INTEREST RECEIVED 7 AND 8 FEBRUARY 2019

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1 INTRODUCTION

In August 2018, Vickery Coal Pty Ltd (a wholly owned subsidiary of Whitehaven Coal Limited [Whitehaven]) lodged an application for the Vickery Extension Project (SSD 7480) (the Project).

The Project would involve the extension of open cut mining operations at the approved, but yet to be constructed, Vickery Coal Project (the Approved Mine). The Project is located in the Gunnedah Coalfield, approximately 25 kilometres (km) north of Gunnedah.

On 6 September 2018 the New South Wales (NSW) Minister for Planning requested the Independent Planning Commission (IPC) conduct a public hearing for the Project. The public hearing was held on 4 and 5 February 2019.

Subsequent to the public hearing, the IPC requested Whitehaven provide clarification on various points of interest.

This document provides responses to the points of interest identified by the IPC. The remaining sections of this document are ordered as follows:

- Project Rail Spur.
- Flooding.
- Groundwater.
- Surface Water.
- On-site Coal Handling and Preparation Plant.
- Noise.
- Air Quality.
- Rehabilitation.
- Visual.
- Social.
- Traffic.

2 PROJECT RAIL SPUR

IPC POINTS OF INTEREST 1 AND 2

The IPC requested:

> ***Details of the assessment of all rail options & particularly the northern loop, providing assumptions and specific reasons for conclusions.***

The IPC also stated:

> ***More explicit arguments need to be provided re the infeasibility of the northern route (e.g. the 2014 EIS indicates that Tarrawonga was to share the Boggabri Mine loading facilities but no commercial agreement could be reached, suggesting that the route can technically carry more coal than its current usage). Are there engineering issues or economic, or something else?***

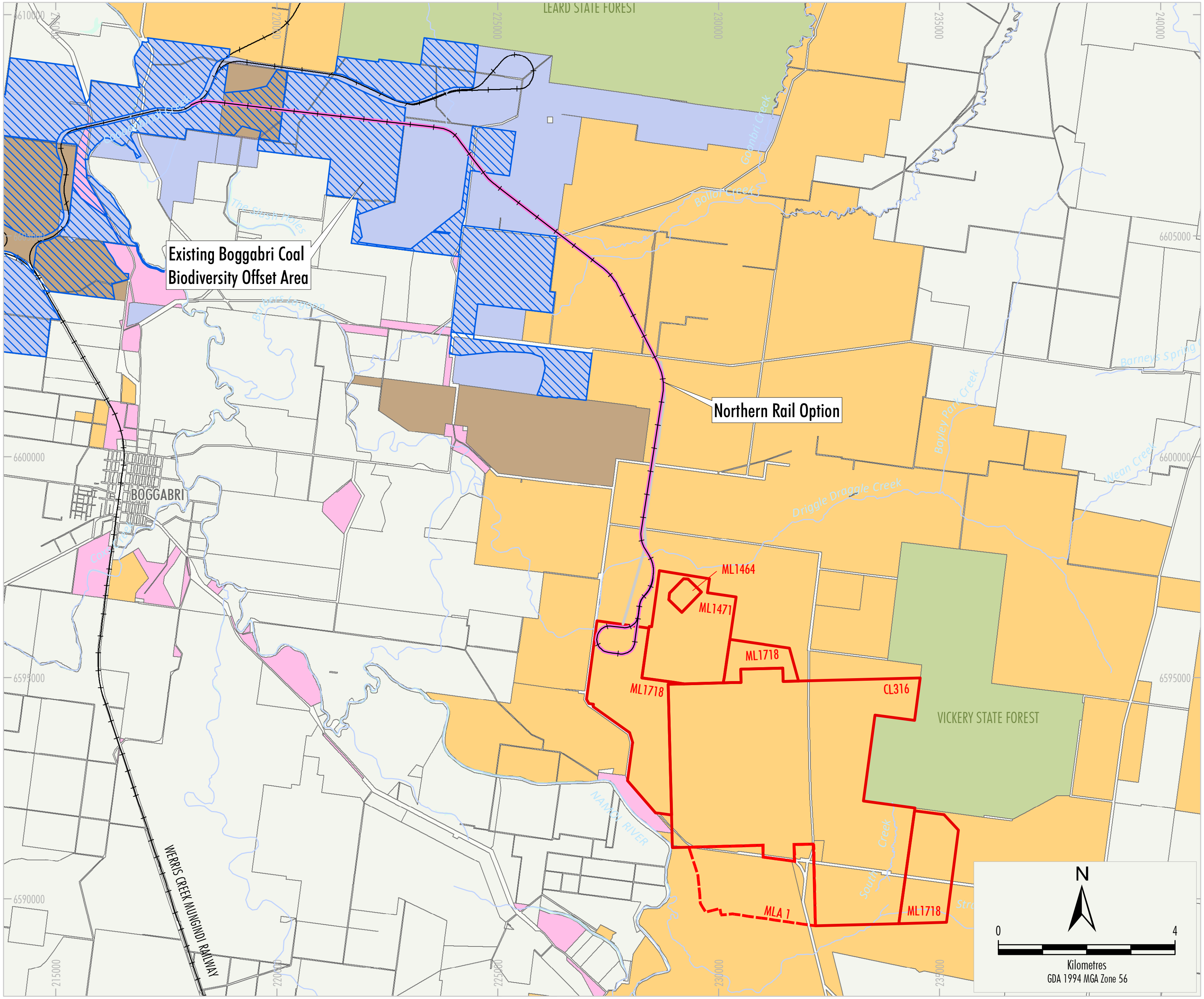
WHITEHAVEN RESPONSE

A number of rail spur alignments were analysed for the Project, in particular, the:

- Project rail spur alignment (as presented in the Project Environmental Impact Statement [EIS]).
- Northern rail option, which comprised a northern rail corridor connecting to the common section of the Maules Creek Coal Mine and Boggabri Coal Mine private rail spur (Maules Creek-Boggabri rail spur).

Whitehaven considers the Project rail spur provides the superior outcome for the Project, given the following:

- Private land access:
  - Whitehaven does not own all private land required for the northern rail option (Figure 1), whereas Whitehaven owns all private land required for the Project rail spur (or a land access agreement is already in place).
- Logistics and congestion on the common section of the existing Maules Creek-Boggabri rail spur:
  - The Common Section of the Maules Creek-Boggabri rail spur has six participants in the joint venture (one of which is Whitehaven).
  - Whitehaven has a share of the capacity of the Maules Creek-Boggabri rail spur commensurate with its percentage of ownership.
  - At the time the original joint venture was formed, the capacity of the Common Section of the Maules Creek-Boggabri rail spur was 28 Mtpa. The Maules Creek Coal Mine has approval to rail 12.4 Mtpa and the Boggabri Coal Mine has approval to rail 10 Mtpa (i.e. 5.6 Mtpa remaining capacity).
  - The Project proposes the rail transport of up to 11.5 million tonnes per annum (Mtpa) run-of-mine (ROM) coal (inclusive of coal from the Rocglen and Tarrawonga Coal Mines).
  - This would create congestion on the common section of the existing Maules Creek-Boggabri rail spur and the adjacent section of the Werris Creek Mungindi Railway (the Main Line) unless new passing loop(s) are constructed and additional train units purchased. An additional crossing of the floodplain may also be required.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Forest
- Crown Land
- Whitehaven Owned Land
- Whitehaven/Idemitsu Boggabri Coal Joint Owned Land
- Idemitsu Boggabri Coal Owned Land
- Privately Owned Land and Other Land
- Railway
- Indicative Northern Rail Option Alignment
- Existing Boggabri Coal Biodiversity Offset Area

Source: Department of Land and Property Information - Land Tenure (2016); Department of Industry (2017); Whitehaven Coal (2016)

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Northern Rail Option Land Tenure

Figure 1

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   - Given these constraints to the feasibility of this option, the Project rail spur alignment was progressed.

- Environmental considerations:
   - The Project rail spur would result in the avoidance of additional coal trains travelling through the town of Boggabri (the majority of dwellings in Boggabri are within 500 metres (m) of the Main Line, with many dwellings within approximately 150 m of the Main Line [see Plate 1a, below]).
   - By comparison, the two closest existing privately-owned dwellings (on Property ID 144) are approximately 500 m and 750 m distance from the Project rail spur (see Plate 1b). All other existing dwellings are further than 800 m from the Project rail spur. Compliance with the relevant rail noise criteria as outlined in Appendix 3 of the NSW *Rail Infrastructure Noise Guideline* (RING) (NSW Environment Protection Authority [EPA], 2013) for noise from trains on non-network rail lines on or exclusively servicing industrial sites (e.g. private rail spurs) is predicted at all existing privately-owned dwellings (refer to Section 7.3.1 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]).[1]
   - The Project rail spur would result in the avoidance of impacts to existing Boggabri Coal Mine biodiversity offset areas (Figure 1). Note Whitehaven isn't a participant of the joint venture for the Boggabri Coal Mine private rail spur and the capacity constraints outlined above for the Common Section also apply. Hence, the Project rail spur could not be realigned to connect directly with the Boggabri Coal Mine private rail spur to avoid impacts to the existing offset areas.

- Economic considerations:
   - Elevation of the Project rail spur (to avoid flooding impacts on any private property and cross the Kamilaroi Highway) would result in increased construction costs of approximately $40 million net present value (NPV) compared to the northern rail option.
   - Notwithstanding, when considering both capital and operational costs over the life of the Project, the economic advantage of the Project rail spur over the northern rail option is in excess of $150 million NPV due to:
      - increased fuel consumption and other operational costs associated with additional distance travelled by coal trains (approximately 30 km each way when travelling to the Project via the Maules Creek-Boggabri rail spur);
      - ongoing fees to access the common section of the Maules Creek-Boggabri rail spur;
      - Main Line passing loop construction costs;
      - additional train unit costs;
      - further land acquisition and agreement costs; and
      - establishment of additional biodiversity offsets for the Boggabri Coal Mine.

[1] The Project EIS acknowledges there is an approved dwelling location on Property ID 144 located approximately 350 m from the Project rail spur. Should a dwelling be constructed at this location, noise levels from trains on the Project rail spur would be managed such that there would be no more than 'negligible' exceedances (i.e. 1 to 2 dB) of the relevant RING criteria, unless an agreement is in place with the landowner.

Plate 1a Proximity of Main Line to Residences in Boggabri

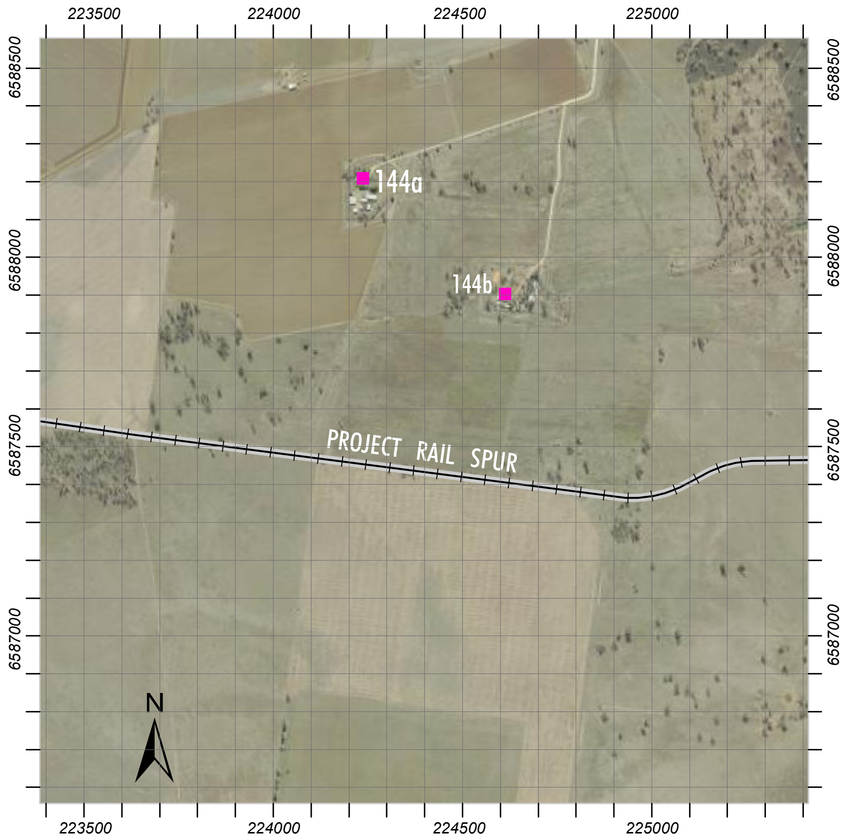

Plate 1b Proximity of Project Rail Spur to Dwellings on Property ID 144

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Proximity of Project Rail Spur and Main Line to Existing Dwellings

Plates 1a and 1b

IPC POINT OF INTEREST 3

The IPC requested:

> ***Specific timing of rail commissioning.***

WHITEHAVEN RESPONSE

Construction of the Project Coal Handling and Preparation Plant (CHPP), train load-out facility and rail spur would commence once Whitehaven obtains all necessary approvals.

Whitehaven's target for construction of the Project CHPP, train load-out facility and rail spur is approximately 12 months following the commencement of construction. Full commissioning of the Project rail spur (e.g. destressing, signalling and defect rectification) is anticipated to take a further six months. This timing is based on recent experience constructing the Maules Creek Coal Mine rail spur.

It is noted some submissions to the IPC public hearing stated that haulage of coal on public roads would continue for "up to 12 years", however, this is not the case. Section 2.7.1 of the Project EIS states (emphasis added):

> *Until the Project CHPP, train load-out facility and rail spur reach full operational capacity, transport of ROM coal from the Project by road to the Whitehaven CHPP (Figure 1-2) would be conducted consistent with the Development Consent conditions for coal haulage for the Approved Mine (i.e. up to a total of 3.5 Mtpa, or up to 4.5 Mtpa ROM coal transport subject to the construction of the approved private haul road and Kamilaroi Highway overpass).*
>
> *Once the Project CHPP, train load-out facility and rail spur reach **full operational capacity**, ROM coal from the Project would no longer be processed at the Whitehaven CHPP*.

It may be that the submitters have mistakenly equated "*full operational capacity*" with the year of maximum coal processing rate (anticipated to occur in Year 9 [refer to Table 2-3 of the EIS]).

Section 2.7.2 of the Project EIS clarifies product coal would be transported from the Project by rail following the **commissioning** of the Project CHPP, train load-out facility and rail spur (i.e. anticipated to be from Project Year 2 onwards):

> *Once the Project train load-out facility and rail spur are commissioned, product coal would be conveyed to the train load-out facility located at the rail loop.*
>
> *Product coal would then be loaded onto trains for transportation to market via the Werris Creek Mungindi Railway and Main Northern Railway.*

3 FLOODING

IPC POINTS OF INTEREST 4

The IPC stated:

> ***The questions below are predicated on the verbal promise by Whitehaven that the entire rail spur will be on viaduct across the floodplain.***

WHITEHAVEN RESPONSE

For clarification, Whitehaven proposes to elevate all sections of the rail spur to the west of the Namoi River on piers and/or pylons. At the point where the elevated rail spur joins the Main Line embankment there will be a short transition zone. To the east of the Namoi River where the rail spur traverses land owned by Whitehaven, the rail spur will be constructed as an elevated structure, partially on embankments and partially as a superstructure supported on piers and/or culverts.

Whitehaven's overarching design principle of the Project rail spur is to comply with the objectives of the *Draft Floodplain Management Plan for the Upper Namoi Valley Floodplain 2016*[2] (Draft FMP) and the *Carroll to Boggabri Floodplain Management Plan 2006* (Department of Natural Resources, 2006) (FMP). In particular, for the proposed rail spur to result in negligible changes in flood depth, velocity and distribution of flow on privately-owned land for all events up to and including the 1 in 100 year (i.e. 1% Annual Exceedance Probability [AEP]) flood event.

This would be achieved by elevating the Project rail spur west of the Namoi River on pylon-like structures. An example of such an elevated superstructure is the existing Maules Creek-Boggabri rail spur where it crosses the Namoi River floodplain (Plates 2a and 2b).

Conceptual 3D drawings of the Project rail spur are provided in Plates 3, 4 and 5.

It is noted the objectives of the FMP and Draft FMP relevant to privately-owned land are for "large design floods", which approximate the 1 in 20 year (i.e. 5% AEP) flood event. Therefore, the Project rail spur design to elevate the superstructure above the 1 in 100 year (i.e. 1% AEP) flood level is considered to be conservative and prevents impacts for flood events above what is required by the FMP and Draft FMP.

Following determination of the Project, Whitehaven will finalise the detailed design of the Project rail spur in consultation with the NSW Office of Environment and Heritage (OEH) and the NSW Department of Planning and Environment (DPE) to confirm the objectives of the FMP and Draft FMP will be achieved.

It is standard practice for Project infrastructure to be conditioned such that detailed design (conducted post-approval) confirms that the infrastructure will achieve the predicted outcomes and/or performance measures identified during the assessment phase.

[2] https://www.industry.nsw.gov.au/__data/assets/pdf_file/0007/146329/Draft-Floodplain-Management-Plan-for-the-Upper-Namoi-Valley-Floodplain-2016.pdf

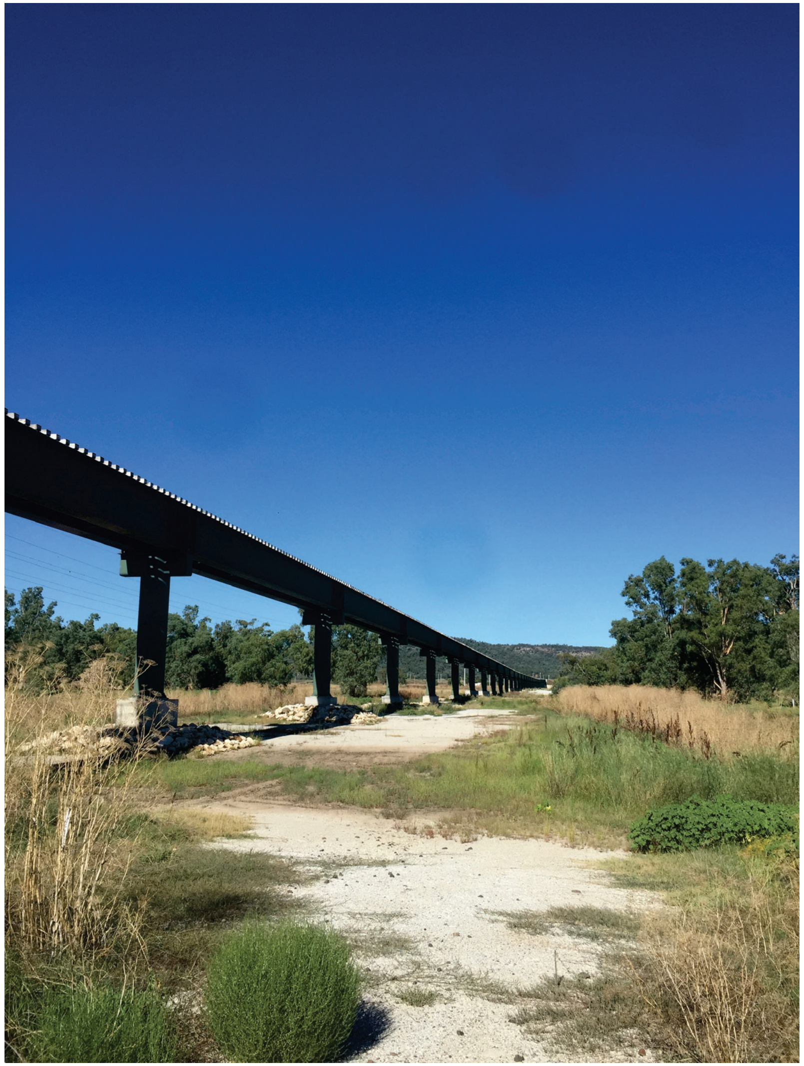

Plate 2a Maules Creek and Boggabri Coal Mine Rail Spur

Plate 2b Maules Creek and Boggabri Coal Mine Rail Spur

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Maules Creek and Boggabri Coal Mine Rail Spur

Plate 2a and 2b

For example, regarding the approved Kamilaroi Highway Overpass, Condition 26 of the Approved Mine Development Consent (SSD-5000) provides:

> *The Applicant must obtain an approval under Part 8 of the Water Act 1912 for all applicable works associated with the Kamilaroi Highway overpass. The Applicant shall ensure that the design and construction of the Kamilaroi Highway overpass is consistent with the Boggabri to Carroll Flood Plain Management Plan, to the satisfaction of NOW.*

IPC POINT OF INTEREST 5

The IPC requested:

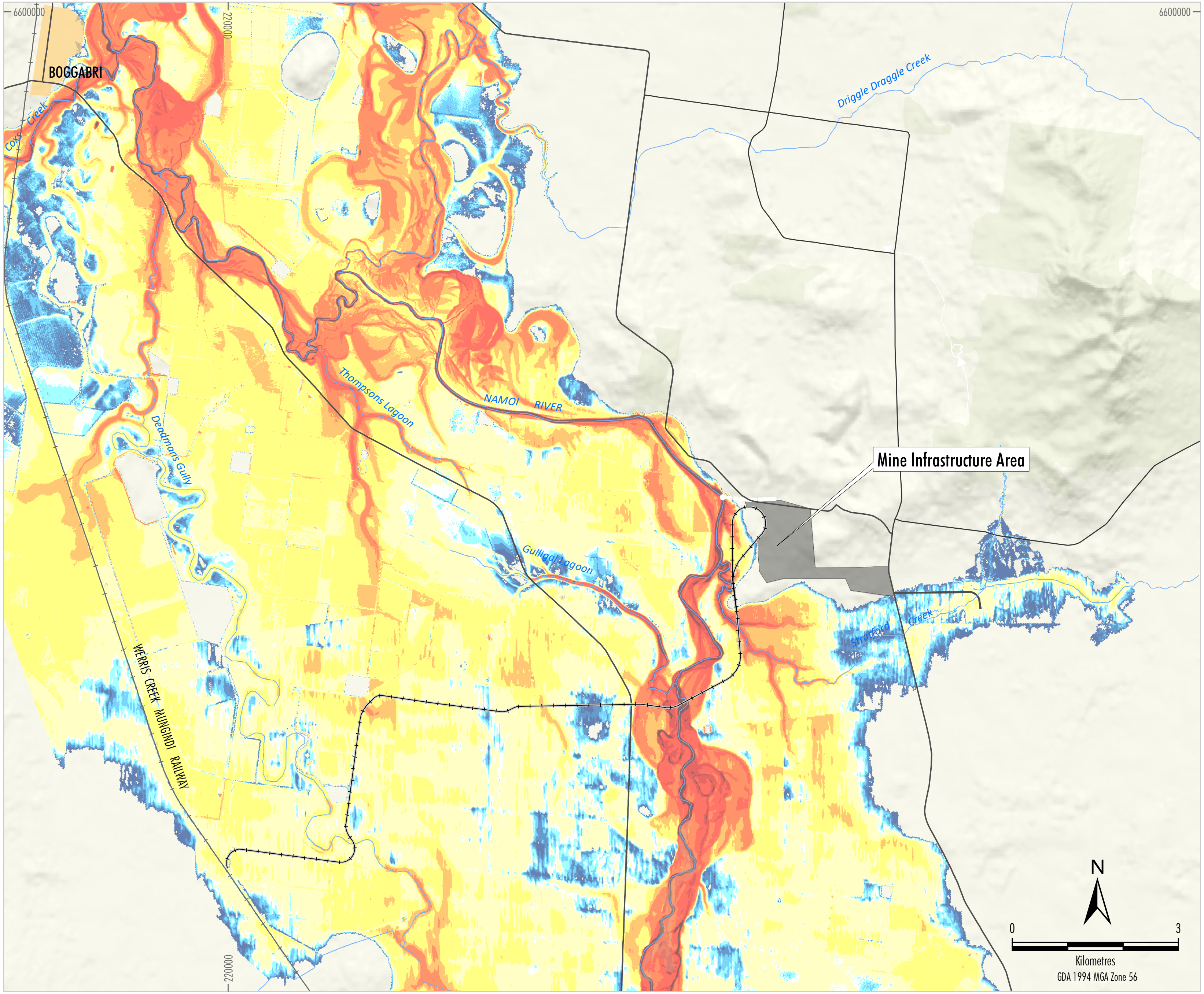
> ***What is the sensitivity of the predicted incremental flood levels (above or below that would occur without the rail spur) at the CHPP and junction with the North-west main line to changes in the flood plain hydraulics parameters?***

WHITEHAVEN RESPONSE

The incremental flood level impact from changes in floodplain hydraulic parameters across the floodplain, including at the Project CHPP and the rail spur junction with the Main Line, would not be significant.

Sensitivity testing undertaken during calibration of the flood model found that predicted peak flood levels for the 1955 flood, which is considered to be equivalent to the 1 in 100 year (i.e. 1% AEP) flood event in both the *Gunnedah and Carroll Floodplain Management Study* (SMEC, 1999) and *Carroll to Boggabri Flood Study* (SMEC, 2003), were not sensitive to changes in floodplain roughness, with peak flood levels varying by less than 0.2 m.

The mine infrastructure area (including the Project CHPP) is located outside the extent of the 1 in 100 year design flood event for the Namoi River (Figure 2), as well as three times the Namoi River 1 in 100 year design flood event (WRM Water & Environment, 2018). The rail level of the Main Line is also not overtopped at the proposed junction with the Project rail spur for a flood event that is three times the 1 in 100 year event. Peak flood levels for three times the 1 in 100 year flood event are up to 1 m higher than the 1 in 100 year flood event. Given this, changes in floodplain roughness would not impact on the flood immunity of the Project CHPP or at the junction with the Main Line.



LEGEND

Major Roads
Railway
Indicative Project Rail Spur
Indicative Extent of Infrastructure Area

Flood Depth (m)

0.0 > 0.1
0.1 > 0.2
0.2 > 0.3
0.3 > 0.4
0.4 > 0.5
0.5 > 1.0
1.0 > 1.5
1.5 > 2.0
2.0 > 3.0
3.0 > 4.0
4.0 > 5.0
> 5.0

Source: LPMA - Topographic Base (2010); NSW Department of Industry (2015); WRM Water & Environment (2018)

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Predicted Flood Depths and Extents for the 1 in 100 Year Flood Event

Figure 2

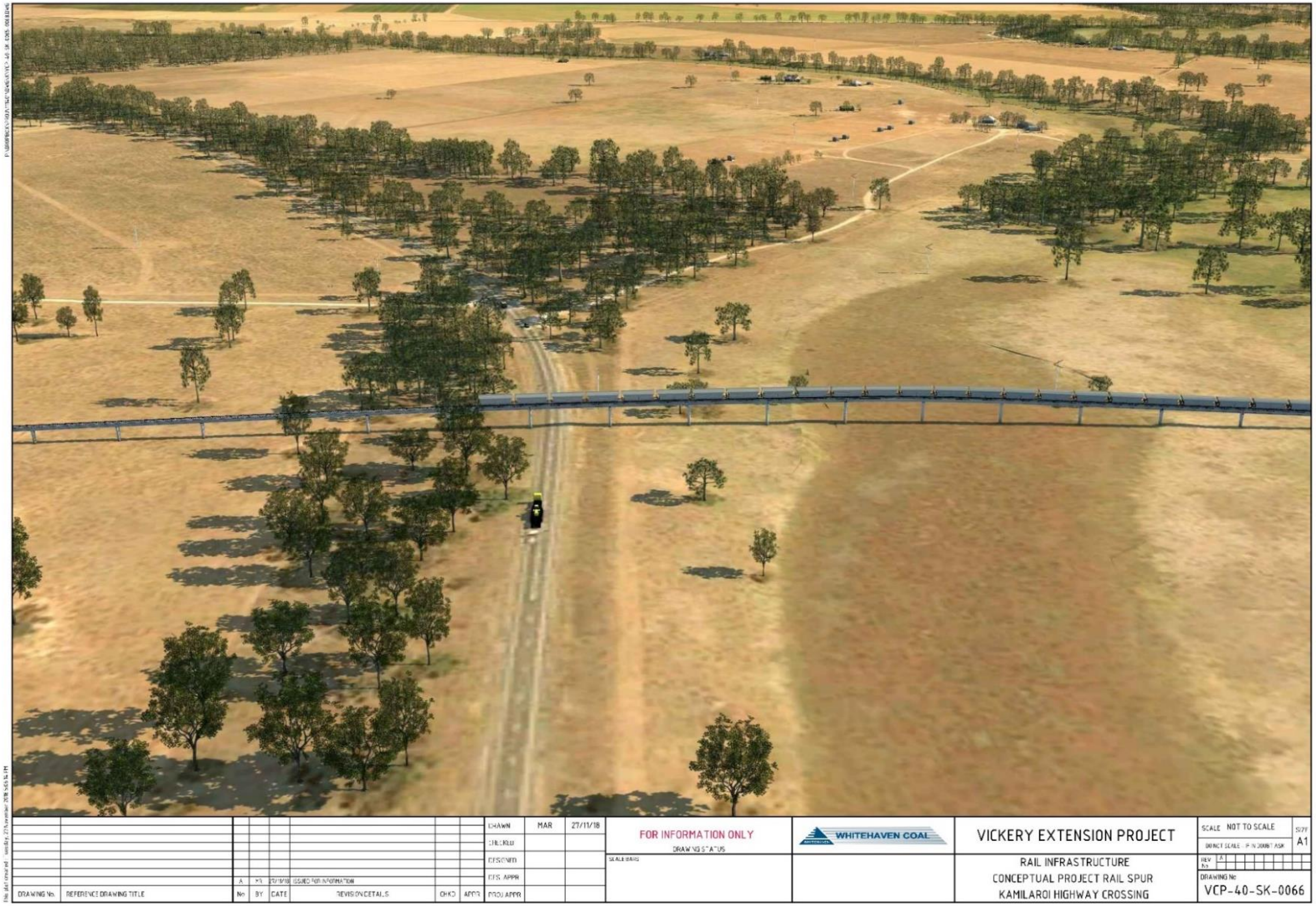


Plate 3: Conceptual Project rail spur crossing of the Kamilaroi Highway

Plate 4: Indicative conceptual view of Project rail spur at a distance of approximately 50 m.

Plate 5: Indicative conceptual view of Project rail spur at a distance of approximately 500 m.

IPC POINT OF INTEREST 6

> ***What is the sensitivity of the incremental flood levels if the peak discharges for the local tributaries all occur at the same time?***

WHITEHAVEN RESPONSE

The catchment area of the Namoi River to Gunnedah is 17,100 square kilometres (km^2) with an estimated 1 in 100 year (i.e. 1% AEP) flood event peak discharge of 9,147 cubic metres per second (m^3/s). By comparison, the catchment areas of Stratford Creek and Collygra Creek that drain to the proposed rail spur is 105 and 252 km^2 respectively, with an estimated combined 1 in 100 year (i.e. 1% AEP) peak discharge of 500 m^3/s at the proposed rail spur.

The relative sizes of the catchments suggest that different storm mechanisms would produce peak discharges in each catchment.

For instance, a long duration, region-wide storm event would produce the peak discharge from the Namoi River, however this would not reach the Project area until days after the peak rainfall. For the local catchments, an intense short-duration storm event would produce the peak discharge, which would peak adjacent to the Project area within hours of the peak rainfall. In other words, the frequency of the regional flood peak discharge event coinciding with the local flood peak discharge event at the Project area is greater than the 1% AEP flood event in the Namoi River.

In addition, the combined 1 in 100 year (i.e. 1% AEP) flood event peak discharge from Stratford Creek and Collygra Creek is less than 6% of the peak discharge from the Namoi River. The increase in peak flood levels (with or without the rail) would be negligible if the two events peaked at the Project mining area at the same time.

4 GROUNDWATER

IPC POINT OF INTEREST 7

The IPC stated:

> ***What is the stratigraphy used in the groundwater model? What data is it based on?***

WHITEHAVEN RESPONSE

Plate 6 provides the lithologies represented by the groundwater model (Figure 34 of the Project Groundwater Assessment [HydroSimulations, 2018]).

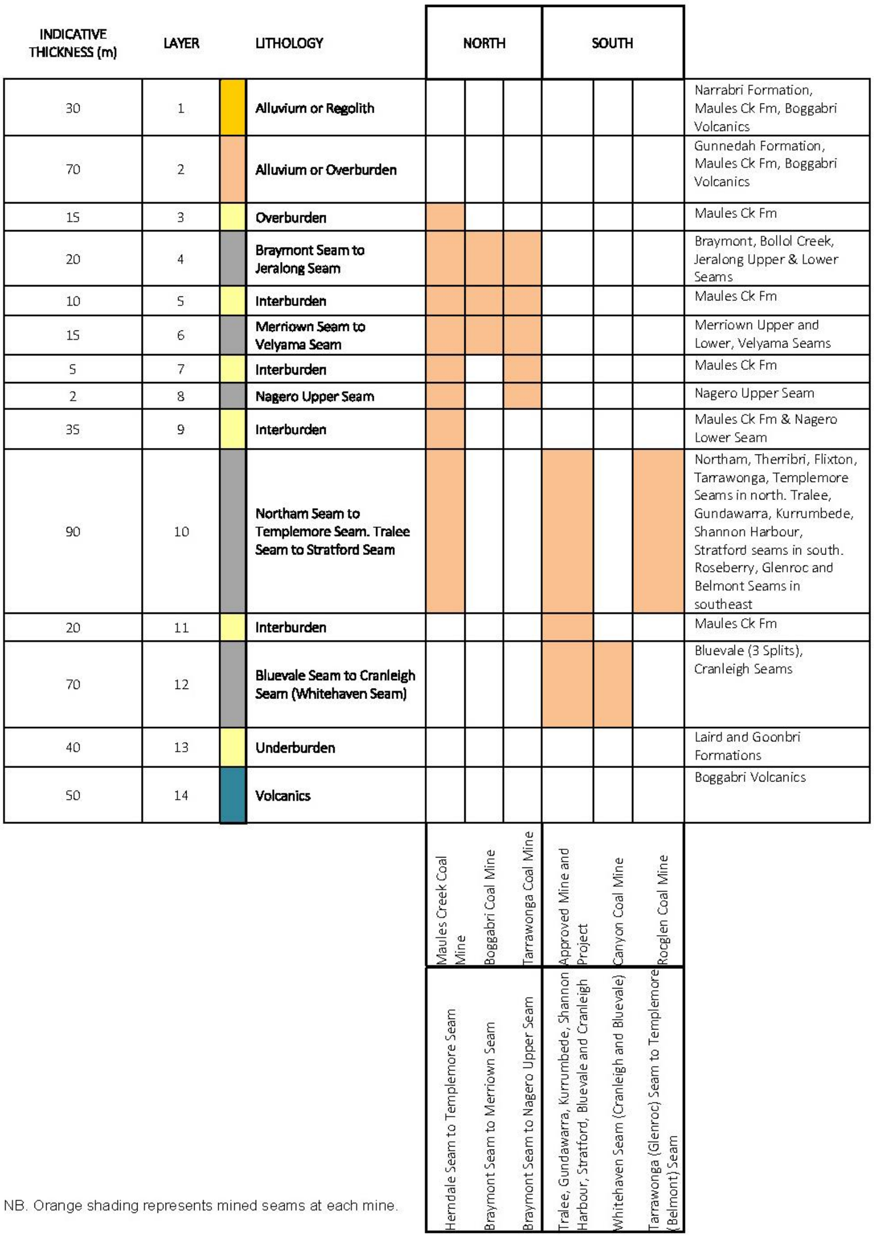


Plate 6: Lithologies Represented by the Groundwater Model (Source: HydroSimulations [2018])

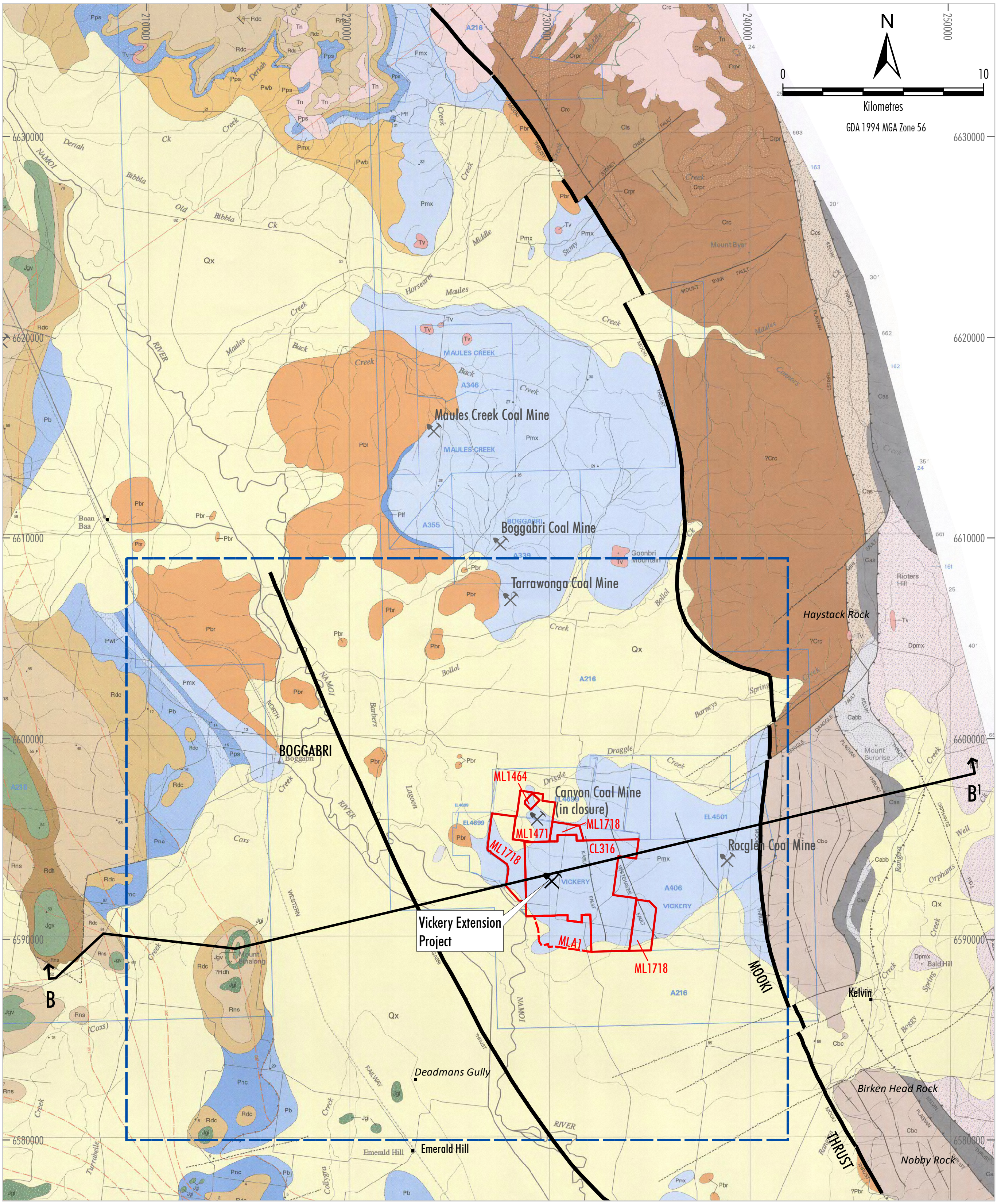
The groundwater model used for the Project was based on the model used for the Approved Mine. The Project groundwater model was updated to more current software (i.e. from MODFLOW-SURFACT to MODFLOW-USG) and incorporated additional hydrogeological data. The development of the model was informed by numerous published data and site-specific test-work, including:

- Review of published regional data of vertical and horizontal extents of geological layers, including:
  - Regional geology mapping published by the NSW Department of Primary Industries (Figures 3, 4 and 5).
- The *Upper Namoi Groundwater Flow Model: Model Development and Calibration* (McNeilage, 2006) prepared for the NSW Department of Natural Resources (now DoI Water).
- Review of regional bore logs and water levels to validate geological depths and water levels, including:
  - The PINNEENA Groundwater Works Database including registered bores and continuous monitoring data (Figure 6).
  - The census of private bores undertaken for the Approved Mine in 2012 (Figure 7).
- Review of local geological and groundwater monitoring data, including groundwater modelling, monitoring, and assessments undertaken at the Tarrawonga and Rocglen Coal Mines (Figure 8).
- Review of site-specific geological and geophysical data, logs and groundwater monitoring data from the previous Vickery exploration programs and the Canyon Coal Mine (Figure 8).
- Numerous groundwater studies conducted for the historical Vickery Mine and immediate surrounds (refer to Section 2.1 of the Project Groundwater Assessment [HydroSimulations, 2018]).
- Groundwater investigation programs conducted specifically for the Approved Mine and the Project (Figure 9), as reported in:
  - *Groundwater Field Investigation* (Groundwater Exploration Services Pty Ltd, 2012) for the Approved Mine (Attachment AA to the Approved Mine Groundwater Assessment and included as Enclosure 1 to this document).
  - *Alluvial Drilling Report* (ENRS, 2016) for the Project (Appendix A to the Project Groundwater Assessment and included as Enclosure 2 to this document).
- The site geological model derived from exploration drilling.

A key aspect of the development and robustness of the groundwater model was the identification of the lateral extent of the Upper Namoi Alluvium. The design of the Project open cut to avoid the alluvium and remain wholly within the extent of the relatively low permeability "island" of rock associated with the Maules Creek Formation minimises propagation of drawdown to the surrounding alluvium.

The extent of the Upper Namoi Alluvium, and associated open cut end design to avoid the alluvium, was informed by:

- Regional geology mapping (Figures 3, 4 and 5).
- Test drilling and seismic refraction surveys performed by the NSW Government in the 1960s.
- The regionally mapped alluvium boundary within the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* (Figure 10).
- Site-specific alluvial investigation programs, including (Figure 9):
  - Transient electromagnetic (TEM) survey.



LEGEND

Mining Tenement Boundary (ML and CL)

Mining Lease Application (MLA)

Groundwater Model Extent

Cross-Section Location*

Note: Refer Figure 4 for Cross Section B-B[1] and Figure 5 for Regional Geology Legend*

Source: NSW Department Primary Industries- Gunnedah CoalfieldNorth 100k (2011)

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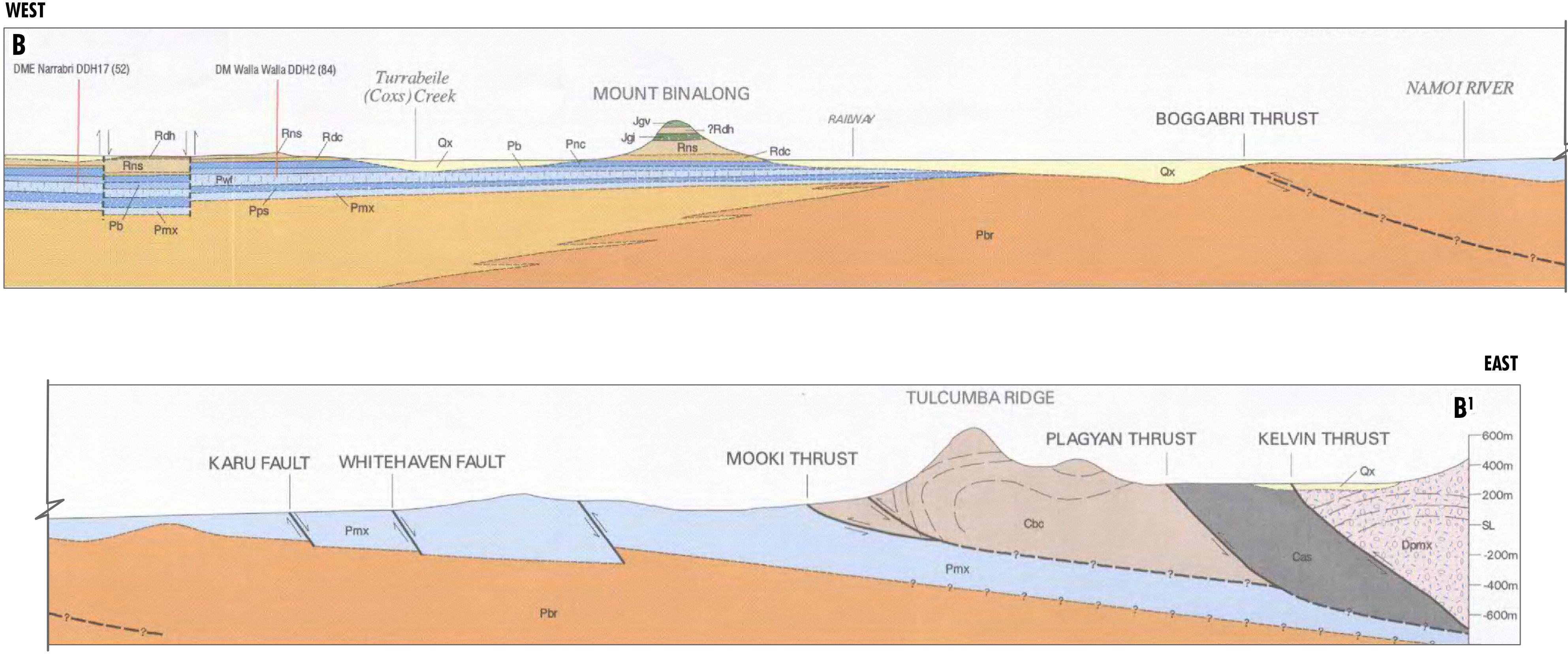
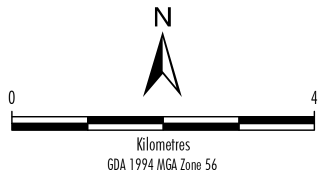
NSW Department of Primary Industries
Regional Geology Mapping

Figure 3



Scale Ration Vertical 0.4 = Horizontal 1.0



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Note: Refer Figure 5 for Regional Geology Legend

Source: NSW Department Primary Industries- Gunnedah CoalfieldNorth 100k (2011)

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NSW Department of Primary Industries
Regional Geology Mapping - Cross Section B -B1

Figure 4

Era		Period		Group		Formation	Symbol	Lithology
CAINOZOIC		QUATERNARY				undifferentiated sediments	Qx	Undifferentiated alluvial deposits; includes Holocene alluvial channels and overbank deposits of sand silt and clay. Generally does not include residual and veneer colluvial deposits
CAINOZOIC		TERTIARY				undifferentiated sediments	Ts	Sand, sandstone, pebble sandstone, pebble to cobble gravels, and tuffs
CAINOZOIC		TERTIARY				Nandewar Volcanic Complex	Tn	Basalt, dolerite, teschenite, nephelinite or trachyte sills, dykes, plugs and flows
CAINOZOIC		TERTIARY				undifferentiated volcanics	Tv	Basalt, dolerite, teschenite, nephelinite or trachyte sills, dykes, plugs and flows
MESOZOIC	Surat Basin Units	JURASSIC				Orallo Formation	Jpo	Fine to coarse grained labile to sub-labile clayey sandstone with interbedded siltstone and mudstone
MESOZOIC	Surat Basin Units	JURASSIC				Pilliga Sandstone	Jps	Quartz pebble and quartzose sandstone with minor lithic sandstone and siltstone
MESOZOIC	Surat Basin Units	JURASSIC				Purlawaugh Formation	Jpx	Thin bedded lithic labile sandstone interbedded with siltstone and mudstone
MESOZOIC	Surat Basin Units	JURASSIC				Glenrowan Intrusives	Jgi	Sills and dykes of alkali dolerite and micro-syenodolerite
MESOZOIC	Surat Basin Units	JURASSIC				Garrawilla Volcanics	Jgv	Vesicular and non-vesicular, alkali olivine basalt, alkali basalt, hawaiite, mugearite, soda trachyte and interbedded pyroclastics
PALAEOZOIC	Gunnedah Basin Units	TRIASSIC	MIDDLE			Deriah Formation	Rdh	Fine to medium grained lithic sandstone rich in volcanic fragments with common mudstone clasts overlain by off-white lithic sandstone and dark grey mudstone
PALAEOZOIC	Gunnedah Basin Units	TRIASSIC	MIDDLE			Napperby Formation	Rns	Coarsening-up sequences of dark-grey siltstone/sandstone laminite overlain by parallel bedded or low-angle crossbedded quartzose sandstone
PALAEOZOIC	Gunnedah Basin Units	TRIASSIC	EARLY			Digby Formation	Rdc	Poorly sorted volcanic-lithic pebble orthoconglomerate overlain by massive, parallel or cross bedded coarse to fine grained quartz-lithic and then quartzose sandstone
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Nea Subgroup	Trinkey Formation	Pnc	Claystone, siltstone and fine grained sandstone intercalated with tuff, carbonaceous claystones and tuffaceous stony coal seams
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Nea Subgroup	Wallala Formation	Pnc	Fining up sequence of dominant lithic conglomerate, sandstone, siltstone, claystone and coal with minor tuff and tuffaceous sediments.
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Coogal Subgroup	Clare Sandstone	Pnc	Medium bedded, cross stratified medium to coarse grained quartzose sandstone. Quartzose conglomerate locally developed
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Coogal Subgroup	Benelabri Formation	Pnc	Interbedded claystone, siltstone and fine grained quartzose sandstone and coal
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Coogal Subgroup	Hoskissons Coal	Pnc	Coal with subordinate layers of fine grained sandstone, carbonaceous siltstone and claystone, and tuff
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Brothers Subgroup	Brigalow Formation / Arkarula Formation	Pb	Fining-up sequence of medium grained quartzose sandstone and siltstone. Fining-up sequence of fine-medium lithic sandstone and siltstone with worm burrows
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Black Jack Group	Brothers Subgroup	Pamboola Formation	Pb	Lithic sandstone, siltstone, claystone, conglomerate and intercalated coals in generally coarsening-up and sporadic fining-up sequences
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Millie Group		Watermark Formation	Pwf	Fining-up sequence of intensely bioturbated silty sandstone to sandstone/claystone laminite with marine fossils overlain by finely laminated siltstone/claystone with little bioturbation, then by coarsening-up sequences of strongly bioturbated silty to sandy laminite
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	LATE	Millie Group		Porcupine Formation	Pps	Basal conglomerate passing upward into bioturbated silty sandstone and minor siltstone with dropped pebbles
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	EARLY	Bellata Group		Maules Creek Formation	Pmx	Basal carbonaceous claystone, pelletoidal clay sandstone, passing into fining-up cycles of sandstone, siltstone and coal. Conglomerate dominant towards top
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	EARLY	Bellata Group		Goonbri Formation	*	Carbonaceous siltstone and thin coal grading upwards to fine to medium sandstone
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	EARLY	Bellata Group		Leard Formation	Plf	Buff coloured flint (pelletoidal)claystone, conglomerate, sandstone and siltstone
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	EARLY			Werrie Basalt	Pwb	Basaltic lavas with intervening palaeosols and local thin coals
PALAEOZOIC	Gunnedah Basin Units	PERMIAN	EARLY			Boggabri Volcanics	Pbr	Rhyolitic to dacitic lavas and ashflow tuffs with interbedded shale. Rare trachyte and andesite
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	LATE			Currabubula Formation	Cbc	Paraconglomerate, orthoconglomerate, crossbedded feldspathic and lithic sandstone, siltstone, mudstone and minor limestone. Felsic ashflow and airfall tuff, rhyolitic to andesitic crystal and vitric tuff.
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	LATE			Lark Hill Formation	Cls	Feldspathic arenite, litharenite, subordinate orthoconglomerate and paraconglomerate, siltstone, rhyodacite, and dacitic ashflow and airflow tuff
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	LATE			Rocky Creek Conglomerate	Crc	Orthoconglomerate, minor feldspathic arenite and litharenite, siltstone and intermediate ashflow tuff
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	LATE			Plagyan Rhyodacite Tuff Member	Crpr	Multiple beds of rhyolitic to andesitic crystal and vitric tuff
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	LATE			Clifden Formation	Ccs	Crossbedded feldspathic and lithic sandstones, subordinate conglomerate, shale, rhyodacitic and dacitic airfall tuffs
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	EARLY			Caroda Formation – Barneys Spring Andesite Member	Cabb	Porphyritic andesite
PALAEOZOIC	New England Orogen Units	CARBONIFEROUS	EARLY			Caroda Formation	Cas	Crossbedded sandstone, minor lenticular oolitic limestone and magnetite sandstone, succeeded by coarse fluvial litharenite, conglomerate, shale, thin coal
PALAEOZOIC	New England Orogen Units	DEVONIAN	LATE	Parry Group		Mostyn Vale Formation	Dpmx	Pebbly lithic wacke, diamictite, lithic wacke, orthoconglomerate, olistostromal volcanic breccia, rhyodacitic to basaltic lavas, tuffs, agglomerates, rare limestones

* Known only from borehole data

WHC-15-33_EIS GW_001C

Source: Dept of Mineral Resources NSW (2006)

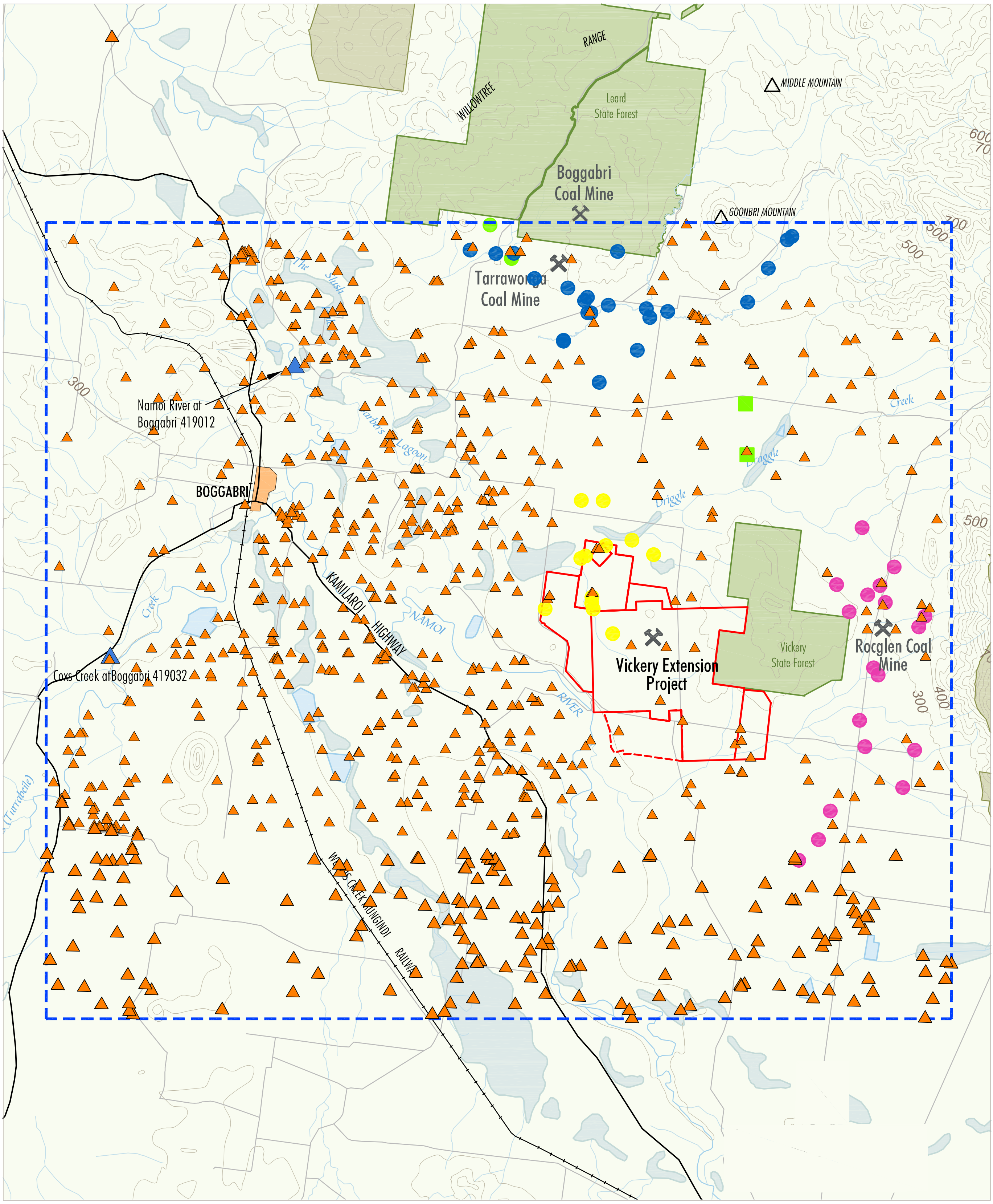
Note: Refer Figure 3 for Regional Geology Mapping.

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

NSW Department of Primary Industries
Regional Geology Legend

Figure 5



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Conservation Area, Aboriginal Area
- State Forest
- Railway
- Major Roads
- DoI Water Gauging Station
- DoI Water Registered Bore
- DoI Water Continuous Monitoring Bore
- Groundwater Model Extent
- Tarrawonga Coal Mine Groundwater Monitoring Location
- Boggabri Coal Mine Groundwater Monitoring Location
- Canyon Coal Mine Groundwater Monitoring Location
- Rocglen Coal Mine Groundwater Monitoring Location
- Petroleum Exploration Bore

Soource: Topographic Base Geoscience Australia (2011); DECC (2009) and NSW Department Primary Industries(2011)

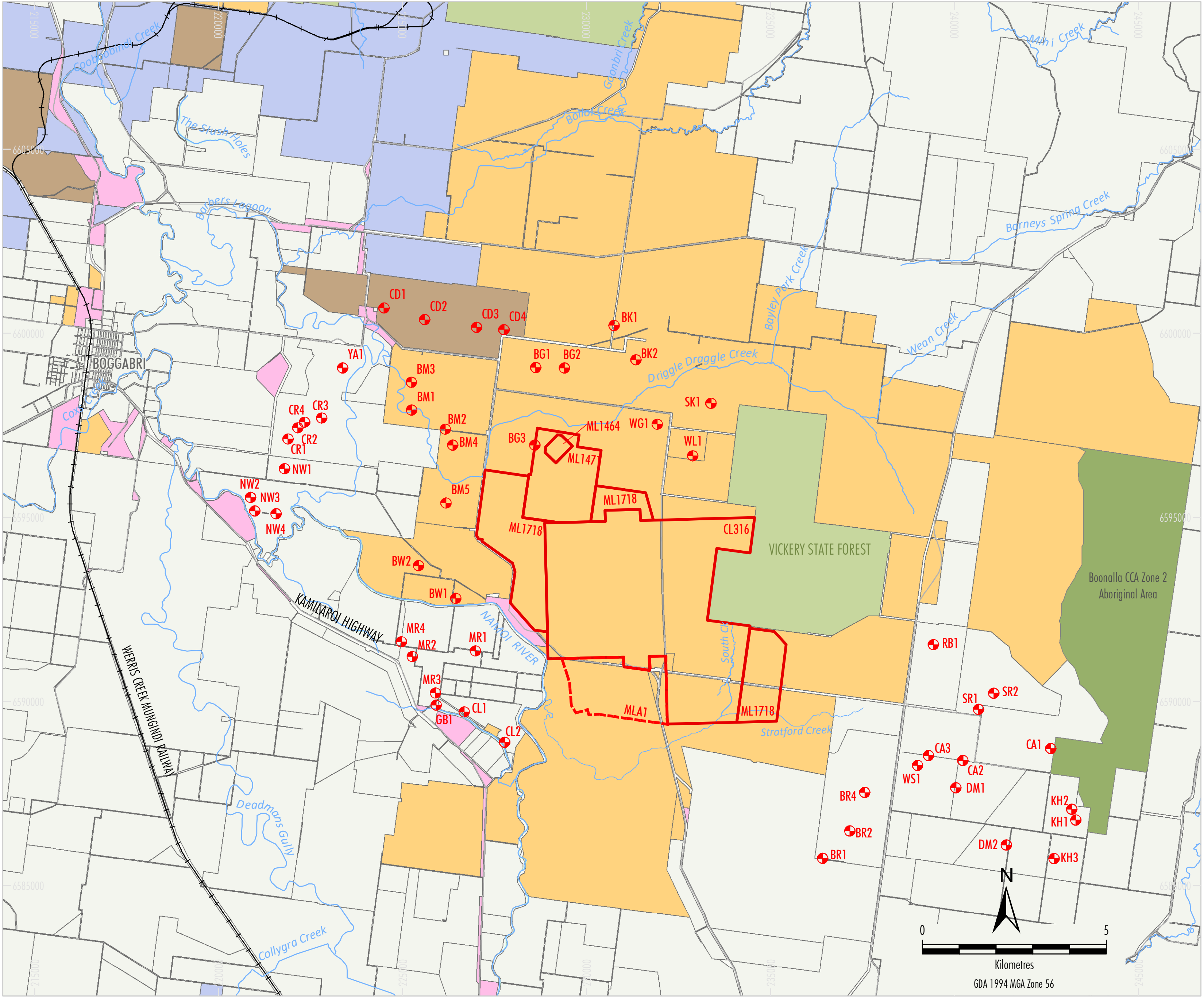
WHC-15-33_IPC PRR__101B

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

PINNEENA Groundwater Works Database Registered Bores Identified Reviewed for Approved Mine

Figure 6



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- Railway
- State Conservation Area, Aboriginal Area
- State Forest
- Crown Land
- Whitehaven Owned Land
- Whitehaven/Idemitsu Boggabri Coal Joint Owned Land
- Idemitsu Boggabri Coal Owned Land
- Privately Owned Land and Other Land
- Bore Identified during Bore Census for Approved Mine (labels reflect property names)

Source: Department of Land and Property Information - Land Tenure (2016); Department of Industry (2016); Whitehaven (2016)

N

0 5

Kilometres

GDA 1994 MGA Zone 56

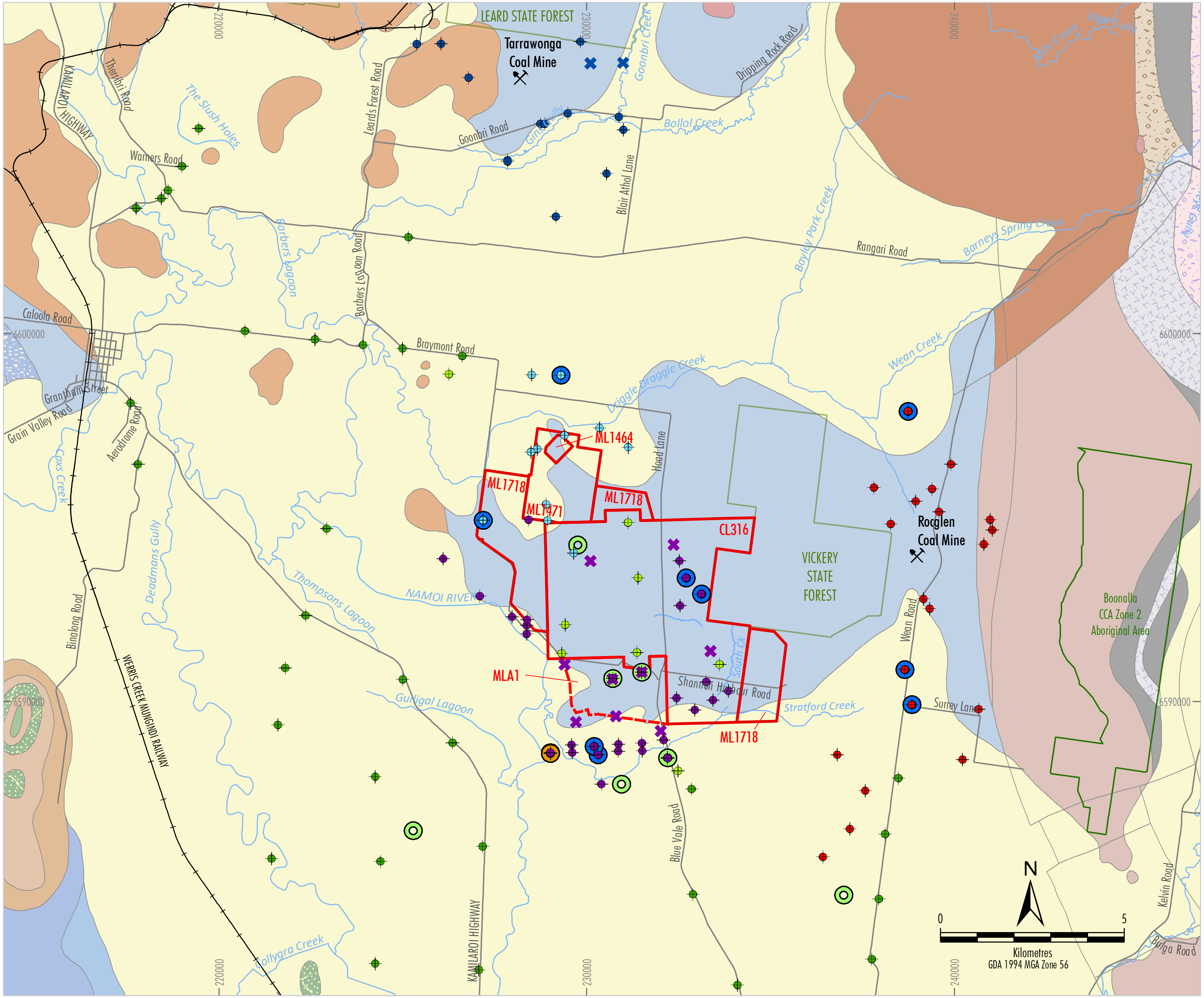
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Results of Bore Census Undertaken for Approved Mine

Figure 7

WHC-15-33_IPC PRR_206A



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Forest
- State Conservation Area, Aboriginal Area
- Vickery Standpipe
- Vickery Vibrating Wire Piezometer
- Stygofauna Sampling Location (2012)
- Stygofauna Sampling Location (2012 and 2016)
- Stygofauna Sampling Location (2016)
- Canyon Standpipe
- Rocglen Standpipe
- Tarrawonga Standpipe
- Tarrawonga Vibrating Wire Piezometer
- Namoi Valley Project Standpipe
- DI Water Standpipe

Regional Geology Legend (relevant formations)

- Undifferentiated Alluvial Deposits
- Maules Creek Formation

Source: *Department of Industry (2015); DPI - Gunnedah Coalfield South (2013)*

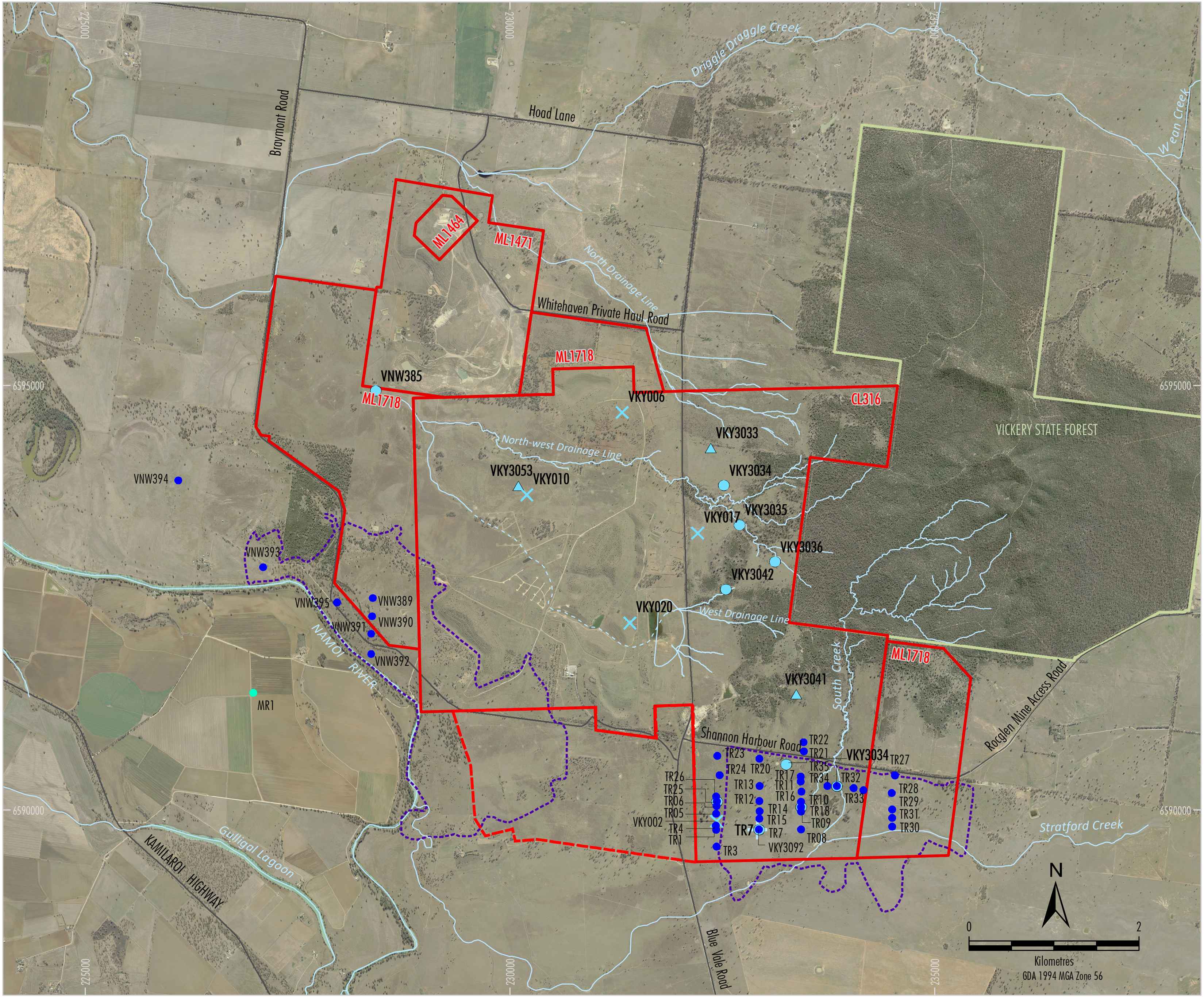
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Groundwater Monitoring Locations and Regional Geology in the Vicinity of the Project

Figure 8

WHC-15-33_IPC PRR_207A



LEGEND

- Mining Tenement Boundary (ML, CL and AUTH)
- Mining Lease Application (MLA)
- State Forest
- Drainage Path
- Modified Drainage Path

Alluvium Investigations

- Alluvium Investigation Hole
- Private Bore
- TEM Survey Extent

Groundwater Monitoring Bores Installed for Approved Mine

- Core permeability test site
- Standpipe
- Vibrating Wire Piezometer

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); Department of Industry (2015); Essential Energy (2015)

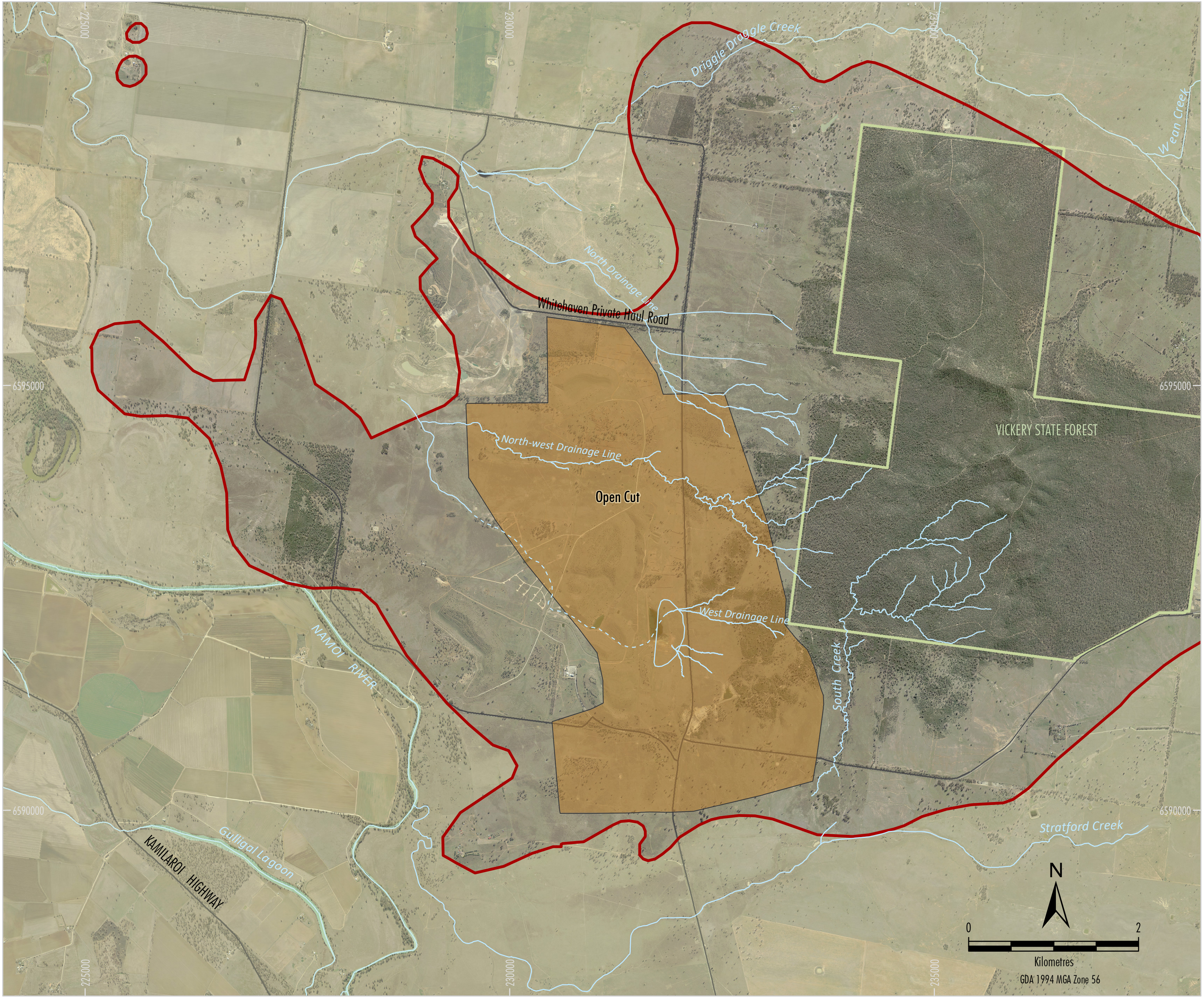
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Groundwater and Alluvium Investigation Programmes Conducted for the Approved Mine and the Project

Figure 9

WHC-15-33_IPC PRR_208A



LEGEND

- State Forest
- Indicative Extent of Open Cut
- Regionally Mapped Alluvial Boundary
- Drainage Path
- Modified Drainage Path

Source: Orthophoto - Department of Land and Property Information, Aerial Photography (July 2011); Department of Industry (2015); Essential Energy (2015); Hydro Simulations (2018)

N

0 2
Kilometres
GDA 1994 MGA Zone 56

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VICKERY EXTENSION PROJECT

Regionally Mapped Upper Namoi Alluvium Boundary

Figure 10

WHC-15-33_IPC PRR_209A

- Drilling and geological logging of 33 shallow investigation drill holes within the Upper Namoi Alluvium and weathered Maules Creek Formation strata within, and to the south of, the proposed open cut extent (refer to Enclosure 1).
- Drilling at six locations, including a transect of four drill holes on the northern side of the Namoi River.

In regard to the site-specific alluvial investigation programs it is noted that the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC), in its advice on the Project, stated:

> *The IESC notes that a number of the studies completed for this project such as the surface water assessment and the studies to determine the extent of the alluvium have been completed to a high standard. The proponent should be commended for these studies and for obtaining peer reviews of many of the major reports provided in the impact assessment.*

IPC POINT OF INTEREST 8

The IPC stated:

> ***What are hydro-geology functional parameters for the stratigraphy (i.e. storativity, specific yield, hydraulic conductivities, any anisotropy)? What data are they based on?***

WHITEHAVEN RESPONSE

Table 1 details the calibrated hydraulic parameters for each layer of the groundwater model lithology.

Table 1
Project Groundwater Model Calibrated Hydraulic Parameters

Layer	Lithology	Horizontal Hydraulic Conductivity (m/day)	Vertical Hydraulic Conductivity (m/day)	Storage Coefficient	Specific Yield
1	Alluvium	0.35-40	0.1-0.01	0.001	0.05
	Regolith / Weathered Permian	0.01	0.001	$1x10^{-4}$	0.01
2	Alluvium	0.35-40	0.05	0.005	0.2
	Overburden/Weathered Permian	0.01	0.001	$1x10^{-4}$	0.01
3	Overburden	$3x10^{-4}$	$3x10^{-5}$	$5x10^{-5}$	0.005
4	Braymont Seam to Jeralong Seam	$4x10^{-3}$	$4x10^{-5}$	$1x10^{-4}$	0.01
5	Interburden	$4x10^{-4}$	$4x10^{-5}$	$5x10^{-5}$	0.005
6	Merriown Seam to Velyama Seam	$4x10^{-3}$	$4x10^{-4}$	$1x10^{-4}$	0.01
7	Interburden	$4x10^{-4}$	$4x10^{-5}$	$5x10^{-5}$	0.005
8	Nagero Upper Seam	$3x10^{-3}$	$3x10^{-4}$	$1x10^{-4}$	0.01
9	Interburden	$3x10^{-4}$	$3x10^{-5}$	$5x10^{-5}$	0.005
10	Tralee Seam to Stratford Seam	$5x10^{-3}$	$5x10^{-4}$	$1x10^{-4}$	0.01
11	Interburden	$3x10^{-4}$	$3x10^{-5}$	$5x10^{-5}$	0.005
12	Bluevale to Cranleigh Seam (Whitehaven Seam)	$5x10^{-3}$	$5x10^{-4}$	$1x10^{-4}$	0.01
13	Underburden	$3x10^{-4}$	$3x10^{-5}$	$5x10^{-5}$	0.005
14	Volcanics	$2.5x10^{-3}$	$2.5x10^{-4}$	$1x10^{-4}$	0.01

Source: HydroSimulations (2018)
m/day = metres per day

As described above, the groundwater model was developed in consideration of published data, regional monitoring and site-specific test work.

The site-specific test work undertaken for the Approved Mine to establish hydraulic properties is described in the *Groundwater Field Investigation* (Groundwater Exploration Services Pty Ltd, 2012) (Enclosure 1 to this document) and included (Figure 9):

- core test work (29 samples from five drill holes [VKY002c, VKY006c, VKY010c, VKY017c and VKY020c]);
- low flow constant rate pumping tests and slug tests at four standpipes screened within the weathered Maules Creek Formation (T7, T18, T35 and T26); and
- slug tests at five standpipes screened within the Maules Creek Formation (VKY3034, VKY3035, VKY3036, VKY3042 and VKY3043).

The final hydraulic parameters adopted for the groundwater modelling prediction scenarios (Table 1) were informed by the steady-state and transient calibration of the model (refer to Sections 4.8 to 4.10 of the Project Groundwater Assessment [HydroSimulations, 2018]) which considered a number of factors, including:

- calibrated alluvium properties in the NSW Government groundwater model;
- historical regional groundwater table levels;
- historical groundwater extraction from agriculture and mining and associated transient responses to groundwater table levels; and
- rainfall recharge.

Dr Frans Kalf, in his peer review of the Project Groundwater Assessment (refer to Attachment 4 of the EIS) appraised the groundwater model calibration as “very good”.

Mr Hugh Middlemis considered the calibration of the groundwater model in his peer review undertaken on behalf of DPE and concluded:

> *The model has a good history match calibration in steady state and transient modes to the data record 2006-2011, with subsequent verification to 2012-2017. This is consistent with best practice and is well-executed to establish the validity of the model as a sound predictive tool.*
>
> *Model calibration performance is acceptable in that is within the guideline 5-10% scaled RMS statistical criterion (SRMS is 6.3% for steady state, 5% for transient 2006-2011 and 7.1% for verification 2012-2017). The simulated groundwater flow system contours and time series matches to observation bore data is mostly good.*
>
> *There are some isolated poor matches apparent in the time series plots (Appendix D to groundwater assessment) that are not well-explained, especially for those bores in other key areas near Canyon, Rocglen and Tarrawonga, although there are usually other bores nearby that show good matches …*

In addition, Mr Middlemis stated the groundwater model was suitable for impact assessment purposes, notwithstanding recommendations for additional sensitivity analysis to align with the recommended approaches in Middlemis & Peeters (2018):

> *While it could be argued that the risk context is fairly low in this case, given its setting in the low permeability Maules Creek Formation and benchmarking to low dewatering rates and lack of widespread drawdown impacts from nearby mines, the assessment does not highlight the use of such arguments to justify the minimum effort approach to uncertainty assessment.*
>
> *…*
>
> *Even after improved uncertainty assessments, uncertainties will remain, and the ongoing monitoring program is well-designed to provide the data in due course for model improvements and assessment of uncertainties. In its current form, the groundwater assessment provides information that is suitable for impact assessments and management plan development, and for licensing decisions.*

Mr Middlemis's overall conclusion stated:

> *My professional opinion is that the Vickery Extension hydrogeological and groundwater modelling assessment is fit for the purpose of mine dewatering environmental impact assessment (including cumulative impacts) and informing management strategies and licensing.*

The IESC, in their independent review of the Project, stated:

> *The IESC notes that the specific storage values used in the alluvial areas of model layer two could be unrealistically high. This may cause the predicted extent and magnitude of drawdown to be under estimated and could result in non-compliance with the NSW Aquifer Interference Policy.*

The IESC has incorrectly interpreted the storage parameters provided in the Project Groundwater Assessment as being the specific storage values of the model layers, when in fact they are storage coefficients (see Table 1 above).

IPC POINT OF INTEREST 9

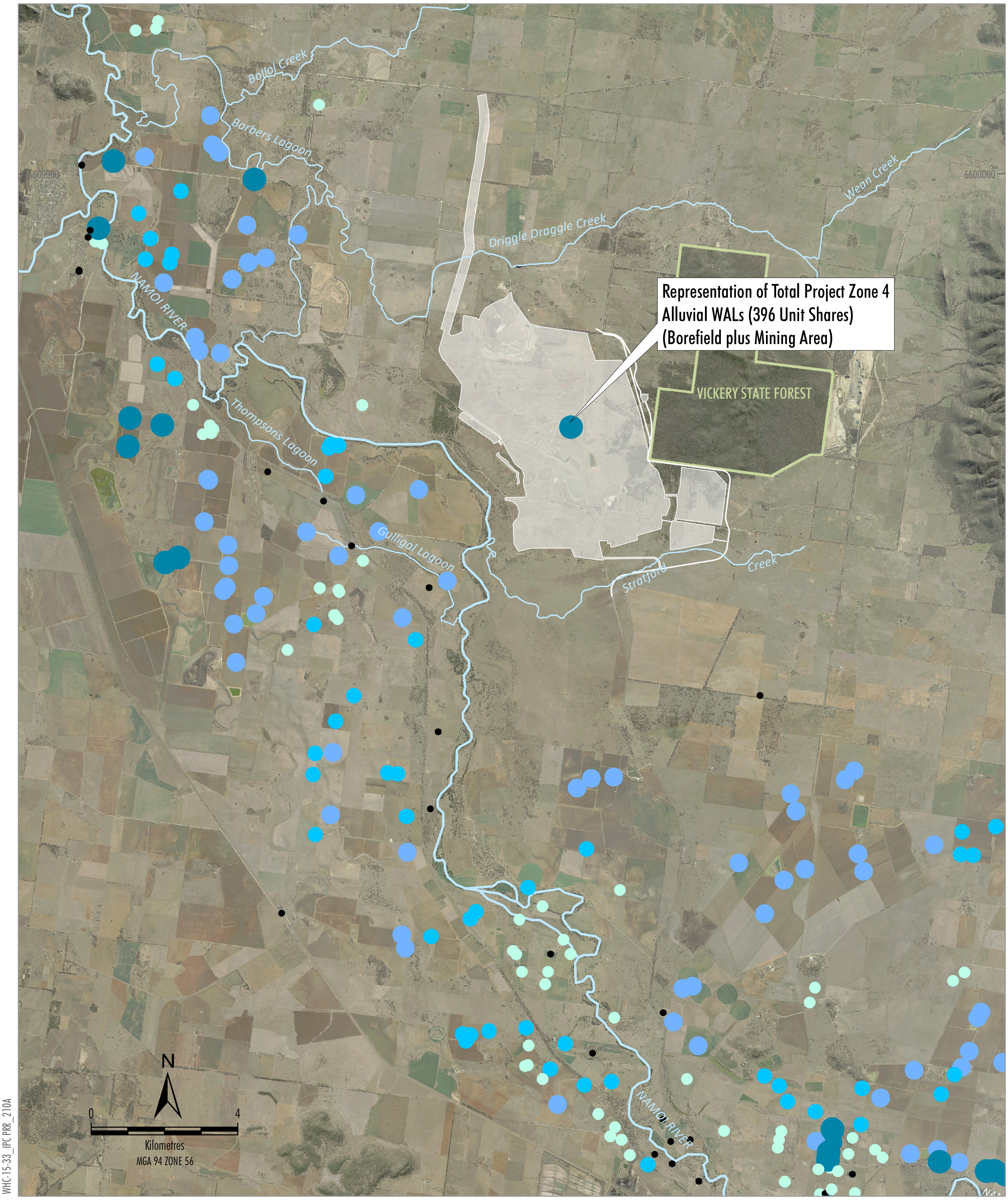
The IPC stated:

> ***What is the reliability of the predictions for the bore field (particularly given no test wells were drilled to the north of the site)? Specifically, what sensitivity studies were performed and what was the rationale for those sensitivity studies that were performed and those that were not?***

WHITEHAVEN RESPONSE

The use of the Project borefield would be in accordance with Whitehaven's licensed entitlements and the extraction and positioning rules of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*. The Water Sharing Plan's stated objectives are for the equitable use of groundwater while protecting other users and the environment.

Figure 11 shows the distribution of existing licenced allocations for the Zone 4 alluvium, based on Water Access Licence title searches. As shown, the Zone 4 alluvial licences held by Whitehaven for the Project are insignificant in the context of the currently licenced extraction in the vicinity of the Project (Figure 11).



LEGEND

NSW State Forest

Project Mining Area and Borefield

Total Alluvial WAL Allocations

- 0 - 10 ML/year
- 10 - 50 ML/year
- 50 - 100 ML/year
- 100 - 250 ML/year
- 250 - 500 ML/year

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Alluvim Water Access Licences in the Vicinity of the Project

Source: Geoscience Australia (2006); DPI Water (2016); Whitehaven (2016)

Figure 11

In addition, the use of the Project borefield has been modelled cumulatively with drawdown due to Project mining (as well as other mining operations and agricultural users) to confirm potential impacts to other users are insignificant.

The following provides background information in regard to the requirement for the Project borefield, the rules of the relevant Water Sharing Plan (which apply to extraction from the Project borefield) and a summary of predicted impacts.

Requirement for the Project Borefield

The Project borefield is proposed to provide a supplementary water source.

To minimise as far as possible the requirement to source water externally, direct rainfall runoff from disturbed mining areas captured on-site would preferentially be used to meet water demands (e.g. runoff captured in the open pit, sediment dams and mine water dams). In addition, reject material would be dewatered (Section 2.6.2 of the EIS) and water captured and reused.

Additional water demands would be met via the following:

1. Licensed extraction from the Namoi River, noting that "general security" licences are subject to annual water determinations (AWDs), and as such, are less reliable during dry periods.
2. Licensed extraction from the Project borefield (i.e. when surface water licenses are insufficient to meet external water demands).

The site water balance modelling conducted by Advisian (2018) for the Project indicates that after the initial years of the Project (which includes expected water demands for the construction period, when there is significantly less runoff being captured on-site) use of the Project borefield is predicted to be limited, with 16 megalitres per year (ML/year) required under a median scenario and between 16 to 274 ML/year required under a 90th percentile scenario (refer to Table 8.13 of the Project Surface Water Assessment [Advisian, 2018]).

During the early years of the Project, expected extraction from the Project borefield is between 199 and 390 ML/year, which is within the Zone 4 alluvial licences currently held by Whitehaven under the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* (refer to Table A6-1 and A6-2 of Attachment 6 of the EIS).

It should be noted the expected historical variability of AWDs of Whitehaven's general security river licences under the *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016* has been considered by Advisian (2018) in the site water balance modelling, in particular, to determine the requirement for supplementary water from the Project borefield.

The historical annual variability of AWDs from 1893 has been sourced from *Water availability in NSW Murray-Darling Basin regulated rivers, Appendix of annual data* (Department of Primary Industries, 2013) (refer to Section 7-10 and Figure 7.6 of the Project Surface Water Assessment [Advisian, 2018]). The distribution of AWDs through the water year have been established based on published data since the commencement of the *Water Sharing Plan for the Upper Namoi and Lower Namoi Regulated River Water Sources 2016*.

Water Sharing Plan Rules and Objectives

The use of the Project borefield would only be conducted in accordance with licenced extraction under the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*.

The objectives of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* are outlined in Clause 11:

The objectives of this Plan are to:

…

(c) manage access to the extraction limits to ensure there are no long-term declines in water levels,

(d) preserve basic landholder rights access to these groundwater sources and ensure the fair, equitable and reliable access to groundwater through the management of local impacts or interference effects,

(e) contribute to the protection, maintenance and enhancement of the economic viability of groundwater users and their communities in the Namoi Valley,

…

DPE (2016) has outlined the function of the Water Sharing Plans as follows:

Water Sharing Plans ensure that all users have equal access rights, all water users are protected from excessive extraction and all water users are afforded water allocations based on regional water availability, groundwater levels, water quality changes, aquifer integrity, river conditions and the health of dependent ecosystems.

To achieve this level of protection, Water Sharing Plans utilise water entitlements to cap total water extraction across the region (i.e. cumulative impacts), and water allocations to cap annual individual bore extraction (i.e. impacts on individual users). Water Sharing Plans also provide for distinct allocations for different water uses, meaning that any water extracted by the borefield [for the Boggabri Coal Mine] *would have no impact of water allocation designated for town water supplies or environmental flows in the Namoi River and its tributaries and wetlands.*

The annual extraction limit for each groundwater source is outlined in Part 9 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*. The annual extraction limit for Zone 4 is 25,700 ML/year.

By comparison, Whitehaven holds 396 unit shares (396 megalitres [ML] based on 1 ML per unit share) for the Project. As described above, median extraction from the Project borefield is predicted to be approximately 16 ML/year for the majority of the Project life.

Figure 11 shows the distribution of existing licenced allocations for the Zone 4 alluvium, based on Water Access Licence title searches. As shown, the Zone 4 alluvial licences held by Whitehaven for the Project are insignificant in the context of the currently licenced extraction shown on Figure 11.

Water Sharing Plan – Location of Extraction Bores

Clause 36 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003* provides requirements for the positioning of groundwater extraction bores:

(1) With the exception of a water supply work (bore) for the supply of basic landholder rights only, applications for a new water supply work (bore) within 100 metres of any bores for the supply of basic landholder rights, will require an investigation by the proponent of the potential impact on neighbouring bores.

(2) A new water supply work (bore) to exercise basic landholder rights will be required to be drilled to sufficient depth to maintain long-term access to the water source.

(3) A minimum distance of 400 metres is to be maintained between all new water supply works (bores), except for a replacement water supply work (bore) and those for the supply of basic landholder rights only.

(4) A new water supply work (bore) that is not a replacement water supply work (bore) or a water supply work (bore) for the supply of basic landholder rights only shall be located no closer than 200 metres from a property boundary.

(5) Notwithstanding the provisions of subclauses (3) and (4), the Minister may, upon request of the applicant for the water supply work approval, vary the distance restrictions specified in subclauses (3) and (4) if the Minister is satisfied that:

(a) a hydrogeological study undertaken by the applicant, assessed as adequate by the Minister, demonstrates that the location of the new water supply work (bore) will have no more than minimal potential for adverse impact on existing authorised extraction, including consideration of cumulative impact, and

(b) written consent has been obtained by the applicant from adjacent landowners, and

(c) there is a process for remediation in the event that an adverse impact occurs in the future, specified as conditions on the water supply work approval.

(6) In the event that there is a dispute between neighbours as to whether the new water supply work has had an impact on overall water security, the Minister may impose or amend conditions on the water supply work approval of any or all parties to address such impact, including requiring the construction of an additional monitoring bore on the property boundary in order to establish conditions to limit the level of drawdown off-site.

(7) A new water supply work (bore) with the exception of a replacement water supply work (bore) or a water supply work (bore) for the supply of basic landholder rights only, cannot be constructed within a minimum distance of:

(a) 500 metres of a bore nominated by a local water utility access licence,

(b) 400 metres of a Departmental monitoring bore,

(c) 400 metres of a bore extracting from the Great Artesian Basin,

(d) 500 metres of a wetland, or

(e) 200 metres of a river.

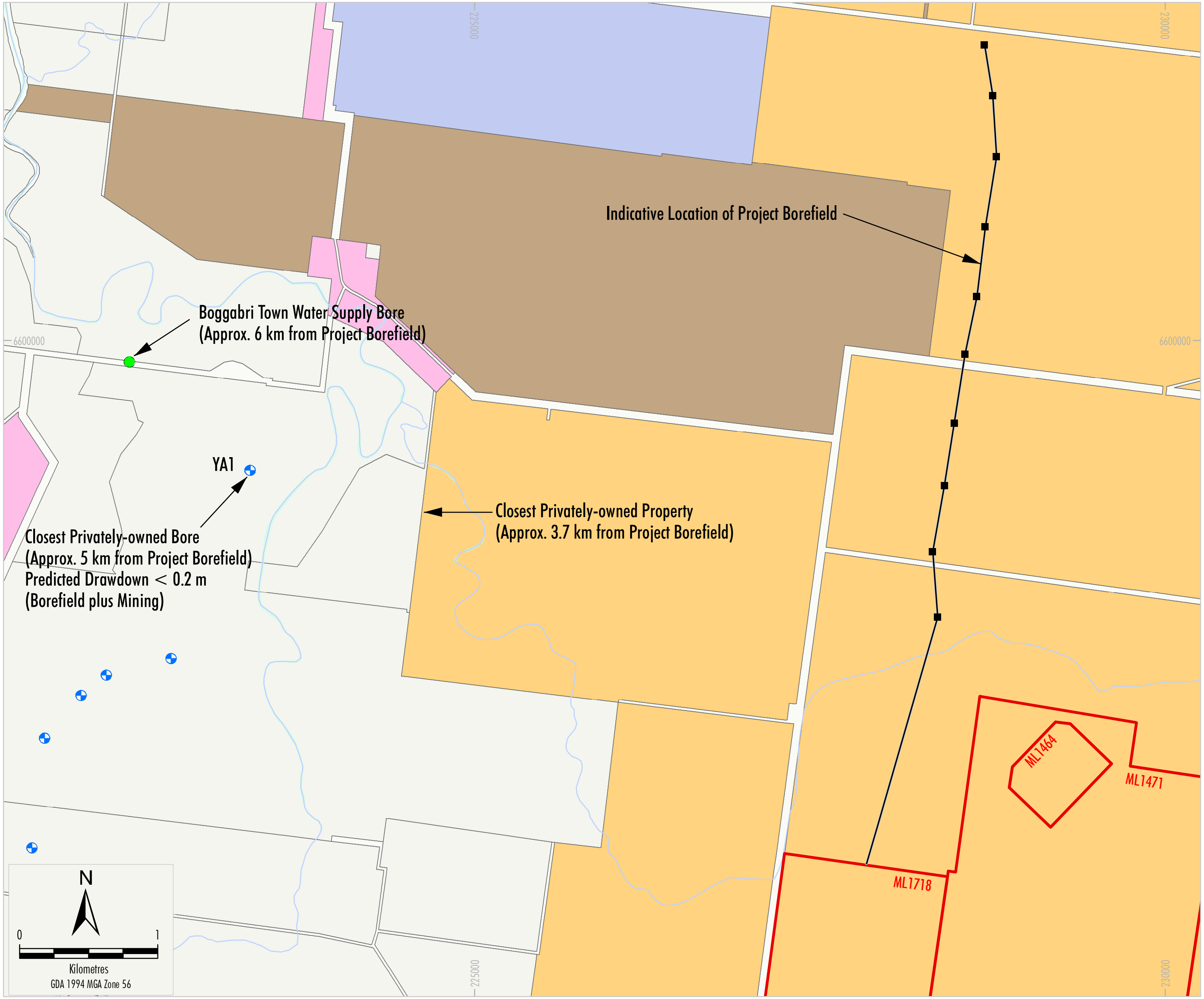
The positioning of the series of bores associated with the Project borefield would be consistent with Clause 36 of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003.*

As shown on Figure 12 the Project borefield is approximately:

- 3.7 km from the boundary of the nearest privately-owned property.
- 5 km from the nearest privately-owned bore.
- 6 km from the Boggabri town water supply bore.

Modelling of Extraction from the Project Borefield

There has been significant investigation of the hydrogeological properties of the alluvium associated with the Project borefield, the results of which were incorporated in the *Upper Namoi Groundwater Flow Model: Model Development and Calibration* (McNeilage, 2006) prepared for the NSW Department of Natural Resources (now DoI Water). Groundwater modelling for the Project borefield incorporated hydrogeological parameters derived from the DoI Water regional groundwater model (McNeilage, 2006). Relevant extracts of the DoI Water regional groundwater model parameters are provided in Plates 7a, 7b, 7c and 7d.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Crown Land
- Whitehaven Owned Land
- Whitehaven/Idemitsu Boggabri Coal Joint Owned Land
- Idemitsu Boggabri Coal Owned Land
- Privately Owned Land and Other Land
- Indicative Location of Groundwater Bores and Pipeline
- Privately-owned Groundwater Bore Identified During Bore Census (2012)

Source: Department of Land and Property Information - Land Tenure (2016); Department of Industry (2017); Whitehaven Coal (2016)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Privately-owned Bores in the Vicinity of the Project Borefield

Figure 12

WHC-15-33_IPC PRR_211A

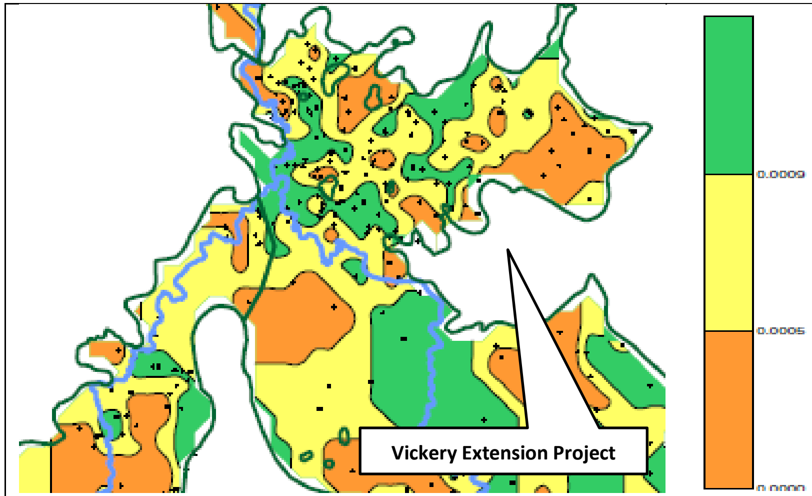


Plate 7a: DoI Water Model - Specific Storage (per metre)

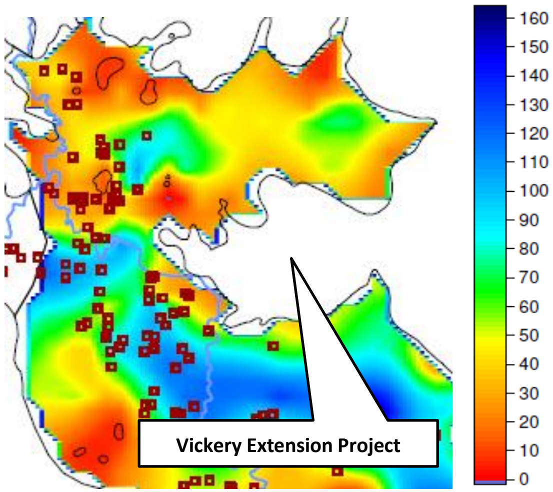


Plate 7b: DoI Water Model - Alluvial Thickness (metres)

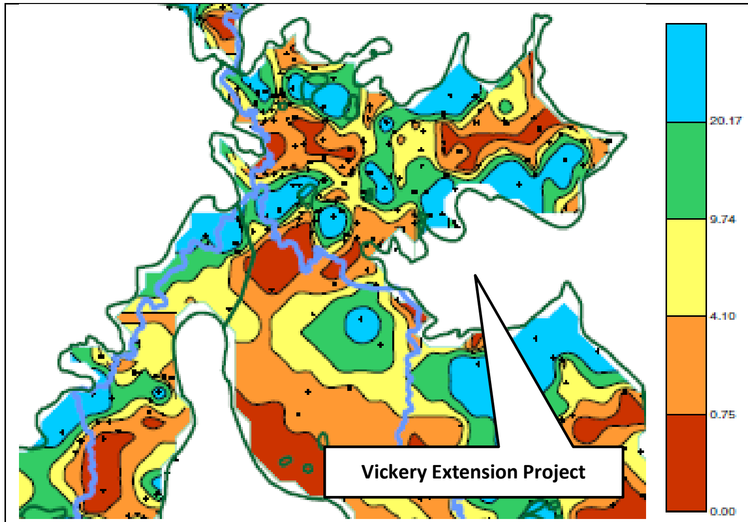


Plate 7c: DoI Water Model - Borelog Hydraulic Conductivity (metres per day)

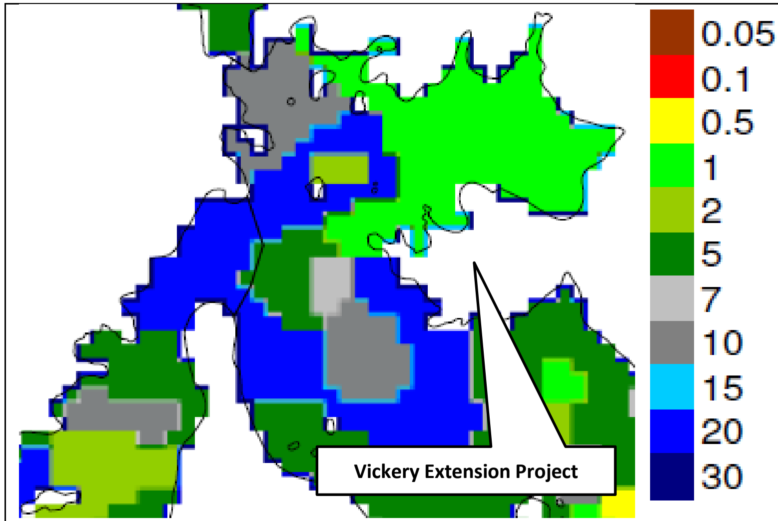


Plate 7d: DoI Water Model - Model Hydraulic Conductivity (metres per day)

Notwithstanding that the Project borefield would comply with the extraction and positioning rules of the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*, extraction from the Project borefield has been modelled cumulatively with predicted drawdown from Project mining (as well as other mining operations and agricultural users).

Although Whitehaven's licensed allocation is limited to 396 ML/year and median extraction from the Project borefield is predicted to be approximately 16 ML/year for the majority of the Project life, the modelling conservatively assumed a total extraction rate of 600 ML/year from the Project borefield (refer to Section 6.4 of the Project Groundwater Assessment [HydroSimulations, 2018]). This rate of modelled extraction could not occur in practice as it exceeds Whitehaven's licensed entitlements, nor is it predicted to be required to meet the Project's water demands.

Even with a conservative 600 ML/year extraction rate estimate, as shown in Table 22 of the Project Groundwater Assessment:

- the predicted cumulative drawdown at all privately-owned bores is less than 0.2 m, with the exception of 'RB1' (predicted drawdown of approximately 0.6 m) located to the south of the Rocglen Coal Mine (Figure 7); and
- the incremental drawdown associated with the Project borefield only (compared to Project mining drawdown and other cumulative sources) is negligible at all privately-owned bores.

The Boggabri town water supply bore location is shown on Figure 12. Based on the conservative predictions at privately-owned bores which are closer to the Project borefield (i.e. 'YA1', approximately 5 km from the Project borefield), predicted cumulative drawdown from the Project is expected to be less than 0.2 m at the Boggabri town water supply bore.

Summary

In summary, the use of the Project borefield would be compliant with the *Water Sharing Plan for the Upper and Lower Namoi Groundwater Sources 2003*. Modelling predictions support that the Project borefield would have negligible impacts on other groundwater users in the vicinity. No further sensitivity of the modelling is considered to be required, particularly given the modelling is conservatively based on an extraction rate of 600 ML/year, which is significantly larger than Whitehaven's licenced entitlements or the extraction predicted to be required from the borefield.

IPC POINT OF INTEREST 10

The IPC stated:

> ***The reports note that post-rehabilitation that groundwater transients are observed for 300 years. Please present results of drawdowns and flow directions for 300 years as the report only shows them for 100 years for the entire domain modelled, not just in the immediate locale of the mine. Justify that the pit lake will be a sink for the entire site for the entire transient period, and at equilibrium.***

WHITEHAVEN RESPONSE

Additional groundwater modelling is not considered warranted as it would not change the conclusion of the final void analysis undertaken by Advisian (2018). The final void would remain a permanent groundwater sink and there is negligible risk of the final void water contaminating groundwater (HydroSimulations, 2018).

The Project Groundwater Assessment (HydroSimulations, 2018) presents predicted post-mining groundwater levels for a period of 100 years following the completion of mining.

However, the Project Surface Water Assessment (Advisian, 2018) predicts the equilibrium water level of the final void pit lake, as the groundwater modelling does not consider rainfall runoff from the catchment area which reports to the final void, evaporation from the final void pit lake, stochastic climate or salinity of the pit lake.

Advisian's (2018) analysis covers a period of 1,000 years following the completion of mining and predicts the final void pit lake water level would reach equilibrium approximately 300 years after the completion of mining, at an elevation of approximately 80 to 120 m Australian Height Datum [AHD] (Chart A).

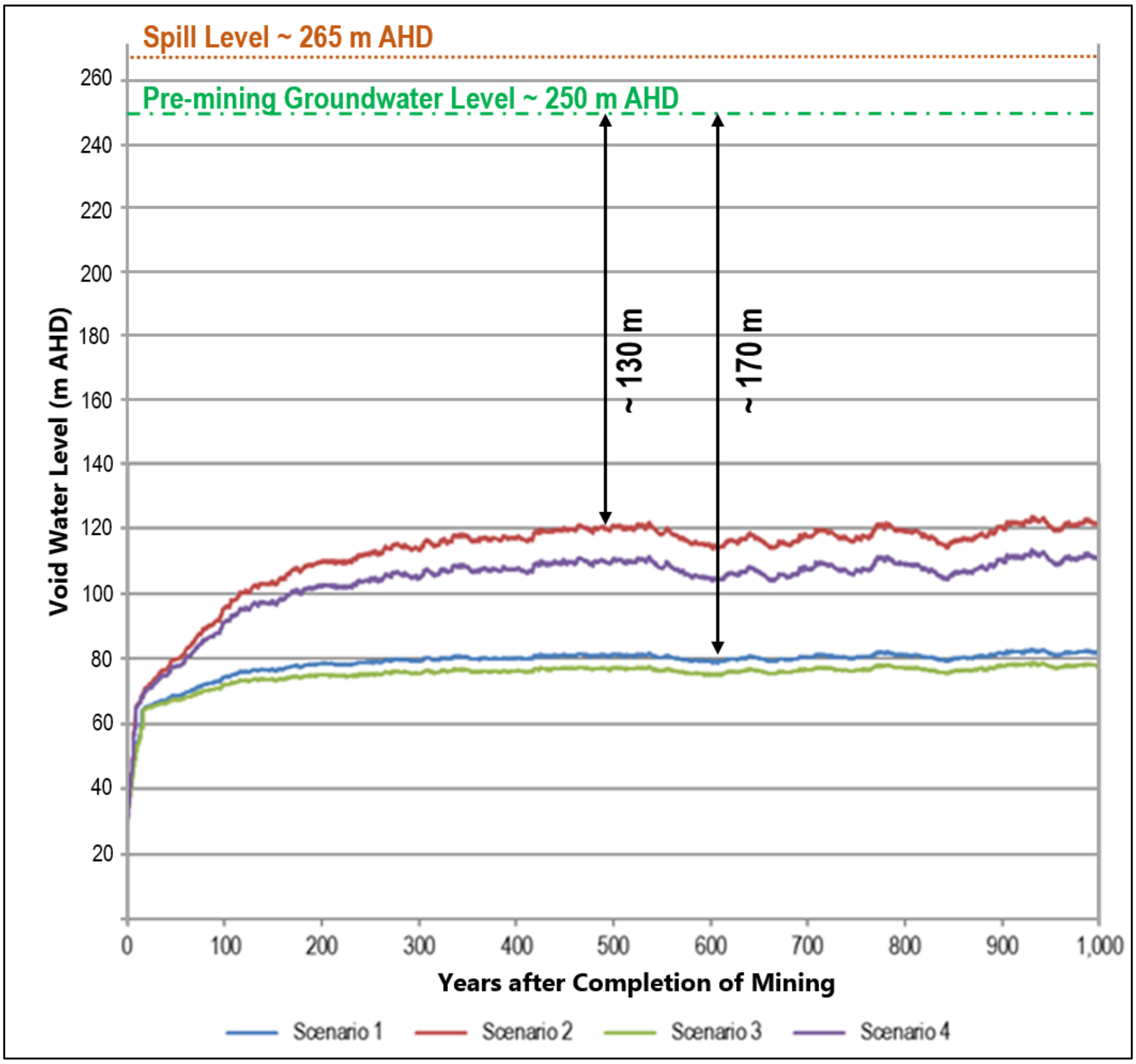


Chart A: Final Void Pit Lake Water Level (Source: Advisian [2018])

Chart A is based on Figure 8.21 from Advisian (2018), with additional information showing surrounding topography and the pre-mining groundwater table level.

As shown, the final void pit lake level is at least approximately 130 m below the surrounding groundwater table. On this basis (i.e. the outcomes of Advisian's [2018] final void analysis), HydroSimulations (2018) concludes the final void would remain a permanent groundwater sink.

Note that Advisian's (2018) analysis includes input from the groundwater modelling with respect to the relationship between groundwater inflows and pit lake elevation (Chart B).

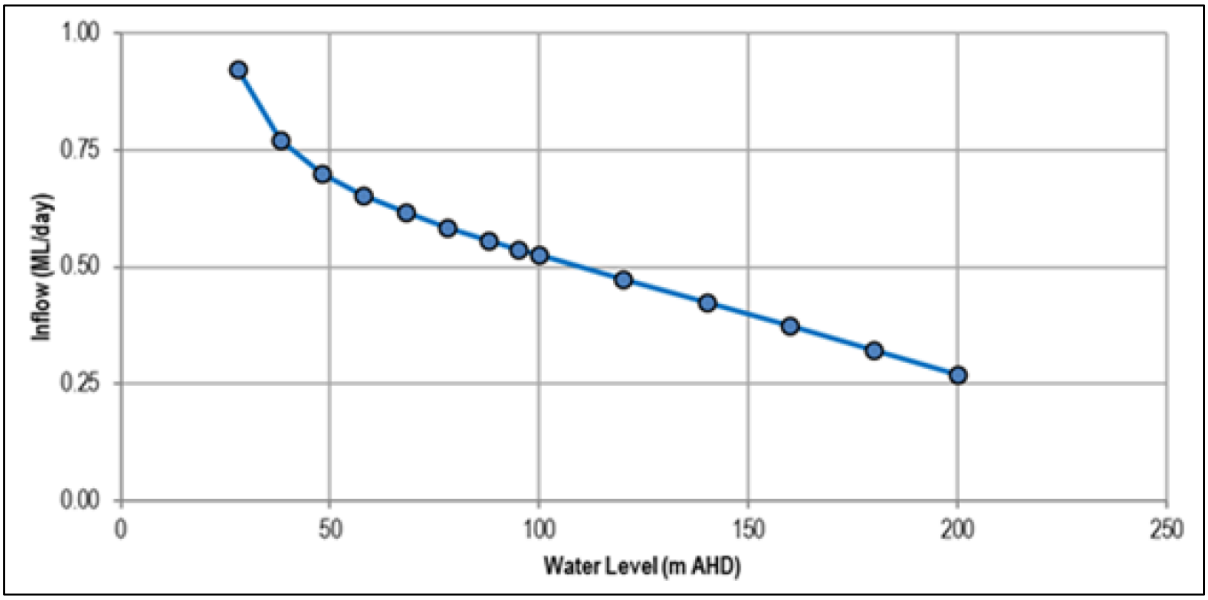


Chart B: Final Void Inflow Stage Relationship (Source: Advisian [2018])

Additional groundwater modelling (e.g. to incorporate the equilibrated final void pit lake level predicted by Advisian [2018]) could be conducted. However, this would not change the conclusions of Advisian's (2018) final void analysis or HydroSimulations' (2018) conclusion that the final void would remain a permanent groundwater sink and that there is negligible risk of the final void water contaminating groundwater.

During the Briefing on 25 February 2019, the IPC requested further clarification of the sources of the groundwater drawdown associated with the final void. The predicted groundwater drawdown for the final void (i.e. Project-only drawdown) is shown in Plate 8 (Figure 51 of the Project Groundwater Assessment [HydroSimulations, 2018]). The extent of drawdown from the Project only does not interact with the Mooki Thrust on the eastern boundary of the model domain. Groundwater drawdown from the Project final void is from the porous rock groundwater source and incidental losses from the Zone 4 Alluvium and Namoi River (refer to Sections 5.5.1, 5.5.2 and 5.6 of the Project Groundwater Assessment [HydroSimulations, 2018]). Whitehaven holds sufficient surface water and groundwater licenses in the relevant Water Sharing Plans to account for the predicted drawdown associated with the Project final void (refer to Attachment 6 of the Project EIS). While Figure 50 of the Project Groundwater Assessment (HydroSimulations, 2018) shows water table drawdowns in the porous rock reaching the trace of the Mooki Thrust fault, these drawdowns are due to the Rocglen mine and not the Project.

In response to the IPC's query regarding the final void remaining a permanent groundwater sink "for the entire site", groundwater (including infiltration to the backfilled portions of the open cut) across the majority of the Project area is predicted to flow towards the final void. However, the Project Groundwater Assessment does not predict groundwater for the entire site would flow to the final void. Hydrosimulations (2018) describes and assesses the potential impacts of seepage from the outer batters of the Western Emplacement being directed towards the surrounding alluvium in addition to the final void (refer to Sections 5.5.3 and 6.1.4 of the Project Groundwater Assessment [HydroSimulations, 2018]). HydroSimulations (2018) concluded that the small amount of predicted seepage from the Western Emplacement will cause no adverse water quality impacts to the alluvium.

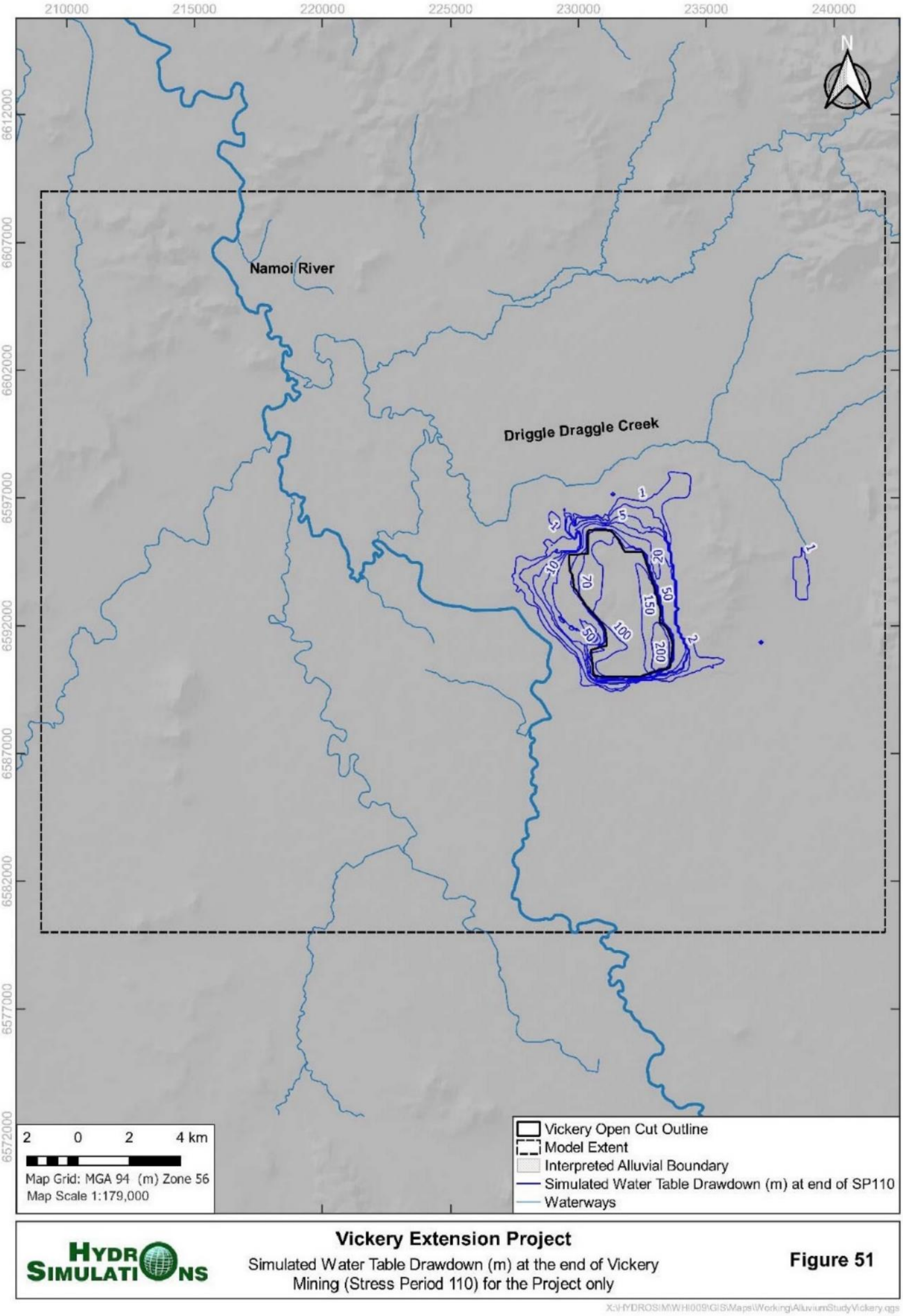


Plate 8: Predicted Project-only Groundwater Drawdown (Source: HydroSimulations, 2018)

Final Void Analysis Methodology Overview

An overview of the final void analysis methodology is provided below.

- The groundwater model post-mining simulation produced a relationship between predicted groundwater inflows and final void pit lake water level. This relationship is reproduced below in Chart B (i.e. Figure 8.20 of the Project Surface Water Assessment [Advisian, 2018]).
- This relationship serves as a "lookup table" for the final void water balance conducted by Advisian (2018). The relationship shows that groundwater inflows to the final void decrease as the pit lake water level increases (i.e. as the pit lake water level approaches the surrounding groundwater table level the relative difference in head decreases and, accordingly, groundwater inflows to the final void above the pit lake water level decrease).
- Advisian's (2018) final void analysis considers other relevant parameters such as rainfall runoff, area of catchment reporting to the final void, evaporation (as a function of salinity) and void dimensions (geometry and final landform), which cannot be considered in the groundwater model.
- Advisian (2018) presents the outcomes of the final void analysis over a period of 1,000 years following the completion of mining. The final void pit lake water level is predicted to reach equilibrium approximately 300 years following the completion of mining (Chart A).
- HydroSimulations' (2018) review of the final void pit lake water level in comparison to the surrounding groundwater table level confirms the final void would remain a permanent groundwater sink.

IPC POINT OF INTEREST 11

The IPC stated:

> ***What is the sensitivity of the equilibrium pit lake elevation to changes in the groundwater parameter assumptions? Do all aquifers drain into the lake or can some be recharged (and thus polluted) by the equilibrium pit lake water level? What is the variability of the lake level with natural climate variability over the long term (e.g. in the first 300 years, and subsequently)?***

WHITEHAVEN RESPONSE

Sensitivity of Equilibrium Pit Lake Level

The final void pit lake water level is not considered to be sensitive to changes in groundwater parameters, as:

- Groundwater inflows would be minor compared to rainfall and evaporation.
- Changes in regional groundwater system properties would have a negligible effect on the discharge-stage curve input to the final void analysis undertaken by Advisian (2018).
- The discharge is controlled by adopted spoil properties. The model uses a horizontal hydraulic conductivity of 1 metre per day (m/d) and a vertical hydraulic conductivity of 0.1 m/d (Mackie, 2009). Spoil properties would have a negligible effect on the discharge-stage curve, as the altered hydraulic gradient through the spoil would be balanced by compensating permeability to give essentially the same discharge to the final void.
- There is negligible risk of the final void not acting as a permanent groundwater sink.

Advisian (2018) has tested the sensitivity of the final void pit lake water level for changes in rainfall and evaporation as per the following scenarios (refer also to Chart A):

- Scenario 1: maximum rainfall reduction (-23%) + minimum evaporation increase (+9.8%);
- Scenario 2: maximum rainfall increase (+18%) + minimum evaporation increase (+9.8%);
- Scenario 3: maximum rainfall reduction (-23%) + maximum evaporation increase (+18.1%); and
- Scenario 4: maximum rainfall increase (+18%) + maximum evaporation increase (+18.1%).

These scenarios are based on the Commonwealth Scientific and Industrial Research Organisations' (CSIRO's) seasonal rainfall and evapotranspiration projections for the near future and far future for three Representative Concentration Pathways (RCPs) used by the International Panel on Climate Change (IPCC) (refer to Sections 8.10.1 and 4.2 of the Project Surface Water Assessment [Advisian, 2018]).

The variability in predicted final void pit lake water level across these four scenarios up to 1,000 years post-mining is provided in Chart A. As shown, the final void pit lake water level is most sensitive to rainfall, however, for all scenarios the equilibrium final void pit lake water level is significantly below the spill level and the surrounding groundwater table level (i.e. would remain a permanent sink) (Chart A).

Aquifers Surrounding the Final Void

The Project open cut (and final void) is wholly located within the extent of the Maules Creek Formation. As the final void would be a permanent sink, the localised direction of groundwater in the Maules Creek Formation would be towards the final void (i.e. rather than the final void water recharging the Maules Creek Formation).

There would be no direct groundwater flow from the alluvium to the final void. Minor induced losses of groundwater from the alluvium are predicted due to localised depressurisation associated with the final void remaining a permanent groundwater sink. These minor losses are quantified in Attachment 6 of the Project EIS (refer to Table A6-3). Whitehaven would retire sufficient licences to account for these minor losses. There is negligible risk for water from the final void to recharge the alluvium.

IPC POINT OF INTEREST 12

The IPC stated:

> ***What is the sensitivity of the results to potential climate change impacts both during and post-mining?***

WHITEHAVEN RESPONSE

Groundwater Model – During Mining

Section 7 of the Project Groundwater Assessment (HydroSimulations, 2018) describes the potential change in rainfall recharge due to climate change based on the *New England North West Region for the NSW/ACT Regional Climate Modelling* (NARCliM) as well as the Eastern Australia Region for the Climate Change in Australia Model (CCiA) both during and post mining.

Note that all 12 NARCliM climate change scenarios were considered in the Project Groundwater Assessment. The aggregation of all 12 scenarios projects an average annual increase in rainfall of 1.6% during Project mining. The CCiA climate change scenario projects an average annual reduction in rainfall of 1% during Project mining.

The modelled rainfall projections result in the following rainfall recharge scenarios:

- NARCliM recharge scenario: +4.8% during Project mining, +23.1% post-mining.
- CCiA recharge scenario: -3% during Project mining, -25.5% post-mining.

An increase in annual rainfall (and associated recharge), as predicted by most of the NARCliM scenarios, would reduce potential groundwater drawdown impacts. Therefore a transient predictive simulation for rainfall recharge was conducted for the pit inflows during mining based on the CCiA scenario with a reduction in recharge of 3% during the life of the Project (i.e. greater potential for groundwater drawdown due to decreased rainfall recharge).

The simulation predicted a reduction of less than 1% in pit inflows for the climate change scenario in response to a reduction in rainfall during the Project life. Overall, the groundwater model was found to be insensitive to rainfall and recharge variation predicted by climate change models. Therefore, further analysis is not considered to be warranted.

Site Water Balance – During Mining

Advisian (2018) conducted a sensitivity analysis of the site water balance with regard to climate change based on CSIRO's seasonal rainfall and evapotranspiration projections for the 'near future' (i.e. 2020-2039) for three RCPs used by the IPCC (refer to Sections 8.8.2 and 4.2 of the Project Surface Water Assessment [Advisian, 2018]).

With respect to reliable water supply, although climate change projections influence the amount of water required to be sourced from the Namoi River or Project borefield, the sensitivity analysis indicated the maximum amount of water required to be held in storage is within the capacity of the proposed on-site water storages and Whitehaven's licensed entitlements (Section 8.8.3 of the Project Surface Water Assessment [Advisian, 2018]).

With respect to containing rainfall runoff from disturbed catchment areas, Advisian (2018) concluded the Project water management system would be capable of operating satisfactorily under the CSIRO's climate change projections.

Final Void Analysis – Post-mining

As described above, the final void analysis conducted by Advisian (2018) determines the expected final void pit lake water level.

Advisian (2018) tested the sensitivity of the final void pit lake water level for changes in rainfall and evaporation as per the following scenarios (refer also to Chart A):

- Scenario 1: maximum rainfall reduction (-23%) + minimum evaporation increase (+9.8%);
- Scenario 2: maximum rainfall increase (+18%) + minimum evaporation increase (+9.8%);
- Scenario 3: maximum rainfall reduction (-23%) + maximum evaporation increase (+18.1%); and
- Scenario 4: maximum rainfall increase (+18%) + maximum evaporation increase (+18.1%).

These scenarios are based on CSIRO's seasonal rainfall and evapotranspiration projections for the 'near future' (i.e. 2020-2039) and 'far future' (i.e. 2080-2099) for three RCPs used by the IPCC (refer to Sections 4.2 and 8.10.1 of the Project Surface Water Assessment [Advisian, 2018]).

The variability in predicted final void pit lake water levels across these four scenarios up to 1,000 years post-mining is provided in Chart A. As shown, the final void pit lake water level is most sensitive to changes in rainfall, however, for all scenarios the equilibrium final void pit lake water level is significantly below the spill level and the surrounding groundwater table level (i.e. would remain a permanent sink) (Chart A).

IPC POINT OF INTEREST 13

The IPC stated:

> ***To what extent does the increasing concentration of solutes in the void with time pose a serious threat to groundwater quality in the region?***

WHITEHAVEN RESPONSE

Advisian (2018) indicated that in the long term the void lake will become increasingly saline (Section 8.10.2 of the Project Surface Water Assessment). However, the hydraulic gradient within the Project mining area will remain towards the final void, precluding migration of poorer quality water outside the void. Therefore, no adverse effect on surrounding groundwater resources is predicted (Section 6.2.3 of the Project Groundwater Assessment [HydroSimulations, 2018]).

5 SURFACE WATER

IPC POINT OF INTEREST 14

The IPC stated:

> ***In the light of the Giles review, what does the Whitehaven Coal consider to be a reasonable range on analytes to be monitored in surface water surrounding the mine and in water released from the mine to ensure no damage to the surrounding environment?***

WHITEHAVEN RESPONSE

It should be noted that "mine water" is not proposed to be released for the Project. Rather, water captured in the mine water management system (i.e. runoff from active waste emplacements and the open cut, and coal contact water) would be reused on-site to reduce demands from external water sources such as the Namoi River and Project borefield.

In regard to the range of analytes to be monitored for the Project, this has been informed by the Geochemistry Assessment, undertaken for the Project by Geo-Environmental Management (GEM) (2018), to determine the geochemical characteristics of ROM coal, coal reject material and overburden/interburden. The test work included pH, electrical conductivity (EC), acid base accounting, net acid generation tests, a sodicity assessment, and multi-element enrichment and solubility test work.

The multi-element analysis was undertaken for a total of 29 metals, as well as chlorine and sulfate (refer Tables B-6, B-7 and B-8 of the Project Geochemistry Assessment [GEM, 2018]). Relatively soluble elements identified in the multi-element analysis informed the water monitoring recommendations.

During the Briefing on 25 February 2019, the IPC queried whether any testing for chlorine and fluoride was undertaken for the Project. The Project Geochemistry Assessment (GEM, 2018) considered potential multi-element enrichment and solubility (including chlorine, as described above) of ROM coal, coal rejects and overburden/interburden, which did not include testing of fluoride. It should be noted Whitehaven would not treat mine water on-site to drinking water quality standards (e.g. via water chlorination). All potable water would be imported on-site.

A summary of these results and relevant recommendations for analytes to be monitored in the surface water and groundwater monitoring programs is provided below.

<u>ROM Coal</u>

Runoff from the ROM coal and product coal stockpiles would report to the mine water management system. As this water is not proposed to be released off-site, no specific analytes have been recommended for monitoring of coal contact water.

Reject Material

Coal reject material is expected to be non-to-slightly saline and non-acid forming (NAF), with a small portion potentially acid forming (PAF). Metals were identified as being enriched and/or readily soluble under pH neutral conditions in the coal rejects. Accordingly, the following measures are proposed to prevent runoff from areas where dewatered reject material would be co-disposed in the waste rock emplacement:

- The Project Geochemistry Assessment (GEM, 2018) recommended that no coal reject material be placed within 30 m of the edge of the Western Emplacement, and coal reject materials be covered with at least 5 m of inert material on the outer surface of the waste rock emplacement.
- The Project Surface Water Assessment (Advisian, 2018) recommended dewatered reject material be co-disposed of in locations such that runoff and infiltration would report to the mine water management system.

Notwithstanding the controls described above, the Project Groundwater Assessment (HydroSimulations, 2018) recommended that the following groundwater quality monitoring be conducted for any bores that would be installed in the waste rock emplacement behind the open cut: pH, dissolved oxygen, EC, total dissolved solids (TDS), iron, aluminium, arsenic, magnesium, molybdenum, selenium, calcium, sodium, chloride and sulphate.

Overburden/Interburden Material

The Project Geochemistry Assessment (GEM, 2018) concluded that the majority of the overburden and interburden generated from the Project would generally be expected to have a low sulfur content and be NAF with a low salinity risk. Therefore, the bulk of the overburden and interburden is expected to be relatively barren with no risk of generating acid or saline conditions.

A small quantity of overburden, typically identified as non-continuous units adjacent to some coal seams, was identified as containing increased sulfur concentrations but with low acid generating capacity. These materials are anticipated to produce acidic conditions only when left exposed to the atmosphere for a number of years. Some interburden material (typically mudstone) was identified as containing increased sulfur concentrations and higher acid generating capacity which would have the potential to generate acidic conditions in a shorter period of time (within weeks of exposure to the atmosphere). Blending of this material during excavation, transport and dumping is expected to produce an overall NAF material. PAF material would not be placed in the final lift of the waste rock emplacement.

Under the prevailing quasi-neutral to moderately alkaline conditions of the overburden and interburden, arsenic, molybdenum and selenium are likely to be readily soluble. Accordingly, the Project Geochemistry Assessment (GEM, 2018) and Project Surface Water Assessment (Advisian, 2018) recommended that monitoring of water quality in sediment dams capturing runoff from the waste emplacement include monitoring of: pH, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium (in addition to total suspended solids [TSS]).

In addition, and consistent with contemporary Environment Protection Licence (EPL) conditions, the following parameters would be monitored during a controlled discharge from a sediment dam (i.e. when releases to restore the capacity of the dam are required following a rainfall event that exceeds the dam design capacity, and when there is insufficient storage available in other on-site storages): pH, EC, TSS, oil and grease and total organic carbon.

Consistent with the conditions of approval for the Approved Mine (Development Consent SSD-5000, Condition 30(c)(ii)) and the recommendations of the Project Surface Water Assessment (Advisian, 2018), trigger values for receiving watercourses would be developed as part of the Water Management Plan for the Project in consideration of the Australian and New Zealand Environmental and Conservation Council (ANZECC) guidelines and baseline monitoring data, with a view to confirm negligible adverse effects to downstream water.

IPC POINT OF INTEREST 15

The IPC stated:

> ***Giles has adversely commented on the amount of information available on baseline surface water monitoring in the Vickery EIS and the adoption of appropriate trigger values. If approved, what steps would Whitehaven take to obtain adequate baseline surface water quality data before commissioning of the plant, especially given its failure to do so to date in the project that was approved in 2014?***

WHITEHAVEN RESPONSE

Baseline surface water quality data considered for the Project Surface Water Assessment (Advisian, 2018) was drawn from the following sources:

- database records for regional monitoring sites operated by the NSW Department of Industry – Water;
- monitoring conducted by Whitehaven in the vicinity of the Project for the Approved Mine and the Project;
- monitoring of mine water dams, sediment dams and final void water bodies at Whitehaven's existing mining operations and other mining operations in the region; and
- water quality data included in the *Vickery Coal Mine Environmental Impact Statement* (Vickery Joint Venture, 1986) for the original Vickery Coal Mine.

The key water course relevant to the Project is the Namoi River. Baseline water quality data for the Namoi River (Section 6.1 of the Project Surface Water Assessment [Advisian, 2018]) has been included from the Gunnedah monitoring site (Station 419001) (data available for the period between 1995 and 2019).

The baseline data indicated existing turbidity and EC levels in the Namoi River are elevated relative to ANZECC default trigger values for aquatic ecosystems.

Other watercourses within and in the vicinity of the Project are ephemeral (Plates 9a and 9b) and are characterised by low or no flow conditions, which limits the ability to collect meaningful water quality data. There have been limited opportunities to collect baseline surface water quality data in local streams due to the prevailing drought conditions that have been experienced in the region.

Notwithstanding, the results of 75 surface water quality samples collected from these ephemeral streams since 2011 were used to inform the Project Surface Water Assessment (Advisian, 2018).

Plate 9a   North-west Drainage Line

Plate 9b   South Creek

WHC-15-33_IPC_HP2018_RespDec2018_001A

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Example of Ephemeral Wartercourses
Within the Vicinity of the Project

Plate 9a and 9b

Leading up to commissioning, surface water monitoring will be undertaken at points upstream and downstream on watercourses closest to the Project mining area (monitoring locations would be selected during development of the Water Management Plan) as follows (Advisian, 2018; GEM, 2018):

- Water quality monitoring of sediment dams would include analysis of pH, TSS, EC, total alkalinity/acidity, sulphate, aluminium, arsenic, molybdenum and selenium.
- Water quality monitoring during a controlled discharge would be conducted in accordance with an EPL for the Project and would include analysis of EC, TSS, pH, oil and grease and total organic carbon.
- Water quality monitoring at selected locations along the ephemeral creeks surrounding the Project (on an opportunistic basis) would include EC, TDS, TSS, turbidity, pH, oil and grease, total organic carbon.

This monitoring would continue throughout the Project life.

As described in the response to IPC Point of Interest 14 (see above), trigger values for receiving watercourses will be determined in consideration of the ANZECC guidelines as well as baseline monitoring and the additional post-determination baseline monitoring described above (Advisian, 2018).

IPC POINT OF INTEREST 16

The IPC stated:

> ***Given the proposed use of untreated mine water for process applications, is there a possibility of solute buildup in water on the site and a concomitant threat to surrounding surface and groundwater? Is there a case for treating process water to remove solutes and to make excess water available for beneficial purposes?***

WHITEHAVEN RESPONSE

There is no risk to the surrounding surface water and groundwater resources from solute build up in the mine water management system. The Project has been designed as a nil discharge mine water site. That is, no mine water or coal contact water will be discharged from the site (Advisian, 2018).

The potential for solute "build-up" in the mine water management system is considered to be low as:

- solute would be lost from the mine water management system as coal 'moisture' during processing;
- inputs to the mine water management system, such as rainfall and water from the Namoi River, would dilute the salinity in mine water storages; and
- any residual process water would be directed to the final void throughout the life of the Project with negligible risk of recharging the surrounding groundwater.

There is negligible environmental risk of build-up of solutes on the surface of roads due to dust suppression with mine water as any infiltration to groundwater would report to the final void.

Mine water and coal contact water dams would be designed in accordance with best practice to prevent impacts to surrounding surface water and groundwater resources, including:

- sizing to deliver sufficient capacity to cater for a 1 in 100 year AEP 'storm event' and thereby provide adequate storage in periods of extended wet weather; and
- construction using sufficiently low permeability material to prevent seepage.

Water captured in mine water dams, coal contact water dams and sediment dams would be preferentially used to meet on-site water demands and thereby reduce reliance on water from external sources, such as the Namoi River or the Project borefield.

Preferential use of water captured in mine water dams, coal contact water dams and sediment dams is a key component of the Project water management system and site water balance. Treatment of mine water and transfer off-site for beneficial reuse (i.e. non-Project use) would increase the requirement for the Project to use external water sources and, for this reason, is not favoured.

IPC POINT OF INTEREST 17

The IPC stated:

> ***Reviewers have suggested that the available storage for mine water needs to be increased to prevent the risk of an inadvertent damaging discharge during prolonged inclement weather. Could Whitehaven comment on the need or otherwise for this?***

WHITEHAVEN RESPONSE

Note that in regard to the Project, the Project EIS describes "mine water" (and coal contact water) as runoff from the open cut, active waste rock emplacement areas reporting to the open cut or mine infrastructure area. The Project has been designed as a 'nil' discharge site and therefore no mine water or coal contact water would be discharged from the site (Advisian, 2018).

Sediment dams would collect sediment-laden runoff, but not mine or coal contact water, from active waste rock emplacement and rehabilitation areas. The proposed sediment dams have been conceptually designed according to standard practice detailed in the publication titled, '*Managing Urban Stormwater: Soils & Construction*' (Landcom, 2004) (consistent with the Secretary's Environmental Assessment Requirements [SEARs] for the Project [Attachment 4 of the EIS]) and contemporary EPL requirements for sediment dams.

Advisian (2018) concluded that the frequency of discharges from Project sediment dams would be less than that prescribed in Landcom (2004). This is because:

- the sediment dams are inherently over-designed at the start of the Project to account for the maximum reporting catchment area over the Project life; and
- water captured in sediment dams would be preferentially used to meet on-site water demands to reduce the reliance on water from external sources (please see response to IPC Point of Interest 16) which would reduce the likelihood of overflow.

During the Briefing on 25 February 2019, the IPC requested further clarification on the volume of water predicted to be discharged from the sediment dams over the Project life. Table 8.10 of the Project Surface Water Assessment (Advisian, 2018) details the sediment dam water balance for the median climatic scenario. Controlled discharges from sediment dams are predicted to be between 148 and 681 ML over the Project life. If averaged, these discharges equate to between 6 and 26 ML/year. Overflows from each sediment dam are predicted to be between 184 and 2,026 ML over the life of the Project, which equates to an average discharge between 7 and 78 ML/year). In comparison, the average flow of the Namoi River is approximately 618,000 ML/year (based on an average streamflow of 1,695 ML per day, as reported by Advisian [2018]).

6 ON-SITE COAL HANDLING AND PREPARATION PLANT

IPC POINT OF INTEREST 18

The IPC requested:

> ***Details of the assessment of all options & assumptions for the location of the CHPP and reasons for the proposed positioning.***

WHITEHAVEN RESPONSE

The location of the on-site CHPP is determined by the location of the Project rail spur. Justification of the rail spur alignment (i.e. approaching from the south) is provided in Section 6.1.8 of the Project EIS and in the response to IPC Point of Interest 1.

In addition, the location of the Project CHPP was developed in consideration of the following legal, economic and environmental considerations:

- It must be located outside the extent of the open cut to avoid resource sterilisation.
- It must be located outside the predicted extent of flooding from the Namoi River.
- It must be located within existing Whitehaven mining tenements and the Mining Lease Application area (MLA 1).
- It should provide the shortest coal haulage distance for the majority of the Project life to minimise potential impacts from noise and dust emissions as far as practicable and minimise construction and operational costs.
- It should provide the shortest practicable rail spur (i.e. be located on the western side of the project) to minimise potential noise impacts from rail movements and minimise construction and operational costs associated with a further extension of the rail spur around the Project.

In consideration of the above, the CHPP is proposed to be located as presented in the EIS.

Modelling of the CHPP in its proposed location has been undertaken for the EIS, which indicates there would be:

- Compliance with air quality criteria at all private receivers.
- Compliance with operational noise criteria at all private receivers, except:
  - During the evening and night-time, ‘negligible’ exceedances of the operational noise criteria are predicted at receivers on private Property IDs 131 and 132 during adverse meteorological conditions.
  - During the evening and night-time, ‘significant’ exceedances are predicted at a receiver on private Property ID 127 during adverse meteorological conditions (noting that this property has the right to acquisition upon request under the Development Consent for the Approved Mine due to predicted ‘significant’ exceedances).
- It should be noted that under P10 noise levels (i.e. the level that is exceeded 10% of the time), receivers on private Property IDs 131 and 132 comply with the operational noise criteria and predicted exceedances at the receiver on Property ID 127 are considered ‘moderate’ (according to the *Voluntary Land Acquisition and Mitigation Policy – For State Significant Mining, Petroleum and Extractive Industry Developments* [NSW Government, 2014]).

Whitehaven has developed an acoustic treatment plan for a receiver on Property ID 127 which has been shared with the relevant landowners. Whitehaven would continue to consult with the landowners of Property ID 127 in regard to potential implementation of noise management measures.

IPC POINT OF INTEREST 19

The IPC requested:

> ***Specific timing of CHPP commissioning.***

WHITEHAVEN RESPONSE

Please refer to the response to IPC Point of Interest 3, which provides expected timing for commissioning of the Project CHPP and rail spur.

7 NOISE

IPC POINT OF INTEREST 20

The IPC stated:

> ***Can the CHPP be bunded to reduce noise impacts on local landowners (e.g. extension of the western emplacement to surround the CHPP).***

WHITEHAVEN RESPONSE

The response to IPC Point of Interest 18 (above), provides the justification for the location of the Project CHPP.

If the Western Emplacement were to extend to the south to surround the CHPP (or the western side of the CHPP) this additional section of the emplacement would need to be long-term safe and stable (to avoid the cost and environmental impacts associated with rehandling the waste rock material).

The slope of the outer batter of the Western Emplacement was determined from the NSW Mineral Council's (2007) *Rehabilitation by Design Practice Notes* and the NSW Department of Environment, Climate Change and Water's (DECCW's) (2008) *Managing Urban Stormwater Soils and Construction Volume 2E Mines and Quarries*, which state that benches are not expected to be required to control the velocity of runoff from batters where waste emplacement slopes are less than 10% (i.e. 1 in 10) (refer to Section 5.3.3 of the EIS).

An extension of the waste rock emplacement to provide a 'bund' for the Project CHPP at a height of 20 m would be approximately 400 m wide (i.e. 200 m either side of the crest of the emplacement at a slope of 1 in 10) to remain a long-term stable landform.

Relocation of the Project CHPP (i.e. coal preparation plant, train load-out facility, stockpiles and dams) and associated rail loop at least 400 m from the location proposed in the Project EIS is not considered feasible given the constraints on the location of the CHPP remain (i.e. Whitehaven mining tenure and avoiding the extent of the open cut).

Noise mitigation measures adopted for the infrastructure items in the Project CHPP to minimise impacts to surrounding landowners are as follows (refer to Section 5.5 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]):

- Coal preparation plant – partial (at least) enclosure/acoustic shrouding.
- Sizer, surge bin and reject bin – acoustic design of facades and penetrations.
- Train loadout bin – acoustic design of facades and enclosure of wagons as they are being loaded.
- Conveyors – acoustic design of idlers and installation of shielding along the belt.

The key outcomes of the noise modelling, inclusive of the Project CHPP, are described in the response to IPC Point of Interest 18 (above).

IPC POINT OF INTEREST 21

The IPC stated:

> ***Questions have been raised about the noise modelling contours. Can the proponent demonstrate that their approach gives valid results for similar scenarios at their other local mine sites (i.e. show that their modelling works)? What is the sensitivity of the predictions to changes in noise assumptions?***

WHITEHAVEN RESPONSE

Wilkinson Murray (2018) was engaged to prepare the Project Noise and Blasting Assessment.

Wilkinson Murray has experience in noise assessment and modelling of large mining projects, including: Cadia Gold Mine; Bulga Coal Mine; Mount Arthur Coal Mine; Mount Pleasant Coal Mine; Mangoola Coal Mine; Ulan Coal Mine; and Tarrawonga Coal Mine.

Predicted operational noise levels from the Project have been calculated using the Environmental Noise Model (ENM), which predicts levels at receivers with consideration of the following input data:

- source Sound Power Level (SWL);
- source locations (including height) for various operational scenarios;
- receiver locations (including height);
- topography within mine site and surrounding areas; and
- local meteorology.

This modelling software is compatible with the *NSW Noise Policy for Industry* (EPA, 2017) (NPfI) and has been previously accepted by the EPA and DPE for use in environmental noise assessments. The ENM has proven accurate in past mining projects where Wilkinson Murray was involved in compliance noise assessments and validation noise assessments.

Wilkinson Murray conducted a noise modelling validation assessment for the Ulan Coal Mine (*Ulan Coal Mine Ulan Coal – Noise & Vibration Assessmen*t [Wilkinson Murray, 2006] and *Ulan Coal Mine Ulan Coal – Continued Operations Noise & Vibration Assessment* [Wilkinson Murray, 2009]).

Noise levels surrounding the Ulan Coal Mine operations were monitored using attended and continuous unattended monitoring methods. For the validation process, actual noise levels at Ulan Village were compared with the predicted noise levels calculated by the ENM for the existing mine operations.

The measured levels used for comparison were captured between 2006 and 2009 and accordingly the validation model was established to reflect the mine operations at that time. The validation model includes sources such as the conveyor system, crushing station, washery, train load-out bin and mobile fleet.

Noise assessment for operational noise can be performed under a single wind condition and, where required, a single temperature inversion condition (typically referred to as 'adverse' meteorological conditions). An alternative method to estimate the effects of meteorological conditions is to predict 10 per cent (%) exceedance (P10) levels or levels under 10th percentile meteorological conditions (i.e. the $L_{Aeq,15min}$ level that is exceeded 10% of the time within any season and assessment period [i.e. day, evening or night] in consideration of local meteorology).

Table 2 presents the comparison of measured noise levels with predicted evening and night-time noise levels at Ulan Village.

Table 2
Comparison of Measured Noise Levels with Predicted Noise Levels (dBA)

Measured 10% Exceedance $L_{Aeq,15min}$ Noise Level for Winter	Predicted 10% Exceedance $L_{Aeq,15min}$ Noise Level for Winter		Predicted $L_{Aeq,15min}$ under Adverse Weather Conditions (3 degrees/100 m or 2 m/s wind from the north-east)	Predicted $L_{Aeq,15min}$ under Isothermal Weather Conditions (0 degrees/100 m)
	Evening	Night-time		
46 - 48	47	46	47	41

dBA = A-weighted decibels
$L_{Aeq,15 min}$ = equivalent continuous noise level (A-weighted), 15 minute period
m/s = metres per second

The predicted 10% exceedance levels are found to be within 1 to 2 decibels (dB) of the measured 10% exceedance noise levels in the worst season (i.e. winter). Therefore, the predicted P10 levels compare favourably with the measured noise levels, hence validating the noise model.

In 2007 a series of measurements was conducted in the Collie Basin, Western Australia, aimed at providing reliable measurements of actual noise levels under a variety of meteorological conditions (*Collie Basin Acoustic Study, Report 8731-3-07076* [Herring Storer Acoustics and Wilkinson Murray, 2008] and *The Harmonoise noise prediction algorithm: Validation and use under Australian conditions* [Bullen, 2012]).

It involved a loudspeaker source producing 1/3-octave bands of filtered pink noise at very loud levels, with measurements at distances between approximately 1 to 3 km, and simultaneous monitoring of meteorological conditions using a tethered balloon with an anemometer.

Attenuations between the speaker and several measurement locations were recorded during 17 periods of approximately 15 minutes on four nights, providing a total of 37 valid 1/3-octave attenuation spectra for various meteorological conditions combining wind speed, wind direction and temperature inversion. The spectra were then applied to a typical dozer SWL spectrum shape and compared with predictions from both ENM and an alternative modelling software (Soundplan [with Concawe algorithm]).

The data indicated that ENM tends to over-predict the results by typically 2 to 4 dB.

As such, Wilkinson Murray considers ENM accurate in modelling noise impacts (with consideration of SWLs, source and receiver location, topography and meteorological assumptions) and the most appropriate noise model to calculate coal mine noise.

It should be noted that when considering the P10 assessment approach, even though noise levels could be higher than predictions for a small proportion of time (i.e. less than 10 % of the time), they would be lower for most of the time (i.e. 90 % of the time).

The Project Noise and Blasting Assessment is based on the NPfI Fact Sheet D noise-enhancing meteorological conditions which are believed to result in noise levels higher than those predicted under P10 conditions (i.e. 1 to 4 dB difference for downwind receivers). For the Project, night-time noise predictions under meteorological conditions determined in accordance with Fact Sheet D of the NPfI are expected to occur between 1 and 2 % of the night-time period during winter at key receivers to the south-west. As such, noise predictions associated with the Project are expected to be very conservative and lower than noise predictions for most of the time.

During the Briefing on 25 February 2019, the IPC requested that Whitehaven provide further information regarding noise exceedances at the existing Maules Creek Coal Mine. The Maules Creek Coal Mine is the largest mine in the Whitehaven portfolio and has been operating since 2014. Since that time there have been a number of investigations conducted by regulatory authorities (i.e. EPA and DPE) into alleged noise exceedances experienced at nearby private receivers. None of those investigations has resulted in any regulatory sanction (e.g. warning, penalty, etc.) when actual noise monitoring data from nearby private receivers was compared to the limits set out in the Project Approval.

In 2016, Whitehaven conducted a Mandatory Noise Management Audit as required by the EPA. An overall summary finding noted:

> *The company is undertaking a range of activities as would be expected to satisfy project approval and good practice in respect of systems, procedures and control measures. The daily operations, training, supervision, monitoring and maintenance are also considered to be industry good practice.*

The audit outcome also included some thirteen recommendations which have all been addressed by Whitehaven.

IPC POINT OF INTEREST 22

The IPC stated:

> ***Can potential noise from the elevated rail spur be ameliorated (e.g. sound barriers on the viaduct)?***

WHITEHAVEN RESPONSE

Installation of noise amelioration measures along the elevated rail spur (e.g. sound barriers) are not considered reasonable as:

- No exceedances of the relevant criteria are predicted at existing privately-owned receivers when considering local noise-enhancing meteorology.
- The cost of construction is prohibitive, noting that the entire elevated rail structure may need to be strengthened to withstand additional weight associated with the required height and length of the barrier.

Noise from the Project rail spur would be minimised by incorporation of the following:

- Restrictions on train speed.
- Measures to minimise rail squeal.
- Use of best practice rolling stock, including locomotives approved to operate on the NSW rail network in accordance with EPLs issued by the EPA.

Whitehaven would have a suitably qualified person/s review the final rail design to determine whether it incorporates all reasonable and feasible mitigation. Whitehaven would also undertake trials to determine optimal train speed to minimise noise impacts (Section 7.3.1 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]).

During the Briefing on 25 February 2019, the IPC requested further clarification on the potential noise and vibration impacts resulting from the Project rail spur viaduct. The Boggabri Coal Mine Project Approval (09_0182) required the viaduct design to be acoustically assessed by a suitably qualified and experienced person(s) in acoustic engineering and to include reasonable and feasible measures to mitigate noise and vibration impacts. The detailed design of the rail spur incorporated noise and vibration measures including timber transoms, high performance elastomer bearings on the viaduct and resilient fasteners. Reasonable and feasible acoustic mitigation measures for the Project rail spur would be confirmed during detailed design, including consideration of the measures successfully adopted for the existing viaduct structure.

IPC POINT OF INTEREST 23

The IPC requested:

> ***Modelling assumptions & outputs, specifically comparing the Approved mine with the Extension Project, including mine extraction, load & haul operations, CHPP, transport, overburden handling, rehabilitation & inputs from other Whitehaven mines.***

WHITEHAVEN RESPONSE

The Project Noise and Blasting Assessment (Wilkinson Murray, 2018) was prepared in accordance with the NPfI, which requires an assessment of potential noise impacts following implementation of all reasonable and feasible mitigation measures.

While key aspects of the Project may appear likely to increase noise levels at sensitive receivers in comparison to the Approved Mine (e.g. the mining rate and number of mobile equipment have increased and an on-site CHPP and train loading facility is proposed), the Project includes a number of improvements with regard to acoustic design.

In addition to design of the waste rock emplacement area, haul roads and mine progression direction to minimise noise impacts to key sensitive receivers, the Project Noise and Blasting Assessment (Wilkinson Murray, 2018) adopts SWLs consistent with current leading practice mining equipment for noise performance, as evidenced by noise performance monitoring from the Maules Creek Coal Mine and other mines in the region.

Table 3 provides a comparison of the total SWLs adopted for the Approved Mine and the Project in Year 7.

Table 3
Predicted Total SWLs for Approved Mine and Project (Year 7)

Equipment	Approved Mine (Year 7)			Project (Year 7)		
	Number	SWL Per Item (dBA)	Total SWL (dBA)	Number	SWL Per Item (dBA)	Total SWL (dBA)
Trucks	33	114 – 118	132	50	107 – 113	130
Dozers	13	114 – 116	127	14	107 – 113	123
Excavators	7	115 – 117	125	9	113 – 114	123
Loaders	2	113	116	1	110	110
Drills	4	114	120	7	113	121
Graders	4	108	114	5	106	113
Scrapers	4	115	121	-	-	-
Water Carts	4	111	117	4	112	118
Ancillary	-	-	117.7	-	-	107
Infrastructure Area*	-	-	115.3	-	-	116.9
Rail	-	-	-	-	-	108
TOTAL	**-**	-	**135**	**-**	-	**132**

Source: Wilkinson Murray (2013; 2018)
** For the Project this includes noise sources at the CHPP and rail loop*

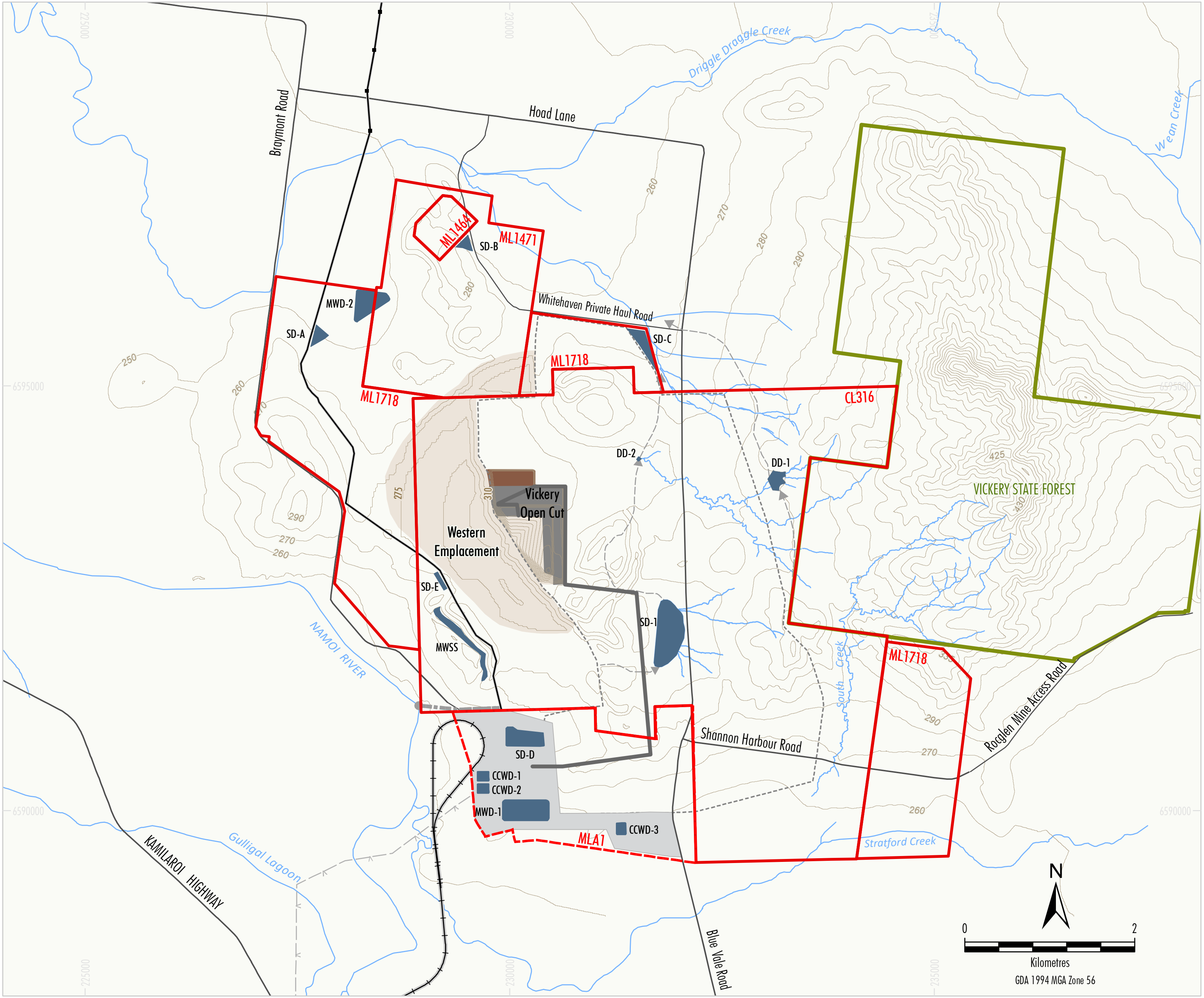
Generally, the total number of equipment required for the Project has increased, however total SWLs have reduced in comparison to those adopted for the Approved Mine (Table 3).

References for each indicative SWL used in the modelling are included in Table 5-4 of the Project Noise and Blasting Assessment in accordance with Section 3.3.1 of the *NPfI*, either to industry (i.e. manufacturer) or measurements conducted at other mine sites (e.g. Maules Creek Coal Mine).

The significant recent reductions in acoustic performance of mining equipment were described in the public hearing submission from manufacturers WesTrac NSW and Hitachi.

There are numerous differences in the proposed operations of the Approved Mine and the Project that would affect predicted noise levels at receiver locations in any given year (refer Figures 13, 14 and 15), including:

- The Approved Mine included the haulage and dumping of waste at the Eastern Emplacement, which is not required for the Project.
- The Project includes the CHPP and rail loop.
- Differences in mine progression, for example, the Approved Mine involves two open cut faces progressing simultaneously, whereas the Project involves a single open cut face.



LEGEND

- Mining Tenement Boundary (ML & CL)
- Mining Lease Application (MLA)
- State Forest
- Existing 66kV Powerline
- Indicative Up-catchment Diversion
- Indicative Namoi River Pump Station and Pipeline
- Indicative Active Mining
- Indicative Active Waste Rock Emplacement
- Indicative Soil Stripped
- Indicative Infrastructure Area
- Indicative Extent of Water Storage
- Indicative Mine Access Road
- Indicative Main ROM Coal Haul Road
- Indicative Rail Spur Alignment
- Indicative Location of Groundwater Bores and Pipeline
- Indicative Maximum Extent of Open Cut

Source: Department of Land and Property Information (2014); Department of Industry (2015)

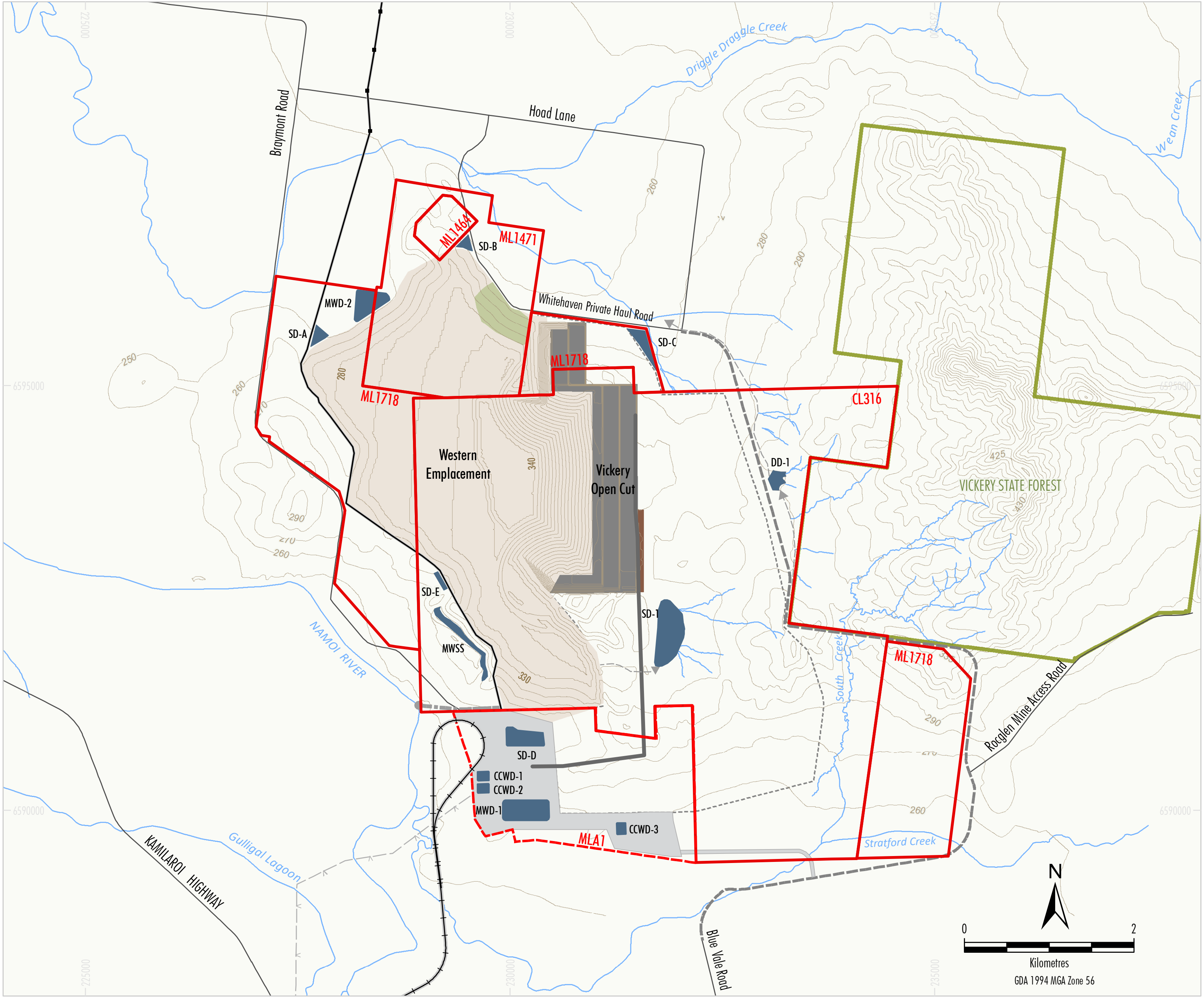
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project General Arrangement - Year 3

Figure 13

WHC-15-33_IPC PRR_213A



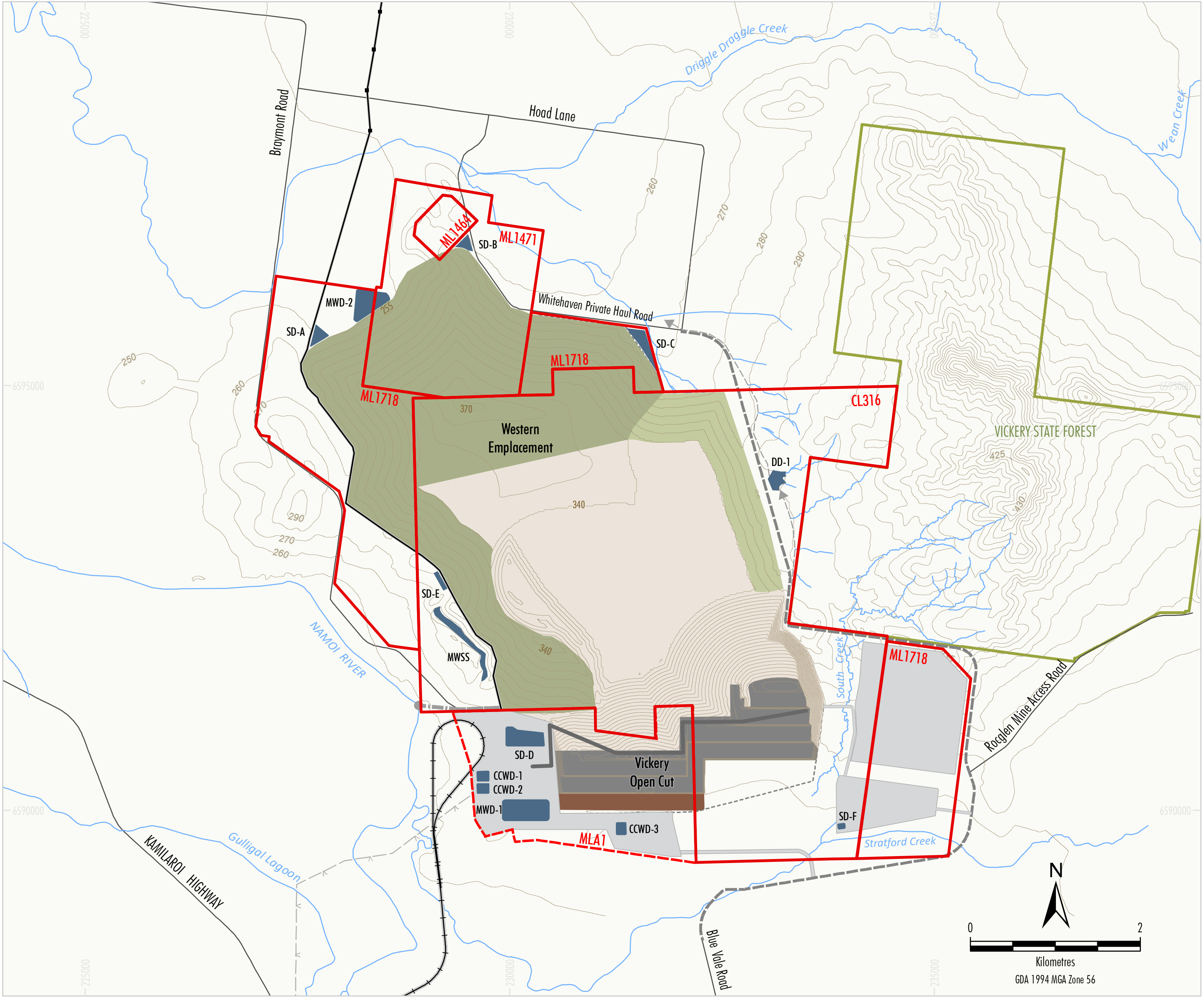
WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project General Arrangement - Year 7

Figure 14

WHC-15-33_IPC PRR_214A



LEGEND

- Mining Tenement Boundary (ML & CL)
- Mining Lease Application (MLA)
- State Forest
- Existing 66kV Powerline
- Indicative Road Realignment
- Indicative Namoi River Pump Station and Pipeline
- Indicative Up-catchment Diversion
- Indicative Active Mining
- Indicative Active Waste Rock Emplacement
- Indicative Soil Stripped
- Indicative Initial Rehabilitation
- Indicative Established Rehabilitation
- Indicative Infrastructure Area
- Indicative Extent of Water Storage
- Indicative Mine Access Road
- Indicative Main ROM Coal Haul Road
- Indicative Rail Spur Alignment
- Indicative Location of Groundwater Bores and Pipeline
- Indicative Maximum Extent of Open Cut

Source: Department of Land and Property Information (2014); Department of Industry (2015)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project General Arrangement - Year 21

Figure 15

WHC-15-33_IPC PRR_215A

As a result of the changes in modelled SWLs and operations, a comparison of noise impacts between the Approved Mine and the Project is summarised as follows:

- At the closest property to the Project (ID 127) 'significant' exceedances of operational noise limits are predicted for the Project and the Approved Mine. Accordingly, the owners of the property have the right to acquisition upon request under the Development Consent for the Approved Mine.
- For receivers to the south-west of the Project, maximum predicted noise levels are greater at receivers on Property IDs 131 and 132 for the Project than the Approved Mine (i.e. 'negligible' exceedances are predicted at these receivers for the Project, which are located to the south-west of the Project CHPP and rail loop).
- For receivers to the south of the Project, the maximum predicted noise levels are lower at the closest property (ID 108) for the Project, due to the removal of the requirement for haulage and dumping at the Eastern Emplacement.
- For receivers to the west of the Project, noise levels are similar for the Project and the Approved Mine (i.e. compliance with noise levels is predicted for all privately-owned receivers except those on Property IDs 127, 131 and 132 as listed above).

IPC POINT OF INTEREST 24

The IPC requested:

> ***Details confirming the scenarios modelled include worst case. Details of the definition of worst case.***

WHITEHAVEN RESPONSE

Three operational scenarios of the Project were assessed for potential noise impacts (Section 2.1 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]):

- Project Year 3 – representative of initial operations (i.e. mining operations in the north-west and central portions of the open cut and waste rock emplacement at the Western Emplacement) (Figure 13);
- Project Year 7 – representative of ongoing operations (i.e. mining operations in the eastern portion of the open cut and waste rock emplacement at the Western Emplacement) (Figure 14); and
- Project Year 21 – representative of ongoing operations i.e. mining operations in the southern portion of the open cut) (Figure 15).

The operational scenarios were selected in consideration of maximum potential noise emissions (e.g. to account for the maximum mobile equipment fleet and maximum elevations that equipment would be working at) to evaluate the potential impacts at the nearest privately-owned receivers over the life of the Project.

Table 4 provides the indicative mine schedule for the Project. Project Years 3, 7 and 21 are highlighted to indicate the rate of mining during each of the modelled scenarios.

Table 4
Indicative Project Mine Schedule

Year	Open Cut Waste Rock (Mbcm)	Open Cut ROM Coal (Mt)
1	-	-
2	12.2	1.0
3	34.0	2.7
4	54.0	4.3
5	74.0	5.5
6	89.0	7.2
7	89.0	8.4
8	89.0	8.5
9	89.0	9.8
10	89.0	9.3
11	89.0	8.8
12	91.9	8.6
13	95.0	8.6
14	95.0	8.3
15	95.0	9.1
16	95.0	9.9
17	95.0	9.6
18	95.0	9.7
19	95.0	9.5
20	90.0	8.9
21	95.0	9.9
22	70.0	7.8
23	55.0	6.5
24	35.0	4.0
25	15.0	2.1
26	5.4	1.1
Total	**1,830**	**179**

Mbcm = *million bank cubic metres*
Mt = *million tonnes*

IPC POINT OF INTEREST 25

The IPC requested:

> ***Modelling of staged infrastructure & handling of imported coal from other Whitehaven sites & how is it considered in the noise assessment scenarios.***

WHITEHAVEN RESPONSE

As outlined above in the response to IPC Point of Interest 24, the earliest operational scenario modelled was Project Year 3. The Project CHPP and rail spur are operating in Project Year 3, including receipt and processing of coal from other Whitehaven operations.

Noise from haul trucks on the Mine Access Road associated with the transport of ROM coal to the Project CHPP from the Rocglen and/or Tarrawonga Coal Mines were explicitly included in the modelling in Project Years 3 and 7 (noting that Year 21 is beyond the approved lives of the Tarrawonga and Rocglen Coal Mines).

Note that noise associated with Project construction, including the CHPP and rail spur, was also assessed (refer to Section 5.13 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]).

IPC POINT OF INTEREST 26

The IPC requested:

> ***Timing of overburden placement & worst-case noise emissions.***

WHITEHAVEN RESPONSE

Project mining operations, including waste rock emplacement, would be conducted up to 24 hours per day, seven days per week.

Waste emplacement would be scheduled to avoid dumping in locations that may exceed noise limits, as identified by the pro-active noise management system. The noise modelling has considered mining equipment operating in exposed and elevated locations on the waste emplacement.

The noise management system for the Project would include a real-time noise monitoring network (including at receivers in the vicinity of the Project) and continued meteorological monitoring at the on-site monitor.

A meteorological forecasting system would also be implemented for the Project to anticipate upcoming periods of adverse weather conditions (e.g. based on wind speed, direction and atmospheric stability).

The meteorological forecasting system would be used in conjunction with the real-time noise and meteorological monitoring system (pro-active noise management system) and would provide an alert for mine personnel to review the real-time data and manage mining activities (e.g. location of waste emplacement) as may be required.

IPC POINT OF INTEREST 27

The IPC requested:

> ***Details of any further mitigation measures considered/modelled & not included in the results.***

WHITEHAVEN RESPONSE

As described above (refer to the response to IPC Point of Interest 23), the Project Noise and Blasting Assessment (Wilkinson Murray, 2018) was prepared in accordance with the NPfI, which requires an assessment of potential noise impacts following implementation of all reasonable and feasible mitigation measures.

Reasonable and feasible mitigation measures that were considered for the Project and incorporated in the modelling include (Wilkinson Murray, 2018):

- Redesign of the waste rock emplacement area, haul road alignments and mine progression direction to provide opportunities for shielding of operations during adverse meteorological conditions.
- Enclosure and/or acoustic shrouding of selected infrastructure items in the mine infrastructure area.
- Noise controls on mobile equipment.

The Project pro-active noise management system (as described above in the response to IPC's Point of Interest 26 as well as Section 5.3 of the Project Noise and Blasting Assessment [Wilkinson Murray, 2018]) was not included in the noise modelling and therefore provides opportunity for further noise attenuation as required during periods of adverse meteorological conditions.

Pro-active noise management is successfully used throughout the mining industry to manage noise levels within compliance limits.

IPC POINT OF INTEREST 28

The IPC requested:

> ***Results of any model calibration of noise modelling with the existing operating mines in the locality.***

WHITEHAVEN RESPONSE

Please refer to the response to IPC Point of Interest 21.

8 AIR QUALITY

IPC POINT OF INTEREST 29

The IPC stated:

> ***The dust modelling does not include impacts of extra traffic on local unsealed roads. What is the extra impact? What would be the impact of sealing all roads leading to the project?***

WHITEHAVEN RESPONSE

Project employees and contractors would not use local unsealed roads to access the Project. Employee and contractor access from the north would be via Hoad Lane (sealed) and from the south would be via Blue Vale Road (sealed) (Figure 16).

Any minor use of local unsealed roads associated with the Project (e.g. light vehicles for environmental monitoring) would be infrequent compared to the existing use of these roads (e.g. from local landowners), thus any impacts would be insignificant. It is noted that any dust from the existing use of local unsealed roads (i.e. non-Project users) has been captured in the historic air quality monitoring and, therefore, has been considered as part of the cumulative air quality modelling conducted by Ramboll (2018) for the Project.

IPC POINT OF INTEREST 30

The IPC requested:

> ***Modelling assumptions & outputs (including staging), comparing the Approved mine with the Extension Project, including mine extraction, load & haul operations, CHPP, transport, overburden handling rehabilitation & inputs from other Whitehaven mines.***

WHITEHAVEN RESPONSE

For both the Project and the Approved Mine annual emissions were estimated based on peak years of waste rock and ROM coal movement, exposed areas and proximity of operations to sensitive receivers.

The modelled dust emissions for the Project, presented as a ratio of total suspended particulates (kg) per tonne of ROM coal mined, are between 0.55 and 0.88 over the life of the Project. This range is consistent with existing mining operations in NSW including, for example: Maules Creek Coal Mine (0.53 to 0.68); Bengalla Coal Mine (0.47 to 0.65); Hunter Valley Operations (0.55 to 0.64); and Warkworth Coal Mine (0.67 to 0.73). The Approved Mine has a TSP:ROM coal ratio between 1.38 and 2.39, which indicates the Approved Mine model used conservative assumptions that overestimated the potential dust generation.

Table 5 provides a comparison of the indicative mine schedule for the Approved Mine and the Project. The Project years that were included in the air quality modelling are highlighted. Figures 17, 18 and 19 provide a comparison between the Approved Mine and Project general arrangements for Project Years 3, 7 and 21 (i.e. Approved Mine Years 2, 7 and 26). Table 6 provides the predicted annual PM_{10}[3] emissions for each modelled scenario for the Approved Mine and the Project.

Ramboll (2018) determined that wheel-generated dust from haul roads is predicted to be the dominant PM_{10} emission source from the Project. A key difference between the PM_{10} emissions inventories for the Project and Approved Mine is that the control factors adopted for surface treatment of haul roads for the Project have improved from those modelled for the Approved Mine (i.e. 90% control has been assumed for the Project compared to compared to 75% for the Approved Mine).

This improvement is justified as subsequent to PAEHolmes (2012) preparing the Air Quality and Greenhouse Gas Assessment for the Approved Mine, the EPA's Dust Stop Pollution Reduction Program required all open cut coal mines in NSW to implement best practice measures to significantly reduce their dust emissions.

The Dust Stop Pollution Reduction Program included a requirement for all mines to demonstrate at least 80% dust control was being achieved on active haul roads (it is noted this expectation from the EPA to achieve at least 80% control contradicts the EPA's submission for the Project stating that a 75% control factor for watering is considered "more realistic and achievable").

As a result of the Dust Stop Pollution Reduction Program, all NSW open cut coal mines successfully demonstrated control efficiencies of 80% or more. Results with greater than or equal to 90% control efficiency were reported by many mines, including:

- Maules Creek Coal Mine (92%). *Maules Creek Coal Mine PRP E1: Monitoring Results – Wheel Generated Dust* (Pacific Environment Limited, 2016).
- Werris Creek Coal Mine (96%). *Werris Creek Coal PRP U1: Monitoring Results – Wheel Generated Dust* (Pacific Environment Limited, 2014).
- Bulga Coal Mine (90%). *Report for U1 Particulate Matter Control Best Practice Implementation – Wheel Generated Dust* (Glencore, 2014).

As Whitehaven has demonstrated it can achieve greater than 90% control efficiency on unsealed haul roads at a number of its existing operations (e.g. Werris Creek and Maules Creek Coal Mines), it is reasonable to expect that at least a 90% level of control can be achieved for the Project.

[3] Particulate matter with an equivalent aerodynamic diameter of 10 micrometres (µm) or less.

Table 5
Indicative Mine Schedule for Approved Mine and Project

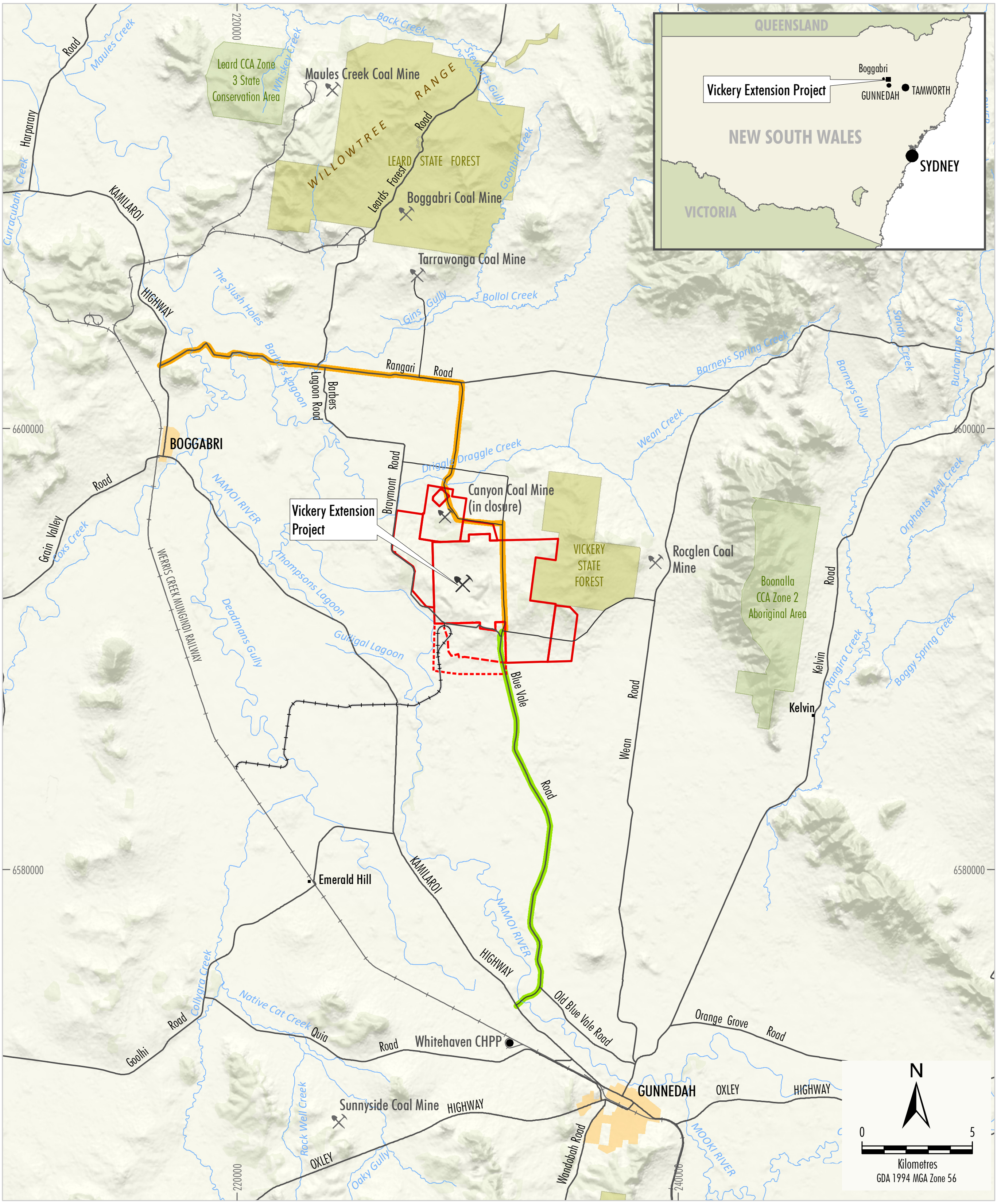
Project Year	Approved Mine		Project	
	Open Cut Waste Rock (Mbcm)	Open Cut ROM Coal (Mt)	Open Cut Waste Rock (Mbcm)	Open Cut ROM Coal (Mt)
1	16	0	-	-
2	25	1.5	12.2	1.0
3	38	3.8	34.0	2.7
4	48	4.1	54.0	4.3
5	47	4.1	74.0	5.5
6	44	4.2	89.0	7.2
7	44	4.5	89.0	8.4
8	43	4.5	89.0	8.5
9	42	4.5	89.0	9.8
10	45	4.5	89.0	9.3
11	41	4.5	89.0	8.8
12	47	4.5	91.9	8.6
13	44	4.5	95.0	8.6
14	47	4.5	95.0	8.3
15	47	4.5	95.0	9.1
16	43	4.5	95.0	9.9
17	45	4.5	95.0	9.6
18	38	4.5	95.0	9.7
19	45	4.5	95.0	9.5
20	45	4.5	90.0	8.9
21	49	4.5	95.0	9.9
22	45	4.5	70.0	7.8
23	45	4.5	55.0	6.5
24	49	4.5	35.0	4.0
25	40	4.5	15.0	2.1
26	51	4.5	5.4	1.1
27	39	4.5	-	-
28	39	4.5	-	-
29	39	4.5	-	-
30	39	4.5	-	-

Mbcm = *million bank cubic metres*
Mt = *million tonnes*

Table 6
Predicted Annual PM_{10} Emissions for the Approved Mine and the Project

	Approved Mine				Project		
	Year 2	Year 7	Year 17	Year 26	Year 3	Year 7	Year 21
PM_{10} emissions (kg/year)	918,646	1,555,292	1,413,473	1,653,679	778,661	1,644,234	1,583,130

kg/year = *kilograms per year*



LEGEND

- Mining Tenement Boundary (ML and CL)
- Exploration Licence Boundary (EL)
- Mining Lease Application (MLA)
- State Forest
- State Conservation Area, Aboriginal Area
- Major Roads
- Railway
- Indicative Project Rail Spur
- Project Access Route from North (Sealed)
- Project Access Route from South (Sealed)

Source: LPMA - Topographic Base (2010); NSW Department of Industry (2015)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project Employee and Contactor Access Routes

Figure 16

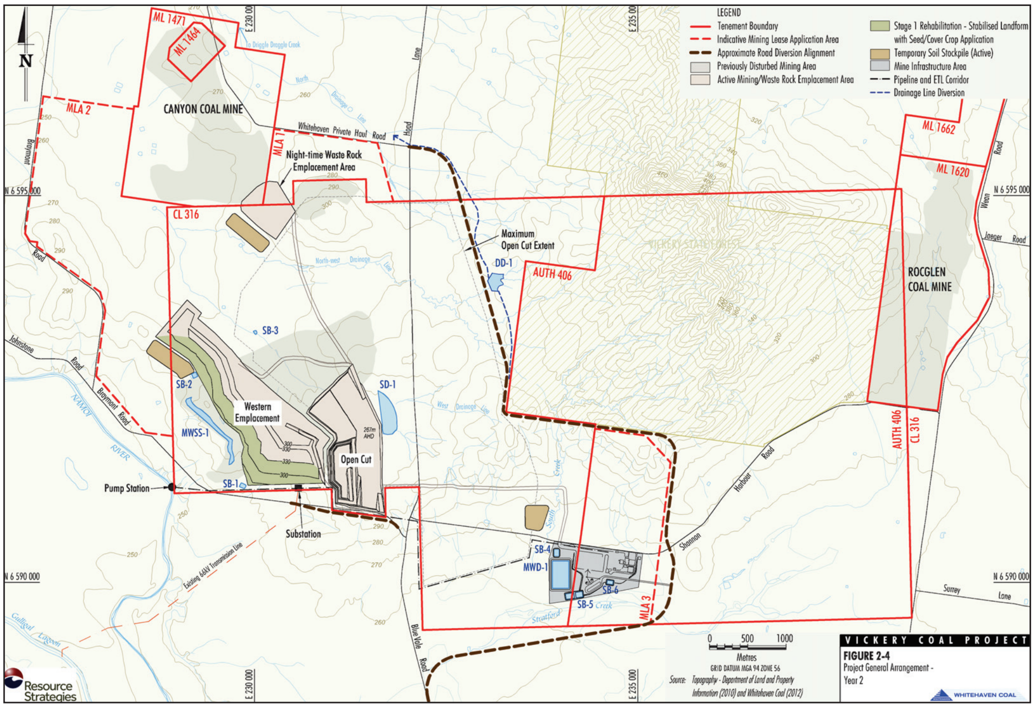


Figure 17a: Approved Mine General Arrangement - Year 2

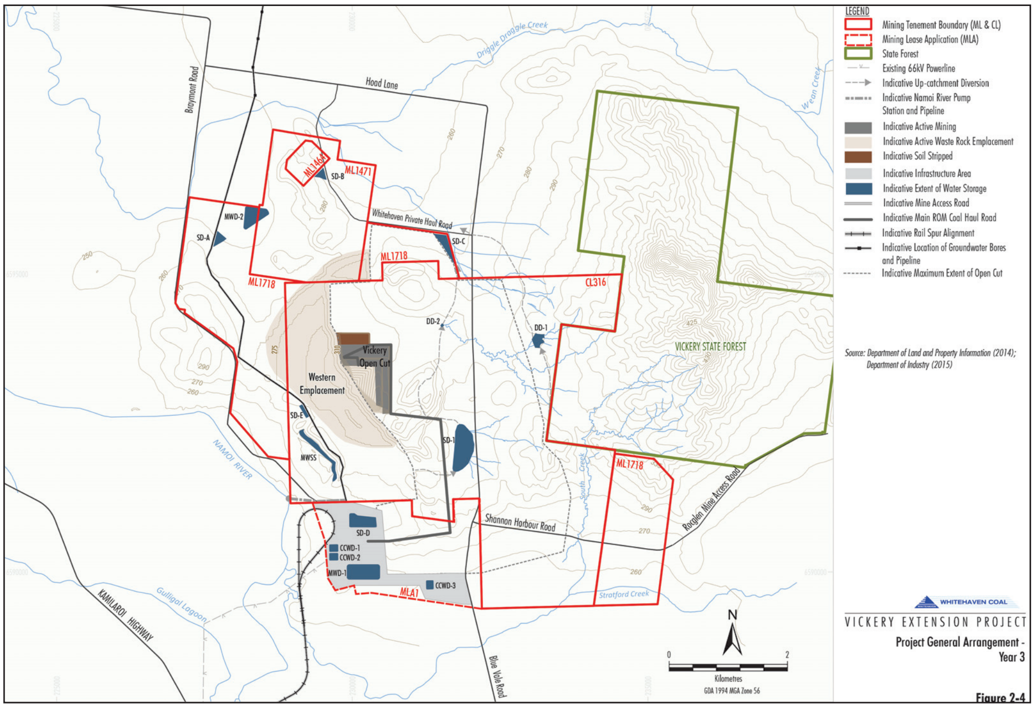


Figure 17b: Project General Arrangement - Year 3

WHC-15-33_IPC PRR__003A

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Approved Mine (Year 2) and Project (Year 3) General Arrangements

Figure 17a & 17b

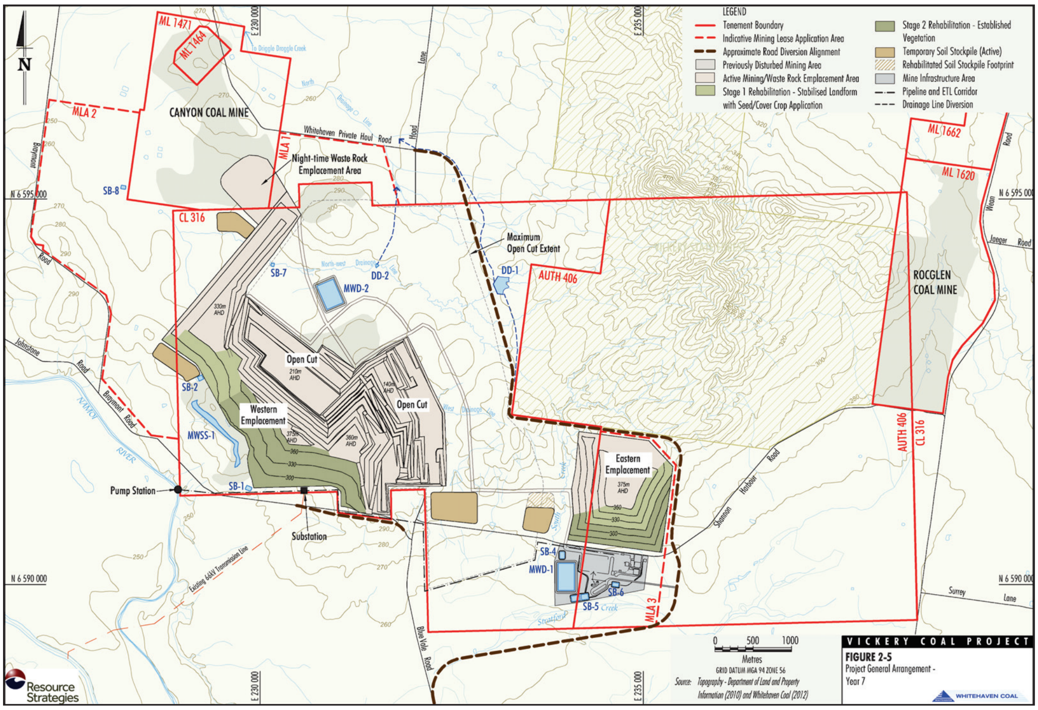


Figure 18a: Approved Mine General Arrangement - Year 7

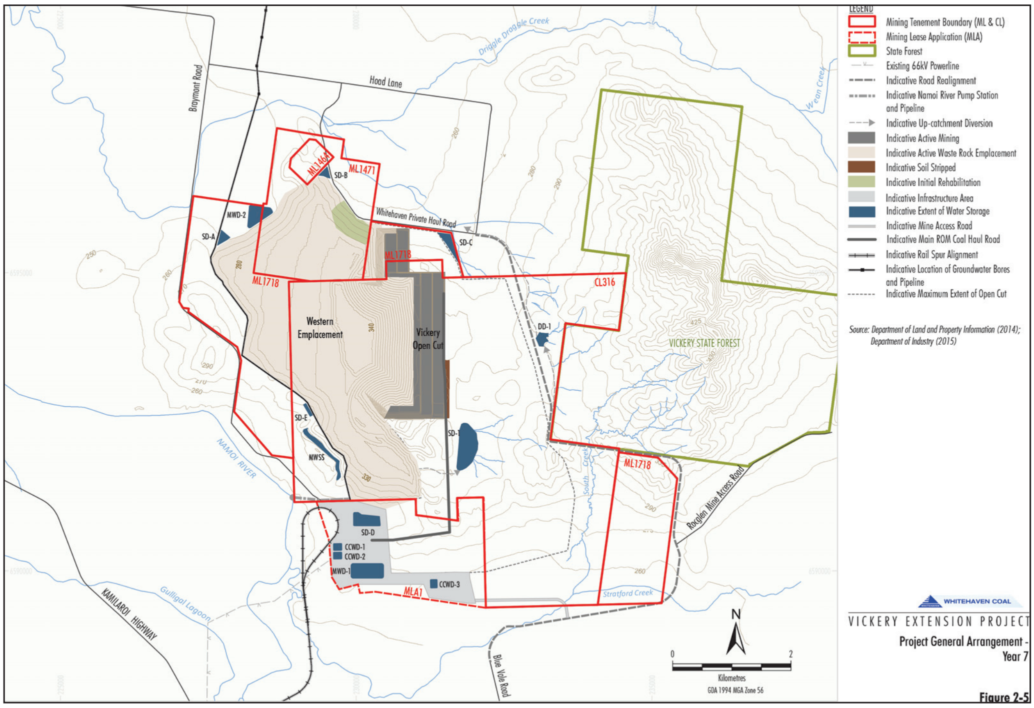


Figure 18b: Project General Arrangement - Year 7

WHC-15-33_IPC PRR__004A

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Approved Mine (Year 7) and Project (Year 7) General Arrangements

Figure 18a & 18b

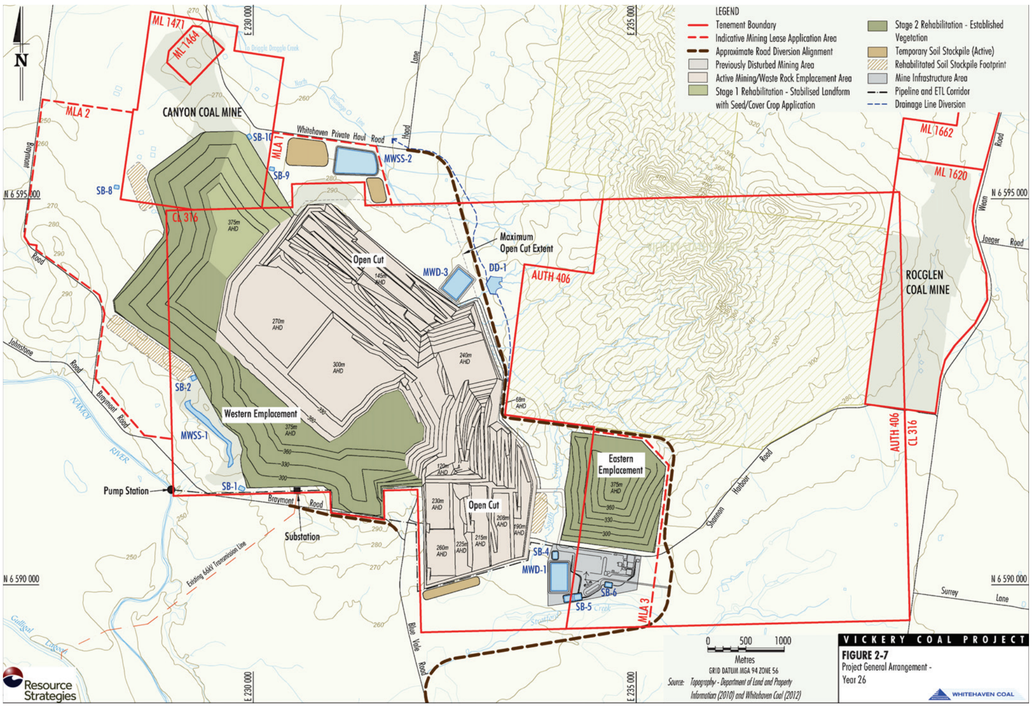


Figure 19a: Approved Mine General Arrangement - Year 26

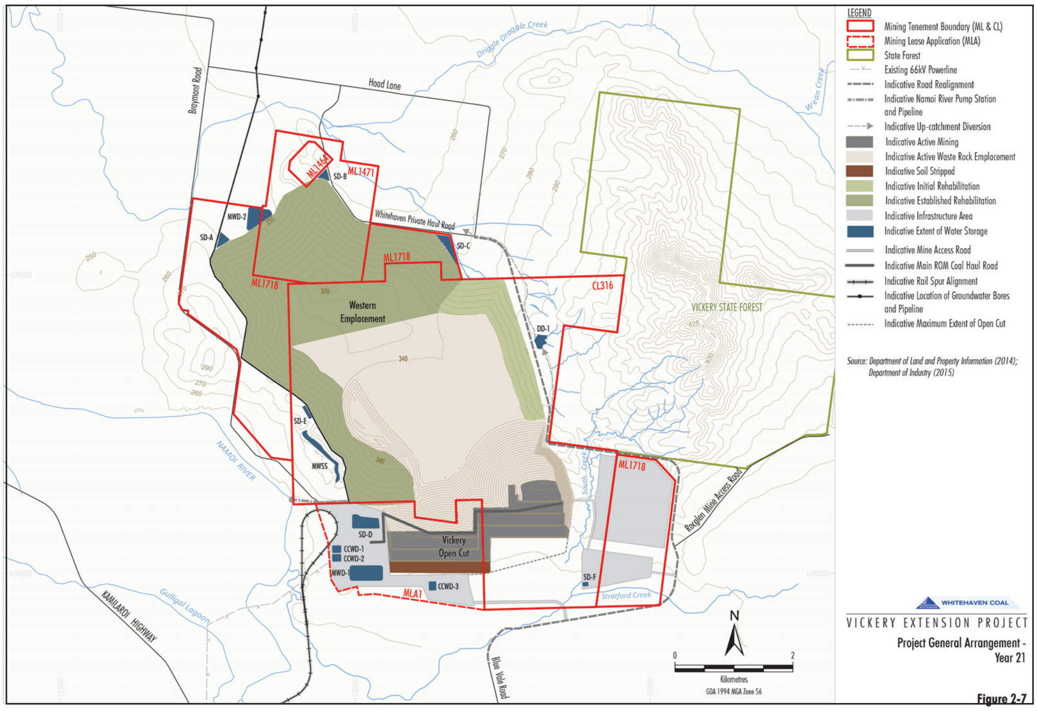


Figure 19b: Project General Arrangement - Year 21

WHC-15-33_IPC PRR__005A

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Approved Mine (Year 26) and Project (Year 21) General Arrangements

Figure 19a & 19b

IPC POINT OF INTEREST 31

The IPC requested:

> ***Details confirming the scenarios modelled include worst case. Details of the definition of worst case.***

WHITEHAVEN RESPONSE

The three operational scenarios of the Project assessed for potential noise impacts (refer to response to IPC Point of Interest 24) were also assessed for potential air quality impacts (Section 2.1 of the Project Air Quality and Greenhouse Gas Assessment [Ramboll, 2018]). The three assessed scenarios are outlined below:

- Project Year 3 – representative of initial operations (i.e. mining operations in the north-west and central portions of the open cut and waste rock emplacement at the Western Emplacement) (Figure 13);
- Project Year 7 – representative of ongoing operations (i.e. mining operations in the eastern portion of the open cut and waste rock emplacement at the Western Emplacement) (Figure 14); and
- Project Year 21 – representative of ongoing operations (i.e. mining operations in the southern portion of the open cut) (Figure 15).

The scenarios are considered to encompass the likely worst case for the range of nearby receptors in terms of likely dust effects. This was determined on the basis of the cases where material movement is high and where extraction or wind erosion areas are largest, or where operations are located closest to receivers. Thus the amount of material handled, the size of exposed areas, and also the relative proximity of activity to receptors was considered when selecting the worst case scenarios.

Table 4 provides the indicative mine schedule (please see response to IPC Point of Interest 24). Project Years 3, 7 and 21 are highlighted to indicate the rate of mining during each of the modelled scenarios.

Other scenarios that were not modelled either had less or equal materials handling and/or less or equal exposed areas and therefore these scenarios would have the same or lower levels of dust emissions. However, in other scenarios with similar dust emissions (e.g. Project Year 16), mining activities are no closer to receivers compared to the scenarios modelled and therefore would not result in an increase predicted dust concentrations at receivers.

IPC POINT OF INTEREST 32

The IPC requested:

> ***Modelling of staged infrastructure & handling of imported coal from other Whitehaven sites.***

WHITEHAVEN RESPONSE

Table 6-3 of the Project Air Quality and Blasting Assessment (Ramboll, 2018), reproduced as Table 7 below, provides the annual PM_{10} emissions inventory for the Project. Crushing and screening emissions (including handling) associated with run-of-mine (ROM) coal from the Tarrawonga and Rocglen Coal Mines have been modelled at the Project CHPP.

Table 7
Annual Project PM_{10} Emissions Inventory

Pit	Activity	PM_{10} (kg/year)		
		Year 3	Year 7	Year 21
Soil Stripping				
Open Cut	Stripping	1,107	718	3,197
	Ex/FEL loading trucks	9	6	27
	Hauling (controlled wheel-generated emissions plus diesel exhaust)	207	459	1,019
	Unloading trucks	9	6	27
Overburden removal and dumping				
Open Cut	Drilling	11,152	29,193	31,161
	Blasting	8,984	23,517	25,103
	Ex/FEL loading trucks	41,840	109,523	116,906
	Hauling (controlled wheel-generated emissions plus diesel exhaust)	120,271	586,966	509,274
	Unloading trucks	20,920	54,761	58,453
	Dozers - Pit	10,665	14,219	14,219
	Dozers - Dump	3,555	5,332	5,332
Coal removal				
Open Cut	Dozer ripping	63,985	76,783	76,783
	Ex/FEL loading trucks	29,459	92,897	109,423
	Hauling (controlled wheel-generated emissions plus diesel exhaust)	21,491	52,836	35,157
Coal processing				
Vickery Coal Mine	Unload to hopper / ROM pad	410	1,294	1,524
	Rehandle - ROM to hopper	2,310	2,310	2,310
	Crushing	716	2,259	2,661
	Screening	982	3,096	3,647
Vickery Coal Mine	Transfer 55% to processing plant (CHPP)	967	3,051	3,593
	Transfer 45% to Bypass circuit	79	250	294
	Loading product stockpile from CHPP	154	481	552
	Loading product stockpile from Bypass	264	832	980
	Product coal transfer station	305	957	1,113
	Loading trains	305	957	1,113
Tarrawonga Coal Mine	Unload to hopper / ROM pad	464	464	0
	Crushing	810	810	0
	Screening	1,110	1,110	0
	Transfer 55% to processing plant (CHPP)	1,094	1,094	0
	Transfer 45% to Bypass circuit	89	89	0
	Loading product stockpile from CHPP	168	168	0
	Loading product stockpile from Bypass	298	298	0
	Product coal transfer station	338	338	0
	Loading trains	338	338	0
Rocglen Coal Mine	Unload to hopper / ROM pad	101	0	0
	Crushing	176	0	0
	Screening	241	0	0
	Transfer 55% to processing plant (CHPP)	237	0	0
Rocglen Coal Mine	Transfer 45% to Bypass circuit	19	0	0
	Loading product stockpile from CHPP	36	0	0
	Loading product stockpile from Bypass	65	0	0
	Product coal transfer station	73	0	0
	Loading trains	73	0	0

Table 7 (continued)
Annual Project PM_{10} Emissions Inventory

Pit	Activity	PM_{10}		
		Year 3	Year 7	Year 21
Coal processing (continued)				
All coal	Product stockpile reclaim (dozers)	21,980	21,980	21,980
Coarse rejects				
Coarse rejects	Ex/FEL loading trucks	2,710	9,722	11,761
	Hauling (controlled wheel-generated emissions plus diesel exhaust)	1,977	5,530	3,779
	Unload to dump	54	193	234
Wind erosion of exposed ground				
Open Cut	Pre-strip	4,701	3,052	13,583
	Active pit	20,912	72,460	84,484
	Active dump	146,254	183,504	164,805
	Inactive dump	0	41,288	37,081
	Active rehabilitation	0	528	2,992
	Soil stockpiles	916	1,200	1,200
Wind erosion and maintenance of stockpiles and ROM pads				
	ROM pads	127,721	127,721	127,721
	Product stockpiles	85,147	85,147	85,147
Miscellaneous				
	Grading roads	20,412	24,494	24,494
Total (kg/year)		**778,661**	**1,644,234**	**1,583,130**

Source: Ramboll (2018)
kg/year = kilograms per year

Haulage of ROM coal from the Tarrawonga and Rocglen Coal Mines along the Approved Road Transport Route is included in the cumulative modelling on the basis that this activity (i.e. on-road haulage of coal from the Tarrawonga and Rocglen Coal Mines) is approved and would occur regardless of the Project (Appendix 1 of the Project Air Quality and Greenhouse Gas Assessment [Ramboll, 2018]).

Note that hauling from the Tarrawonga and Rocglen Coal Mines would occur along sealed roads (including the on-site access road to the mine infrastructure area). Wheel generated dust emissions along sealed roads are very low (e.g. by comparison to wheel generated dust from unsealed roads). Notwithstanding, the Project would reduce dust emissions from on-road haulage as it would reduce the distance travelled by trucks transporting coal to and from the Tarrawonga and Rocglen Coal Mines.

IPC POINT OF INTEREST 33

The IPC requested:

> ***Results on any model calibration with the existing operating mines in the locality.***

WHITEHAVEN RESPONSE

It is unusual to calibrate an air quality model with existing operating mines, especially in this case where the nearest mines are a significant distance away, are located in significantly different terrain and the only available baseline monitoring data includes a large, highly variable fraction of dust from many sources other than mining operations.

Unlike some other environmental models, air dispersion models used for EIS assessments are relatively standardised, and effectively translate source emissions and meteorological and terrain data into dust concentrations at receptors using well-defined, standardised dispersion equations.

Whilst the available air dispersion models are many and varied, they include a class of models known as regulatory models, which are approved to be used directly for regulatory compliance purposes and EIS assessments. The AERMOD model (and meteorological component AERMET), which is perhaps the most frequently used regulatory model, has been used in the Project Air Quality and Greenhouse Gas Assessment (Ramboll, 2018).

The regulatory models are designed to not under-predict likely impacts, as validated under a range of conditions and a range of source types (in this case by the United States Environmental Protection Agency and the Victorian Environment Protection Authority), using high quality tracer gas data sets. Generally, SF_6 gas is released and measured in the environment at many locations simultaneously, along with meteorological data and other parameters. SF_6 is not a naturally occurring substance, which allows a valid calibration to be made, in the absence of confounding other sources.

Inputs to the air quality model (e.g. emissions) and outputs (e.g. predicted concentrations at receptors) have been benchmarked and are consistent with expectations.

IPC POINT OF INTEREST 34

The IPC requested clarification regarding:

> ***Dust impacts on agricultural activity, particularly cotton.***

WHITEHAVEN RESPONSE

Effects of Project-related dust on agricultural activity are expected to be minimal.

Impacts of the Project (e.g. air quality) on surrounding agricultural enterprises have been considered in the Project Agricultural Impact Statement based on the predictions of the Project Air Quality and Greenhouse Gas Assessment (Ramboll, 2018). It should be noted that the relevant air quality consideration with respect to agriculture is dust deposition (measured as grams per square metre per month [g/m^2/month]), as opposed to concentrations of dust in the atmosphere (measured as micrograms per cubic metre [µg/m^3])

The potential effects of coal dust on agricultural production have been the subject of previous study (Andrews and Skriskandarajah, 1992; in Connell Hatch, 2008), which found that:

- Cattle did not find feed unpalatable if coal mine dust was present at a dust deposition level of approximately 120 g/m^2/month.
- The presence of coal mine dust in feed did not affect the amount of feed that the cattle ate or the amount of milk that the cattle produced at a level equivalent to a dust deposition level of approximately 120 g/m^2/month.
- Cattle did not preferentially eat feed that did not contain coal mine dust. The cattle were able to choose between feed that was free of coal mine dust, feed that contained 120 g/m^2/month of coal mine dust and feed that contained 240 g/m^2/month of coal mine dust.

A review by Farmer (1993) found that the lowest rate of application of inert dusts to commercial crops observed to cause an effect was approximately 15 g/m^2/month.

It is noted that some submissions at the public hearing raised the potential for discolouration of cotton crops due to coal dust from the Project.

The annual average background dust deposition rate (e.g. from existing agricultural activities) recorded across all eight baseline monitoring sites in the vicinity of the Project (Figure 20) is 2.8 g/m^2/month for the period 2012 to 2016 (with the highest annual average at any of the monitors being approximately 8.7 g/m^2/month at 'DDG2', representative of air quality at privately-owned receiver 127b [Figure 20]) (Ramboll, 2018).

The maximum predicted incremental increase in dust deposition due to the Project is 1 g/m^2/month (at receiver 127b). Therefore the maximum predicted cumulative dust deposition rate, based on the annual average background and maximum predicted incremental Project dust deposition rate, is predicted to be 3.8 g/m^2/month (Ramboll, 2018).

The maximum predicted cumulative dust deposition rate due to the Project is far lower than those detailed in Andrews and Skriskandarajah (1992; in Connell Hatch, 2008) and Farmer (1993), therefore effects of Project-related dust on agricultural production are expected to be minimal.

IPC POINT OF INTEREST 35

The IPC requested:

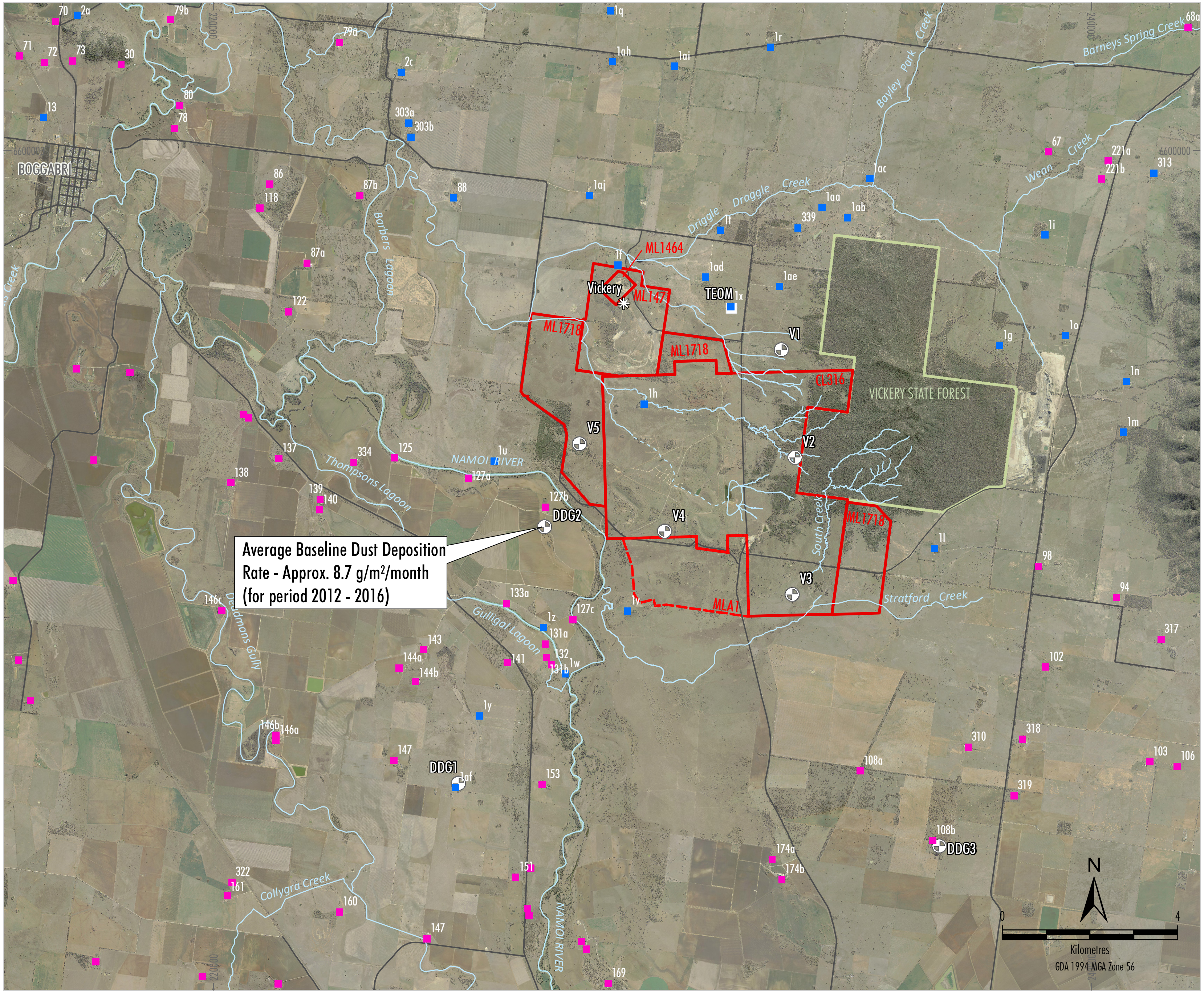
> ***Consideration of covered coal wagons.***

WHITEHAVEN RESPONSE

The covering of coal wagons is not considered to be reasonable given studies commissioned by the EPA (including Ryan and Malecki [2015] and AECOM [2016]) have demonstrated that dust from uncovered wagons is negligible.

A summary of the outcomes of these studies is below (refer to Section 8 of the Project Air Quality and Greenhouse Gas Assessment [Ramboll, 2018]):

- Monitoring commissioned by the EPA in Newcastle and the Lower Hunter region found that nuisance coal dust in the vicinity of rail corridors is not an issue.
  - All monitoring results were well below the amenity dust criteria and of the dust that was collected on average only 6.2% was coal dust.
- Other monitoring studies commissioned by the EPA found that loaded coal trains were not distinguishable from unloaded coal trains or freight trains in terms of dust monitoring during train pass-bys.
  - It was found diesel exhaust was unlikely to have caused any increase in dust levels.
  - Rather, any minor increase in dust was concluded to have been caused by passing trains 'stirring up' dust already on the tracks.



LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- State Forest
- Mine-owned Dwelling
- Private Dwelling

Whitehaven Monitoring

- Dust Deposition Gauge
- TEOM
- Meteorological Station

Source: LPMA - Topographic Base (2010) and Orthophoto (Boggabri 2011); Department of Industry (2015); Whitehaven (2016)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Project Air Quality Monitoring Sites

Figure 20

WHC-15-33_IPC PRR_218A

IPC POINT OF INTEREST 36

The IPC requested:

> ***Consideration of the establishment of an air quality monitoring station at Boggabri.***

WHITEHAVEN RESPONSE

Considering dust from the Project is predicted to be undetectable in Boggabri (Ramboll, 2018) and the extensive coverage of existing monitors in the region, Project-specific air quality monitoring in Boggabri is not considered to be required.

The NSW air quality monitoring network is managed by OEH and includes monitoring stations in Gunnedah, Narrabri and Tamworth. The Namoi Regional Air Quality Monitoring Program (NRAQMP) is managed by the EPA and includes four Tapered Element Oscillating Micro Balance (TEOM) industry monitoring stations (Maules Creek, Wil-gai, Breeza and Werris Creek) (Figure 21). Data from the NRAQMP is reported weekly on the EPA's website[4].

In addition, the Namoi Region Air Quality Advisory Committee has been established and comprises representatives from community environmental groups, local councils, NSW Farmers, Indigenous communities, DPE and industry (e.g. Whitehaven). The terms of reference for the Advisory committee are available at: https://www.epa.nsw.gov.au/working-together/community-engagement/community-news/namoi-air-quality-advisory-committee/terms-of-reference.

The NRAQMP 'Wil-gai' monitor, which has been operational since 2012, is located within the Project mining area and considered by the EPA to be representative of ambient air quality at Boggabri and other rural residences in the region[6].

A monitor in Boggabri would not be able to reasonably measure dust from the mine, therefore following Project commencement, real-time air quality monitoring would be conducted at locations significantly closer to the Project than Boggabri, where dust from the mine may potentially be measurable, in order to demonstrate compliance with air quality limits. The Project monitoring, in addition to OEH, EPA and other industry monitoring, is considered to provide sufficient information to confirm there would be no tangible air quality impacts from the Project at Boggabri.

It is noted some submitters to the IPC public hearing stated that the OEH air quality rating for Boggabri was "poor".

OEH's (2018) *Air Quality Monitoring Network Namoi/North-West slopes May 2017 to July 2018 seasonal newsletter* provided a summary of air quality monitoring results between May 2017 and July 2018 at all Namoi Region monitors. Chart C shows measured PM_{10} levels and Chart D shows $PM_{2.5}$[5] levels with respect to the impact assessment criteria.

The OEH attributed exceedances of the PM_{10} impact assessment criteria (Chart C) to regional dust storms and exceedances of the $PM_{2.5}$ criteria (Chart D) to domestic woodsmoke. These are normal events common to country towns and are the only instances of the air quality levels reaching into the "Poor" category.

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[4] https://www.epa.nsw.gov.au/your-environment/air/regional-air-quality/namoi-air-quality-monitoring-project

[5] Particulate matter with an equivalent aerodynamic diameter of 2.5 µm or less.

LEGEND

- Mining Tenement Boundary (ML and CL)
- Mining Lease Application (MLA)
- Highway
- Major Railway
- OEH Air Quality Monitoring Site
- Industry Air Quality Monitoring Site

Source: Geoscience Australia (2011)

WHITEHAVEN COAL

VICKERY EXTENSION PROJECT

Air Quality Monitoring Sites
in Namoi/ North-West Slopes Region

Figure 21

OEH (2018) concluded that air quality within the Namoi/North-West slopes region (including Boggabri) was "Very Good" to "Fair" (i.e. below impact assessment criteria) for 97% of the time between May 2017 to July 2018.

Community members who have previously requested an air quality monitor at Boggabri via the Advisory Committee have been encouraged to apply for funding for such a monitor via the Boggabri-Tarrawonga-Maules Creek (BTM) Environmental Trust. No such application has been received to date.

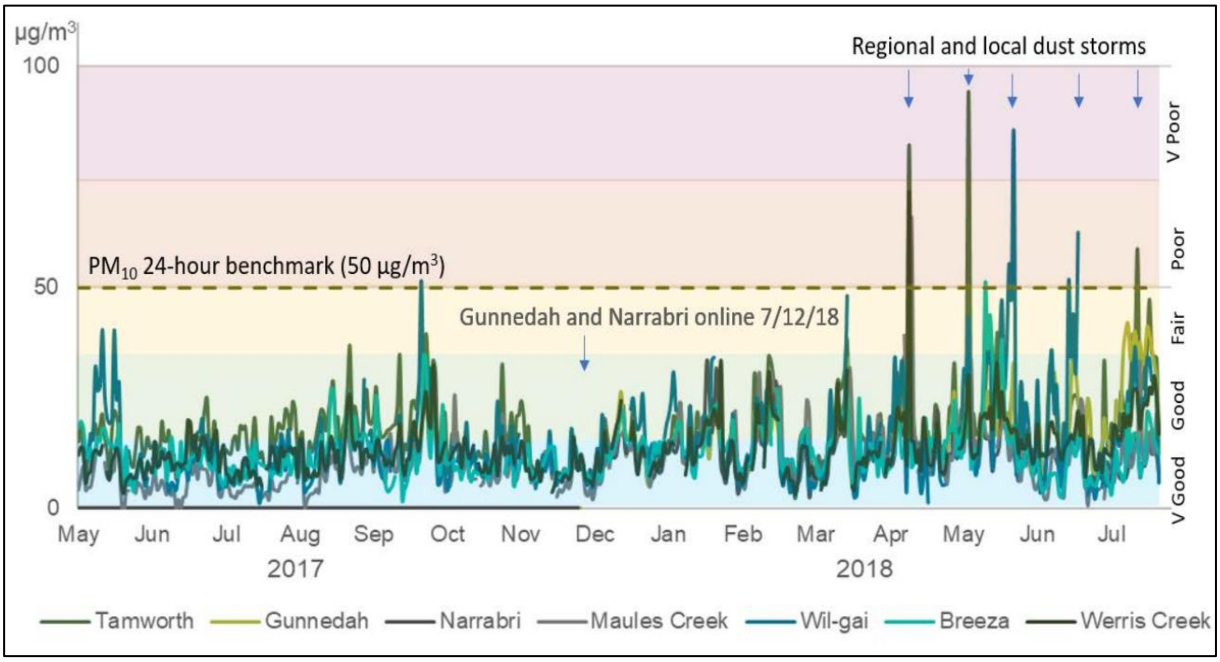


Chart C: Daily Average PM_{10} – May 2017 to July 2018 (Source: OEH [2018])

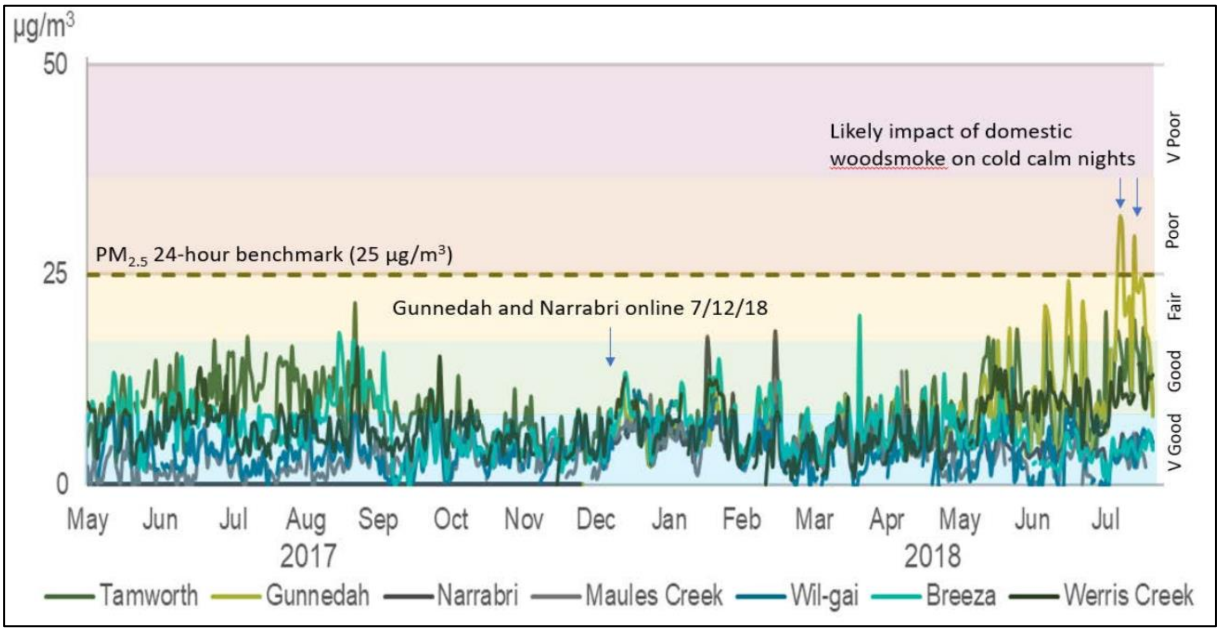


Chart D: Daily Average $PM_{2.5}$ – May 2017 to July 2018 (Source: OEH [2018])

In addition, blast fume management measures that would be implemented for the Project include:

- The use of risk assessments prior to blasting, in order to review factors, such as:
  - geological conditions;
  - ground conditions (e.g. presence of clay or loose/broken ground or heavy rain affected ground);
  - location of the blast relative to previous blasts which may have triggered fume events;
  - blasting product selection; and
  - presence of groundwater;
- The use of the outcomes of the risk assessment to alter the blasting method where necessary by:
  - minimising the time between drilling and loading, and loading and shooting of the blast;
  - formulation of explosive products to an appropriate oxygen balance to reduce the likelihood of fumes; and
  - adjusting the blast scheduling to avoid unfavourable meteorological conditions.

These management measures would be detailed in the Project Blast Management Plan.

9 REHABILITATION

IPC POINT OF INTEREST 37

The IPC stated:

> ***The EIS indicates that rehabilitation will be progressive with soils from newly cleared areas being used on rehabilitated areas. Significant parts of the north and the west of the proposed mine are previously rehabilitated sites and no soil data about the reconstructed soil properties in these previously rehabilitated areas have been provided in the report. Is data available which demonstrates that the soils from these previously rehabilitated areas will be suitable as source materials for progressive soil profile reconstruction.***

WHITEHAVEN RESPONSE

The conclusion that suitable soil resources are available to achieve the rehabilitation outcomes for the Project includes consideration of soil test work within rehabilitated mining areas.

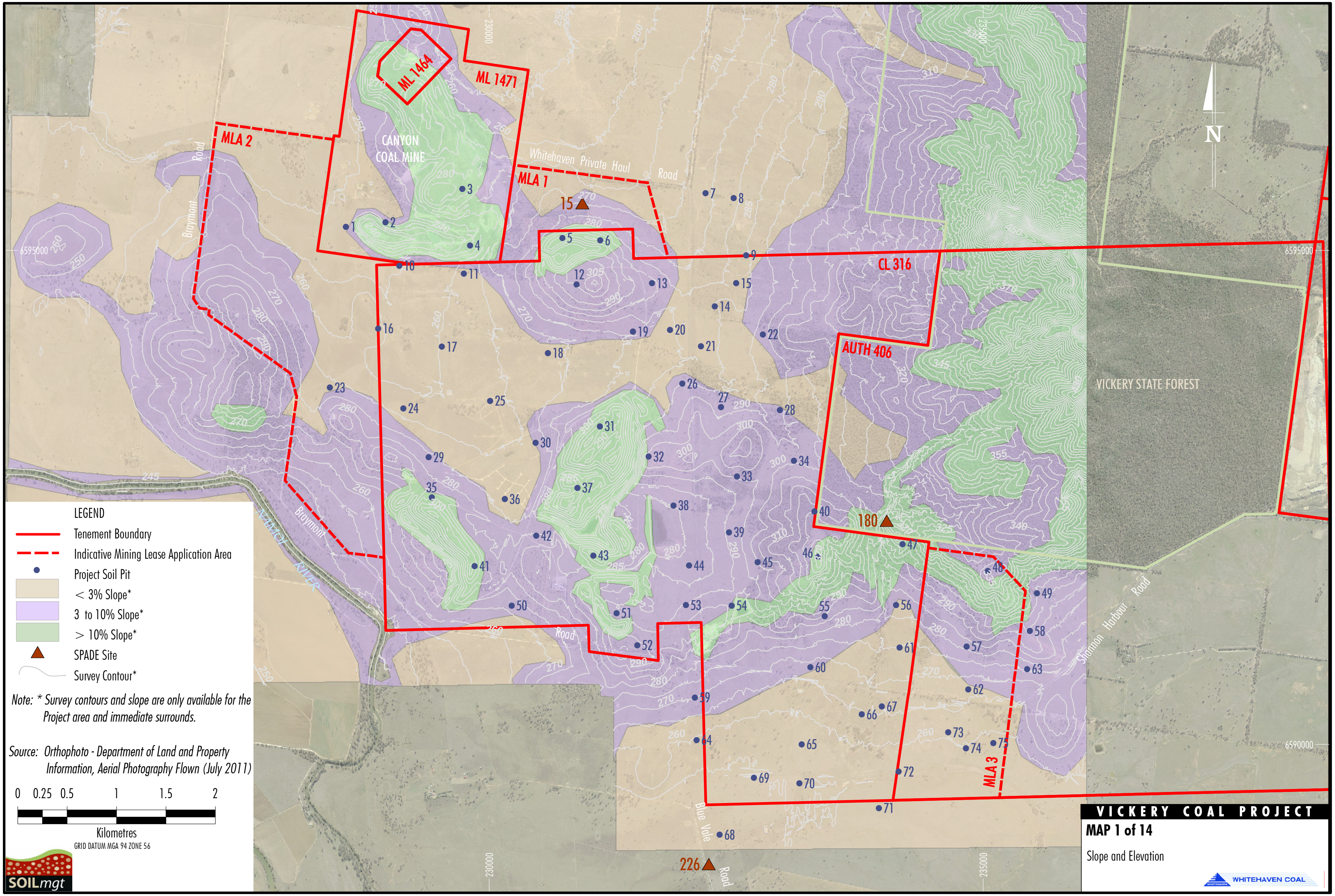
The *Vickery Coal Project Agricultural Resource Assessment* undertaken by McKenzie Soil Management (2012) (Attachment A to the Approved Mine Agricultural Impact Assessment) assessed a total of 75 soil test pits within the extent of the Approved Mine, including within rehabilitated historic mining areas as shown on Maps 1 to 14 from the *Vickery Coal Project Agricultural Resource Assessment* (McKenzie Soil Management, 2012).

McKenzie Soil Management (2012) established that soils within the Approved Mine area (including historic mine rehabilitation) are suitable as a rehabilitation medium for agricultural and native vegetation land uses, provided suitable soil management measures and amelioration are implemented.

The *Vickery Extension Project Soil Resource Assessment* undertaken by SESL Australia (2018) for the Project considered the results of McKenzie Soil Management (2012), including within rehabilitated historic mining areas, as well as further soil test studies conducted in the Project extension areas to inform the calculation of the indicative soil inventory available for rehabilitation over the life of the Project.

SESL Australia (2018) concluded that there would be adequate soil resources available to meet the rehabilitation concepts for the Project.

Soil management measures that would be implemented for the Project are detailed in Sections 4.3.3 and 5.4.2 of the Project EIS.



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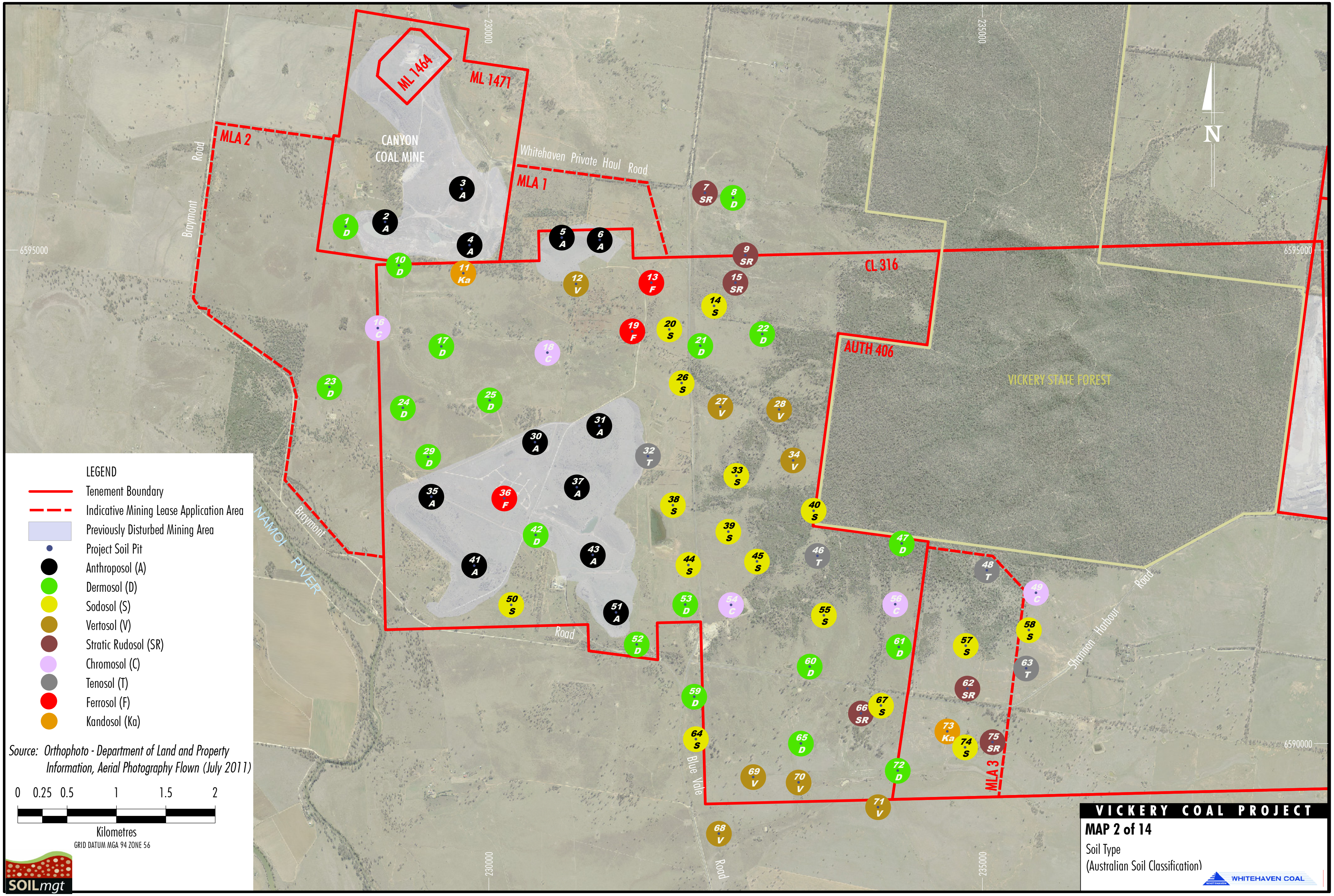

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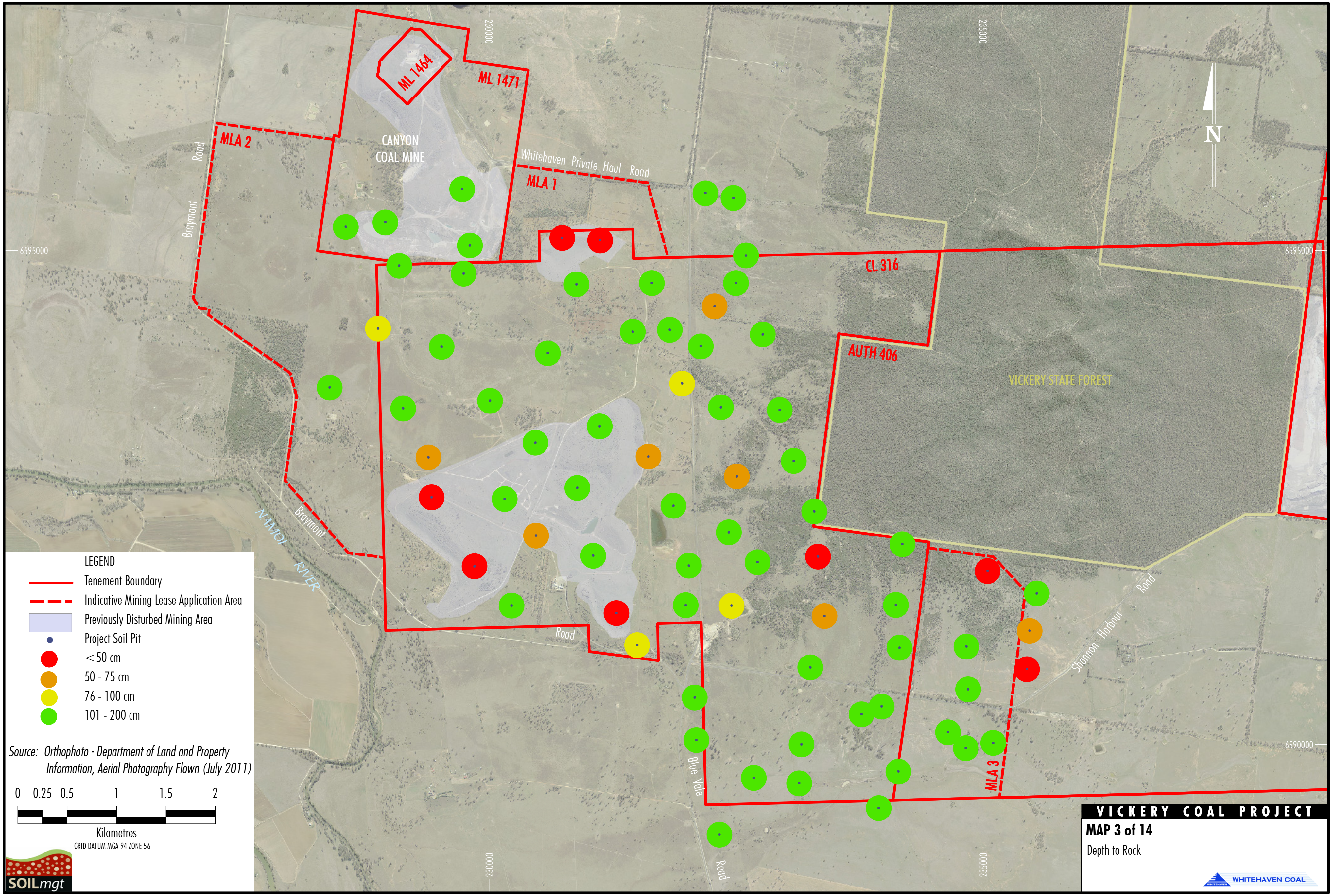

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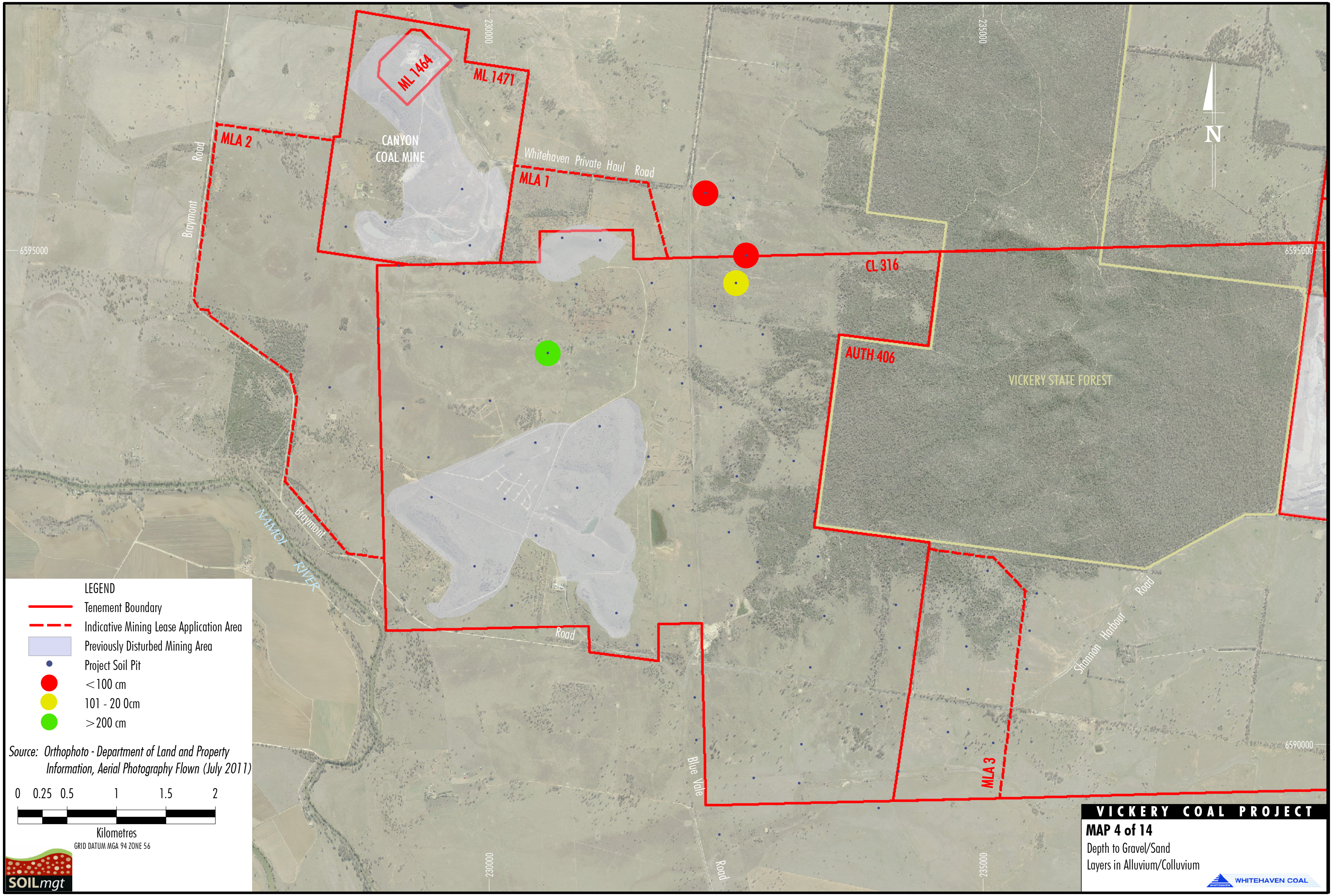
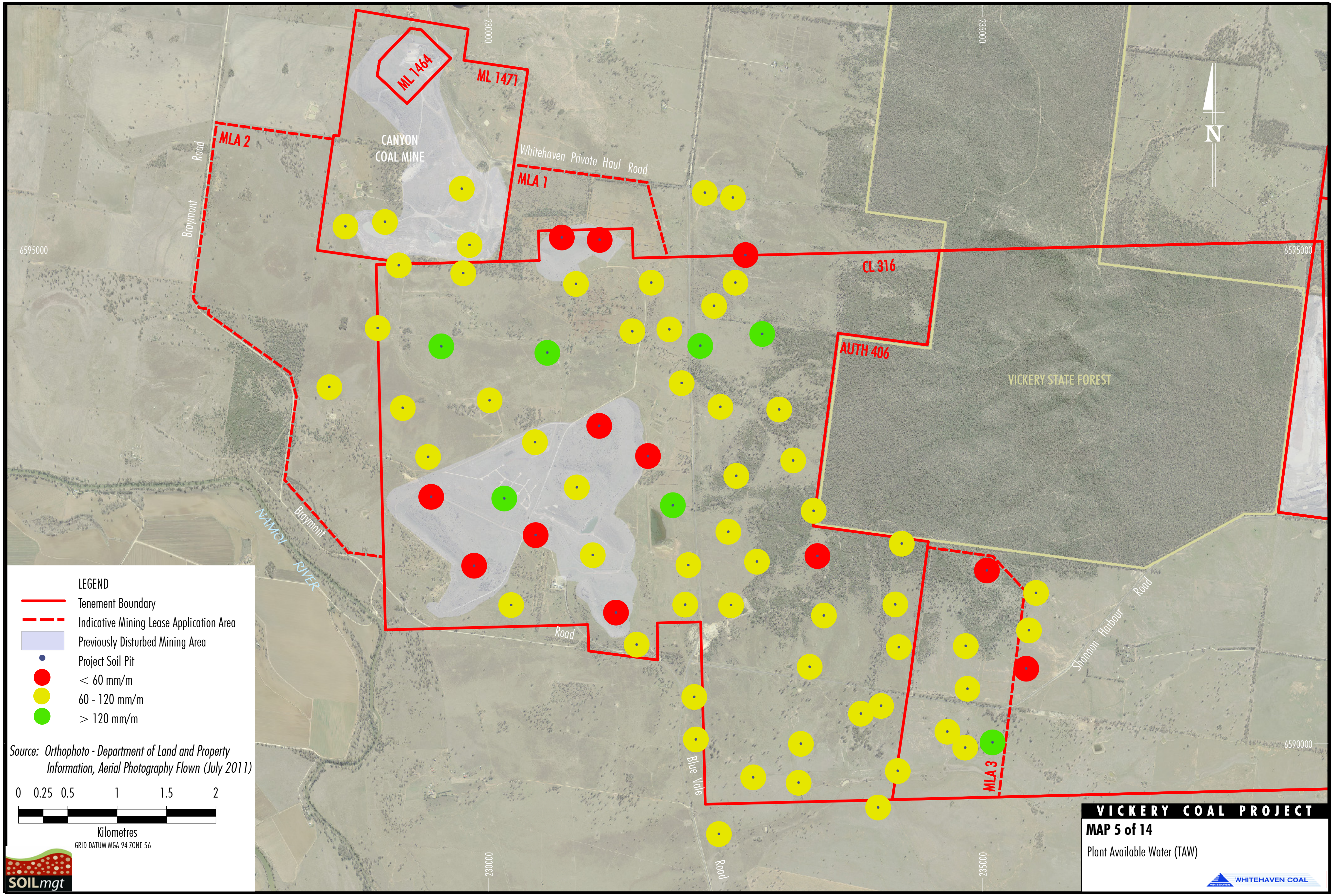
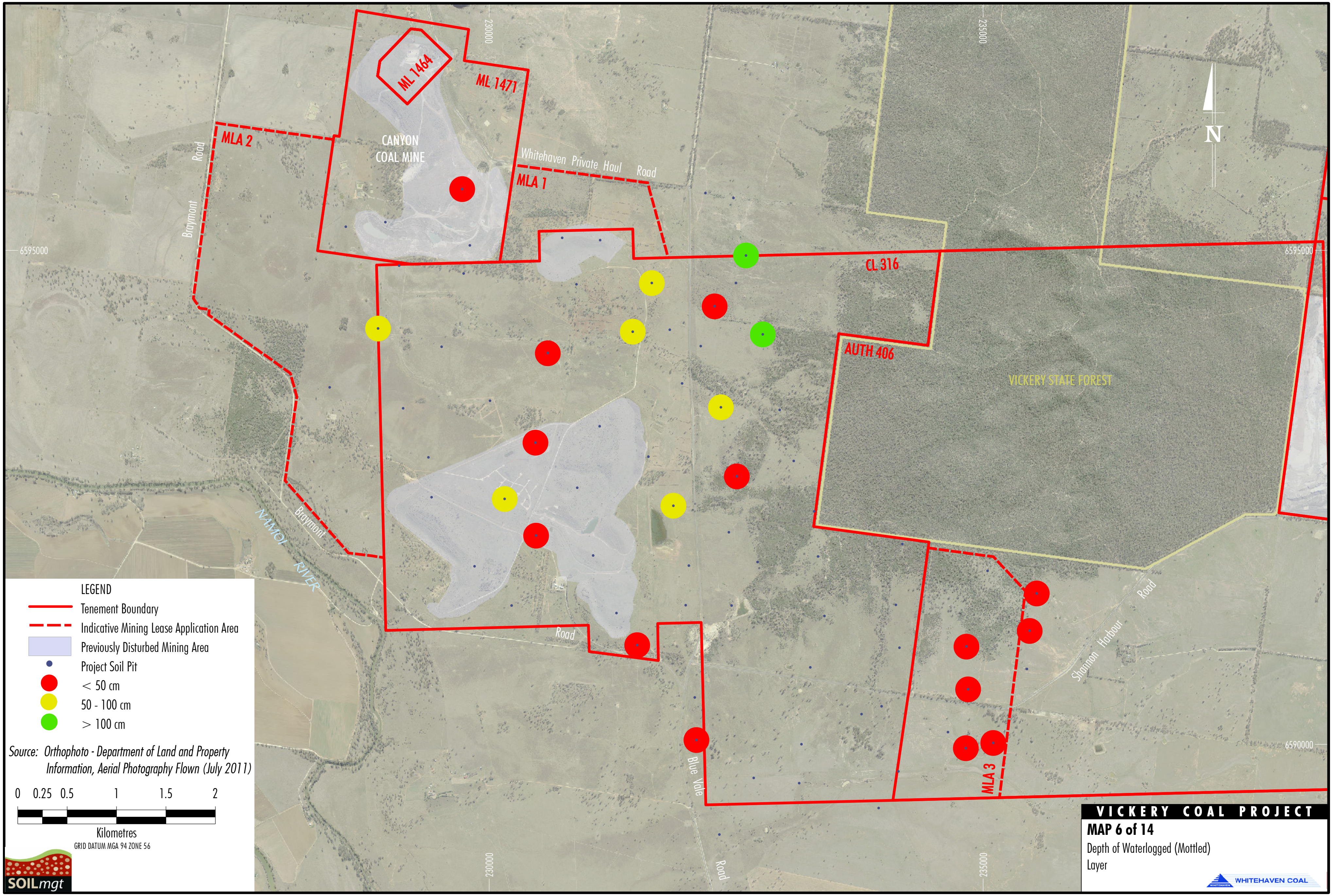

ML 1464
ML 1471
MLA 2
CANYON
COAL MINE
Whitehaven Private Haul Road
MLA 1
Braymont Road
CL 316
AUTH 406
VICKERY STATE FOREST
NAMOI RIVER
Braymont
Road
Blue Vale Road
Shannon Harbour Road
MLA 3
N
230000
235000
6595000
6590000
LEGEND
Tenement Boundary
Indicative Mining Lease Application Area
Previously Disturbed Mining Area
Project Soil Pit
<100 cm
101 - 20 0cm
>200 cm
Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)
0 0.25 0.5 1 1.5 2
Kilometres
GRID DATUM MGA 94 ZONE 56
SOILmgt
VICKERY COAL PROJECT
MAP 4 of 14
Depth to Gravel/Sand
Layers in Alluvium/Colluvium
WHITEHAVEN COAL



WHC-10-03 EIS_App AIA AM_204D



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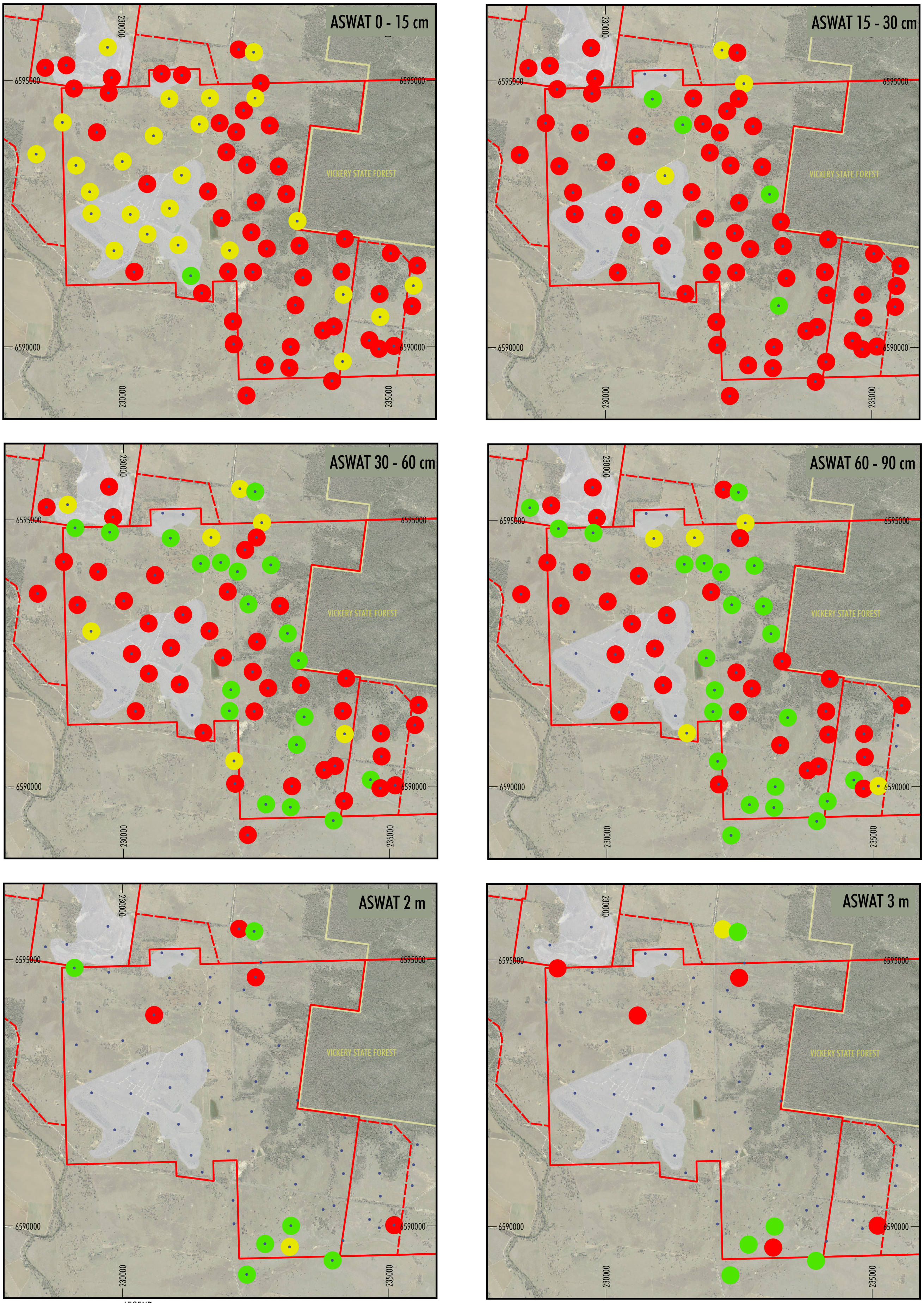


LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit
- > 6
- 2 - 6
- < 2

0 0.5 1 2 3 4

Kilometres

GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

SOILmgt

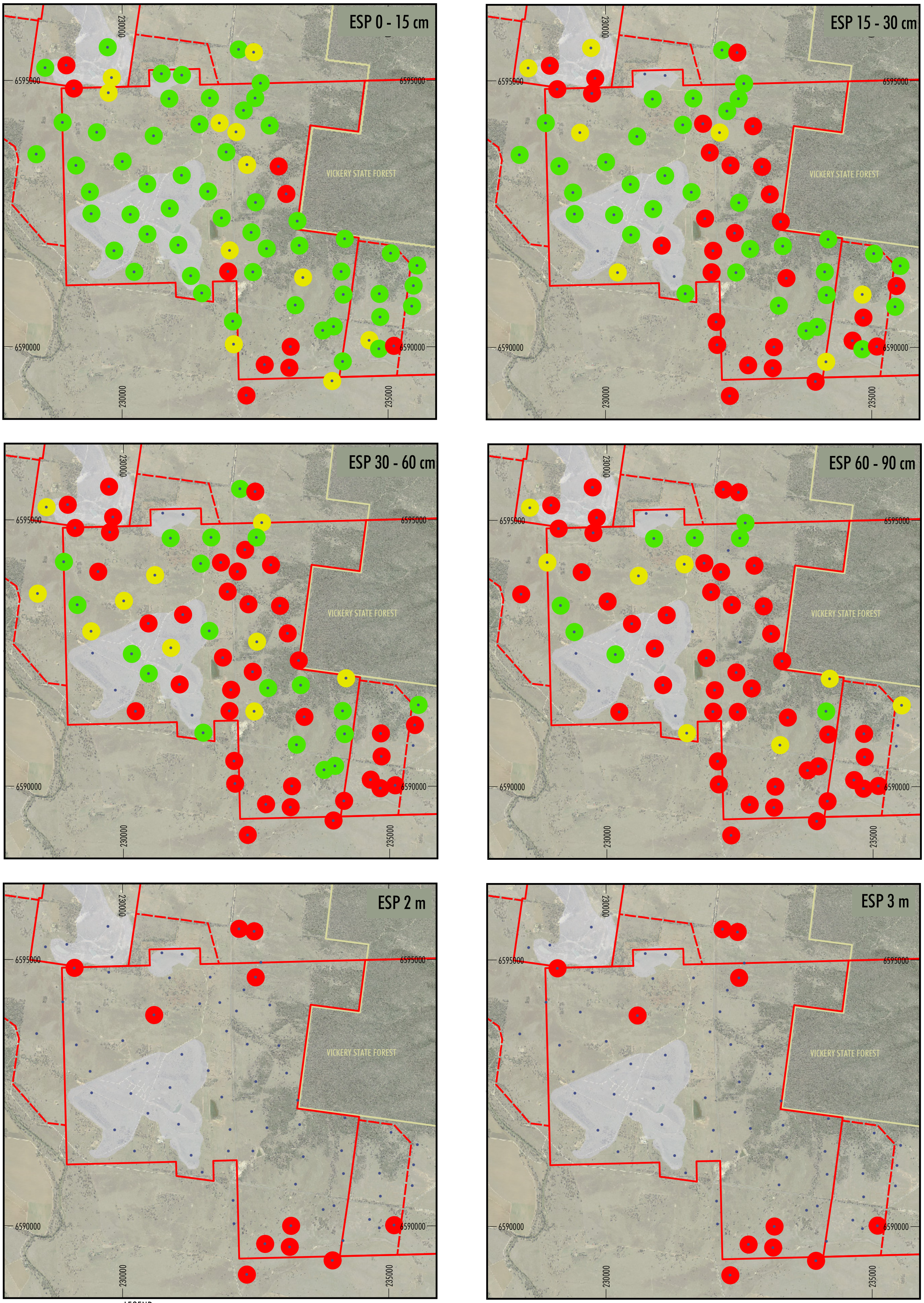
VICKERY COAL PROJECT

MAP 7 of 14

Dispersion (ASWAT scores)

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_206D



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit

- > 6
- 3 - 6
- < 3

0 0.5 1 2 3 4

Kilometres

GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

VICKERY COAL PROJECT

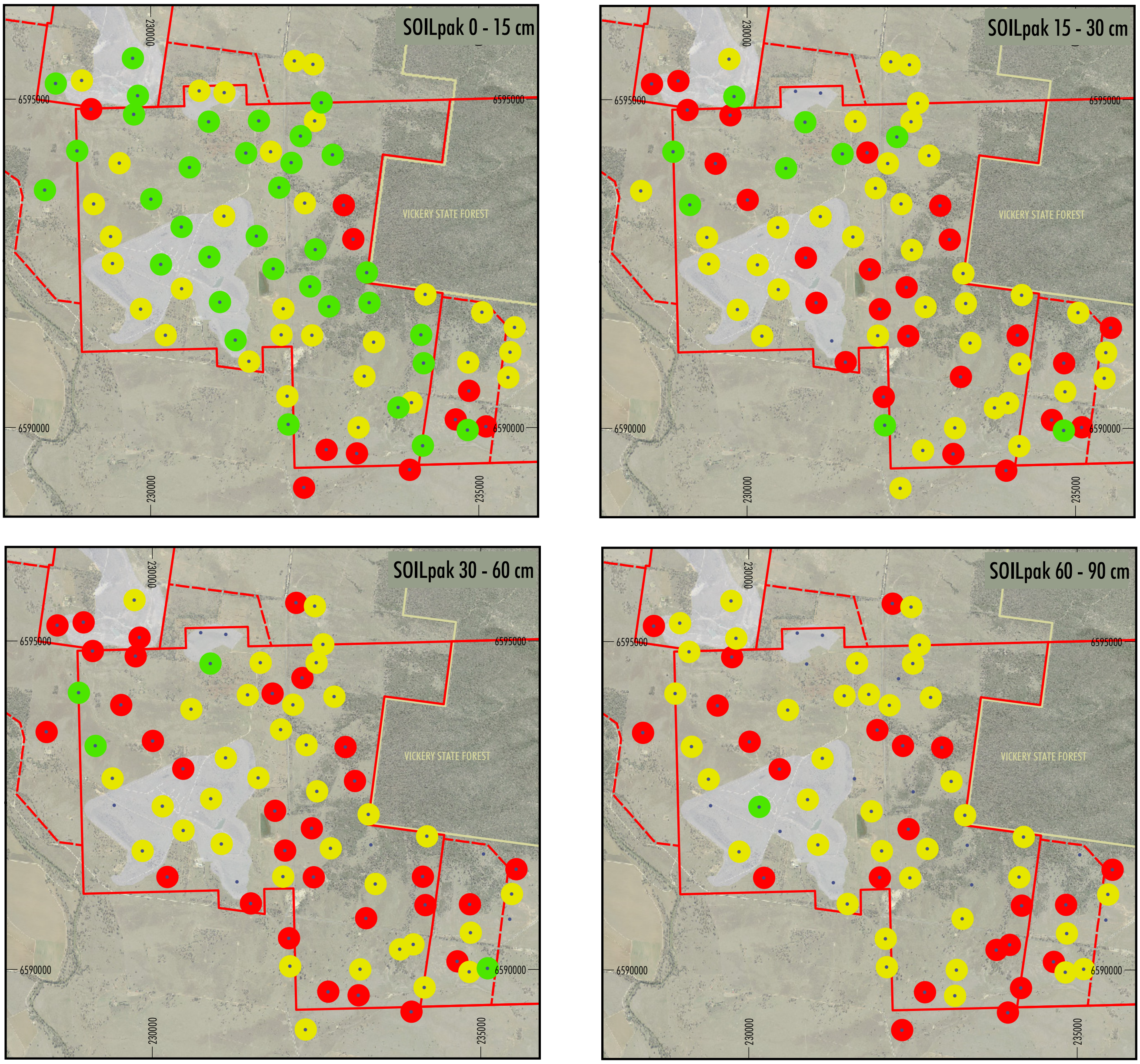
MAP 8 of 14

Dispersion (ESP Values)

SOILmgt

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_207D



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit

- < 1.0
- 1.0 – 1.5
- > 1.5

0 0.5 1 2 3 4
Kilometres
GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

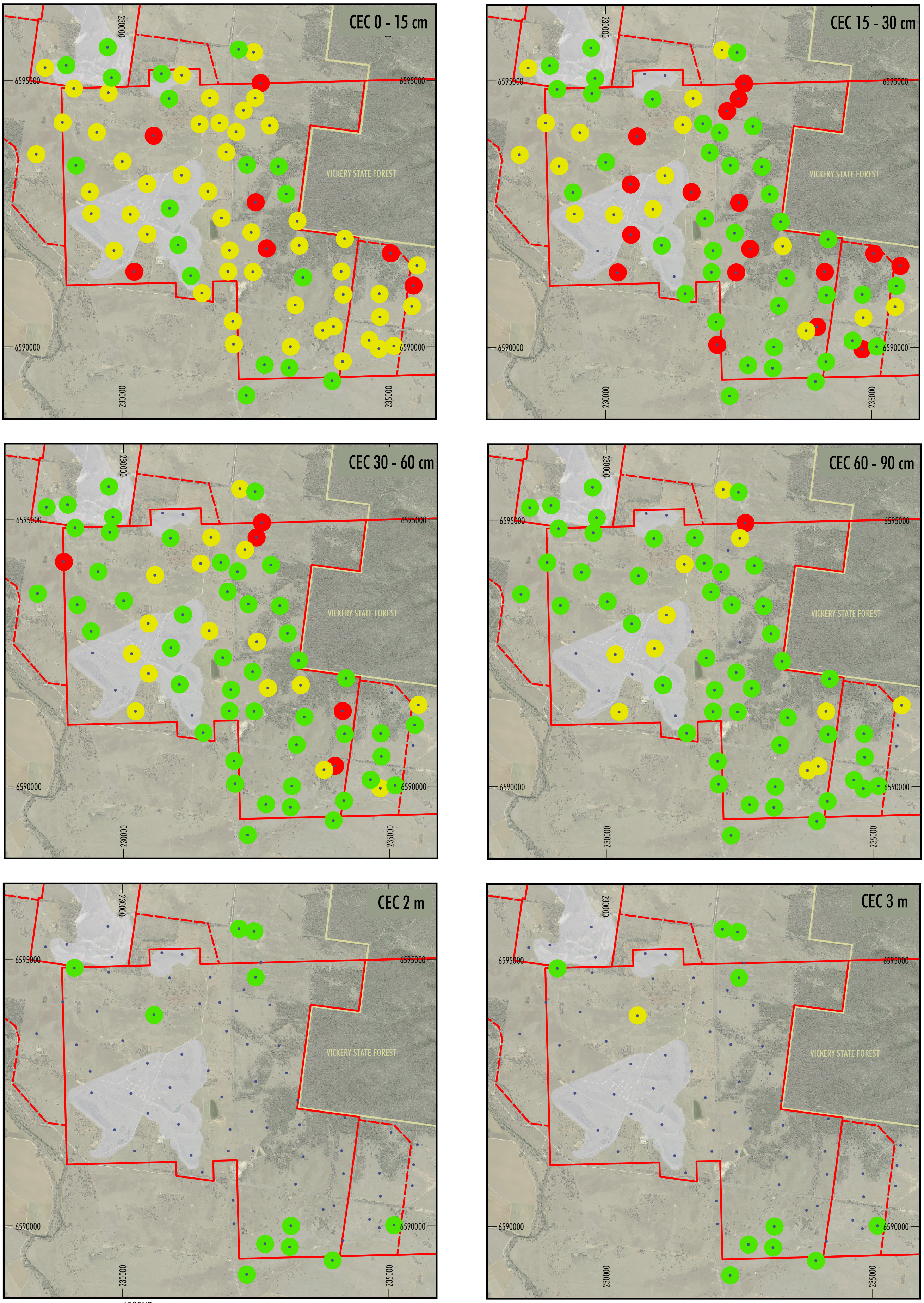
VICKERY COAL PROJECT

MAP 9 of 14
Compaction Severity
(SOILpak Score)

SOILmgt

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_208D



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit

- < 5 (meq/100g)
- 5 - 15 (meq/100g)
- > 15 (meq/100g)

0 0.5 1 2 3 4

Kilometres

GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

VICKERY COAL PROJECT

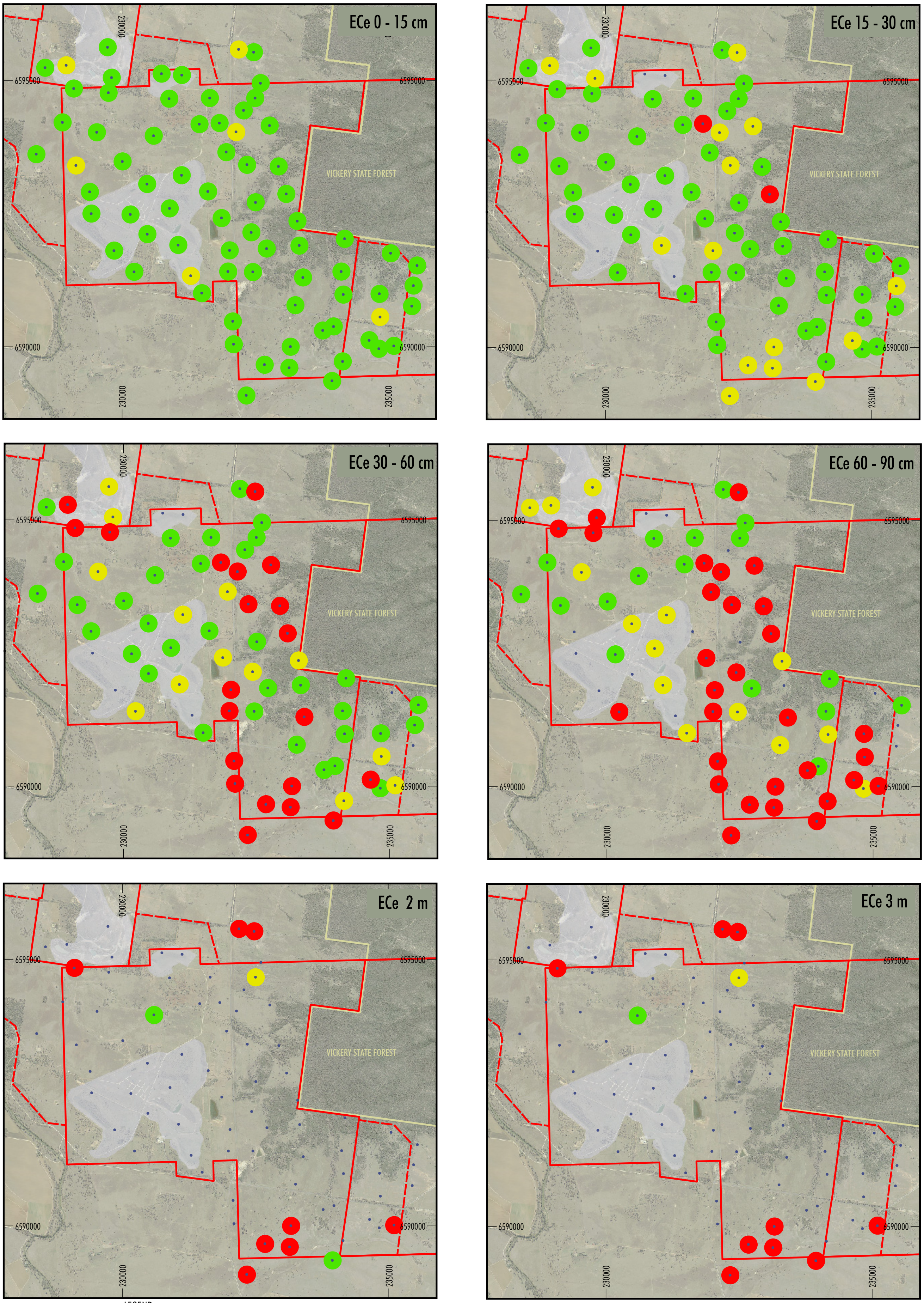
MAP 10 of 14

Cation Exchange Capacity

SOILmgt

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_209D



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit
- > 3.0 dS/m
- 1.5 – 3.0 dS/m
- < 1.5 dS/m

0 0.5 1 2 3 4
Kilometres
GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

SOILmgt

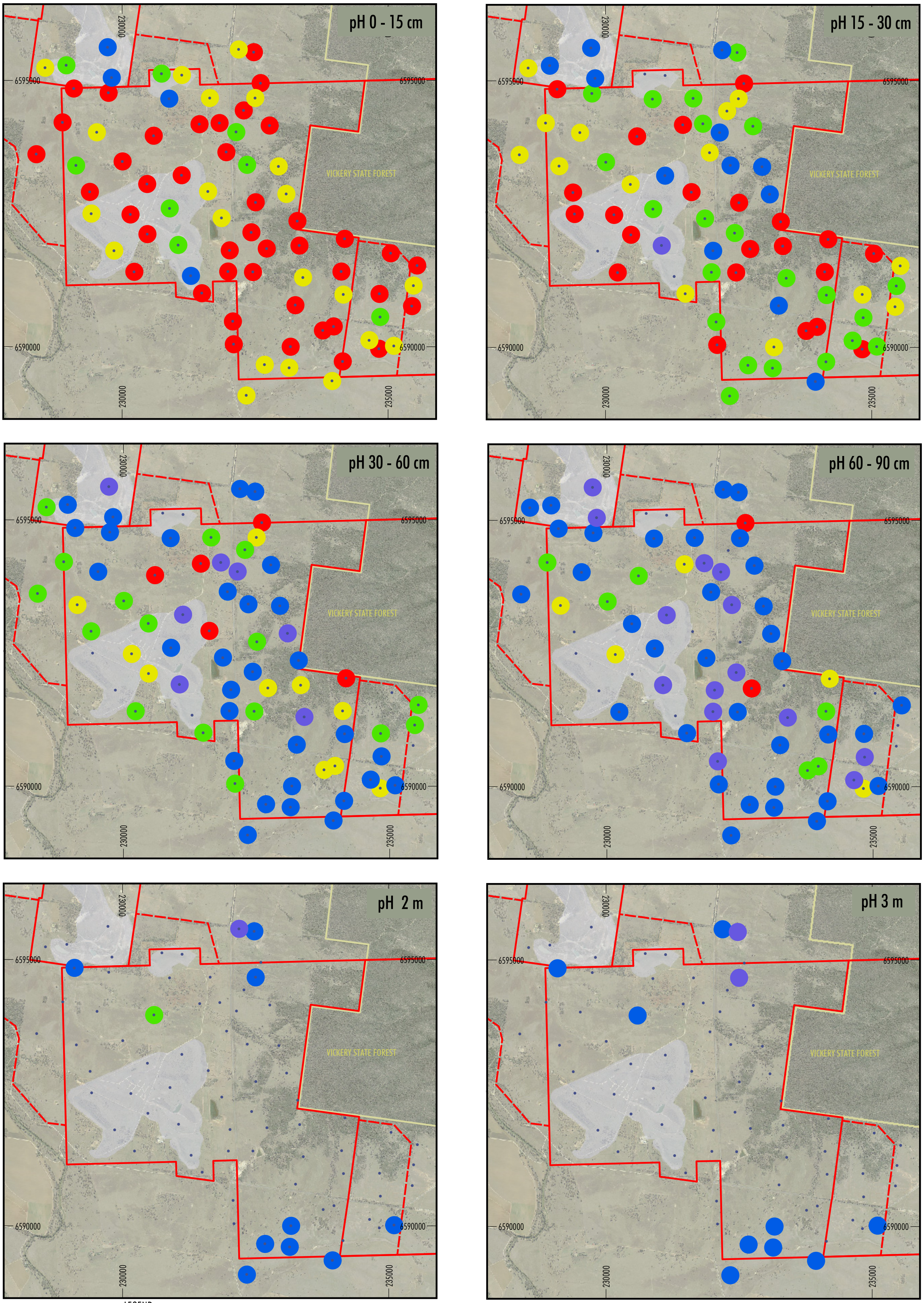
VICKERY COAL PROJECT

MAP 11 of 14

Salinity
(Electrical Conductivity – ECe)

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_210E



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit

- < 5.5
- 5.6 – 6.5
- 6.6 – 7.5
- 7.6 – 8.5
- > 8.5

0 0.5 1 2 3 4

Kilometres

GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

VICKERY COAL PROJECT

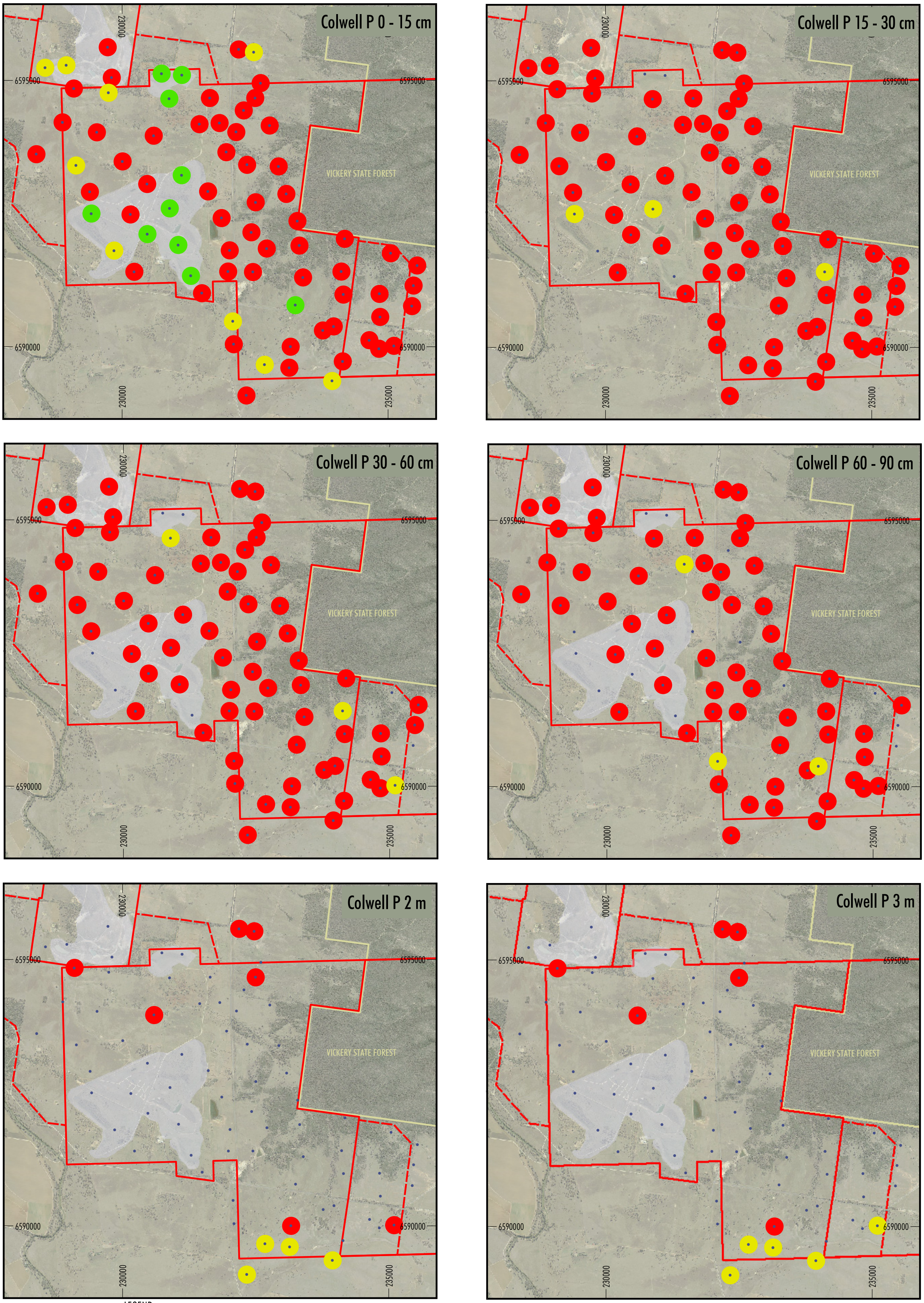
MAP 12 of 14

pH ($CaCl_2$)

SOILmgt

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_211D



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit
- < 10 mg/kg
- 10 - 30 mg/kg
- > 30 mg/kg

0 0.5 1 2 3 4

Kilometres

GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

SOILmgt

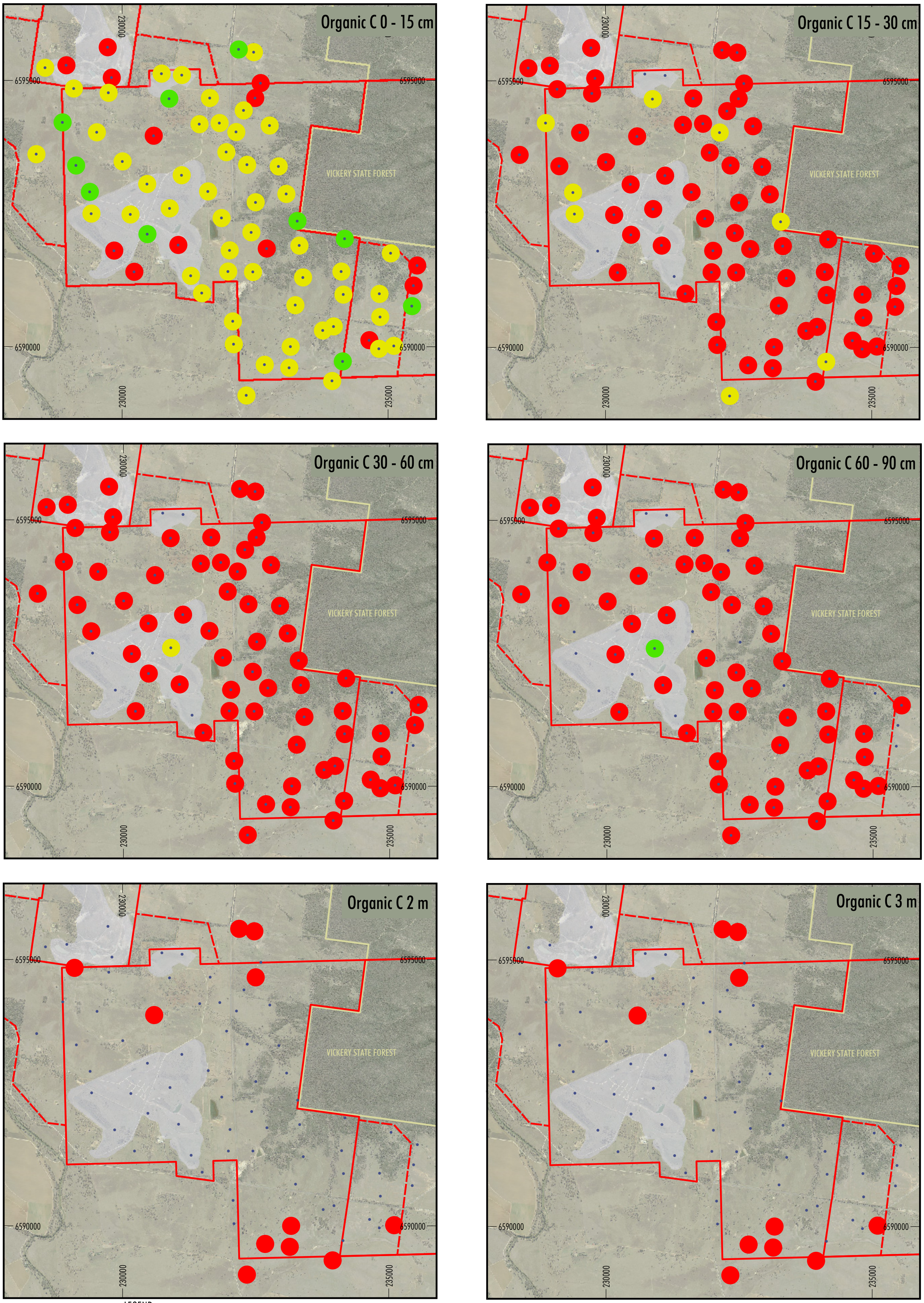
VICKERY COAL PROJECT

MAP 13 of 14

Phosphorus (Colwell P)

WHITEHAVEN COAL

WHC-10-03 EIS_App AIA AM_212D



LEGEND

- Tenement Boundary
- Indicative Mining Lease Application Area
- Previously Disturbed Mining Area
- Project Soil Pit
- < 0.8%
- 0.8 - 1.5%
- > 1.5%

0 0.5 1 2 3 4

Kilometres

GRID DATUM MGA 94 ZONE 56

Source: Orthophoto - Department of Land and Property Information, Aerial Photography Flown (July 2011)

VICKERY COAL PROJECT

MAP 14 of 14

Organic Carbon

WHITEHAVEN COAL

SOILmgt

WHC-10-03 EIS_App AIA AM_213D

10 VISUAL

IPC POINT OF INTEREST 38

The IPC stated:

> ***Can the outer batters of the emplacements be made to blend into the local topography with a more natural drainage lines and hill/valley (e.g. Geofluv type design)?***

WHITEHAVEN RESPONSE

Including natural landform design features (e.g. drainage lines, hills and valleys) is a design objective of the Western Emplacement, and a proposed improvement in comparison to the Approved Mine.

The waste rock emplacement for the Project would reach an elevation of approximately 370 m AHD similar to the maximum elevation of the Approved Mine, however, it would include the following features that were not incorporated in the Approved Mine landform (Section 5.3 of the Project EIS):

- Micro-relief (i.e. gently undulating surface typically ranging in elevation by 1 to 2 m) to assist in drainage design that replicates natural drainage systems.
- Macro-relief (i.e. 10 to 20 m hills similar to those found in the Vickery State Forest) to the top surface of the waste rock emplacement to improve the integration of the landform with the surrounding environment and mitigate potential visual impacts.

This would improve the integration of the landform with the surrounding environment and mitigate potential visual impacts (Section 4.1.1 of the Project Visual Assessment).

The waste rock emplacement would be progressively shaped for rehabilitation activities (i.e. final re-contouring, topsoiling and revegetation) to minimise the contrast between the Project and the surrounding environment consistent with the rehabilitation and landscape management strategy provided in Section 5 of the Project EIS.

Note that the Eastern Emplacement planned for the Approved Mine is no longer required as a waste rock emplacement for the Project and would not be a component of the final landform. This is an additional landform improvement for the Project in comparison to the Approved Mine.

11 SOCIAL

IPC POINT OF INTEREST 39

The IPC stated:

> ***What plans do Whitehaven have for Kurrumbede that would be of value to the local community?***

WHITEHAVEN RESPONSE

It should be noted that the Project would not disturb the Kurrumbede Homestead or its associated outbuildings. Blasting for the Project would be designed to remain below the building damage criteria at the Kurrumbede Homestead, as demonstrated by the modelling conducted by Wilkinson Murray (2018).

Consistent with the recommendations of the Project Historic Heritage Assessment (Extent Heritage, 2018), Whitehaven will implement the following management measures for the Kurrumbede Homestead:

- blast monitoring to demonstrate blast levels remain below building damage criteria;
- maintenance of the landscaping surrounding the Homestead; and
- maintenance of the Homestead and associated outbuildings to ensure they are safe and weatherproof.

Whitehaven will prepare a Heritage Management Plan for the Project incorporating the recommended management measures in the Historic Heritage Assessment, including those specific to the Kurrumbede Homestead.

Whitehaven has also recently advised the Dorothea Mackellar Society of a significant financial contribution to enhance the landscaping surrounding the Kurrumbede Homestead. Whitehaven will continue to consult with the Dorothea Mackellar Society regarding the implementation of the enhancement works. Any enhancement works would also be detailed in the Heritage Management Plan.

12 TRAFFIC

IPC POINT OF INTEREST 40

The IPC stated:

> ***If Vickery Mining is now an independent entity from Whitehaven can they provide guarantees re decommissioning of the southern Blue Vale Road coal transport and the Gunnedah CHPP?***

WHITEHAVEN RESPONSE

The premise of the query is incorrect. Vickery Coal Pty Ltd is a wholly owned subsidiary of Whitehaven and Whitehaven is able to stand behind the commitment.

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