Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	14
Listed Migratory Species:	11

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	17
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	14
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat may occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat known to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Petauroides minor Greater Glider (northern), Greater Glider (north-eastern Queensland) [92008]	Vulnerable	Species or species habitat likely to occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Endangered	Species or species habitat may occur within area
Rhinolophus robertsi Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	Vulnerable	Species or species habitat may occur within area
Saccolaimus saccolaimus nudicluniatus Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Plants		

Name	Status	Type of Presence
Cycas platyphylla a cycad [55796]	Vulnerable	Species or species habitat may occur within area
Dichanthium setosum bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat may occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Reptiles		
Crocodylus johnstoni		
Freshwater Crocodile, Johnston's Crocodile, Johnstone's Crocodile [1773]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Cobbold Gorge	QLD
Granite Creek	QLD
Rungulla	QLD
Rungulla	QLD
Stuarts Spring	QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove, Spotted Dove [780]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina		
Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus		
Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus		
Horse [5]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora		
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Vachellia nilotica		
Prickly Acacia, Blackthorn, Prickly Mimosa, Black Piquant, Babul [84351]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-18.99579 143.54935

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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WildNet species list

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Queensland status: All
Records: All
Date: All
Latitude: -18.9961
Longitude: 143.5492
Distance: 20
Email: matt@candrconsulting.com.au
Date submitted: Friday 22 Jul 2022 11:10:40
Date extracted: Friday 22 Jul 2022 11:20:02

The number of records retrieved = 556

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			1
animals	amphibians	Hylidae	*Litoria caerulea*	common green treefrog		C		1
animals	amphibians	Hylidae	*Litoria inermis*	bumpy rocketfrog		C		5
animals	amphibians	Hylidae	*Litoria rubella*	ruddy treefrog		C		2
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		2
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		6
animals	birds	Accipitridae	*Accipiter cirrocephalus*	collared sparrowhawk		C		1
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		4
animals	birds	Accipitridae	*Circus assimilis*	spotted harrier		C		2
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		3
animals	birds	Accipitridae	*Hamirostra melanosternon*	black-breasted buzzard		C		1
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		2
animals	birds	Alcedinidae	*Ceyx azureus*	azure kingfisher		C		1
animals	birds	Anatidae	*Anas gracilis*	grey teal		C		1
animals	birds	Anatidae	*Chenonetta jubata*	Australian wood duck		C		1
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		1
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		C		1
animals	birds	Ardeidae	*Ardea pacifica*	white-necked heron		C		1
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		3
animals	birds	Ardeidae	*Nycticorax caledonicus*	nankeen night-heron		C		1
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		2
animals	birds	Artamidae	*Artamus cyanopterus*	dusky woodswallow		C		1
animals	birds	Artamidae	*Artamus minor*	little woodswallow		C		1
animals	birds	Artamidae	*Artamus personatus*	masked woodswallow		C		1
animals	birds	Artamidae	*Artamus superciliosus*	white-browed woodswallow		C		1
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		8
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		5
animals	birds	Artamidae	*Gymnorhina tibicen*	Australian magpie		C		7
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		6
animals	birds	Cacatuidae	*Cacatua galerita*	sulphur-crested cockatoo		C		1
animals	birds	Cacatuidae	*Calyptorhynchus banksii*	red-tailed black-cockatoo		C		4
animals	birds	Cacatuidae	*Eolophus roseicapilla*	galah		C		1
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		4
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		2
animals	birds	Campephagidae	*Edolisoma tenuirostre*	common cicadabird		C		1
animals	birds	Campephagidae	*Lalage tricolor*	white-winged triller		C		2
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		2
animals	birds	Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork		C		2
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		3
animals	birds	Columbidae	*Geopelia cuneata*	diamond dove		C		2
animals	birds	Columbidae	*Geopelia placida*	peaceful dove		C		6
animals	birds	Columbidae	*Geophaps plumifera*	spinifex pigeon		C		1
animals	birds	Columbidae	*Geophaps scripta*	squatter pigeon		C		4
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		3
animals	birds	Columbidae	*Phaps chalcoptera*	common bronzewing		C		2
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		9

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		5
animals	birds	Cuculidae	*Cacomantis pallidus*	pallid cuckoo		C		1
animals	birds	Cuculidae	*Centropus phasianinus*	pheasant coucal		C		1
animals	birds	Cuculidae	*Cuculus sp.*			C		1
animals	birds	Estrildidae	*Poephila cincta*	black-throated finch		C		2
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		3
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		3
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		1
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		4
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		4
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		2
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		3
animals	birds	Megapodiidae	*Alectura lathami*	Australian brush-turkey		C		1
animals	birds	Meliphagidae	*Cissomela pectoralis*	banded honeyeater		C		1
animals	birds	Meliphagidae	*Conopophila rufogularis*	rufous-throated honeyeater		C		1
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		6
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		4
animals	birds	Meliphagidae	*Manorina flavigula*	yellow-throated miner		C		2
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		3
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		3
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		3
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		2
animals	birds	Meliphagidae	*Ptilotula flavescens*	yellow-tinted honeyeater		C		1
animals	birds	Meliphagidae	*Ptilotula plumula*	grey-fronted honeyeater		C		1
animals	birds	Meliphagidae	*Stomiopera flava*	yellow honeyeater		C		1
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		6
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		5
animals	birds	Monarchidae	*Myiagra inquieta*	restless flycatcher		C		2
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		1
animals	birds	Motacillidae	*Anthus novaeseelandiae*	Australasian pipit		C		2
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		5
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		1
animals	birds	Pachycephalidae	*Colluricincla harmonica*	grey shrike-thrush		C		2
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		5
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		8
animals	birds	Petroicidae	*Melanodryas cucullata*	hooded robin		C		1
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		2
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		1
animals	birds	Podargidae	*Podargus strigoides*	tawny frogmouth		C		2
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		5
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		4
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		5
animals	birds	Psittacidae	*Platycercus adscitus adscitus*	pale-headed rosella (northern form)		C		6
animals	birds	Psittacidae	*Trichoglossus moluccanus*	rainbow lorikeet		C		6
animals	birds	Ptilonorhynchidae	*Chlamydera nuchalis*	great bowerbird		C		4
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		5
animals	birds	Strigidae	*Ninox boobook*	southern boobook		C		3
animals	birds	Tytonidae	*Tyto novaehollandiae*	masked owl		C		1
animals	insects	Nymphalidae	*Euploea corinna*	common crow				2
animals	mammals	Bovidae	*Bos taurus*	European cattle	Y			1
animals	mammals	Emballonuridae	*Taphozous troughtoni*	Troughton's sheathtail bat		C		1
animals	mammals	Equidae	*Equus caballus*	horse	Y			1
animals	mammals	Leporidae	*Oryctolagus cuniculus*	rabbit	Y			2
animals	mammals	Macropodidae	*Macropus giganteus*	eastern grey kangaroo		C		4
animals	mammals	Macropodidae	*Onychogalea unguifera*	northern nailtail wallaby		C		1
animals	mammals	Macropodidae	*Osphranter antilopinus*	antilopine wallaroo		C		4
animals	mammals	Macropodidae	*Osphranter robustus*	common wallaroo		C		2
animals	mammals	Macropodidae	*Wallabia bicolor*	swamp wallaby		C		2
animals	mammals	Petauridae	*Petaurus norfolcensis*	squirrel glider		C		1
animals	mammals	Phalangeridae	*Trichosurus vulpecula*	common brushtail possum		C		4
animals	mammals	Phascolarctidae	*Phascolarctos cinereus*	koala		E	E	3
animals	ray-finned fishes	Eleotridae	*Mogurnda mogurnda*	northern purplespotted gudgeon				1
animals	reptiles	Agamidae	*Diporiphora australis*	tommy roundhead		C		1
animals	reptiles	Agamidae	*Tympanocryptis sp.*			C		1
animals	reptiles	Crocodylidae	*Crocodylus johnstoni*	Australian freshwater crocodile		C		2
animals	reptiles	Diplodactylidae	*Amalosia rhombifer*	zig-zag gecko		C		1
animals	reptiles	Diplodactylidae	*Diplodactylus platyurus*	eastern fat-tailed gecko		C		1
animals	reptiles	Diplodactylidae	*Lucasium steindachneri*	Steindachner's gecko		C		1
animals	reptiles	Diplodactylidae	*Oedura argentea*	silver-eyed velvet gecko		C		5
animals	reptiles	Diplodactylidae	*Oedura castelnaui*	northern velvet gecko		C		2
animals	reptiles	Gekkonidae	*Gehyra dubia*	dubious dtella		C		2
animals	reptiles	Gekkonidae	*Gehyra einasleighensis*	Einasleigh rock dtella		C		1
animals	reptiles	Gekkonidae	*Heteronotia binoei*	Bynoe's gecko		C		14
animals	reptiles	Pygopodidae	*Lialis burtonis*	Burton's legless lizard		C		1
animals	reptiles	Scincidae	*Carlia jarnoldae*	lined rainbow-skink		C		2
animals	reptiles	Scincidae	*Carlia munda*	shaded-litter rainbow-skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus pannosus*	ragged snake-eyed skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus virgatus*	striped snake-eyed skink		C		1
animals	reptiles	Scincidae	*Ctenotus spaldingi*	straight-browed ctenotus		C		1
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		1
animals	reptiles	Varanidae	*Varanus scalaris*	spotted tree monitor		C		1
animals	reptiles	Varanidae	*Varanus storri*	Storr's monitor		C		1
animals	reptiles	Varanidae	*Varanus tristis*	black-tailed monitor		C		2
animals	uncertain	Indeterminate	*Indeterminate*	Unknown or Code Pending				1
plants	land plants	Acanthaceae	*Dicliptera armata*			C		1/1
plants	land plants	Acanthaceae	*Nelsonia campestris*			C		2/2
plants	land plants	Acanthaceae	*Rostellularia adscendens*			C		2/2
plants	land plants	Acanthaceae	*Rostellularia adscendens var. hispida*			C		1/1
plants	land plants	Amaranthaceae	*Achyranthes aspera*			C		1/1
plants	land plants	Amaranthaceae	*Alternanthera denticulata var. denticulata*			C		1/1
plants	land plants	Amaranthaceae	*Alternanthera nana*	hairy joyweed		C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Amaranthaceae	*Amaranthus interruptus*			C		3/3
plants	land plants	Amaranthaceae	*Gomphrena celosioides*	gomphrena weed	Y			1/1
plants	land plants	Amaranthaceae	*Gomphrena flaccida*			C		2/2
plants	land plants	Amaranthaceae	*Gomphrena lanata*			C		1/1
plants	land plants	Amaranthaceae	*Ptilotus fusiformis*			C		1/1
plants	land plants	Amaranthaceae	*Ptilotus psilorhachis*			C		1/1
plants	land plants	Apocynaceae	*Calotropis procera*		Y			1/1
plants	land plants	Apocynaceae	*Cryptostegia grandiflora*	rubber vine	Y			3
plants	land plants	Apocynaceae	*Leichhardtia microlepis*			C		1/1
plants	land plants	Asteraceae	*Acanthospermum hispidum*	star burr	Y			1/1
plants	land plants	Asteraceae	*Blumea saxatilis*			C		1/1
plants	land plants	Asteraceae	*Blumea tenella*			C		1/1
plants	land plants	Asteraceae	*Coronidium lanuginosum*			C		1/1
plants	land plants	Asteraceae	*Emilia sonchifolia var. sonchifolia*		Y			1/1
plants	land plants	Asteraceae	*Peripleura*					1/1
plants	land plants	Asteraceae	*Peripleura bicolor*			C		1/1
plants	land plants	Asteraceae	*Pluchea dentex*	bowl daisy		C		1/1
plants	land plants	Asteraceae	*Pluchea punctata*			E		2/2
plants	land plants	Asteraceae	*Pluchea rubelliflora*			C		1/1
plants	land plants	Asteraceae	*Pterocaulon ciliosum*			C		2/2
plants	land plants	Asteraceae	*Pterocaulon serrulatum var. velutinum*			C		1/1
plants	land plants	Asteraceae	*Pterocaulon verbascifolium*			C		1/1
plants	land plants	Asteraceae	*Sigesbeckia orientalis*	Indian weed		C		1/1
plants	land plants	Asteraceae	*Streptoglossa odora*			C		1/1
plants	land plants	Blechnaceae	*Blechnum cartilagineum*	gristle fern		C		1/1
plants	land plants	Blechnaceae	*Blechnum orientale*			SL		5/4
plants	land plants	Boraginaceae	*Heliotropium brachygyne*			C		2/2
plants	land plants	Boraginaceae	*Heliotropium collinum*			C		1/1
plants	land plants	Boraginaceae	*Heliotropium cunninghamii*			C		1/1
plants	land plants	Boraginaceae	*Heliotropium tabuliplagae*			C		1/1
plants	land plants	Boraginaceae	*Heliotropium tenuifolium*			C		1/1
plants	land plants	Boraginaceae	*Trichodesma zeylanicum*			C		1/1
plants	land plants	Byblidaceae	*Byblis liniflora*			SL		1/1
plants	land plants	Byttneriaceae	*Dicarpidium monoicum*			C		1/1
plants	land plants	Byttneriaceae	*Seringia adenolasia*			C		4/4
plants	land plants	Byttneriaceae	*Waltheria indica*			C		1/1
plants	land plants	Caryophyllaceae	*Polycarpaea corymbosa*			C		1/1
plants	land plants	Caryophyllaceae	*Polycarpaea corymbosa var. corymbosa*			C		1/1
plants	land plants	Caryophyllaceae	*Polycarpaea spirostylis*			C		2/2
plants	land plants	Caryophyllaceae	*Polycarpaea spirostylis subsp. spirostylis*			C		1/1
plants	land plants	Caryophyllaceae	*Polycarpaea tenax*			C		2/2
plants	land plants	Celastraceae	*Siphonodon pendulus*			C		1/1
plants	land plants	Chrysobalanaceae	*Parinari nonda*			C		2/1
plants	land plants	Commelinaceae	*Commelina agrostophylla*			C		1/1
plants	land plants	Convolvulaceae	*Bonamia*					2/2
plants	land plants	Convolvulaceae	*Bonamia media*			C		1/1

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plants	land plants	Convolvulaceae	*Bonamia multiflora*			C		1/1
plants	land plants	Convolvulaceae	*Evolvulus alsinoides var. decumbens*			C		1/1
plants	land plants	Convolvulaceae	*Ipomoea coptica*			C		1/1
plants	land plants	Convolvulaceae	*Ipomoea eriocarpa*			C		1/1
plants	land plants	Convolvulaceae	*Ipomoea funicularis*			C		2/2
plants	land plants	Convolvulaceae	*Ipomoea nil*		Y			1/1
plants	land plants	Convolvulaceae	*Ipomoea plebeia*	bellvine		C		2/2
plants	land plants	Convolvulaceae	*Ipomoea polymorpha*			C		1/1
plants	land plants	Convolvulaceae	*Jacquemontia*					1/1
plants	land plants	Convolvulaceae	*Jacquemontia sp. (Fairview R.W.Johnson 4026)*			C		2/2
plants	land plants	Convolvulaceae	*Polymeria*					1/1
plants	land plants	Convolvulaceae	*Polymeria ambigua*			C		1/1
plants	land plants	Convolvulaceae	*Xenostegia tridentata*			C		1/1
plants	land plants	Cucurbitaceae	*Citrullus colocynthis*	colocynth	Y			1/1
plants	land plants	Cucurbitaceae	*Cucumis althaeoides*			C		1/1
plants	land plants	Cucurbitaceae	*Cucumis anguria var. anguria*	West Indian gherkin	Y			2/2
plants	land plants	Cucurbitaceae	*Cucumis melo*			C		1/1
plants	land plants	Cupressaceae	*Callitris intratropica*	coast cypress pine		C		1/1
plants	land plants	Cyperaceae	*Anthelepis undulata*			C		1/1
plants	land plants	Cyperaceae	*Bulbostylis barbata*			C		1/1
plants	land plants	Cyperaceae	*Cyperus castaneus*			C		1/1
plants	land plants	Cyperaceae	*Cyperus conicus*			C		1/1
plants	land plants	Cyperaceae	*Cyperus decompositus*			C		3/2
plants	land plants	Cyperaceae	*Cyperus difformis*	rice sedge		C		2/1
plants	land plants	Cyperaceae	*Cyperus flaccidus*			C		1/1
plants	land plants	Cyperaceae	*Cyperus haspan*			C		1
plants	land plants	Cyperaceae	*Cyperus haspan subsp. juncoides*			C		2/2
plants	land plants	Cyperaceae	*Cyperus javanicus*			C		1/1
plants	land plants	Cyperaceae	*Cyperus microcephalus subsp. microcephalus*			C		2/2
plants	land plants	Cyperaceae	*Cyperus polystachyos*			C		1
plants	land plants	Cyperaceae	*Eleocharis atropurpurea*			C		1/1
plants	land plants	Cyperaceae	*Eleocharis geniculata*			C		1/1
plants	land plants	Cyperaceae	*Fimbristylis acicularis*			C		1/1
plants	land plants	Cyperaceae	*Fimbristylis depauperata*			C		1/1
plants	land plants	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		2/1
plants	land plants	Cyperaceae	*Fimbristylis microcarya*			C		1/1
plants	land plants	Cyperaceae	*Fimbristylis nutans*			C		3/2
plants	land plants	Cyperaceae	*Fimbristylis pauciflora*			C		3/3
plants	land plants	Cyperaceae	*Fimbristylis sphaerocephala*			C		1/1
plants	land plants	Cyperaceae	*Fuirena ciliaris*			C		2/1
plants	land plants	Cyperaceae	*Fuirena incrassata*			C		1/1
plants	land plants	Cyperaceae	*Fuirena umbellata*			C		2/1
plants	land plants	Cyperaceae	*Machaerina rubiginosa*			C		2/1
plants	land plants	Cyperaceae	*Rhynchospora brownii*	beak rush		C		1/1
plants	land plants	Cyperaceae	*Scleria brownii*			C		2/2
plants	land plants	Cyperaceae	*Scleria rugosa*			C		2/1

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plants	land plants	Dennstaedtiaceae	*Microlepia speluncae*	cave fern		C		1/1
plants	land plants	Dilleniaceae	*Hibbertia lepidota*			C		2/2
plants	land plants	Droseraceae	*Drosera burmanni*			SL		1/1
plants	land plants	Ebenaceae	*Diospyros humilis*	small-leaved ebony		C		1/1
plants	land plants	Eriocaulaceae	*Eriocaulon pygmaeum*			C		1/1
plants	land plants	Erythroxylaceae	*Erythroxylum ellipticum*			C		1
plants	land plants	Euphorbiaceae	*Croton arnhemicus*			C		1/1
plants	land plants	Euphorbiaceae	*Euphorbia hassallii*			C		1/1
plants	land plants	Euphorbiaceae	*Euphorbia hirta*		Y			2/2
plants	land plants	Euphorbiaceae	*Euphorbia mitchelliana var. mitchelliana*			C		3/3
plants	land plants	Euphorbiaceae	*Euphorbia schultzii var. comans*			C		1/1
plants	land plants	Euphorbiaceae	*Euphorbia schultzii var. schultzii*			C		1/1
plants	land plants	Gentianaceae	*Canscora diffusa*			C		2/2
plants	land plants	Gleicheniaceae	*Dicranopteris linearis*			C		1
plants	land plants	Gleicheniaceae	*Dicranopteris linearis var. linearis*			C		3/3
plants	land plants	Goodeniaceae	*Goodenia effusa*			C		3/3
plants	land plants	Goodeniaceae	*Goodenia grandiflora*			C		1/1
plants	land plants	Goodeniaceae	*Goodenia pumilio*			C		1/1
plants	land plants	Goodeniaceae	*Goodenia redacta*			C		3/3
plants	land plants	Haloragaceae	*Gonocarpus acanthocarpus*			C		1/1
plants	land plants	Hemerocallidaceae	*Dianella longifolia*			C		1/1
plants	land plants	Hernandiaceae	*Gyrocarpus americanus*			C		1
plants	land plants	Lamiaceae	*Anisomeles ornans*			C		4/4
plants	land plants	Lamiaceae	*Callicarpa candicans*			C		3/3
plants	land plants	Lamiaceae	*Coleus*					2/2
plants	land plants	Lamiaceae	*Mesosphaerum suaveolens*		Y			2/2
plants	land plants	Lamiaceae	*Ocimum caryophyllinum*			C		2/2
plants	land plants	Lamiaceae	*Pityrodia salviifolia*	pityrodia		C		1/1
plants	land plants	Lamiaceae	*Prostanthera sp. (Gilbert River M.D.Godwin+ C4040)*			C		4/4
plants	land plants	Lamiaceae	*Teucrium argutum*			C		2/2
plants	land plants	Leguminosae	*Abrus precatorius subsp. precatorius*			C		1/1
plants	land plants	Leguminosae	*Acacia*					1/1
plants	land plants	Leguminosae	*Acacia brassii*			C		1/1
plants	land plants	Leguminosae	*Acacia chisholmii*			C		2/2
plants	land plants	Leguminosae	*Acacia drepanocarpa subsp. drepanocarpa*			C		4/4
plants	land plants	Leguminosae	*Acacia gonoclada*			C		2/2
plants	land plants	Leguminosae	*Acacia hemsleyi*			C		4/4
plants	land plants	Leguminosae	*Acacia holosericea*			C		8/8
plants	land plants	Leguminosae	*Acacia julifera subsp. curvinervia*			C		1/1
plants	land plants	Leguminosae	*Acacia julifera subsp. gilbertensis*			C		1/1
plants	land plants	Leguminosae	*Acacia julifera subsp. julifera*			C		2/2
plants	land plants	Leguminosae	*Acacia leptostachya*	Townsville wattle		C		4/4
plants	land plants	Leguminosae	*Acacia multisiliqua*			C		2/2
plants	land plants	Leguminosae	*Acacia neurocarpa*			C		1/1
plants	land plants	Leguminosae	*Acacia orthocarpa*			C		6/6
plants	land plants	Leguminosae	*Acacia platycarpa*			C		1/1

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plants	land plants	Leguminosae	*Acacia shirleyi*	lancewood		C		2/1
plants	land plants	Leguminosae	*Acacia simsii*			C		2/1
plants	land plants	Leguminosae	*Acacia torulosa*			C		1/1
plants	land plants	Leguminosae	*Adenanthera abrosperma*			C		1/1
plants	land plants	Leguminosae	*Aeschynomene americana var. glandulosa*		Y			1/1
plants	land plants	Leguminosae	*Aeschynomene villosa*		Y			1/1
plants	land plants	Leguminosae	*Aphyllodium biarticulatum*			C		1/1
plants	land plants	Leguminosae	*Bossiaea armitii*			C		1/1
plants	land plants	Leguminosae	*Cajanus acutifolius*			C		7/7
plants	land plants	Leguminosae	*Cajanus scarabaeoides var. scarabaeoides*			C		1/1
plants	land plants	Leguminosae	*Chamaecrista absus*			C		1/1
plants	land plants	Leguminosae	*Chamaecrista longipes*			C		1/1
plants	land plants	Leguminosae	*Crotalaria aridicola subsp. aridicola*			C		3/3
plants	land plants	Leguminosae	*Crotalaria juncea*	sunhemp	Y			2/2
plants	land plants	Leguminosae	*Crotalaria medicaginea*	trefoil rattlepod		C		2/2
plants	land plants	Leguminosae	*Crotalaria medicaginea var. medicaginea*			C		1/1
plants	land plants	Leguminosae	*Crotalaria novae-hollandiae subsp. novae-hollandiae*			C		2/2
plants	land plants	Leguminosae	*Desmodium brachypodum*	large ticktrefoil		C		1/1
plants	land plants	Leguminosae	*Desmodium filiforme*			C		1/1
plants	land plants	Leguminosae	*Desmodium hannii*			C		1/1
plants	land plants	Leguminosae	*Desmodium pycnotrichum*			C		1/1
plants	land plants	Leguminosae	*Galactia sp. (Myall Creek J.R.Clarkson 4885)*			C		2/2
plants	land plants	Leguminosae	*Galactia tenuiflora var. lucida*			C		1/1
plants	land plants	Leguminosae	*Glycine*					2/2
plants	land plants	Leguminosae	*Hovea parvicalyx*			C		3/3
plants	land plants	Leguminosae	*Indigofera brevidens*			C		1/1
plants	land plants	Leguminosae	*Indigofera colutea*	sticky indigo		C		3/3
plants	land plants	Leguminosae	*Indigofera hirsuta*	hairy indigo		C		2/2
plants	land plants	Leguminosae	*Indigofera linifolia*			C		1/1
plants	land plants	Leguminosae	*Indigofera linnaei*	Birdsville indigo		C		1/1
plants	land plants	Leguminosae	*Indigofera queenslandica*			C		1/1
plants	land plants	Leguminosae	*Indigofera sericovexilla*			C		2/2
plants	land plants	Leguminosae	*Jacksonia ramosissima*			C		2/2
plants	land plants	Leguminosae	*Labichea brassii*			NT		7/7
plants	land plants	Leguminosae	*Leptosema oxylobioides*			C		1/1
plants	land plants	Leguminosae	*Macrotyloma axillare var. axillare*		Y			1/1
plants	land plants	Leguminosae	*Macrotyloma uniflorum var. stenocarpum*		Y			1/1
plants	land plants	Leguminosae	*Neptunia dimorphantha*			C		1/1
plants	land plants	Leguminosae	*Rhynchosia minima var. australis*			C		1/1
plants	land plants	Leguminosae	*Senna leptoclada*			C		1/1
plants	land plants	Leguminosae	*Senna occidentalis*	coffee senna	Y			1/1
plants	land plants	Leguminosae	*Sesbania campylocarpa*			C		1/1
plants	land plants	Leguminosae	*Stylosanthes hamata*		Y			1/1
plants	land plants	Leguminosae	*Stylosanthes scabra*		Y			1/1
plants	land plants	Leguminosae	*Tephrosia astragaloides*			C		2/2
plants	land plants	Leguminosae	*Tephrosia barbatala*			C		1/1

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plants	land plants	Leguminosae	*Tephrosia conspicua*			C		2/2
plants	land plants	Leguminosae	*Tephrosia delestangii*			C		2/2
plants	land plants	Leguminosae	*Tephrosia filipes forma vestita*			C		1/1
plants	land plants	Leguminosae	*Tephrosia filipes subsp. filipes*			C		2/2
plants	land plants	Leguminosae	*Tephrosia filipes var. (Mt Blackjack A.R.Bean+ 7332)*			C		2/2
plants	land plants	Leguminosae	*Tephrosia juncea*			C		3/3
plants	land plants	Leguminosae	*Tephrosia leptoclada*			C		2/2
plants	land plants	Leguminosae	*Tephrosia macrostachya*			C		1/1
plants	land plants	Leguminosae	*Tephrosia sp. (Cobbold Gorge B.S.Wannan 1167)*			C		6/6
plants	land plants	Leguminosae	*Tephrosia sp. (Pannikan Springs A.R.Bean+ 5612)*			C		2/2
plants	land plants	Leguminosae	*Tephrosia sp. (Settlement Creek L.J.Brass 272)*			C		1/1
plants	land plants	Leguminosae	*Uraria lagopodioides*			C		1/1
plants	land plants	Leguminosae	*Vachellia clarksoniana*			C		1/1
plants	land plants	Leguminosae	*Vachellia ditricha*			C		1/1
plants	land plants	Leguminosae	*Vachellia farnesiana*		Y			1/1
plants	land plants	Leguminosae	*Vigna lanceolata var. filiformis*			C		1/1
plants	land plants	Leguminosae	*Vigna radiata var. sublobata*			C		1/1
plants	land plants	Leguminosae	*Vigna sp. (Station Creek R.J.Lawn CQ3284)*			C		2/2
plants	land plants	Leguminosae	*Zornia areolata*			C		2/2
plants	land plants	Leguminosae	*Zornia muriculata subsp. angustata*			C		2/2
plants	land plants	Leguminosae	*Zornia prostrata var. prostrata*			C		1/1
plants	land plants	Leguminosae	*Zornia stirlingii*			C		3/3
plants	land plants	Lentibulariaceae	*Utricularia gibba*	floating bladderwort		SL		1/1
plants	land plants	Linderniaceae	*Lindernia aplectra*			C		1/1
plants	land plants	Linderniaceae	*Torenia crustacea*			C		1/1
plants	land plants	Lindsaeaceae	*Lindsaea brachypoda*			C		1/1
plants	land plants	Lindsaeaceae	*Lindsaea ensifolia*			C		1
plants	land plants	Lindsaeaceae	*Lindsaea ensifolia subsp. agatii*			C		2/2
plants	land plants	Lindsaeaceae	*Lindsaea ensifolia subsp. ensifolia*			C		2/2
plants	land plants	Loganiaceae	*Mitrasacme nidulifera*			C		1/1
plants	land plants	Loranthaceae	*Dendrophthoe glabrescens*			C		1/1
plants	land plants	Loranthaceae	*Lysiana spathulata subsp. spathulata*			C		1/1
plants	land plants	Lycopodiaceae	*Palhinhaea cernua*			C		2/2
plants	land plants	Lygodiaceae	*Lygodium microphyllum*	snake fern		C		1/1
plants	land plants	Lythraceae	*Ammannia baccifera*			C		1/1
plants	land plants	Lythraceae	*Rotala occultiflora*			C		1/1
plants	land plants	Malvaceae	*Abelmoschus ficulneus*	native rosella		C		1/1
plants	land plants	Malvaceae	*Abutilon hannii*			C		5/5
plants	land plants	Malvaceae	*Gossypium nelsonii*			C		5/5
plants	land plants	Malvaceae	*Gossypium sturtianum*			C		1/1
plants	land plants	Malvaceae	*Hibiscus*					1/1
plants	land plants	Malvaceae	*Hibiscus meraukensis*	Merauke hibiscus		C		1/1
plants	land plants	Malvaceae	*Hibiscus setulosus*			C		3/3
plants	land plants	Malvaceae	*Sida*					1/1
plants	land plants	Malvaceae	*Sida cordifolia*		Y			1/1

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plants	land plants	Malvaceae	*Sida corrugata*			C		1/1
plants	land plants	Malvaceae	*Sida hackettiana*			C		1/1
plants	land plants	Malvaceae	*Sida macropoda*			C		4/4
plants	land plants	Malvaceae	*Sida pleiantha*			C		1/1
plants	land plants	Malvaceae	*Sida rohlenae subsp. rohlenae*			C		1/1
plants	land plants	Malvaceae	*Sida sp. (Musselbrook M.B.Thomas+ MRS437)*			C		1/1
plants	land plants	Malvaceae	*Sida spinosa*	spiny sida	Y			1/1
plants	land plants	Melastomataceae	*Melastoma malabathricum subsp. malabathricum*			C		6/5
plants	land plants	Menyanthaceae	*Nymphoides indica*	water snowflake		SL		1/1
plants	land plants	Moraceae	*Ficus opposita*			C		1/1
plants	land plants	Myrtaceae	*Calytrix leptophylla*			C		4/4
plants	land plants	Myrtaceae	*Corymbia erythrophloia*	variable-barked bloodwood		C		1/1
plants	land plants	Myrtaceae	*Corymbia gilbertensis*	Gilbert River ghost gum		C		3/3
plants	land plants	Myrtaceae	*Corymbia pocillum*			C		2/2
plants	land plants	Myrtaceae	*Corymbia serendipita*			C		1/1
plants	land plants	Myrtaceae	*Corymbia terminalis*			C		1/1
plants	land plants	Myrtaceae	*Corymbia tessellaris*	Moreton Bay ash		C		1/1
plants	land plants	Myrtaceae	*Eucalyptus ammophila*	sandplain red gum		C		2/2
plants	land plants	Myrtaceae	*Eucalyptus brassiana*	Cape York red gum		C		1/1
plants	land plants	Myrtaceae	*Eucalyptus camaldulensis*			C		2
plants	land plants	Myrtaceae	*Eucalyptus camaldulensis subsp. obtusa*			C		1/1
plants	land plants	Myrtaceae	*Eucalyptus chartaboma*			C		2/1
plants	land plants	Myrtaceae	*Eucalyptus exserta*	Queensland peppermint		C		1/1
plants	land plants	Myrtaceae	*Eucalyptus leptophleba*	Molloy red box		C		1/1
plants	land plants	Myrtaceae	*Eucalyptus microneura*	Gilbert River box		C		2/2
plants	land plants	Myrtaceae	*Eucalyptus provecta*			C		3/3
plants	land plants	Myrtaceae	*Eucalyptus shirleyi*			C		1/1
plants	land plants	Myrtaceae	*Eucalyptus whitei*	White's ironbark		C		3/3
plants	land plants	Myrtaceae	*Leptospermum pallidum*			NT		3/3
plants	land plants	Myrtaceae	*Lithomyrtus hypoleuca*			C		2/2
plants	land plants	Myrtaceae	*Lithomyrtus retusa*			C		3/3
plants	land plants	Myrtaceae	*Lophostemon grandiflorus subsp. riparius*			C		3/3
plants	land plants	Myrtaceae	*Lophostemon suaveolens*	swamp box		C		1/1
plants	land plants	Myrtaceae	*Melaleuca bracteata*			C		1/1
plants	land plants	Myrtaceae	*Melaleuca citrolens*			C		2/2
plants	land plants	Myrtaceae	*Melaleuca fluviatilis*			C		2/2
plants	land plants	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree		C		1
plants	land plants	Myrtaceae	*Melaleuca viridiflora var. viridiflora*			C		1/1
plants	land plants	Myrtaceae	*Xanthostemon umbrosus*			C		3/3
plants	land plants	Nyctaginaceae	*Boerhavia dominii*			C		1/1
plants	land plants	Nyctaginaceae	*Boerhavia pubescens*			C		1/1
plants	land plants	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		2/1
plants	land plants	Orchidaceae	*Arthrochilus*					1/1
plants	land plants	Orchidaceae	*Cymbidium canaliculatum*			SL		3/3
plants	land plants	Orchidaceae	*Geodorum densiflorum*	pink nodding orchid		SL		1/1
plants	land plants	Orobanchaceae	*Striga curviflora*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Papaveraceae	*Argemone ochroleuca subsp. ochroleuca*	Mexican poppy	Y			1/1
plants	land plants	Pentapetaceae	*Melhania brachycarpa*			C		4/4
plants	land plants	Pentapetaceae	*Melhania oblongifolia*			C		1/1
plants	land plants	Philydraceae	*Philydrum lanuginosum*	frogsmouth		C		1/1
plants	land plants	Phyllanthaceae	*Flueggea virosa subsp. melanthesoides*			C		1/1
plants	land plants	Phyllanthaceae	*Phyllanthus amarus*		Y			1/1
plants	land plants	Phyllanthaceae	*Phyllanthus hebecarpus*			C		5/5
plants	land plants	Phyllanthaceae	*Phyllanthus maderaspatensis*			C		5/5
plants	land plants	Phyllanthaceae	*Phyllanthus minutiflorus*			C		1/1
plants	land plants	Phyllanthaceae	*Phyllanthus trachygyne*			C		1/1
plants	land plants	Phyllanthaceae	*Phyllanthus virgatus*			C		1/1
plants	land plants	Phyllanthaceae	*Synostemon elachophyllus subsp. elachophyllus*			C		4/4
plants	land plants	Plantaginaceae	*Bacopa floribunda*			C		1/1
plants	land plants	Plantaginaceae	*Scoparia dulcis*	scoparia	Y			1/1
plants	land plants	Plantaginaceae	*Stemodia lythrifolia*			C		3/3
plants	land plants	Plumbaginaceae	*Plumbago zeylanica*	native plumbago		C		1/1
plants	land plants	Poaceae	*Alloteropsis cimicina*			C		2/2
plants	land plants	Poaceae	*Alloteropsis semialata*	cockatoo grass		C		1/1
plants	land plants	Poaceae	*Aristida acuta*			C		1/1
plants	land plants	Poaceae	*Aristida calycina var. calycina*			C		1/1
plants	land plants	Poaceae	*Aristida exserta*			C		1/1
plants	land plants	Poaceae	*Aristida hygrometrica*			C		1/1
plants	land plants	Poaceae	*Aristida ingrata*			C		1/1
plants	land plants	Poaceae	*Aristida jerichoensis var. subspinulifera*			C		1/1
plants	land plants	Poaceae	*Aristida pruinosa*			C		1/1
plants	land plants	Poaceae	*Aristida warburgii*			C		3/3
plants	land plants	Poaceae	*Arthragrostis aristispicula*			C		1/1
plants	land plants	Poaceae	*Arundinella nepalensis*	reedgrass		C		2/1
plants	land plants	Poaceae	*Arundinella setosa*			C		1/1
plants	land plants	Poaceae	*Bothriochloa bladhii subsp. bladhii*			C		1/1
plants	land plants	Poaceae	*Bothriochloa decipiens var. cloncurrensis*			C		1/1
plants	land plants	Poaceae	*Bothriochloa pertusa*		Y			3/3
plants	land plants	Poaceae	*Brachyachne convergens*	common native couch		C		1/1
plants	land plants	Poaceae	*Chloris lobata*			C		1/1
plants	land plants	Poaceae	*Chloris pumilio*			C		1/1
plants	land plants	Poaceae	*Chrysopogon fallax*			C		2/2
plants	land plants	Poaceae	*Chrysopogon pallidus*			C		1/1
plants	land plants	Poaceae	*Cleistochloa subjuncea*			C		1/1
plants	land plants	Poaceae	*Cymbopogon ambiguus*	lemon grass		C		1/1
plants	land plants	Poaceae	*Cymbopogon procerus*			C		1/1
plants	land plants	Poaceae	*Digitaria bicornis*			C		1/1
plants	land plants	Poaceae	*Digitaria breviglumis*			C		1/1
plants	land plants	Poaceae	*Digitaria brownii*			C		1/1
plants	land plants	Poaceae	*Digitaria ciliaris*	summer grass	Y			1/1
plants	land plants	Poaceae	*Digitaria diminuta*			C		1/1
plants	land plants	Poaceae	*Digitaria minima*			C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Poaceae	*Digitaria papposa*			C		1/1
plants	land plants	Poaceae	*Echinochloa colona*	awnless barnyard grass	Y			1/1
plants	land plants	Poaceae	*Enneapogon lindleyanus*			C		2/2
plants	land plants	Poaceae	*Enneapogon polyphyllus*	leafy nineawn		C		6/6
plants	land plants	Poaceae	*Enteropogon unispiceus*			C		1/1
plants	land plants	Poaceae	*Eragrostis cilianensis*		Y			2/2
plants	land plants	Poaceae	*Eragrostis cumingii*			C		1/1
plants	land plants	Poaceae	*Eragrostis schultzii*			C		2/2
plants	land plants	Poaceae	*Eragrostis spartinoides*			C		1/1
plants	land plants	Poaceae	*Eragrostis speciosa*			C		1/1
plants	land plants	Poaceae	*Eragrostis tenellula*	delicate lovegrass		C		4/4
plants	land plants	Poaceae	*Eriachne obtusa*			C		1/1
plants	land plants	Poaceae	*Eriachne pallescens var. pallescens*			C		1/1
plants	land plants	Poaceae	*Eriachne sp. (Dugald River B.K.Simon+ 3007)*			C		1/1
plants	land plants	Poaceae	*Eriachne squarrosa*			C		1/1
plants	land plants	Poaceae	*Eriachne triseta*			C		1/1
plants	land plants	Poaceae	*Heteropogon contortus*	black speargrass		C		1/1
plants	land plants	Poaceae	*Heteropogon triticeus*	giant speargrass		C		1/1
plants	land plants	Poaceae	*Melinis repens*	red natal grass	Y			2/2
plants	land plants	Poaceae	*Mnesithea rottboellioides*			C		1/1
plants	land plants	Poaceae	*Oxychloris scariosa*	winged chloris		C		2/2
plants	land plants	Poaceae	*Panicum effusum*			C		1/1
plants	land plants	Poaceae	*Panicum robustum*			C		2/2
plants	land plants	Poaceae	*Panicum trichoides*			C		3/3
plants	land plants	Poaceae	*Paspalidium gracile*	slender panic		C		1/1
plants	land plants	Poaceae	*Paspalidium rarum*			C		1/1
plants	land plants	Poaceae	*Perotis rara*	comet grass		C		1/1
plants	land plants	Poaceae	*Sarga plumosum*			C		1/1
plants	land plants	Poaceae	*Schizachyrium fragile*	firegrass		C		2/2
plants	land plants	Poaceae	*Setaria surgens*			C		2/2
plants	land plants	Poaceae	*Sporobolus australasicus*			C		1/1
plants	land plants	Poaceae	*Sporobolus caroli*	fairy grass		C		1/1
plants	land plants	Poaceae	*Thaumastochloa pubescens*			C		3/3
plants	land plants	Poaceae	*Themeda quadrivalvis*	grader grass	Y			1/1
plants	land plants	Poaceae	*Themeda triandra*	kangaroo grass		C		1/1
plants	land plants	Poaceae	*Triodia*					1/1
plants	land plants	Poaceae	*Triodia molesta*			C		2/2
plants	land plants	Poaceae	*Urochloa holosericea subsp. holosericea*			C		3/3
plants	land plants	Poaceae	*Urochloa holosericea subsp. velutina*			C		3/3
plants	land plants	Poaceae	*Urochloa mosambicensis*	sabi grass	Y			2/2
plants	land plants	Poaceae	*Urochloa pubigera*			C		1/1
plants	land plants	Poaceae	*Urochloa subquadripara*		Y			1/1
plants	land plants	Poaceae	*Urochloa whiteana*			C		1/1
plants	land plants	Poaceae	*Yakirra pauciflora*			C		1/1
plants	land plants	Polygalaceae	*Comesperma pallidum*			C		1/1
plants	land plants	Polygalaceae	*Polygala pterocarpa*			C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Portulacaceae	*Calandrinia arenicola*			C		1/1
plants	land plants	Portulacaceae	*Calandrinia uniflora*			C		1/1
plants	land plants	Portulacaceae	*Portulaca australis*			C		1/1
plants	land plants	Portulacaceae	*Portulaca bicolor*			C		1/1
plants	land plants	Portulacaceae	*Portulaca digyna*			C		1/1
plants	land plants	Proteaceae	*Grevillea decora subsp. decora*			C		4/4
plants	land plants	Proteaceae	*Hakea arborescens*			C		1/1
plants	land plants	Proteaceae	*Persoonia falcata*			C		1/1
plants	land plants	Proteaceae	*Xylomelum scottianum*			C		1/1
plants	land plants	Pteridaceae	*Cheilanthes caudata*			C		3/3
plants	land plants	Pteridaceae	*Cheilanthes nitida*			C		1/1
plants	land plants	Pteridaceae	*Cheilanthes pumilio*			C		2/2
plants	land plants	Pteridaceae	*Pteris platyzomopsis*			SL		1/1
plants	land plants	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		2/2
plants	land plants	Rhamnaceae	*Ziziphus mauritiana*	Indian jujube	Y			1/1
plants	land plants	Rubiaceae	*Gardenia tessellaris*			C		1/1
plants	land plants	Rubiaceae	*Gardenia vilhelmii*			C		1/1
plants	land plants	Rubiaceae	*Paranotis mitrasacmoides subsp. nigricans*			C		1/1
plants	land plants	Rubiaceae	*Pavetta granitica*			C		1/1
plants	land plants	Rubiaceae	*Psydrax*					1/1
plants	land plants	Rubiaceae	*Scleromitrion galioides*			C		1/1
plants	land plants	Rubiaceae	*Spermacoce baileyana*			C		1/1
plants	land plants	Rubiaceae	*Spermacoce brachystema*			C		1/1
plants	land plants	Rutaceae	*Boronia bowmanii*			C		9/9
plants	land plants	Rutaceae	*Cyanothamnus occidentalis*			C		1/1
plants	land plants	Rutaceae	*Drummondita calida*			V		3/3
plants	land plants	Rutaceae	*Zieria tenuis*			C		2/2
plants	land plants	Sapindaceae	*Atalaya hemiglauca*			C		1/1
plants	land plants	Sapindaceae	*Dodonaea*					5/5
plants	land plants	Sapindaceae	*Dodonaea filifolia*			C		3/3
plants	land plants	Sapindaceae	*Dodonaea hispidula var. hispidula*			C		1/1
plants	land plants	Sapindaceae	*Dodonaea stenophylla*			C		1/1
plants	land plants	Scrophulariaceae	*Eremophila longifolia*	berrigan		C		1/1
plants	land plants	Solanaceae	*Datura ferox*	fierce thornapple	Y			1/1
plants	land plants	Solanaceae	*Solanum capitaneum*			C		3/3
plants	land plants	Solanaceae	*Solanum carduiforme*			V		4/4
plants	land plants	Solanaceae	*Solanum crebrispinum*			C		2/2
plants	land plants	Sparrmanniaceae	*Corchorus aestuans*			C		1/1
plants	land plants	Sparrmanniaceae	*Corchorus sericeus subsp. densiflorus*			C		2/2
plants	land plants	Sparrmanniaceae	*Grewia savannicola*			C		1/1
plants	land plants	Sparrmanniaceae	*Triumfetta*					1/1
plants	land plants	Sparrmanniaceae	*Triumfetta pentandra*		Y			1/1
plants	land plants	Sparrmanniaceae	*Triumfetta rhomboidea*	chinese burr	Y			2/2
plants	land plants	Stylidiaceae	*Stylidium adenophorum*			SL		1/1
plants	land plants	Stylidiaceae	*Stylidium tenerum*			SL		3/3
plants	land plants	Ulmaceae	*Trema tomentosa*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	land plants	Ulmaceae	*Trema tomentosa var. tomentosa*			C		1/1
plants	land plants	Violaceae	*Pigea enneasperma*			C		1/1
plants	land plants	Xyridaceae	*Xyris complanata*	yellow-eye		C		3/2
plants	land plants	Zygophyllaceae	*Tribulopis pentandra*			C		1/1
plants	land plants	Zygophyllaceae	*Tribulopis solandri*			C		2/2

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.*
The codes are Extinct (EX), Extinct in the Wild (PE), Critically Endangered (CR), Endangered (E), Vulnerable (V), Near Threatened (NT), Special Least Concern (SL) and Least Concern (C).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.*
The values of EPBC are Extinct (EX), Extinct in the Wild (XW), Critically Endangered (CE), Endangered (E), Vulnerable (V) and Conservation Dependent (CD).

Records - The first number indicates the total number of records of the taxon (wildlife records and species listings for selected areas).
This number is output as 99999 if it equals or exceeds this value. A second number located after a / indicates the number of specimen records for the taxon.
This number is output as 999 if it equals or exceeds this value.

Department of Environment and Science

Environmental Reports

Biodiversity and Conservation Values

Biodiversity Planning Assessments and Aquatic Conservation Assessments

For the selected area of interest
Longitude: 143.5492 Latitude: -18.9961 with 2 kilometre radius

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or Area of Interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "Central co-ordinates" option, the resulting assessment area encompasses an area extending from 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: biodiversity.planning@des.qld.gov.au

Disclaimer

Whilst every care is taken to ensure the accuracy of the information provided in this report, the Queensland Government makes no representations or warranties about its accuracy, reliability, completeness, or suitability, for any particular purpose and disclaims all responsibility and all liability (including without limitation, liability in negligence) for all expenses, losses, damages (including indirect or consequential damage) and costs which the user may incur as a consequence of the information being inaccurate or incomplete in any way and for any reason.

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Summary Information

Tables 1 to 8 provide an overview of the AOI with respect to selected topographic and environmental values.

Table 1: Area of interest details: Longitude: 143.5492 Latitude: -18.9961

Size (ha)	1,256.55
Local Government(s)	Etheridge Shire
Bioregion(s)	Gulf Plains, Einasleigh Uplands
Subregion(s)	Gilberton Plateau, Kidston
Catchment(s)	Gilbert

The following table identifies available Biodiversity Planning Assessments (BPAs) and Aquatic Conservation Assessments (ACAs) with respect to the AOI.

Table 2: Available Biodiversity Planning and Aquatic Conservation Assessments

Assessment Type	Assessment Area and Version
Biodiversity Planning Assessment(s)	Gulf Plains v1.1, Einasleigh Uplands v1.1
Aquatic Conservation Assessment(s) (riverine)	Eastern Gulf of Carpentaria v1.1
Aquatic Conservation Assessment(s) (non-riverine)	Eastern Gulf of Carpentaria v1.1

Table 3: Remnant regional ecosystems within the AOI as per the Qld Herbarium's 'biodiversity status'

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	48.76	3.88
No concern at present	1,207.79	96.12

The following table identifies the extent and proportion of the user specified area of interest (AOI) which is mapped as being of "State", "Regional" or "Local" significance via application of the Queensland Department of Environment and Science's *Biodiversity Assessment and Mapping Methodology* (BAMM).

Table 4: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	0.0	0.0
State	818.42	65.13
Regional	0.69	0.05
Local or Other Values	366.76	29.19

Table 5: Non-riverine wetlands intersecting the AOI

Non-riverine wetland types intersecting the area of interest	#
(No Records)	

NB. The figures presented in the table above are derived from the relevant non-riverine Aquatic Conservation Assessment(s). Later releases of wetland mapping produced via the Queensland Wetland Mapping Program may provide more recent information in regards to wetland extent.

Table 6: Named waterways intersecting the AOI

Name	Permanency
AGATE CREEK	Non-perennial

Refer to **Map 1** for general locality information.

The following two tables identify the extent and proportion of the user specified AOI which is mapped as being of "Very High", "High", "Medium", "Low", or "Very Low" aquatic conservation value for riverine and non-riverine wetlands via application of the Queensland Department of Environment and Science's *Aquatic Biodiversity Assessment and Mapping Method* (AquaBAMM).

Table 7: Summary table, aquatic conservation significance (riverine)

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0
High	1,256.55	100.0
Medium	0.0	0.0
Low	0.0	0.0
Very Low	0.0	0.0

Table 8: Summary table, aquatic conservation significance (non-riverine)

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
(No Records)		

Biodiversity Planning Assessments

Introduction

The Department of Environment and Science (DES) attributes biodiversity significance on a bioregional scale through a Biodiversity Planning Assessment (BPA). A BPA involves the integration of ecological criteria using the *Biodiversity assessment and Mapping Methodology* (BAMM) and is developed in two stages: 1) **diagnostic criteria**, and 2) **expert panel criteria**. The diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion, while the expert panel criteria allows for the refinement of the mapped information from the diagnostic output by incorporating local knowledge and expert opinion.

The BAMM methodology has application for identifying areas with various levels of significance solely for biodiversity reasons. These include threatened ecosystems or taxa, large tracts of habitat in good condition, ecosystem diversity, landscape context and connection, and buffers to wetlands or other types of habitat important for the maintenance of biodiversity or ecological processes. While natural resource values such as dryland salinity, soil erosion potential or land capability are not dealt with explicitly, they are included to some extent within the biodiversity status of regional ecosystems recognised by the DES.

Biodiversity Planning Assessments (BPAs) assign three levels of overall biodiversity significance.

- **State significance** - areas assessed as being significant for biodiversity at the bioregional or state scales. They also include areas assessed by other studies/processes as being significant at national or international scales. In addition, areas flagged as being of State significance due to the presence of endangered, vulnerable and/or near threatened taxa, are identified as "State Habitat for EVNT taxa".
- **Regional significance** - areas assessed as being significant for biodiversity at the subregional scale. These areas have lower significance for biodiversity than areas assessed as being of State significance.
- **Local significance and/or other values** - areas assessed as not being significant for biodiversity at state or regional scales. Local values are of significance at the local government scale.

For further information on released BPAs and a copy of the underlying methodology, go to:

http://www.qld.gov.au/environment/plants-animals/biodiversity/planning/

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

http://qspatial.information.qld.gov.au/geoportal/

The following table identifies the extent and proportion of the user specified AOI which is mapped as being of "State", "Regional" or "Local" significance via application of the BAMM.

Table 9: Summary table, biodiversity significance

Biodiversity significance	Area (Ha)	% of AOI
State Habitat for EVNT taxa	0.0	0.0
State	818.42	65.13
Regional	0.69	0.05
Local or Other Values	366.76	29.19

Refer to **Map 2** for further information.

Diagnostic Criteria

Diagnostic criteria are based on existing data which is reliable and uniformly available across a bioregion. These criteria are diagnostic in that they are used to filter the available data and provide a "first-cut" or initial determination of biodiversity significance. This initial assessment is then combined through a second group of other essential criteria.

A description of the individual diagnostic criteria is provided in the following sections.

Criteria A. Habitat for EVNT taxa: Classifies areas according to their significance based on the presence of endangered, vulnerable and/or rare (EVNT) taxa. EVNT taxa are those scheduled under the *Nature Conservation Act 1992* and/or the

Environment Protection and Biodiversity Conservation Act 1999. It excludes highly mobile fauna taxa which are instead considered in Criterion H and brings together information on EVNT taxa using buffering of recorded sites or habitat suitability models (HSM) where available.

Criteria B. Ecosystem value: Classifies on the basis of biodiversity status of regional ecosystems, their extent in protected areas (presence of poorly conserved regional ecosystems), the presence of significant wetlands; and areas of national importance such as the presence of Threatened Ecological Communities, World Heritage areas and Ramsar sites. Ecosystem value is applied at a bioregional (**B1**) and regional (**B2**) scale.

Criteria C. Tract size: Measures the relative size of tracts of vegetation in the landscape. The size of any tract is a major indicator of ecological significance, and is also strongly correlated with the long-term viability of biodiversity values. Larger tracts are less susceptible to ecological edge effects and are more likely to sustain viable populations of native flora and fauna than smaller tracts.

Criteria D. Relative size of regional ecosystems: Classifies the relative size of each regional ecosystem unit within its bioregion (**D1**) and its subregion (**D2**). Remnant units are compared with all other occurrences with the same regional ecosystem. Large examples of a regional ecosystem are more significant than smaller examples of the same regional ecosystem because they are more representative of the biodiversity values particular to the regional ecosystem, are more resilient to the effects of disturbance, and constitute a significant proportion of the total area of the regional ecosystem.

Criteria F. Ecosystem diversity: Is an indicator of the number of regional ecosystems occurring within an area. An area with high ecosystem diversity will have many regional ecosystems and ecotones relative to other areas within the bioregion.

Criteria G. Context and connection: Represents the extent to which a remnant unit incorporates, borders or buffers areas such as significant wetlands, endangered ecosystems; and the degree to which it is connected to other vegetation.

A summary of the biodiversity status based upon the diagnostic criteria is provided in the following table.

Table 10: Summary of biodiversity significance based upon diagnostic criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains an RE that is one of the largest of its type in the bioregion (D1) & Remnant has high connectivity or buffers an endangered RE or Sig. Wetland (G)	756.43	60.2
Local or Other Values	Refer to diagnostic data for additional information	429.44	34.18

Assessment of diagnostic criteria with respect to the AOI

The following table reflects an assessment of the individual diagnostic criteria noted above in regards to the AOI.

Table 11: Assessment of individual diagnostic criteria with respect to the AOI

Diagnostic Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
A: Habitat for EVNT Taxa							1,185.86	94.4
B1: Ecosystem Value (Bioregion)					1,185.86	94.4		
B2: Ecosystem Value (Subregion)					1,185.86	94.4		
C: Tract Size			1,185.86	94.4				
D1: Relative RE Size (Bioregion)	756.43	60.2					429.43	34.2
D2: Relative RE Size (Subregion)	756.43	60.2			0.41		429.02	34.1
F: Ecosystem Diversity	34.13	2.7	1,151.73	91.7				
G: Context and Connection	1,185.86	94.4						

Other Essential Criteria

Other essential criteria (also known as expert panel criteria) are based on non-uniform information sources and which may rely more upon expert opinion than on quantitative data. These criteria are used to provide a "second-cut" determination of biodiversity significance, which is then combined with the diagnostic criteria for an overall assessment of relative biodiversity significance. A summary of the biodiversity status based upon the other essential criteria is provided in the following table.

Table 12: Summary of biodiversity significance based upon other essential criteria with respect to the AOI

Biodiversity significance	Description	Area (Ha)	% of AOI
State	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	379.3	30.19
Regional	Refer to Expert Panel data for additional information	0.69	0.05

Biodiversity significance	Description	Area (Ha)	% of AOI
Regional	Remnant contains Special Biodiversity Values (view Expert Panel data for further information) (I)	54.04	4.3

A description of each of the other essential criteria and associated assessment in regards to the AOI is provided in the following sections.

Criteria H. Essential and general habitat for priority taxa: Priority taxa are those which are at risk or of management concern, taxa of scientific interest as relictual (ancient or primitive), endemic taxa or locally significant populations (such as a flying fox camp or heronry), highly specialised taxa whose habitat requirements are complex and distributions are not well correlated with any particular regional ecosystem, taxa important for maintaining genetic diversity (such as complex spatial patterns of genetic variation, geographic range limits, highly disjunct populations), taxa critical for management or monitoring of biodiversity (functionally important or ecological indicators), or economic and culturally important taxa.

Criteria I. Special biodiversity values: areas with special biodiversity values are important because they contain multiple taxa in a unique ecological and often highly biodiverse environment. Areas with special biodiversity values can include the following:

- Ia - centres of endemism - areas where concentrations of taxa are endemic to a bioregion or subregion are found.
- Ib - wildlife refugia (Morton *et al*. 1995), for example, islands, mound springs, caves, wetlands, gorges, mountain ranges and topographic isolates, ecological refuges, refuges from exotic animals, and refuges from clearing. The latter may include large areas that are not suitable for clearing because of land suitability/capability.
- Ic - areas with concentrations of disjunct populations.
- Id - areas with concentrations of taxa at the limits of their geographic ranges.
- Ie - areas with high species richness.
- If - areas with concentrations of relictual populations (ancient and primitive taxa).
- Ig - areas containing REs with distinct variation in species composition associated with geomorphology and other environmental variables.
- Ih - an artificial waterbody or managed/manipulated wetland considered by the panel/s to be of ecological significance.
- Ii - areas with a high density of hollow-bearing trees that provide habitat for animals.
- Ij - breeding or roosting sites used by a significant number of individuals.
- Ik - climate change refuge.

The following table identifies the value and extent area of the Other Essential Criteria H and I within the AOI.

Table 13: Relative importance of expert panel criteria (H and I) used to access overall biodiversity significance with respect to the AOI

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
H: Core Habitat Priority Taxa			0.69	0.1				
Ia: Centres of Endemism			73.24	5.8				
Ib: Wildlife Refugia	379.28	30.2	54.04	4.3				
Ic: Disjunct Populations			338.99	27.0				
Id: Limits of Geographic Ranges	265.75	21.1						
Ie: High Species Richness	113.53	9.0	319.79	25.4				

Expert Panel	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
If: Relictual Populations								
Ig: Variation in Species Composition	113.53	9.0	319.79	25.4				
Ih: Artificial Wetland								
Ii: Hollow Bearing Trees			113.53	9.0				
Ij: Breeding or Roosting Site	113.53	9.0						
Ik: Climate Refugia								

NB. Whilst biodiversity values associated with Criteria I may be present within the site (refer to tables 12 and 15), for the New England Tableland and Central Queensland Coast BPAs, area and % area figures associated with Criteria Ia through to Ij cannot be listed in the table above (due to slight variations in data formats between BPAs).

Criteria J. Corridors: areas identified under this criterion qualify either because they are existing vegetated corridors important for contiguity, or cleared areas that could serve this purpose if revegetated. Some examples of corridors include riparian habitats, transport corridors and "stepping stones".

Bioregional and subregional conservation corridors have been identified in the more developed bioregions of Queensland through the BPAs, using an intensive process involving expert panels. Map 3 displays the location of corridors as identified under the Statewide Corridor network. The Statewide Corridor network incorporates BPA derived corridors and for bioregions where no BPA has been assessed yet, corridors derived under other planning processes. *Note: as a result of updating and developing a statewide network, the alignment of corridors may differ slightly in some instances when compared to those used in individual BPAs.*

The functions of these corridors are:

- **Terrestrial** Bioregional corridors, in conjunction with large tracts of remnant vegetation, maintain ecological and evolutionary processes at a landscape scale, by:

    • Maintaining long term evolutionary/genetic processes that allow the natural change in distributions of species and connectivity between populations of species over long periods of time;

    • Maintaining landscape/ecosystems processes associated with geological, altitudinal and climatic gradients, to allow for ecological responses to climate change;

    • Maintaining large scale seasonal/migratory species processes and movement of fauna;

    • Maximising connectivity between large tracts/patches of remnant vegetation;

    • Identifying key areas for rehabilitation and offsets; and

- **Riparian** Bioregional Corridors also maintain and encourage connectivity of riparian and associated ecosystems.

The location of the corridors is determined by the following principles:

- Terrestrial

    • Complement riparian landscape corridors (i.e. minimise overlap and maximise connectivity);

    • Follow major watershed/catchment and/or coastal boundaries;

    • Incorporate major altitudinal/geological/climatic gradients;

    • Include and maximise connectivity between large tracts/patches of remnant vegetation;

    • Include and maximise connectivity between remnant vegetation in good condition; and

- Riparian

    • Located on the major river or creek systems within the bioregion in question.

The total extent of remnant vegetation triggered as being of "State", "Regional" or "Local" significance due to the presence of an overlying BPA derived terrestrial or riparian corridor within the AOI, is provided in the following table. For further information on how remnant vegetation is triggered due to the presence of an overlying BPA derived corridor, refer to the relevant landscape BPA expert panel report(s).

Table 14: Extent of triggered remnant vegetation due to the presence of BPA derived corridors with respect to the AOI

Biodiversity Significance	Area (Ha)	% of AOI
State	0.0	0.0
Regional	0.0	0.0
Local	0.0	0.0

NB: area figures associated with the extent of corridor triggered remnant vegetation are only available for those bioregions where a BPA has been undertaken.

Refer to **Map 3** for further information.

Threatening process/condition (Criteria K) - areas identified by experts under this criterion may be used to amend (upgrade or downgrade) biodiversity significance arising from the "first-cut" analysis. The condition of remnant vegetation is affected by threatening processes such as weeds, ferals, grazing and burning regime, selective timber harvesting/removal, salinity, soil erosion, and climate change.

Assessment of Criteria K with respect to the AOI is not currently included in the "Biodiversity and Conservation Values" report, as it has not been applied to the majority of Queensland due to data/information limitations and availability.

Special Area Decisions

Expert panel derived "Special Area Decisions" are used to assign values to Other Essential Criteria. The specific decisions which relate to the AOI in question are listed in the table below.

Table 15: Expert panel decisions for assigning levels of biodiversity significance with respect to the AOI

Decision Number	Description	Panel Recommended Significance	Criteria Values
eiu_l_03	Riparian ecosystems and associated areas.	State	Ib (wildlife refugia): VERY HIGH Ie (high species richness): VERY HIGH Ig (RE's with distinct variation): VERY HIGH Ii (high density of hollow-bearing trees): HIGH Ij (significant breeding or roosting sites): VERY HIGH
eiu_l_17	Agate Creek Pocket	Regional	Ia (centre of endemism): HIGH Ib (wildlife refugia): HIGH Ic (disjunct populations): HIGH Ie (high species richness): HIGH Ig (RE's with distinct variation): HIGH
gup_fl_20	High precision records for priority taxa of Regional significance are contained within the remnant.	Regional	Criteria H: HIGH
gup_l_31	Gregory Range	State	Ib (wildlife refugia): VERY HIGH Ic (disjunct populations): HIGH Id (species at geographic range limit): VERY HIGH Ie (high species diversity): HIGH Ig (REs show distinct variation in species composition): HIGH

Expert panel decision descriptions:

eiu_l_03

Most of the Einasleigh Uplands is dominated by open vegetation on shallow or skeletal soils. Riparian RE's associated with the larger river systems function as important refuges for many species of flora and fauna because of the relatively high nutrient levels associated with most of these areas, their better moisture balance and their generally well developed vegetation. These mesic ribbons of habitat provide an important seasonal refuge and resources for a variety of species, in particular arboreal mammals, woodland birds, hollow-roosting species and amphibians. Many raptor species preferentially nest in tall riparian trees.

Riparian areas are also biogeographically significant habitat as they allow inland incursions of many east coast species into drier areas on the edge of their geographic range.

Riparian areas were given a 200m buffer with the same significance rating to ensure that adjacent habitat used opportunistically by species using the riparian areas was also included.

This decision includes Landscape decision 4.

eiu_l_17

This is an isolated area of high fertility geologies, including basaltic andesites and dolerite, surrounded by siliceous sandstones and acid igneous rocks. The resulting high fertility soils, including black cracking clays, provide a biogeographic isolate, and a refuge for plants and animals. Although poorly known, the area includes restricted and unusual variations of RE's that are otherwise broadly mapped, disjunct and range extension populations of a number of plant species. New flora species have been found here and the potential for further new species of both flora and fauna to be found is very high. The area also contains springs and permanent waterholes. Further investigation is likely to lead to higher value ratings for this area.

gup_fl_20

Remnant contains habitat for priority taxa with high precision records.

gup_l_31

Isolated tableland and dissected plateau system at the northern part of the subregion. Most northerly plateau of the subregion, up to 150m above the surrounding plains. Very little grazing, no water points or fencing. Refugia from grazing, fire and climate.

No data and therefore any vegetation types are a guess. Believed to have interesting fauna. No access. Contains permanent water, suspected swamp wallabies Wallabia bicolor at the limit of its range. Most fauna surveys in areas along eastern margin in adjoining Einasleigh Uplands bioregion.

Aquatic Conservation Assessments

Introduction

The Aquatic Biodiversity Assessment and Mapping Method or AquaBAMM (Clayton *et al.* 2006), was developed to assess conservation values of wetlands in queensland, and may also have application in broader geographical contexts. It is a comprehensive method that uses available data, including data resulting from expert opinion, to identify relative wetland conservation/ecological values within a specified study area (usually a catchment). The product of applying this method is an Aquatic Conservation Assessment (ACA) for the study area.

An ACA using AquaBAMM is non-social, non-economic and identifies the conservation/ecological values of wetlands at a user-defined scale. It provides a robust and objective conservation assessment using criteria, indicators and measures that are founded upon a large body of national and international literature. The criteria, each of which may have variable numbers of indicators and measures, are naturalness (aquatic), naturalness (catchment), diversity and richness, threatened species and ecosystems, priority species and ecosystems, special features, connectivity and representativeness. An ACA using AquaBAMM is a powerful decision support tool that is easily updated and simply interrogated through a geographic information system (GIS).

Where they have been conducted, ACAs can provide a source of baseline wetland conservation/ecological information to support natural resource management and planning processes. They are useful as an independent product or as an important foundation upon which a variety of additional environmental and socio-economic elements can be added and considered (i.e. an early input to broader 'triple-bottom-line' decision-making processes). An ACA can have application in:

- determining priorities for protection, regulation or rehabilitation of wetlands and other aquatic ecosystems
- on-ground investment in wetlands and other aquatic ecosystems
- contributing to impact assessment of large-scale development (e.g. dams)
- water resource and strategic regional planning prcesses

For a detailed explanation of the methodology please refer to the summary and expert panel reports relevant to the ACA utilised in this assessment. These reports can be accessed at Wetland *Info*:

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca

The GIS results can be downloaded from the Queensland Spatial Catalogue at:

http://qspatial.information.qld.gov.au/geoportal/

Explanation of Criteria

Under the AquaBAMM, eight criteria are assessed to derive an overall conservation value. Similar to the Biodiversity Assessment and Mapping Methodology, the criteria may be primarily diagnostic (quantitative) or primarily expert opinion (qualitative) in nature. The following sections provide a brief description of each of the 8 criteria.

Criteria 1. Naturalness - Aquatic: This attribute reflects the extent to which a wetland's (riverine, non-riverine, estuarine) aquatic state of naturalness is affected through relevant influencing indicators which include: presence of exotic flora and fauna; presence of aquatic communities; degree of habitat modification and degree of hydrological modification.

Criteria 2. Naturalness - Catchment: The naturalness of the terrestrial systems of a catchment can have an influence on many wetland characteristics including: natural ecological processes e.g. nutrient cycling, riparian vegetation, water chemistry, and flow. The indicators utilised to assess this criterion include: presence of exotic flora and/or fauna; riparian, catchment and flow modification.

Criteria 3. Naturalness - Diversity and Richness: This criterion is common to many ecological assessment methods and can include both physical and biological features. It includes such indicators as species richness, riparian ecosystem richness and geomorphological diversity.

Criteria 4. Threatened Species and Ecosystems: This criterion evaluates ecological rarity characteristics of a wetland. This includes both species rarity and rarity of communities / assemblages. The communities and assemblages are best represented by regional ecosystems. Species rarity is determined by NCA and EPBC status with Endangered, Vulnerable or Near-threatened species being included in the evaluation. Ecosystem rarity is determined by regional ecosystem biodiversity status i.e. Endangered, Of Concern, or Not of Concern.

Criteria 5. Priority Species and Ecosystems: Priority flora and fauna species lists are expert panel derived. These are aquatic, semi-aquatic and riparian species which exhibit at least 1 particular trait in order to be eligible for consideration. For flora species the traits included:

- It forms significant macrophyte beds (in shallow or deep water).
- It is an important food source.
- It is important/critical habitat.
- It is implicated in spawning or reproduction for other fauna and/or flora species.
- It is at its distributional limit or is a disjunct population.
- It provides stream bank or bed stabilisation or has soil binding properties.
- It is a small population and subject to threatening processes.

Fauna species are included if they meet at least one of the following traits:

- It is endemic to the study area (>75 per cent of its distribution is in the study area/catchment).
- It has experienced, or is suspected of experiencing, a serious population decline.
- It has experienced a significant reduction in its distribution and has a naturally restricted distribution in the study area/catchment.
- It is currently a small population and threatened by loss of habitat.
- It is a significant disjunct population.
- It is a migratory species (other than birds).
- A significant proportion of the breeding population (>one per cent for waterbirds, >75 per cent other species) occurs in the waterbody (see Ramsar criterion 6 for waterbirds).
- Limit of species range.

See the individual expert panel reports for the priority species traits specific to an ACA.

Criteria 6. Special Features: Special features are areas identified by flora, fauna and ecology expert panels which exhibit characteristics beyond those identified in other criteria and which the expert panels consider to be of the highest ecological importance. Special feature traits can relate to, but are not solely restricted to geomorphic features, unique ecological processes, presence of unique or distinct habitat, presence of unique or special hydrological regimes e.g. spring-fed streams. Special features are rated on a 1 - 4 scale (4 being the highest).

Criteria 7. Connectivity: This criterion is based on the concept that appropriately connected aquatic ecosystems are healthy and resilient, with maximum potential biodiversity and delivery of ecosystem services.

Criteria 8. Representativeness: This criterion applies primarily to non-riverine assessments, evaluates the rarity and uniqueness of a wetland type in relation to specific geographic areas. Rarity is determined by the degree of wetland protection within "protected Areas" estate or within an area subject to the *Fisheries Act 1994*, *Coastal Protection and Management Act 1995*, or *Marine Parks Act 2004*. Wetland uniqueness evaluates the relative abundance and size of a wetland or wetland management group within geographic areas such as catchment and subcatchment.

Riverine Wetlands

Riverine wetlands are all wetlands and deepwater habitats within a channel. The channels are naturally or artificially created, periodically or continuously contain moving water, or connecting two bodies of standing water. AquaBAMM, when applied to riverine wetlands uses a discrete spatial unit termed subsections. A subsection can be considered as an area which encompasses discrete homogeneous stream sections in terms of their natural attributes (i.e. physical, chemical, biological and utilitarian values) and natural resources. Thus in an ACA, an aquatic conservation significance score is calculated for each subsection and applies to all streams within a subsection, rather than individual streams as such.

Please note, the area figures provided in Tables 16 and 17, are derived using the extent of riverine subsections within the AOI. Refer to **Map 5** for further information. A summary of the conservation significance of riverine wetlands within the AOI is provided in the following table.

Table 16: Overall level/s of riverine aquatic conservation significance

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
Very High	0.0	0.0

Aquatic conservation significance (riverine wetlands)	Area (Ha)	% of AOI
High	1,256.55	100.0
Medium	0.0	0.0
Low	0.0	0.0
Very Low	0.0	0.0

The individual aquatic conservation criteria ratings for riverine wetlands within the AOI are listed below.

Table 17: Level/s of riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
1. Naturalness aquatic					1,256.55	100.0		
2. Naturalness catchment			1,256.55	100.0				
3. Diversity and richness			1,256.55	100.0				
4. Threatened species and ecosystems			1,256.55	100.0				
5. Priority species and ecosystems					1,256.55	100.0		
6. Special features			1,256.55	100.0				
7. Connectivity			1,256.55	100.0				
8. Representative-ness								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to riverine wetlands within the AOI.

Table 18: Expert panel decisions for assigning overall levels of riverine aquatic conservation significance

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
gi_r_ec_07	Cobbold Gorge	Gilbert	6.1.1, 6.2.1, 6.3.1, 6.3.4, 6.4.1, 7.2.1	3, 3, 3, 3, 3, 3

4 is the highest rating/value

Expert panel decision descriptions:

gi_r_ec_07

The Cobbold Gorge is located close to the junction with the Robertson River. There is a unique spring located in this gorge. It is recognised that the damming effect associated with organic matter build up that occurs in this area is one that is unique and should be protected. In addition, the area has interesting springs, sandstone faces, and unusual terrestrial ecology. The gorge is also unusual in that it is deep and it is well documented that this gorge is the only significant waterbody in the entire sandstone block (although other waterholes in the region remain unexplored). The gorge contains areas of refugia for fish and freshwater crocodiles **Crocodylus johnstoni**, as well as refugial rainforest flora species in riparian communities. Deep waterholes such as Fish Hole and Cobbold Gorge are recognised for their high freshwater fish diversity (Ecowise Environmental 2007).

Non-riverine Wetlands

Non-riverine wetlands include both lacustrine and palustrine wetlands, however, do not currently incorporate estuarine, marine or subterranean wetland types. A summary of the conservation significance of non-riverine wetlands within the AOI is provided in the following table. Refer to **Map 6** for further information.

Table 19: Overall level/s of non-riverine aquatic conservation significance

Aquatic conservation significance (non-riverine wetlands)	Area (Ha)	% of AOI
(No Records)		

The following table provides an assessment of non-riverine wetlands within the AOI and associated aquatic conservation criteria values.

Table 20: Level/s of non-riverine aquatic conservation significance based on selected criteria

Criteria	Very High Rating - Area (Ha)	Very High Rating - % of AOI	High Rating - Area (Ha)	High Rating - % of AOI	Medium Rating - Area (Ha)	Medium Rating - % of AOI	Low Rating - Area (Ha)	Low Rating - % of AOI
(No Records)								

The table below lists and describes the relevant expert panel decisions used to assign conservation significance values to non-riverine wetlands within the AOI.

Table 21: Expert panel decisions for assigning overall levels of non-riverine aquatic conservation significance.

Decision number	Special feature	Catchment	Criteria/Indicator/Measure	Conservation rating (1-4)
(No Records)				

4 is the highest rating/value

Expert panel decision descriptions:

(No Records)

Threatened and Priority Species

Introduction

This chapter contains a list of threatened and priority flora and/or fauna species that have been recorded on, or within 4km of the Assessment Area.

The information presented in this chapter with respect to species presence is derived from compiled databases developed primarily for the purpose of BPAs and ACAs. Data is collated from a number of sources and is updated periodically.

It is important to note that the list of species provided in this report, may differ when compared to other reports generated from other sources such as the State government's WildNet, Herbrecs or the federal government's EPBC database for a number of reasons.

Records for threatened and priority species are filtered and checked based on a number of rules including:

- Taxonomic nomenclature - current scientific names and status,
- Location - cross-check co-ordinates with location description,
- Taxon by location - requires good knowledge of the taxon and history of the record,
- Duplicate records - identify and remove,
- Expert panels - check records and provide new records,
- Flora cultivated records excluded,
- Use precise records less than or equal to 2000m,
- Use recent records greater than or equal to 1975 animals, greater than or equal to 1950 plants.

Threatened Species

Threatened species are those species classified as "Endangered" or "Vulnerable" under the *Environment Protection and Biodiversity Conservation Act 1999* or "Endangered", "Vulnerable" or "Near threatened" under the *Nature Conservation Act 1992*.

The following threatened species have been recorded on, or within approximately 4km of the AOI.

Table 22: Threatened species recorded on, or within 4km of the AOI

(no results)

NB. Please note that the threatened species listed in this section are based upon the most recently compiled DES internal state-wide threatened species dataset. This dataset may contain additional records that were not originally available for inclusion in the relevant individual BPAs and ACAs.

**JAMBA - Japan-Australia Migratory Bird Agreement; CAMBA - China-Australia Migratory Bird Agreement; ROKAMBA - Republic of Korea-Australia Migratory Bird Agreement; CMS - Convention on the Conservation of Migratory Species*.

***I - wetland indicator species; D - wetland dependent species.*.

BPA Priority Species

A list of BPA priority species that have been recorded on, or within approximately 4km of the AOI is contained in the following table.

Table 23: Priority species recorded on, or within 4km of the AOI

Species	Common name	Back on Track rank	Identified flora/fauna
Acacia orthocarpa	None	None	FL
Corymbia serendipita	None	L	FL
Eucalyptus microneura	Gilbert River box	L	FL
Eucalyptus provecta	None	L	FL
Hibbertia lepidota	None	None	FL

Species	Common name	Back on Track rank	Identified flora/fauna
Phyllanthus maderaspatensis	None	None	FL
Tephrosia astragaloides	None	None	FL
Tephrosia virens	None	None	FL

NB. Please note that the list of priority species is based on those species identified in the BPAs, however records for these species may be more recent than the originals used. furthermore, the BPA priority species databases are updated from time to time. At each update, the taxonomic details for all species are amended as necessary to reflect current taxonomic name and/or status changes.

ACA Priority Species

A list of ACA priority species used in riverine and non-riverine ACAs that have been recorded on, or within approximately 4km of the AOI are contained in the following tables.

Table 24: Priority species recorded on, or within 4 km of the AOI - riverine

(no results)

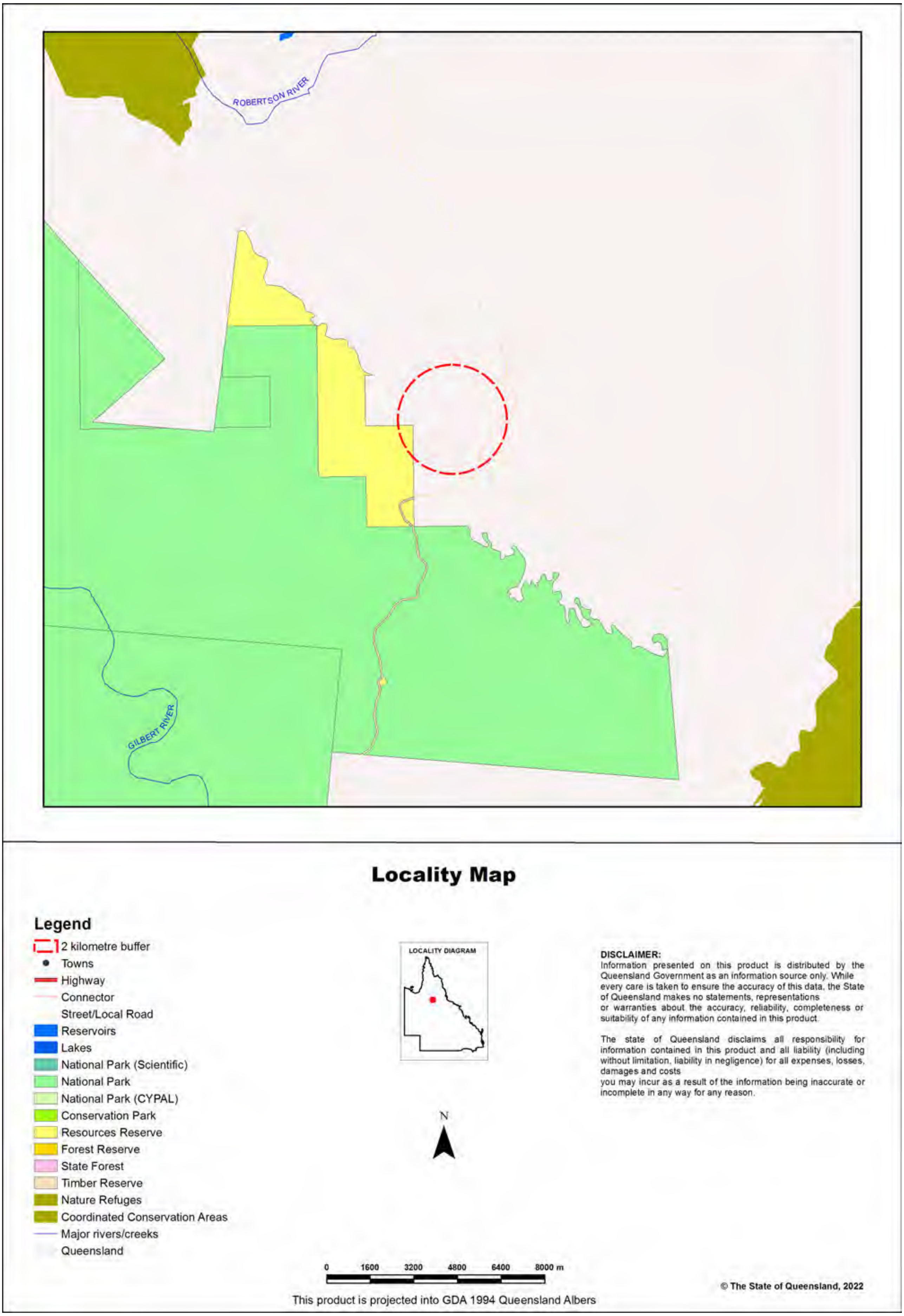
Table 25: Priority species recorded on, or within 4 km of the AOI - non-riverine

Species	Common name	Back on Track rank	Identified flora/fauna
Commelina agrostophylla	None	None	FL

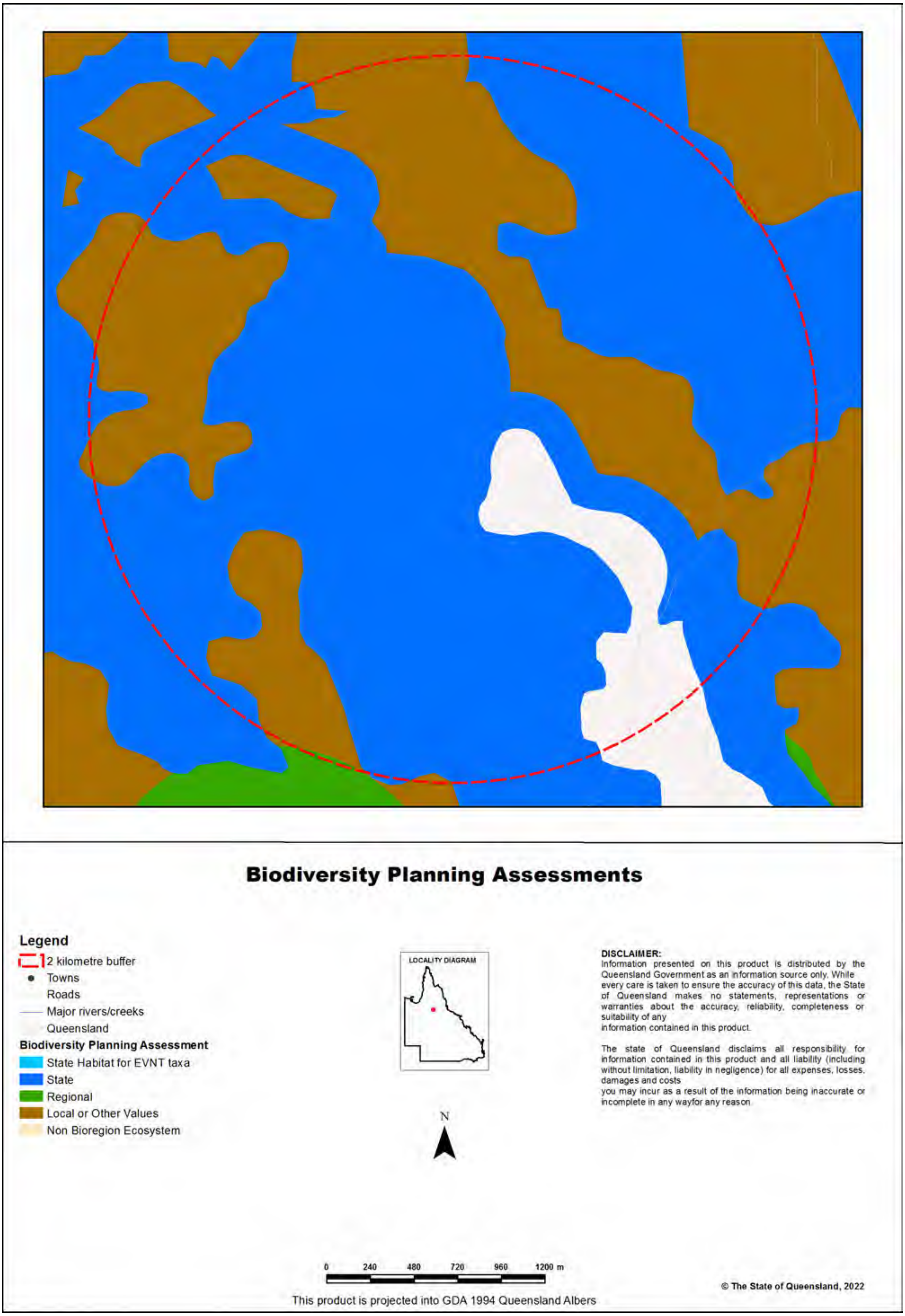
NB. Please note that the priority species records used in the above two tables are comprised of those adopted for the released individual ACAs. The ACA riverine and non-riverine priority species databases are updated from time to time to reflect new release of ACAs. At each update, the taxonomic details for all ACAs records are amended as necessary to reflect current taxonomic name and/or status changes.

Maps

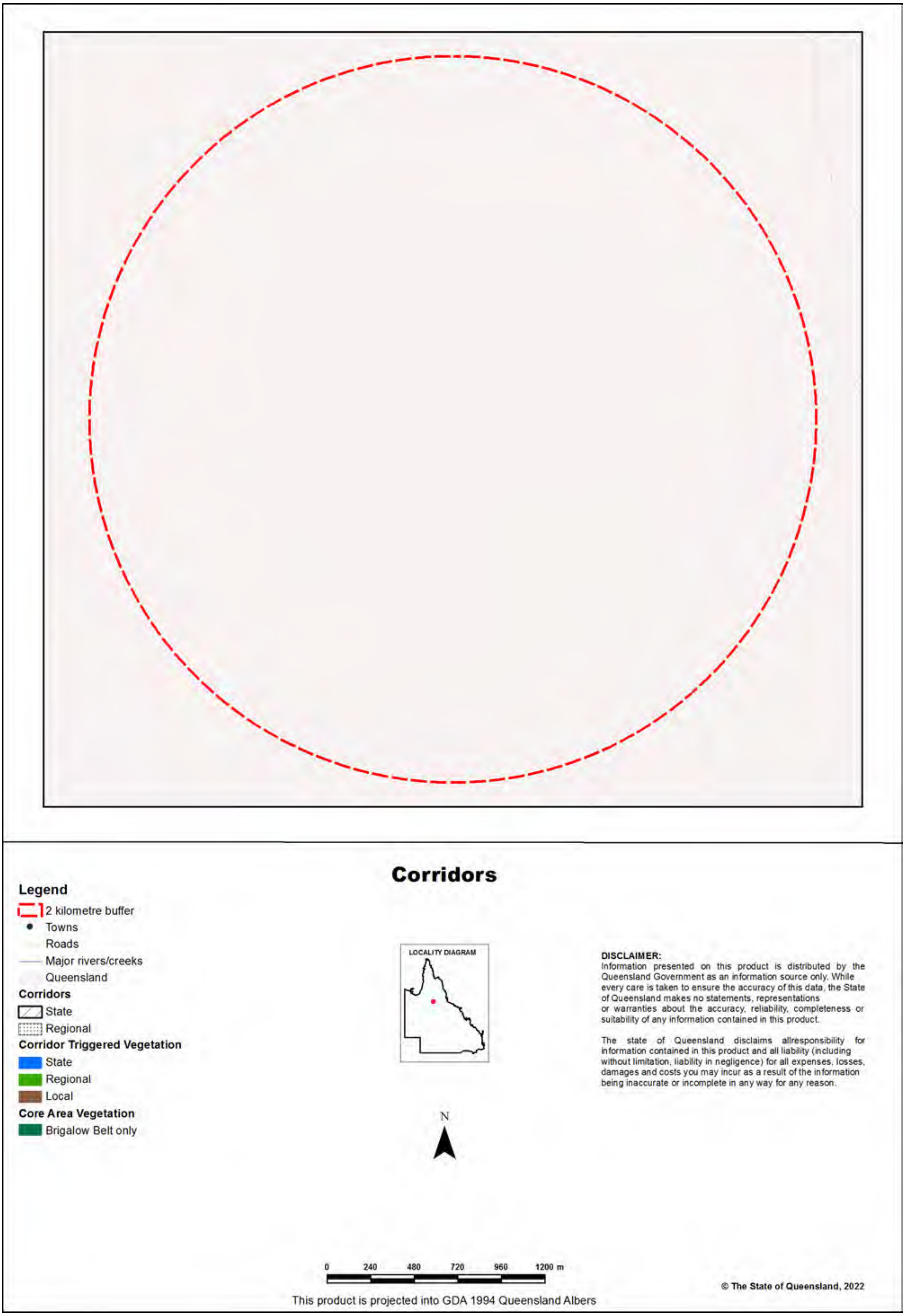
Map 1 - Locality Map



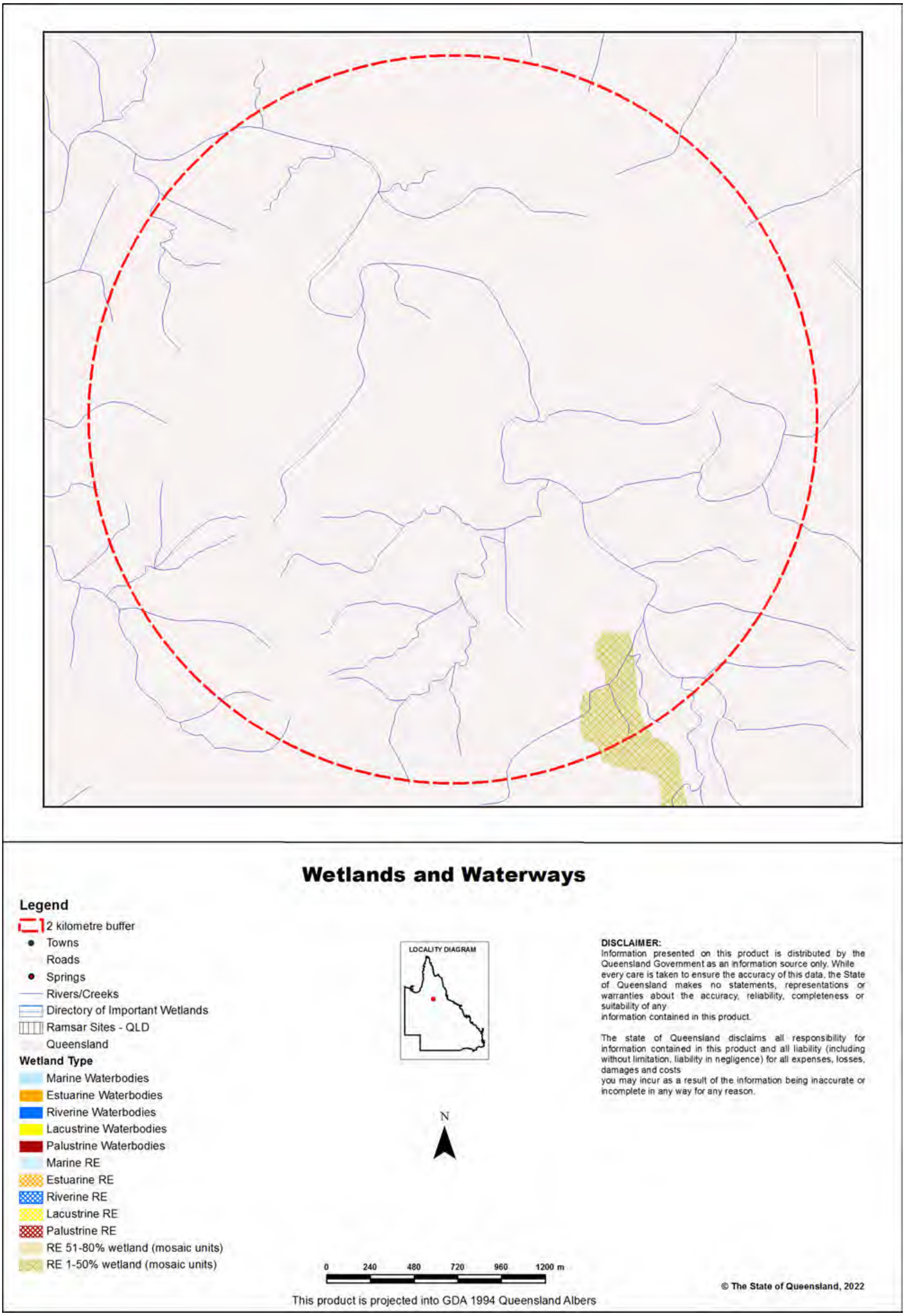
Map 2 - Biodiversity Planning Assessment (BPA)



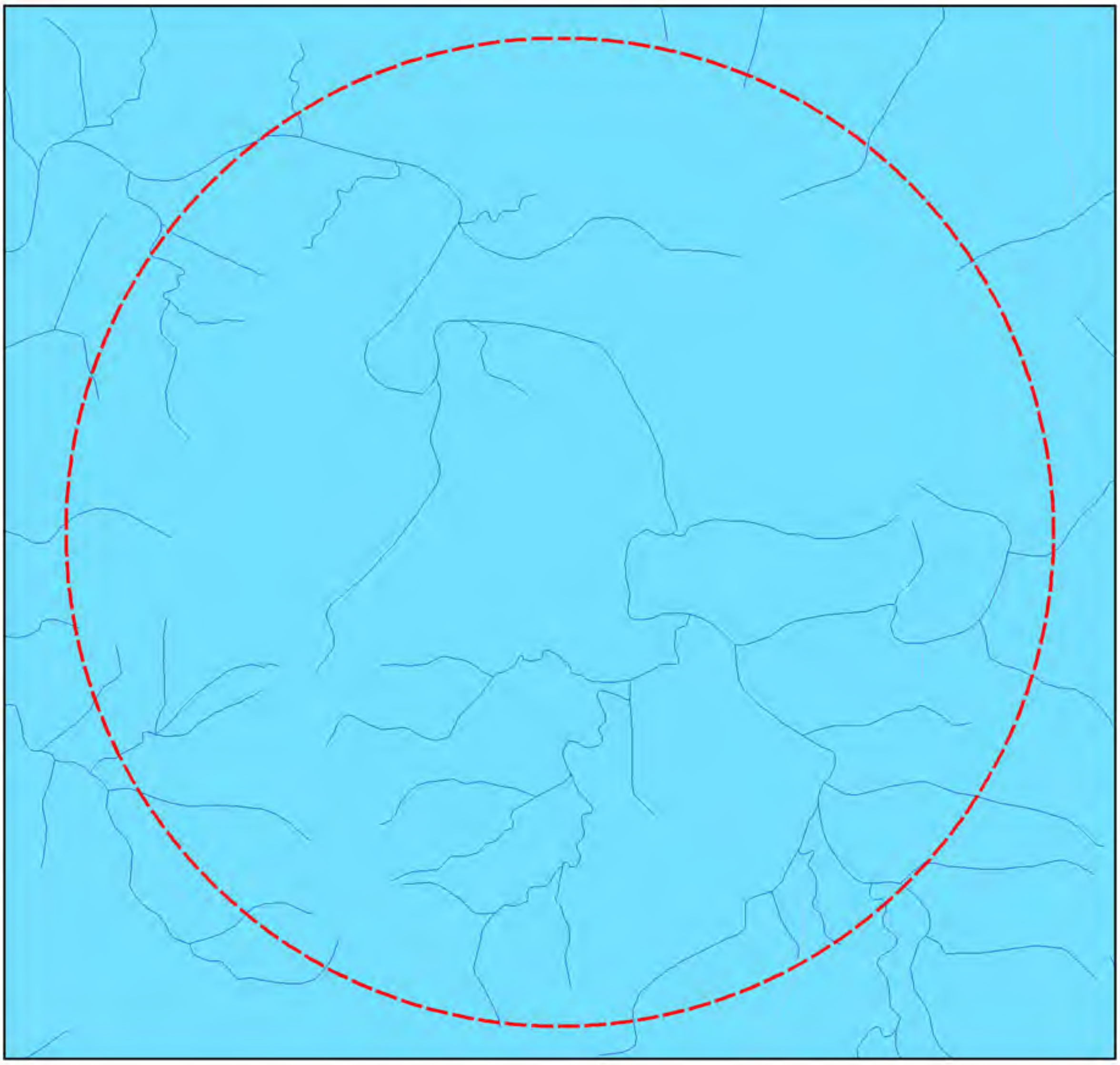
Map 3 - Corridors



Map 4 - Wetlands and waterways



Map 5 - Aquatic Conservation Assessment (ACA) - riverine



Aquatic Conservation Assessment (ACA) - riverine

Legend

- 2 kilometre buffer
- Towns
- Roads
- Rivers/Creeks
- Queensland

ACA Riverine - Subcatchment Significance

- Very High
- High
- Medium
- Low
- Very Low

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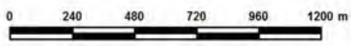
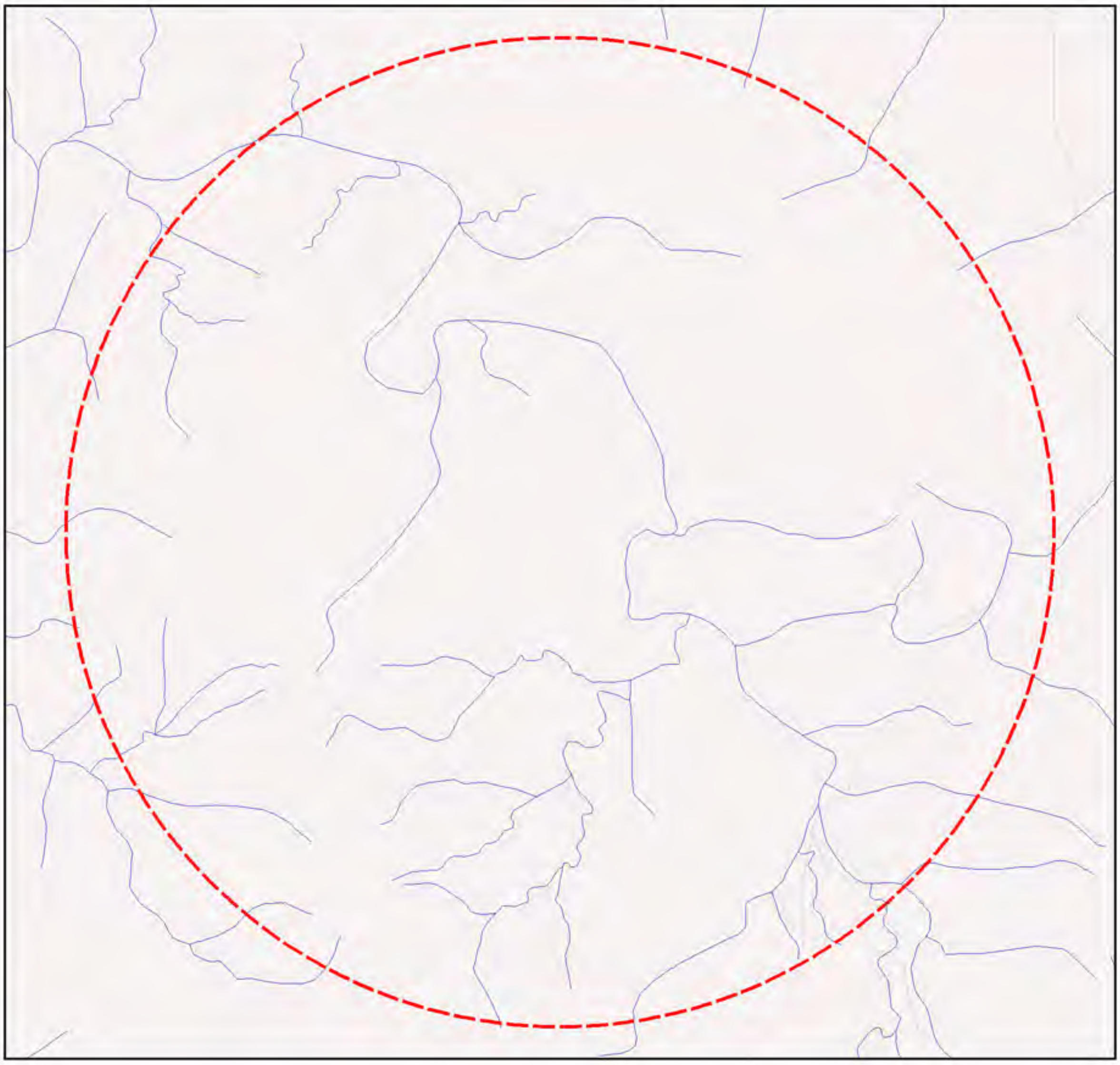


This product is projected into GDA 1994 Queensland Albers

Map 6 - Aquatic Conservation Assessment (ACA) - non-riverine



Aquatic Conservation Assessment (ACA) - nonriverine

Legend

- 2 kilometre buffer
- Towns
- Roads
- Rivers/Creeks
- Queensland

ACA Non-riverine

- Very High
- High
- Medium
- Low
- Very Low

N

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0 240 480 720 960 1200 m

This product is projected into GDA 1994 Queensland Albers

References

Clayton, P.D., Fielder, D.F., Howell, S. and Hill, C.J. (2006) *Aquatic biodiversity assessment and mapping method (AquaBAMM): a conservation values assessment tool for wetlands with trial application in the Burnett River catchment.* Published by the Environmental Protection Agency, Brisbane. ISBN 1-90928-07-3. Available at

http://wetlandinfo.des.qld.gov.au/wetlands/assessment/assessment-methods/aca/

Environmental Protection Agency (2002) *Biodiversity Assessment and Mapping Methodology. Version 2.1, July 2002.* (Environmental Protection Agency, Brisbane).

Morton, S. R., Short, J. and Barker, R. D. with an Appendix by G.F. Griffin and G. Pearce (1995). *Refugia for Biological Diversity in Arid and Semi-arid Australia. Biodiversity Series* , Paper No. 4, Biodiversity Unit, Environment Australia.

Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

Theme	Datasets
Aquatic Conservation Assessments Non-riverine*	Combination of the following datasets: Cape York Peninsula Non-riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Non-riverine v1.3 Lake Eyre and Bulloo Basins v1.1 QMDB Non-riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Non-riverine ACA v1.1 Southern Gulf Catchments Non-riverine ACA v1.1
Aquatic Conservation Assessments Riverine*	Combination of the following datasets: Cape York Peninsula Riverine v1.1 Eastern Gulf of Carpentaria v1.1 Great Barrier Reef Catchment Riverine v1.1 Lake Eyre and Bulloo Basins v1.1 QMDB Riverine ACA v1.4 Southeast Queensland ACA v1.1 WBB Riverine ACA v1.1 Southern Gulf Catchments Riverine ACA v1.1
Biodiversity Planning Assessments*	Combination of the following datasets: Brigalow Belt BPA v2.1 Cape York Peninsula BPA v1.1 Central Queensland Coast BPA v1.3 Channel Country BPA v1.1 Desert Uplands BPA v1.3 Einasleigh Uplands BPA v1.1 Gulf Plains BPA v1.1 Mitchell Grass Downs BPA v1.1 Mulga Lands BPA v1.4 New England Tableland v2.3 Northwest Highlands v1.1 Southeast Queensland v4.1 Wet Tropics v1.1
Statewide BPA Corridors*	Statewide corridors v1.6
Threatened Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
BPA Priority Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.
ACA Priority Species	An internal DES database compiled from Wildnet, Herbrecs, Corveg, the QLD Museum, as well as other incidental sources.

***These datasets are available at:**

http://dds.information.qld.gov.au/DDS

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
ACA	- Aquatic Conservation Assessment
AQUABAMM	- Aquatic Biodiversity Assessment and Mapping Methodology
BAMM	- Biodiversity Assessment and Mapping Methodology
BoT	- Back on Track
BPA	- Biodiversity Planning Assessment
CAMBA	- China-Australia Migratory Bird Agreement
DES	- Department of Environment and Science
EPBC	- *Environment Protection and Biodiversity Conservation Act 1999*
EVNT	- Endangered, Vulnerable, Near Threatened
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
JAMBA	- Japan-Australia Migratory Bird Agreement
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
ROKAMBA	- Republic of Korea-Australia Migratory Bird Agreement

Queensland Government

Department of Environment and Science

Environmental Reports

Matters of State Environmental Significance

For the selected area of interest
Longitude: 143.5492 Latitude: -18.9961 with 2 kilometre radius

Environmental Reports - General Information

The Environmental Reports portal provides for the assessment of selected matters of interest relevant to a user specified location, or area of interest (AOI). All area and derivative figures are relevant to the extent of matters of interest contained within the AOI unless otherwise stated. Please note, if a user selects an AOI via the "central coordinates" option, the resulting assessment area encompasses an area extending for a 2km radius from the point of interest.

All area and area derived figures included in this report have been calculated via reprojecting relevant spatial features to Albers equal-area conic projection (central meridian = 146, datum Geocentric Datum of Australia 1994). As a result, area figures may differ slightly if calculated for the same features using a different co-ordinate system.

Figures in tables may be affected by rounding.

The matters of interest reported on in this document are based upon available state mapped datasets. Where the report indicates that a matter of interest is not present within the AOI (e.g. where area related calculations are equal to zero, or no values are listed), this may be due either to the fact that state mapping has not been undertaken for the AOI, that state mapping is incomplete for the AOI, or that no values have been identified within the site.

The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Please direct queries about these reports to: Planning.Support@des.qld.gov.au

Disclaimer

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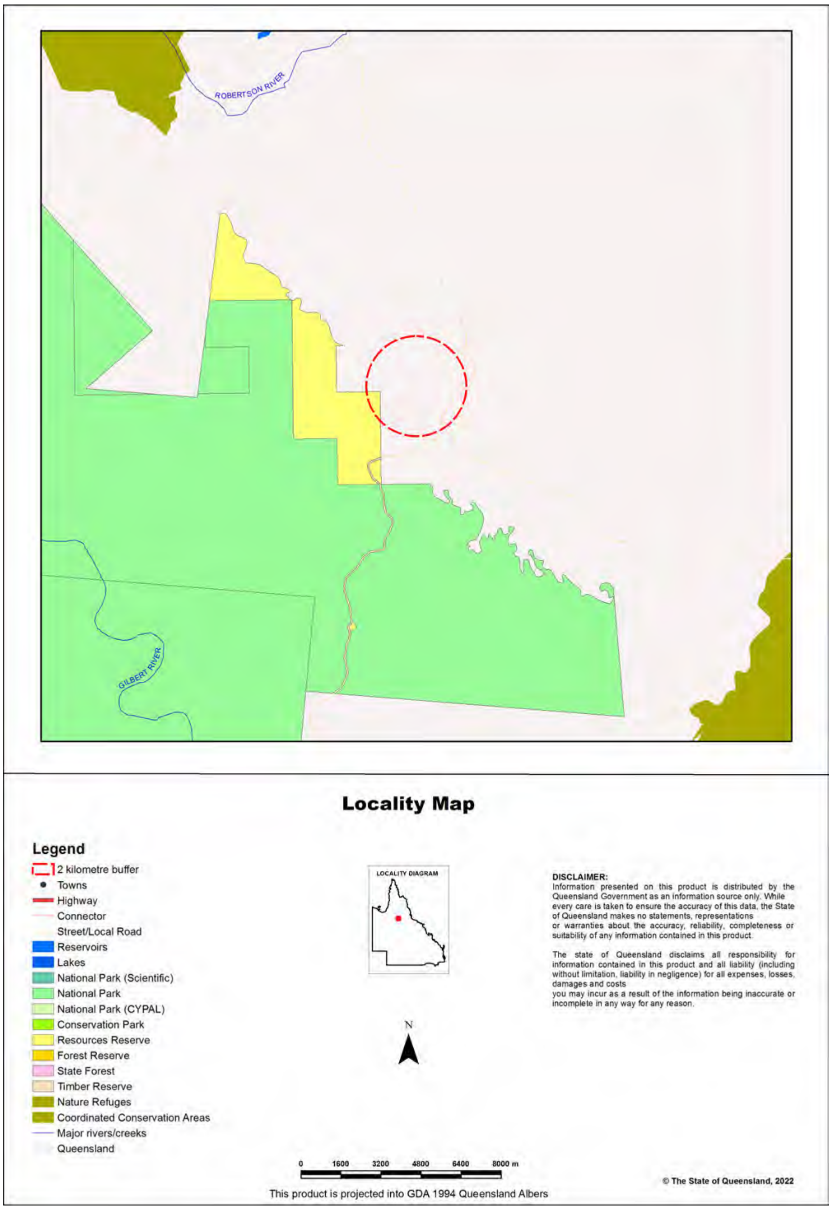
Assessment Area Details

The following table provides an overview of the area of interest (AOI) with respect to selected topographic and environmental values.

Table 1: Summary table, details for AOI Longitude: 143.5492 Latitude: -18.9961

Size (ha)	1,256.55
Local Government(s)	Etheridge Shire
Bioregion(s)	Gulf Plains, Einasleigh Uplands
Subregion(s)	Gilberton Plateau, Kidston
Catchment(s)	Gilbert



Matters of State Environmental Significance (MSES)

MSES Categories

Queensland's State Planning Policy (SPP) includes a biodiversity State interest that states:

'The sustainable, long-term conservation of biodiversity is supported. Significant impacts on matters of national or state environmental significance are avoided, or where this cannot be reasonably achieved; impacts are minimised and residual impacts offset.'

The MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The SPP defines matters of state environmental significance as:

- Protected areas (including all classes of protected area except coordinated conservation areas) under the *Nature Conservation Act 1992* ;

- Marine parks and land within a 'marine national park', 'conservation park', 'scientific research', 'preservation' or 'buffer' zone under the *Marine Parks Act 2004* ;

- Areas within declared fish habitat areas that are management A areas or management B areas under the Fisheries Regulation 2008;

- Threatened wildlife under the *Nature Conservation Act 1992* and special least concern animals under the Nature Conservation (Wildlife) Regulation 2006;

- Regulated vegetation under the *Vegetation Management Act 1999* that is:

    • Category B areas on the regulated vegetation management map, that are 'endangered' or 'of concern' regional ecosystems;

    • Category C areas on the regulated vegetation management map that are 'endangered' or 'of concern' regional ecosystems;

    • Category R areas on the regulated vegetation management map;

    • Regional ecosystems that intersect with watercourses identified on the vegetation management watercourse and drainage feature map;

    • Regional ecosystems that intersect with wetlands identified on the vegetation management wetlands map;

- Strategic Environmental Areas under the *Regional Planning Interests Act 2014* ;

- Wetlands in a wetland protection area of wetlands of high ecological significance shown on the Map of Queensland Wetland Environmental Values under the Environment Protection Regulation 2019;

- Wetlands and watercourses in high ecological value waters defined in the Environmental Protection (Water) Policy 2009, schedule 2;

- Legally secured offset areas.

MSES Values Present

The MSES values that are present in the area of interest are summarised in the table below:

Table 2: Summary of MSES present within the AOI

1a Protected Areas- estates	41.29 ha	3.3%
1b Protected Areas- nature refuges	0.0 ha	0.0 %
1c Protected Areas- special wildlife reserves	0.0 ha	0.0 %
2 State Marine Parks- highly protected zones	0.0 ha	0.0 %
3 Fish habitat areas (A and B areas)	0.0 ha	0.0 %
4 Strategic Environmental Areas (SEA)	0.0 ha	0.0 %
5 High Ecological Significance wetlands on the map of Referable Wetlands	0.0 ha	0.0 %
6a High Ecological Value (HEV) wetlands	0.0 ha	0.0 %
6b High Ecological Value (HEV) waterways	0.0 km	Not applicable
7a Threatened (endangered or vulnerable) wildlife	0.0 ha	0.0 %
7b Special least concern animals	0.0 ha	0.0 %
7c i Koala habitat area - core (SEQ)	0.0 ha	0.0 %
7c ii Koala habitat area - locally refined (SEQ)	0.0 ha	0.0 %
7d Sea turtle nesting areas	0.0 km	Not applicable
8a Regulated Vegetation - Endangered/Of concern in Category B (remnant)	0.0 ha	0.0 %
8b Regulated Vegetation - Endangered/Of concern in Category C (regrowth)	0.0 ha	0.0 %
8c Regulated Vegetation - Category R (GBR riverine regrowth)	0.0 ha	0.0 %
8d Regulated Vegetation - Essential habitat	0.0 ha	0.0 %
8e Regulated Vegetation - intersecting a watercourse	22.9 km	Not applicable
8f Regulated Vegetation - within 100m of a Vegetation Management Wetland	0.0 ha	0.0 %
9a Legally secured offset areas- offset register areas	0.0 ha	0.0 %
9b Legally secured offset areas- vegetation offsets through a Property Map of Assessable Vegetation	0.0 ha	0.0 %

Additional Information with Respect to MSES Values Present

MSES - State Conservation Areas

1a. Protected Areas - estates

Estate name
Rungulla Resources Reserve

1b. Protected Areas - nature refuges

(no results)

1c. Protected Areas - special wildlife reserves

(no results)

2. State Marine Parks - highly protected zones

(no results)

3. Fish habitat areas (A and B areas)

(no results)

Refer to **Map 1 - MSES - State Conservation Areas** for an overview of the relevant MSES.

MSES - Wetlands and Waterways

4. Strategic Environmental Areas (SEA)

(no results)

5. High Ecological Significance wetlands on the Map of Queensland Wetland Environmental Values

(no results)

6a. Wetlands in High Ecological Value (HEV) waters

(no results)

6b. Waterways in High Ecological Value (HEV) waters

(no results)

Refer to **Map 2 - MSES - Wetlands and Waterways** for an overview of the relevant MSES.

MSES - Species

7a. Threatened (endangered or vulnerable) wildlife

Not applicable

7b. Special least concern animals

Not applicable

7c i. Koala habitat area - core (SEQ)

Not applicable

7c ii. Koala habitat area - locally refined (SEQ)

Not applicable

7d. Wildlife habitat (sea turtle nesting areas)

Not applicable

Threatened (endangered or vulnerable) wildlife habitat suitability models

Species	Common name	NCA status	Presence
Boronia keysii		V	None
Calyptorhynchus lathami	Glossy black cockatoo	V	None
Casuarius casuarius johnsonii	Sthn population cassowary	E	None
Crinia tinnula	Wallum froglet	V	None
Denisonia maculata	Ornamental snake	V	None
Litoria freycineti	Wallum rocketfrog	V	None
Litoria olongburensis	Wallum sedgefrog	V	None
Macadamia integrifolia		V	None
Macadamia ternifolia		V	None
Macadamia tetraphylla		V	None
Melaleuca irbyana		E	None
Petaurus gracilis	Mahogany Glider	E	None
Petrogale persephone	Proserpine rock-wallaby	E	None
Pezoporus wallicus wallicus	Eastern ground parrot	V	None
Phascolarctos cinereus	Koala - outside SEQ*	V	None
Taudactylus pleione	Kroombit tinkerfrog	E	None
Xeromys myoides	Water Mouse	V	None

**For koala model, this includes areas outside SEQ. Check 7c SEQ koala habitat for presence/absence.*

Threatened (endangered or vulnerable) wildlife species records

(no results)

Special least concern animal species records

(no results)

Shorebird habitat (critically endangered/endangered/vulnerable)

Not applicable

Shorebird habitat (special least concern)

Not applicable

**Nature Conservation Act 1992 (NCA) Status- Endangered (E), Vulnerable (V) or Special Least Concern Animal (SL). Environment Protection and Biodiversity Conservation Act 1999 (EPBC) status: Critically Endangered (CE) Endangered (E), Vulnerable (V)*

Migratory status (M) - China and Australia Migratory Bird Agreement (C), Japan and Australia Migratory Bird Agreement (J), Republic of Korea and Australia Migratory Bird Agreement (R), Bonn Migratory Convention (B), Eastern Flyway (E)

To request a species list for an area, or search for a species profile, access Wildlife Online at:
https://www.qld.gov.au/environment/plants-animals/species-list/

Refer to **Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals, Map 3b - MSES - Species - Koala habitat area (SEQ)** and **Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)** for an overview of the relevant MSES.

MSES - Regulated Vegetation

For further information relating to regional ecosystems in general, go to:
https://www.qld.gov.au/environment/plants-animals/plants/ecosystems/
For a more detailed description of a particular regional ecosystem, access the regional ecosystem search page at:
https://environment.ehp.qld.gov.au/regional-ecosystems/

8a. Regulated Vegetation - Endangered/Of concern in Category B (remnant)

Not applicable

8b. Regulated Vegetation - Endangered/Of concern in Category C (regrowth)

Not applicable

8c. Regulated Vegetation - Category R (GBR riverine regrowth)

Not applicable

8d. Regulated Vegetation - Essential habitat

Not applicable

8e. Regulated Vegetation - intersecting a watercourse**

A vegetation management watercourse is mapped as present

8f. Regulated Vegetation - within 100m of a Vegetation Management wetland

Not applicable

Refer to **Map 4 - MSES - Regulated Vegetation** for an overview of the relevant MSES.

MSES - Offsets

9a. Legally secured offset areas - offset register areas

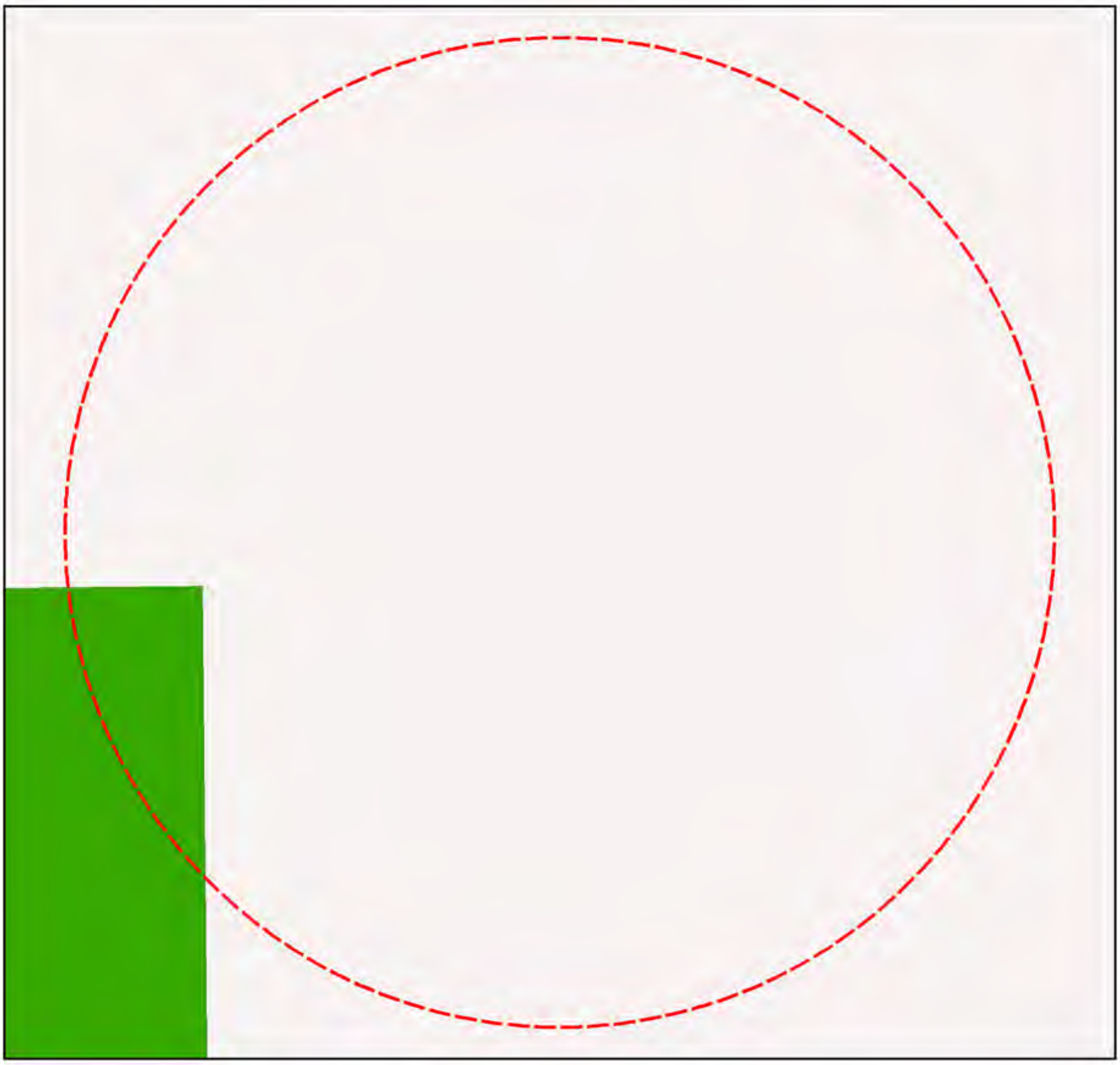
(no results)

9b. Legally secured offset areas - vegetation offsets through a Property Map of Assessable Vegetation

(no results)

Refer to **Map 5 - MSES - Offset Areas** for an overview of the relevant MSES.

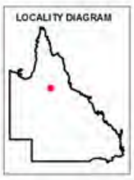
Map 1 - MSES - State Conservation Areas



MSES - State Conservation Areas

Area of Interest

- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Protected area (estates, nature refuges, special wildlife reserves)
- Declared fish habitat area (A and B areas)
- Marine park (highly protected)



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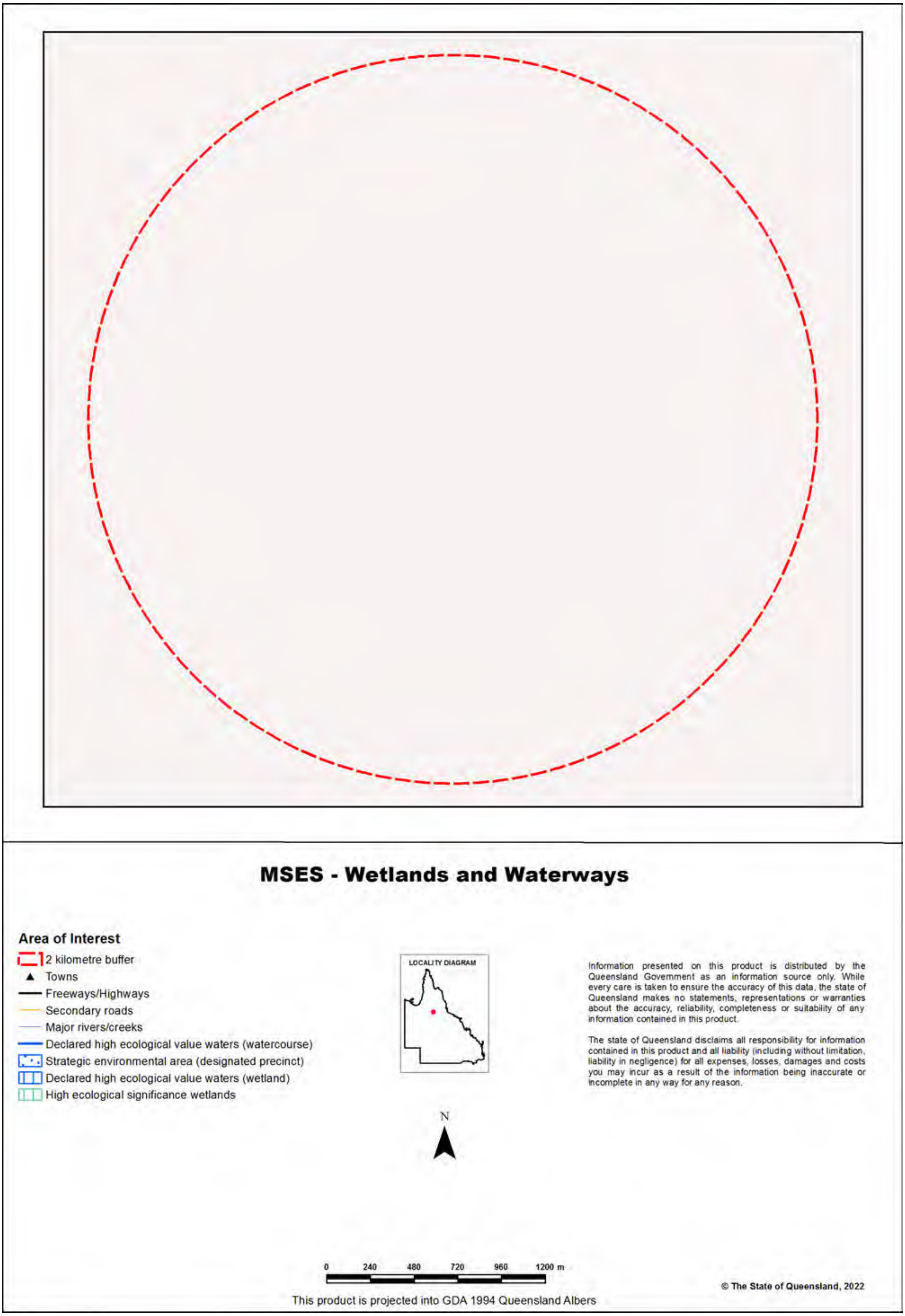
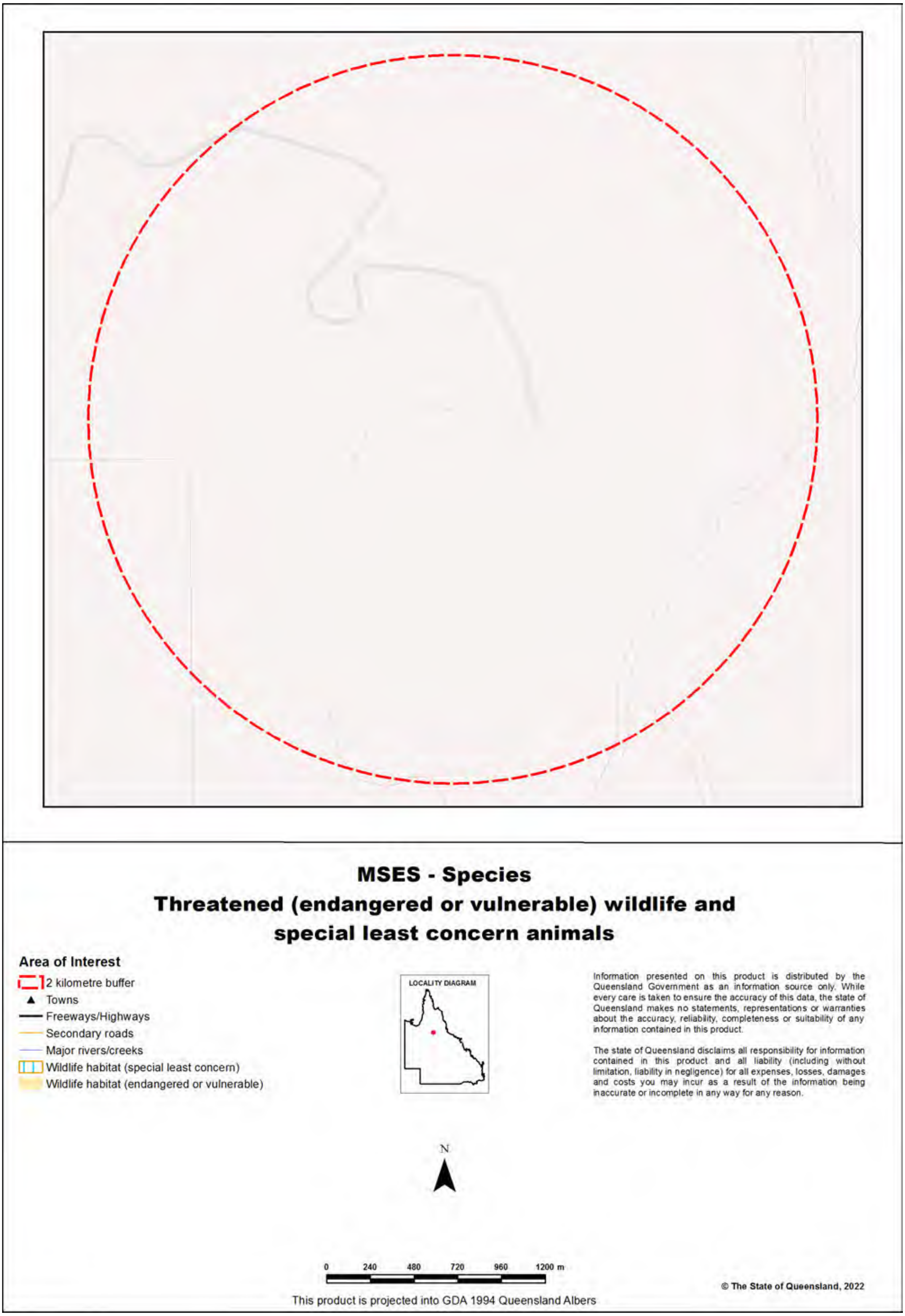
0 240 480 720 960 1200 m

This product is projected into GDA 1994 Queensland Albers

Map 2 - MSES - Wetlands and Waterways



Map 3a - MSES - Species - Threatened (endangered or vulnerable) wildlife and special least concern animals

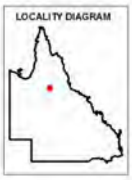


Map 3b - MSES - Species - Koala habitat area (SEQ)

MSES - Species
Koala habitat area (SEQ)

Area of Interest

- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Koala habitat area (core)
- Koala habitat area (locally refined)



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The represented layers for SEQ 'koala habitat area-core' and 'koala habitat area- locally refined' in MSES are sourced directly from the regulatory mapping under the Nature Conservation (Koala) Conservation Plan 2017. Whilst every effort is made to ensure the information remains current, there may be delays between updating versions. Please refer to the original mapping for the most recent version. See https://environment.des.qld.gov.au/wildlife/animals/living-with/koalas/mapping

The koala habitat mapping within South East Queensland uses regional ecosystem linework compiled at a scale varying from 1:25,000 to 1:100,000. Linework should be used as a guide only. The positional accuracy of regional ecosystem data mapped at a scale of 1:100,000 is +/- 100 metres.

0 220 440 660 880 1,100 m

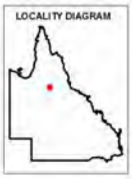
This product is projected into GDA 1994 Queensland Albers

Map 3c - MSES - Wildlife habitat (sea turtle nesting areas)

MSES - Wildlife habitat (sea turtle nesting areas)

Area of Interest

- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Wildlife habitat (sea turtle nesting areas)



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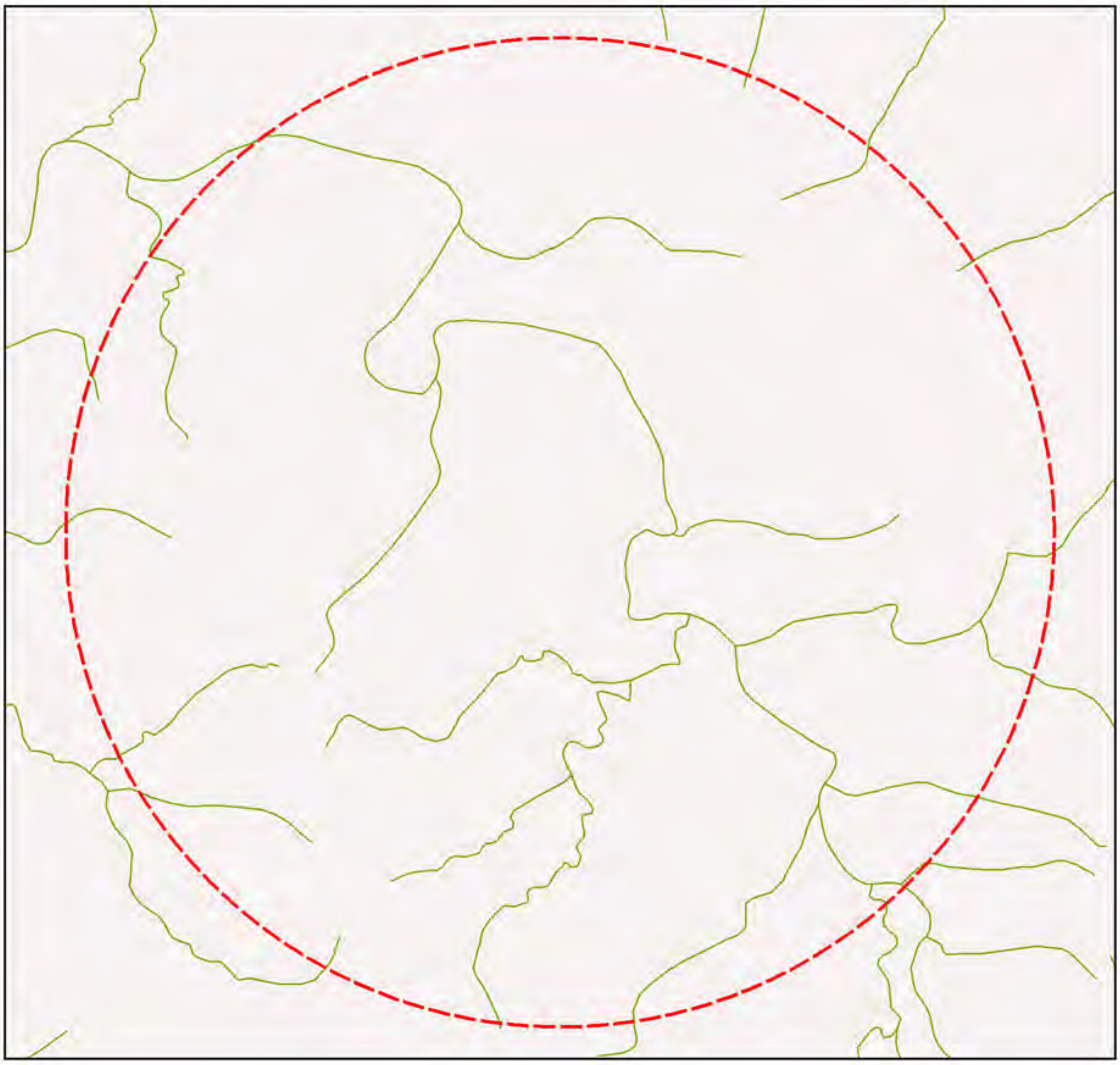
MSES mapping of sea turtle nesting areas identifies beaches where the recorded number of turtle nests are over 1% of the turtle species or genetic stock. The linework is also deliberately extended along nearby rocky coastlines and headlands to recognise that significant numbers of nesting adults and hatchlings can become disoriented by light pollution from development on rocky coastlines and headlands while navigating offshore from nesting beaches.

0 220 440 660 880 1,100 m

This product is projected into GDA 1994 Queensland Albers

Map 4 - MSES - Regulated Vegetation



MSES - Regulated Vegetation

Area of Interest

- 2 kilometre buffer
- Towns
- Freeways/Highways
- Secondary roads
- Major rivers/creeks
- Regulated vegetation (intersecting a watercourse)
- Regulated vegetation (100m from wetland)
- Regulated vegetation (category B - endangered or of concern)
- Regulated vegetation (category C - endangered or of concern)
- Regulated vegetation (category R - GBR riverine)
- Regulated vegetation (essential habitat)

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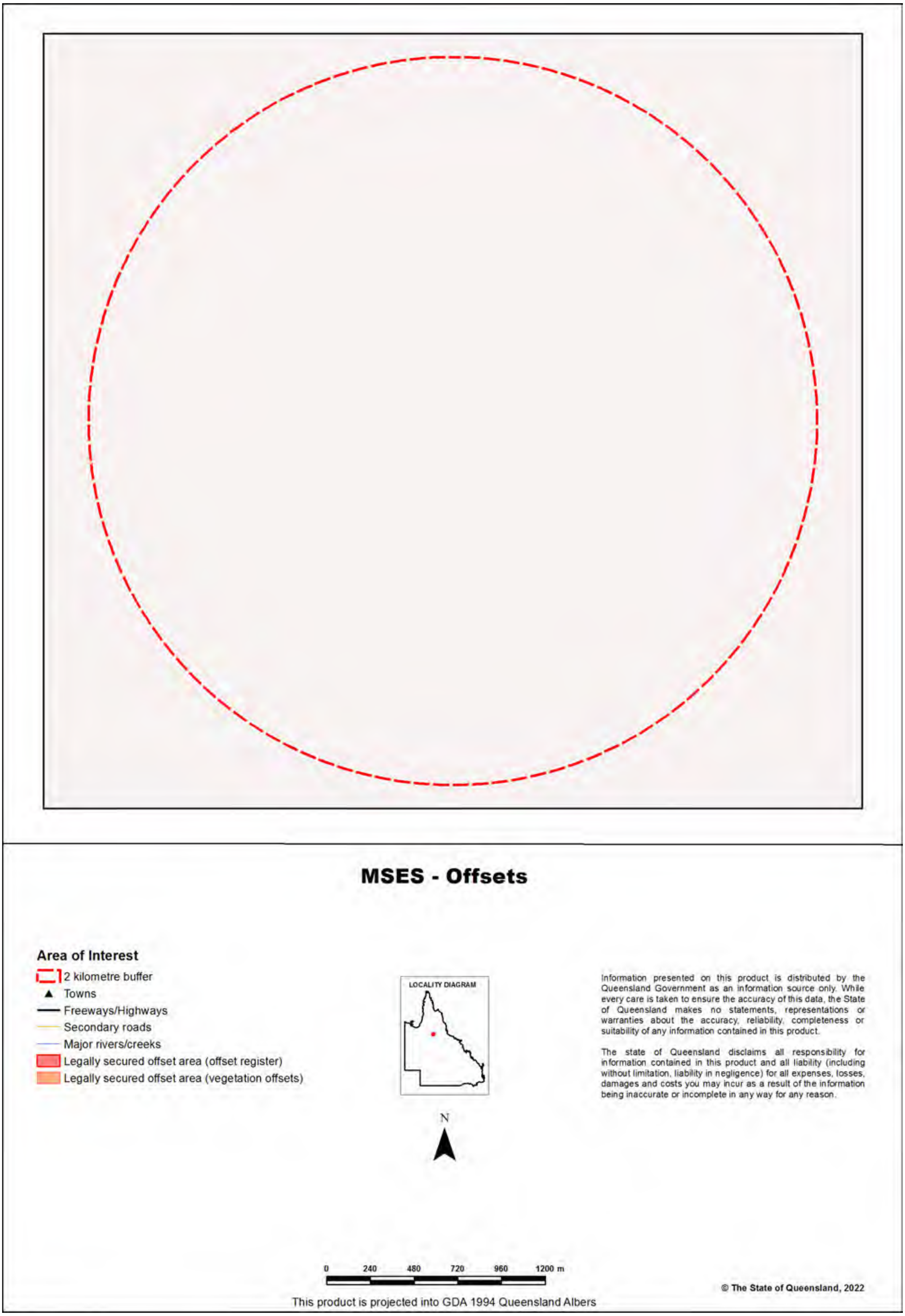
0 240 480 720 960 1200 m

This product is projected into GDA 1994 Queensland Albers

Map 5 - MSES - Offset Areas



Appendices

Appendix 1 - Matters of State Environmental Significance (MSES) methodology

MSES mapping is a regional-scale representation of the definition for MSES under the State Planning Policy (SPP). The compiled MSES mapping product is a guide to assist planning and development assessment decision-making. Its primary purpose is to support implementation of the SPP biodiversity policy. While it supports the SPP, the mapping does not replace the regulatory mapping or environmental values specifically called up under other laws or regulations. Similarly, the SPP biodiversity policy does not override or replace specific requirements of other Acts or regulations.

The Queensland Government's "Method for mapping - matters of state environmental significance for use in land use planning and development assessment" can be downloaded from:

http://www.ehp.qld.gov.au/land/natural-resource/method-mapping-mses.html .

Appendix 2 - Source Data

The datasets listed below are available on request from:

http://qldspatial.information.qld.gov.au/catalogue/custom/index.page

- Matters of State environmental significance

Note: MSES mapping is not based on new or unique data. The primary mapping product draws data from a number of underlying environment databases and geo-referenced information sources. MSES mapping is a versioned product that is updated generally on a twice-yearly basis to incorporate the changes to underlying data sources. Several components of MSES mapping made for the current version may differ from the current underlying data sources. To ensure accuracy, or proper representation of MSES values, it is strongly recommended that users refer to the underlying data sources and review the current definition of MSES in the State Planning Policy, before applying the MSES mapping.

Individual MSES layers can be attributed to the following source data available at QSpatial:

MSES layers	**current QSpatial data (http://qspatial.information.qld.gov.au)**
Protected Areas-Estates, Nature Refuges, Special Wildlife Reserves	- Protected areas of Queensland - Nature Refuges - Queensland - Special Wildlife Reserves- Queensland
Marine Park-Highly Protected Zones	Moreton Bay marine park zoning 2008
Fish Habitat Areas	Queensland fish habitat areas
Strategic Environmental Areas-designated	Regional Planning Interests Act - Strategic Environmental Areas
HES wetlands	Map of Queensland Wetland Environmental Values
Wetlands in HEV waters	HEV waters: - EPP Water intent for waters Source Wetlands: - Queensland Wetland Mapping (Current version 5) Source Watercourses: - Vegetation management watercourse and drainage feature map (1:100000 and 1:250000)
Wildlife habitat (threatened and special least concern)	- WildNet database species records - habitat suitability models (various) - SEQ koala habitat areas under the Koala Conservation Plan 2019 - Sea Turtle Nesting Areas records
VMA regulated regional ecosystems	Vegetation management regional ecosystem and remnant map
VMA Essential Habitat	Vegetation management - essential habitat map
VMA Wetlands	Vegetation management wetlands map
Legally secured offsets	Vegetation Management Act property maps of assessable vegetation. For offset register data-contact DES
Regulated Vegetation Map	Vegetation management - regulated vegetation management map

Appendix 3 - Acronyms and Abbreviations

AOI	- Area of Interest
DES	- Department of Environment and Science
EP Act	- *Environmental Protection Act 1994*
EPP	- Environmental Protection Policy
GDA94	- Geocentric Datum of Australia 1994
GEM	- General Environmental Matters
GIS	- Geographic Information System
MSES	- Matters of State Environmental Significance
NCA	- *Nature Conservation Act 1992*
RE	- Regional Ecosystem
SPP	- State Planning Policy
VMA	- *Vegetation Management Act 1999*

Queensland Government

Department of Environment and Science

Environmental Reports

Regional Ecosystems

Biodiversity Status

For the selected area of interest
Longitude: 143.5492 Latitude: -18.9961 with 2 kilometre radius

Environmental Reports - General Information

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The information presented in this report should be considered as a guide only and field survey may be required to validate values on the ground.

Important Note to User

Information presented in this report is based upon the Queensland Herbarium's Regional Ecosystem framework. The Biodiversity Status has been used to depict the extent of "Endangered", "Of Concern" and "No Concern at Present" regional ecosystems in all cases, rather than the classes used for the purposes of the *Vegetation Management Act 1999* (VMA). Mapping and figures presented in this document reflect the Queensland Herbarium's Remnant and Pre-clearing Regional Ecosystem Datasets, and not the certified mapping used for the purpose of the VMA.

For matters relevant to vegetation management under the VMA, please refer to the Department of Resources website
https://www.dnrme.qld.gov.au/

Please direct queries about these reports to: Queensland.Herbarium@qld.gov.au

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Summary Information

The following table provides an overview of the AOI with respect to selected topographic and environmental themes. Refer to **Map 1** for locality information.

Table 1: Area of interest details: Longitude: 143.5492 Latitude: -18.9961 with 2 kilometre radius

Size (ha)	1,256.55
Local Government(s)	Etheridge Shire
Bioregion(s)	Gulf Plains, Einasleigh Uplands
Subregion(s)	Gilberton Plateau, Kidston
Catchment(s)	Gilbert

The table below summarizes the extent of remnant vegetation classed as "Endangered", "Of concern" and "No concern at present" regional ecosystems classified by Biodiversity Status within the area of interest (AOI).

Table 2: Summary table, biodiversity status of regional ecosystems within the AOI

Biodiversity Status	Area (Ha)	% of AOI
Endangered	0.0	0.0
Of concern	48.76	3.88
No concern at present	1,207.79	96.12
Total remnant vegetation	1,256.55	100.0

Refer to **Map 2** for further information.

Regional Ecosystems

1. Introduction

Regional ecosystems are vegetation communities in a bioregion that are consistently associated with particular combinations of geology, landform and soil (Sattler and Williams 1999). Descriptions of Queensland's Regional ecosystems are available online from the Regional Ecosystem Description Database (REDD). Descriptions are compiled from a broad range of information sources including vegetation, land system and geology survey and mapping and detailed vegetation site data. The regional ecosystem classification and descriptions are reviewed as new information becomes available. A number of vegetation communities may form a single regional ecosystem and are usually distinguished by differences in dominant species, frequently in the shrub or ground layers and are denoted by a letter following the regional ecosystem code (e.g. a, b, c). Vegetation communities and regional ecosystems are amalgamated into a higher level classification of broad vegetation groups (BVGs).

A published methodology for survey and mapping of regional ecosystems across Queensland (Neldner et al 2020) provides further details on regional ecosystem concepts and terminology.

This report provides information on the type, status, and extent of vegetation communities, regional ecosystems and broad vegetation groups present within a user specified area of interest. Please note, for the purpose of this report, the Biodiversity Status is used. This report has not been developed for application of the *Vegetation Management Act 1999* (VMA). Additionally, information generated in this report has been derived from the Queensland Herbarium's Regional Ecosystem Mapping, and not the regulated mapping certified for the purposes of the VMA. If your interest/matter relates to regional ecosystems and the VMA, users should refer to the Department of Resources website.

https://www.dnrme.qld.gov.au/

With respect to the Queensland Biodiversity Status,

"Endangered" regional ecosystems are described as those where:

- remnant vegetation is less than 10 per cent of its pre-clearing extent across the bioregion; or 10-30% of its pre-clearing extent remains and the remnant vegetation is less than 10,000 hectares, or
- less than 10 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss*, or
- 10-30 per cent of its pre-clearing extent remains unaffected by severe degradation and/or biodiversity loss and the remnant vegetation is less than 10,000 hectares; or
- it is a rare** regional ecosystem subject to a threatening process.***

"Of concern" regional ecosystems are described as those where:

- the degradation criteria listed above for 'Endangered' regional ecosystems are not met and,
- remnant vegetation is 10-30 per cent of its pre-clearing extent across the bioregion; or more than 20 per cent of its pre-clearing extent remains and the remnant extent is less than 10,000 hectares, or
- 10-30 percent of its pre-clearing extent remains unaffected by moderate degradation and/or biodiversity loss.****

and "No concern at present" regional ecosystems are described as those where:

- remnant vegetation is over 30 per cent of its pre-clearing extent across the bioregion, and the remnant area is greater than 10,000 hectares, and
- the degradation criteria listed above for 'Endangered' or 'Of concern' regional ecosystems are not met.

**Severe degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 50 years even with the removal of threatening processes; or soil surface is severely degraded, for example, by loss of A horizon, surface expression of salinity; surface compaction, loss of organic matter or sheet erosion.*

***Rare regional ecosystem: pre-clearing extent (1000 ha); or patch size (100 ha and of limited total extent across its range).*

****Threatening processes are those that are reducing or will reduce the biodiversity and ecological integrity of a regional ecosystem. For example, clearing, weed invasion, fragmentation, inappropriate fire regime or grazing pressure, or infrastructure development.*

*****Moderate degradation and/or biodiversity loss is defined as: floristic and/or faunal diversity is greatly reduced but unlikely to recover within the next 20 years even with the removal of threatening processes; or soil surface is moderately degraded.*

2. Remnant Regional Ecosystems

The following table identifies the remnant regional ecosystems and vegetation communities mapped within the AOI and provides their short descriptions, Biodiversity Status, and remnant extent within the selected AOI. Please note, where heterogeneous vegetated patches (mixed patches of remnant vegetation mapped as containing multiple regional ecosystems) occur within the AOI, they have been split and listed as individual regional ecosystems (or vegetation communities where present) for the purposes of the table below. In such instances, associated area figures have been generated based upon the estimated proportion of each regional ecosystem (or vegetation community) predicted to be present within the larger mixed patch.

Table 3: Remnant regional ecosystems, description and status within the AOI

Regional Ecosystem	Short Description	BD Status	Area (Ha)	% of AOI
2.10.5a	Acacia shirleyi woodland and Triodia pungens hummock grassland on scarps and stony ledges	No concern at present	117.14	9.32
2.10.9	Rock pavements and outcrops with patches of Acacia spp., Corymbia spp. and Eucalyptus spp. in dissected Mesozoic sandstone ranges.	Of concern	34.13	2.72
2.11.1a	Eucalypt woodland and deciduous woodland on stony hills on folded sediments	No concern at present	265.75	21.15
9.11.16	Eucalyptus crebra +/- Corymbia erythrophloia or C. pocillum woodland on steep to rolling hills	No concern at present	222.41	17.7
9.11.30b	Acacia leptostachya low woodland with emergents on stony and rocky metamorphic hills	No concern at present	29.63	2.36
9.12.11	Eucalyptus crebra and/or E. whitei +/- Corymbia erythrophloia open woodland on steep to rolling hills on igneous rocks	No concern at present	490.68	39.05
9.12.36a	Cochlospermum gregorii or C. gillivraei deciduous low woodland on rocky outcrops	No concern at present	25.72	2.05
9.3.20	Eucalyptus microneura +/- Corymbia spp. +/- E. leptophleba woodland on alluvial plains	No concern at present	56.04	4.46
9.3.26	Mixed grassland to open grassland including Eragrostis sp., Aristida sp., Enneapogon sp., Iseilema sp., Chloris sp. or Dichanthium sp. on non-basalt derived alluvial deposits	Of concern	14.63	1.16
9.5.10a	Eucalyptus microneura +/- Terminalia spp. low woodland on sand sheets	No concern at present	0.41	0.03

Refer to **Map 2** for further information. **Map 3** also provides a visual estimate of the distribution of regional ecosystems present before clearing.

Table 4 provides further information in regards to the remnant regional ecosystems present within the AOI. Specifically, the extent of remnant vegetation remaining within the bioregion, the 1:1,000,000 broad vegetation group (BVG) classification, whether the regional ecosystem is identified as a wetland, and extent of representation in Queensland's Protected Area Estate. For a description of the vegetation communities within the AOI and classified according to the 1:1,000,000 BVG, refer to **Table 6**.

Table 4: Remnant regional ecosystems within the AOI, additional information

Regional Ecosystem	Remnant Extent	BVG (1 Million)	Wetland	Representation in protected estate
2.10.5a	Pre-clearing 343000 ha; Remnant 2019 343000 ha	24a	Not a Wetland	High
2.10.9	Pre-clearing 8000 ha; Remnant 2019 8000 ha	29b	Not a Wetland	High
2.11.1a	Pre-clearing 57000 ha; Remnant 2019 57000 ha	13c	Not a Wetland	High
9.11.16	Pre-clearing 312000 ha; Remnant 2019 312000 ha	13c	Not a Wetland	Medium
9.11.30b	Pre-clearing 18000 ha; Remnant 2019 18000 ha	24a	Not a Wetland	High
9.12.11	Pre-clearing 160000 ha; Remnant 2019 160000 ha	13c	Not a Wetland	Low
9.12.36a	Pre-clearing 186000 ha; Remnant 2019 185000 ha	27c	Not a Wetland	Medium
9.3.20	Pre-clearing 44000 ha; Remnant 2019 44000 ha	18d	Not a Wetland	Low
9.3.26	Pre-clearing 23000 ha; Remnant 2019 22000 ha	32a	Contains Palustrine	Medium
9.5.10a	Pre-clearing 94000 ha; Remnant 2019 93000 ha	18d	Not a Wetland	Medium

Representation in Protected Area Estate: High greater than 10% of pre-clearing extent is represented; Medium 4 - 10% is represented; Low less than 4% is represented, No representation.

The distribution of mapped wetland systems within the area of interest is displayed in **Map 6**.

The following table lists known special values associated with a regional ecosystem type.

Table 5: Remnant regional ecosystems within the AOI, special values

Regional Ecosystem	Special Values
2.10.5a	Potential habitat for NCA listed species: Drummondita calida, Labichea brassii, Leptospermum pallidum 2.10.5a: Supports plant species with restricted geographic ranges.
2.10.9	None
2.11.1a	Potential habitat for NCA listed species: Pluchea punctata 2.11.1c: Supports plant species with restricted geographic ranges.
9.11.16	Potential habitat for NCA listed species: Labichea brassii, Macropteranthes montana
9.11.30b	None
9.12.11	None
9.12.36a	Potential habitat for NCA listed species: Acacia guymeri, Cycas cairnsiana, Euphorbia carissoides, Macropteranthes montana 9.12.36a: Habitat for the vulnerable plant species Cycas cairnsiana
9.3.20	Significant habitat particularly for herbivores such as macropods and arboreal mammals
9.3.26	Significant habitat particularly for herbivores such as macropods and arboreal mammals
9.5.10a	None

3. Remnant Regional Ecosystems by Broad Vegetation Group

BVGs are a higher-level grouping of vegetation communities. Queensland encompasses a wide variety of landscapes across temperate, wet and dry tropics and semi-arid climatic zones. BVGs provide an overview of vegetation communities across the state or a bioregion and allow comparison with other states. There are three levels of BVGs which reflect the approximate scale at which they are designed to be used: the 1:5,000,000 (national), 1:2,000,000 (state) and 1:1,000,000 (regional) scales.

A comprehensive description of BVGs is available at:

https://publications.qld.gov.au/dataset/redd/resource/

The following table provides a description of the 1:1,000,000 BVGs present and their associated extent within the AOI.

Table 6: Broad vegetation groups (1 million) within the AOI

BVG (1 Million)	Description	Area (Ha)	% of AOI
13c	Woodlands of Eucalyptus crebra (sens. lat.) (narrow-leaved red ironbark), E. drepanophylla (grey ironbark), E. fibrosa (dusky-leaved ironbark), E. shirleyi (shirley's silver-leaved ironbark) on granitic and metamorphic ranges (land zones 12, 11, 9, [5]) (BRB, EIU, SEQ, NET, CQC)	978.85	77.9
18d	Woodlands to low open woodlands dominated by Eucalyptus microneura (Gilbert River box) sometimes with Corymbia spp. (land zones 5, 10, 3, 12) (GUP, EIU)	56.45	4.49
24a	Low woodlands to tall shrublands dominated by Acacia spp. on residuals. Species include A. shirleyi (lancewood), A. catenulata (bendee), A. microsperma (bowyakka), A. clivicola, A. sibirica, A. rhodoxylon (rosewood) and A. leptostachya (Townsville wattle). (land zones 7, 10, 5, 12, 11, [9, 3]) (MUL, CHC, BRB, GUP, EIU, MGD, DEU, NWH, [CYP])	146.77	11.68
27c	Low open woodlands dominated by a variety of species including Grevillea striata (beefwood), Acacia spp., Terminalia spp. or Cochlospermum spp. (land zones 9, 12, 3, 11, 5) (NWH, EIU, DEU, GUP, [BRB])	25.72	2.05
29b	Open shrublands to open heaths in montane frequently rocky locations. (land zones 7, 12, 11, 5, 8, 10) (BRB, NWH, WET, CYP, EIU, SEQ, DEU, [NET, CQC])	34.13	2.72
32a	Closed tussock grasslands dominated by Themeda arguens, Dichanthium sericeum (Queensland bluegrass) or Panicum spp., Eriachne spp., Fimbristylis spp., Aristida spp. or Imperata cylindrica (blady grass) on marine and alluvial plains. (land zones 3, [5]) (GUP, CYP, [BRB,EIU, WET, CQC])	14.63	1.16

Refer to **Map 4** for further information. **Map 5** also provides a representation of the distribution of vegetation communities as per the 1:5,000,000 BVG believed to be present prior to European settlement.

4. Technical and BioCondition Benchmark Descriptions

Technical descriptions provide a detailed description of the full range in structure and floristic composition of regional ecosystems (e.g. 11.3.1) and their component vegetation communities (e.g. 11.3.1a, 11.3.1b). See:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

The descriptions are compiled using site survey data from the Queensland Herbarium's CORVEG database. Distribution maps, representative images (if available) and the pre-clearing and remnant extent (hectares) of each vegetation community derived from the regional ecosystem mapping data are included. The technical descriptions should be used in conjunction with the fields from the regional ecosystem description database (REDD) for a full description of the regional ecosystem.

Technical descriptions include data on canopy height, canopy cover and native plant species composition of the predominant layer, which are attributes relevant to assessment of the remnant status of vegetation under the *Vegetation Management Act 1999*. However, as technical descriptions reflect the full range in structure and floristic composition across the climatic, natural disturbance and geographic range of the regional ecosystem, local reference sites should be used for remnant assessment where possible (Neldner et al. 2020 (PDF))* section 3.3 of:

https://publications.qld.gov.au/dataset/redd/resource/

The technical descriptions are subject to review and are updated as additional data becomes available.

When conducting a BioCondition assessment, these technical descriptions should be used in conjunction with BioCondition benchmarks for the specific regional ecosystem, or component vegetation community.

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

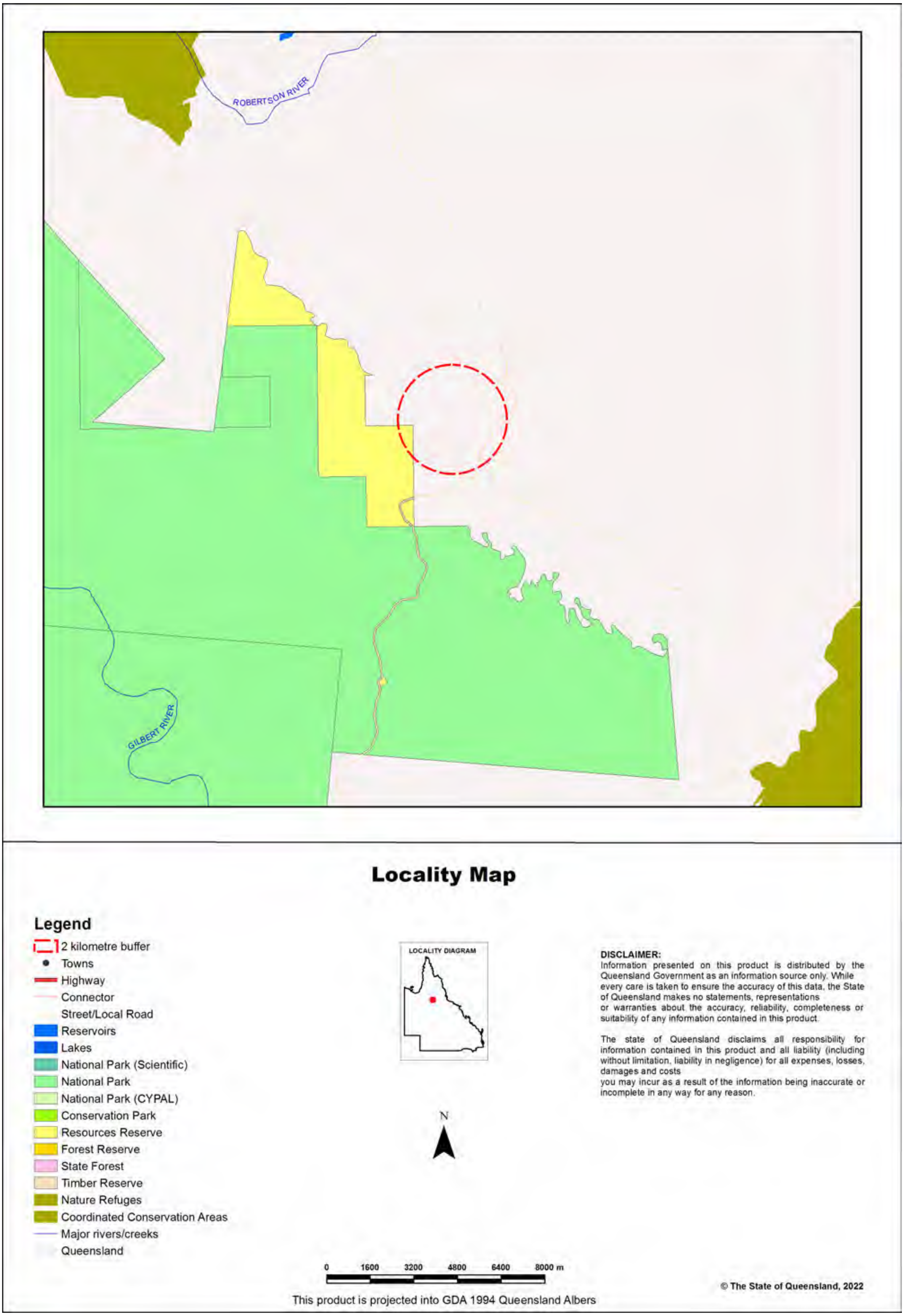
Benchmarks are based on a combination of quantitative and qualitative information and should be used as a guide only. Benchmarks are specific to one regional ecosystem vegetation community, however, the natural variability in structure and floristic composition under a range of climatic and natural disturbance regimes has been considered throughout the geographic extent of the regional ecosystem. Local reference sites should be used for this spatial and temporal (seasonal and annual) variability.

Table 7: List of remnant regional ecosystems within the AOI for which technical and biocondition benchmark descriptions are available

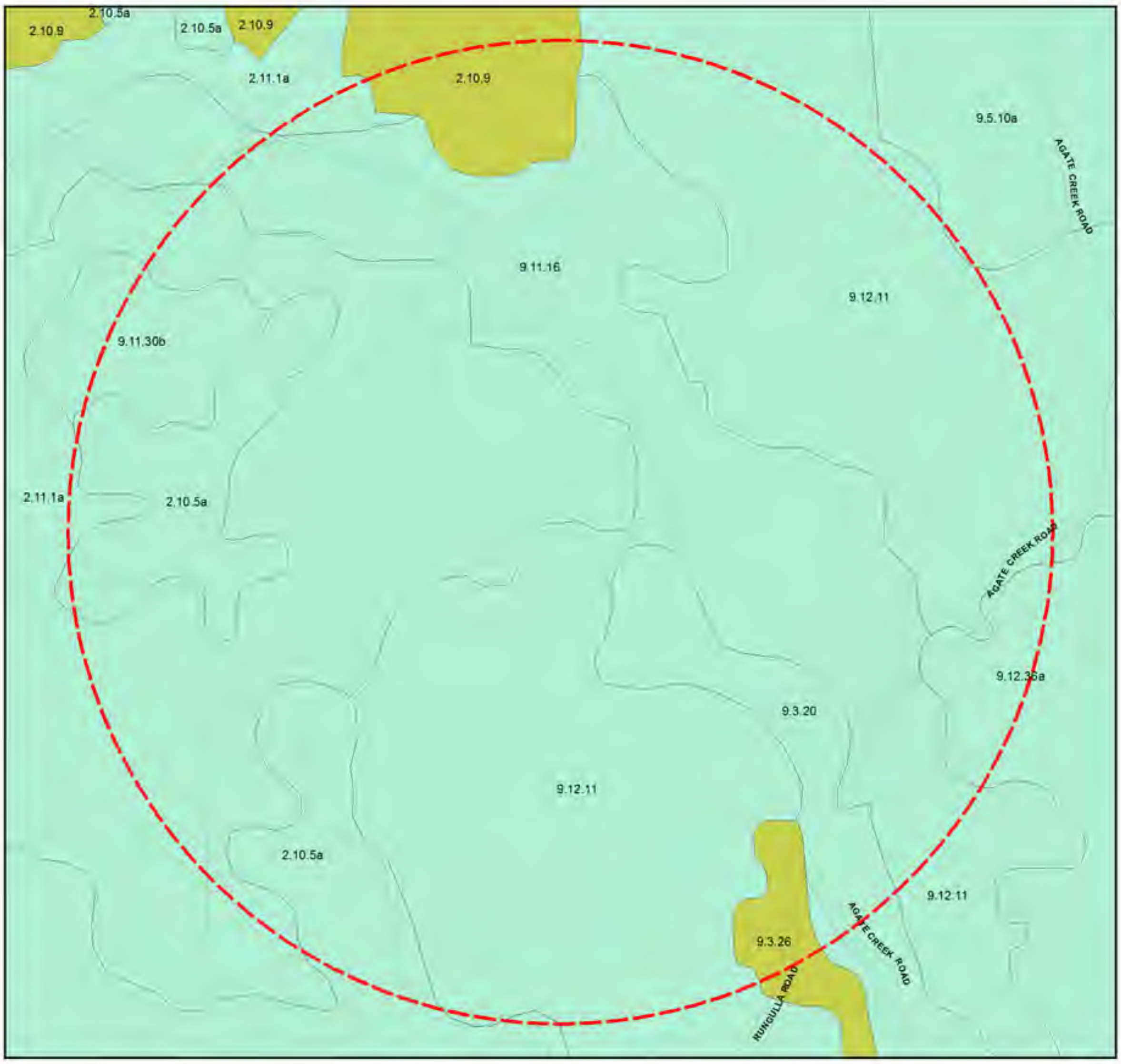
Regional ecosystems mapped as within the AOI	Technical Descriptions	Biocondition Benchmarks
2.10.5a	Not currently available	Not currently available
2.10.9	Not currently available	Not currently available
2.11.1a	Not currently available	Not currently available
9.11.16	Available	Not currently available
9.11.30b	Not currently available	Not currently available
9.12.11	Available	Not currently available
9.12.36a	Available	Not currently available
9.3.20	Available	Not currently available
9.3.26	Not currently available	Not currently available
9.5.10a	Available	Not currently available

Maps

Map 1 - Location



Map 2 - Remnant 2019 regional ecosystems



Remnant 2019 Regional Ecosystems

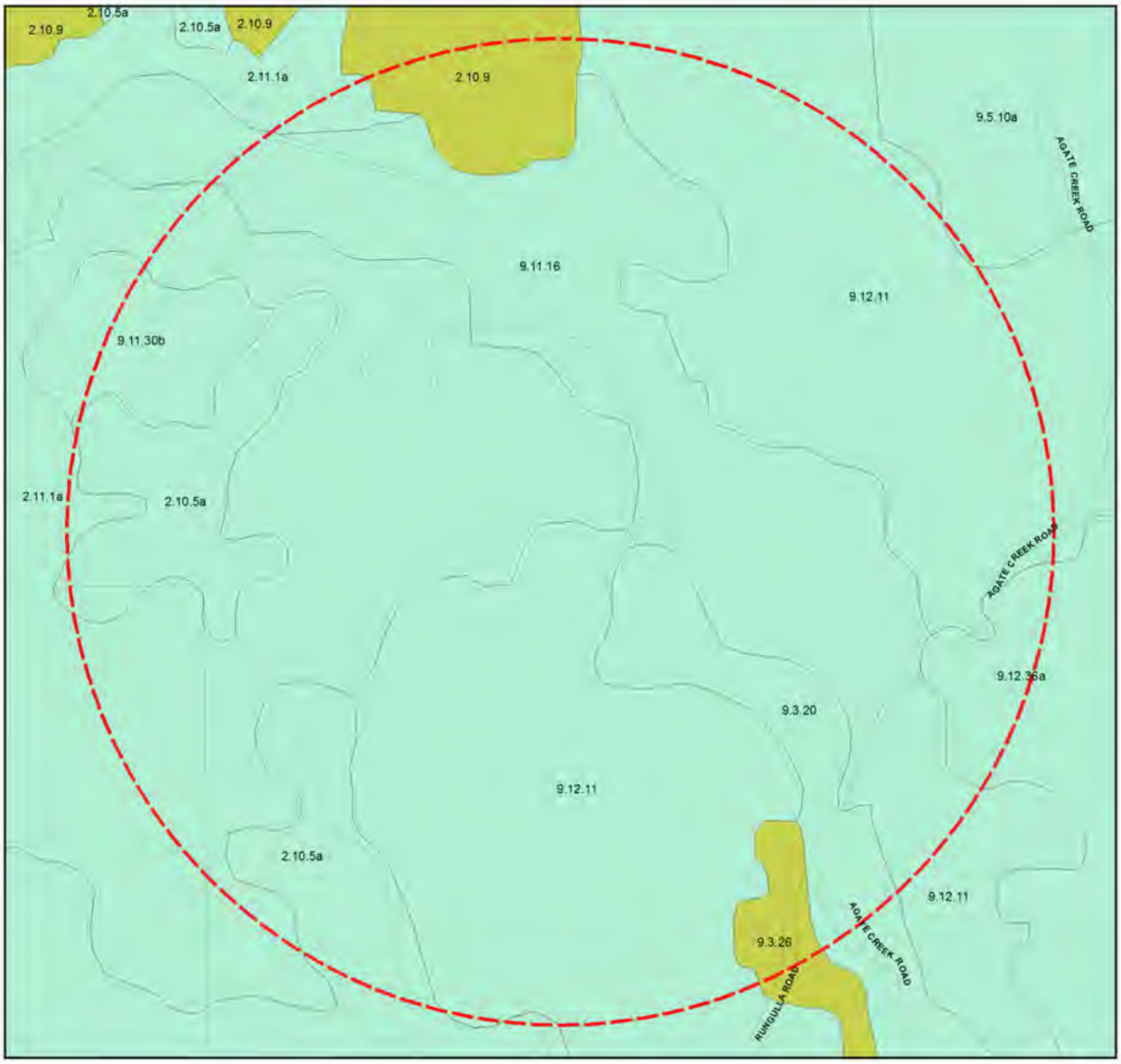
Biodiversity Status

- 2 kilometre buffer
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Non-remnant vegetation, cultivated or built environment
- Plantation
- Water
- Cadastral Boundaries

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The polygons are labelled by regional ecosystem (RE); where more than one RE occurs, the percentage of each is labelled. The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

This product is projected into GDA 1994 Queensland Albers

Map 3 - Pre-clearing regional ecosystems



Pre-clearing Regional Ecosystems

Biodiversity Status

- 2 kilometre buffer
- Endangered - Dominant vegetation
- Endangered - Sub-dominant
- Of Concern - Dominant
- Of Concern - Sub-dominant
- No concern at present
- Water
- Cadastral Boundaries

N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
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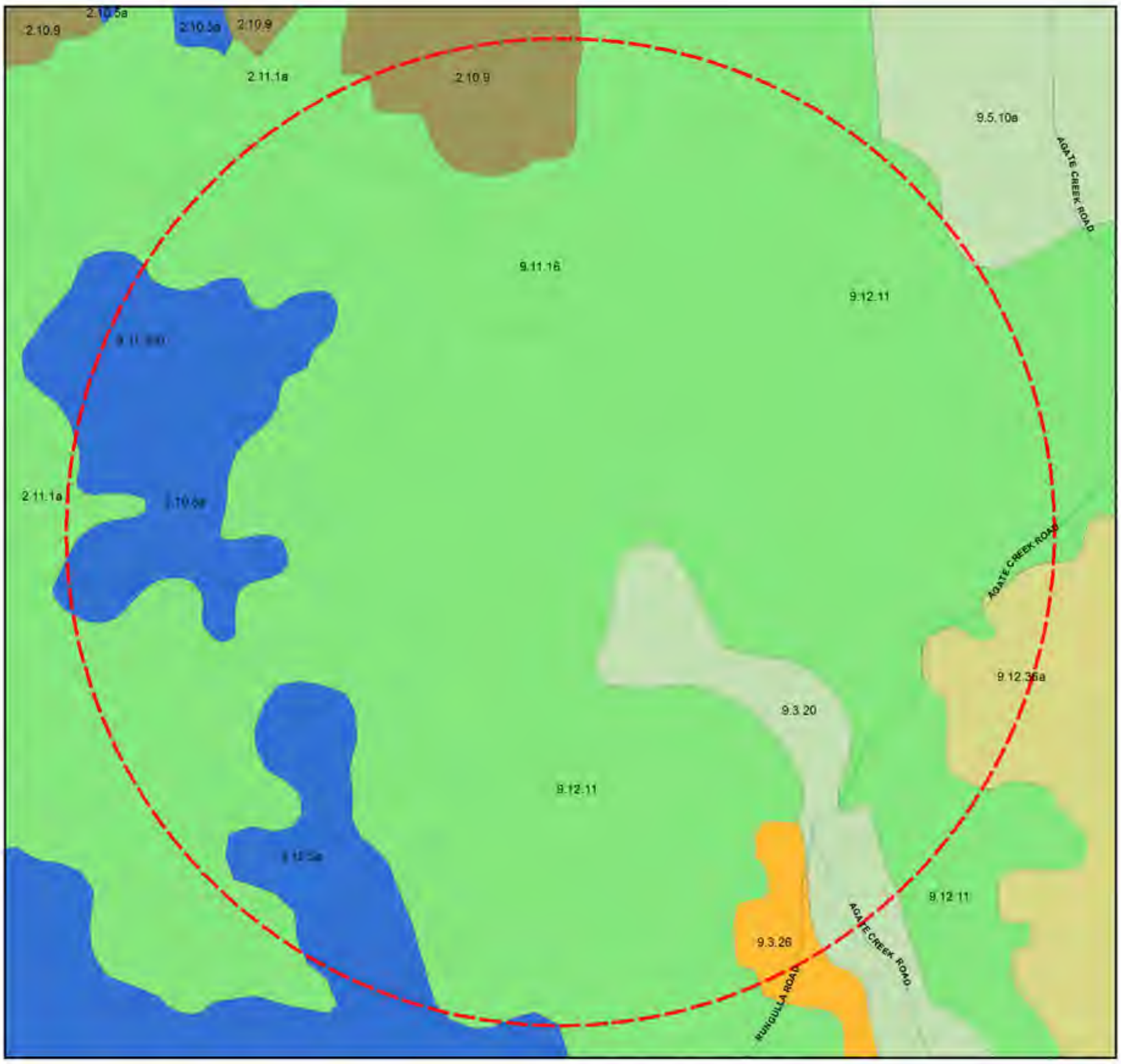
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Map 4 - Remnant 2019 regional ecosystems by BVG (5M)



Remnant 2019 Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups

BVG5M Description (BVG1M codes)

- 2 kilometre buffer
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
- 11. Mixed species woodlands, open woodland - (inland bioregions) includes wooded downs (27-27c)
- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Non-remnant vegetation, cultivated or built environment
- Water
- Cadastral Boundaries

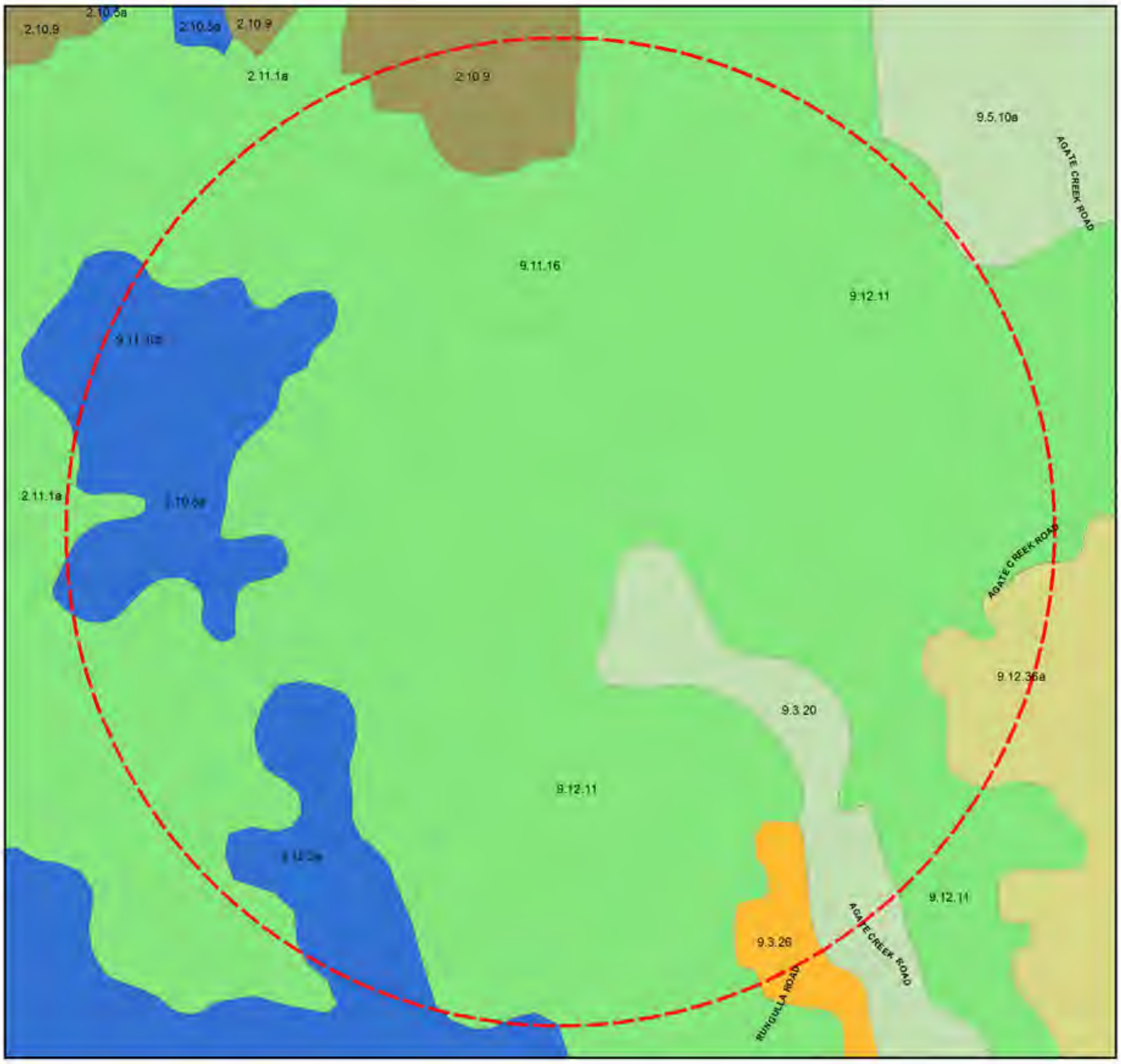
N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.
Remnant woody vegetation is defined as vegetation that has not been cleared or vegetation that has been cleared but where the dominant canopy has >70% of the height and >50% of the cover relative to the undisturbed height and cover of that stratum and is dominated by species characteristic of the vegetation's undisturbed canopy.
Non-remnant vegetation includes regrowth and disturbed native vegetation.

Map 5 - Pre-clearing regional ecosystems by BVG (5M)



Pre-clearing Regional Ecosystems coloured by Broad Vegetation Groups

Broad Vegetation Groups
BVG5M Description (BVG1M codes)

- 2 kilometre buffer
- 1. Rainforests and scrubs (1-7b)
- 2. Wet eucalypt open forests (8-8b)
- 3. Eucalypt woodlands to open forests (mainly eastern Qld) (9-15b)
- 4. Eucalypt open forests to woodlands on floodplains (16-16d)
- 5. Eucalypt dry woodlands on inland depositional plains (17-18d)
- 6. Eucalypt low open woodlands usually with spinifex understorey (19-19d)
- 7. Callitris woodland - open forests (20a)
- 8. Melaleuca open woodlands on depositional plains (21-22c)
- 9. Acacia aneura (mulga) dominated open forests, woodlands and shrublands (23-23b)
- 10. Other acacia dominated open forests, woodlands and shrublands (24-26a)
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- 12. Other coastal communities or heaths (28-29b)
- 13. Tussock grasslands, forblands (30-32b)
- 14. Hummock grasslands (33-33b)
- 15. Wetlands (swamps and lakes) (34-34g)
- 16. Mangroves and saltmarshes (35-35b)
- Water
- Cadastral Boundaries

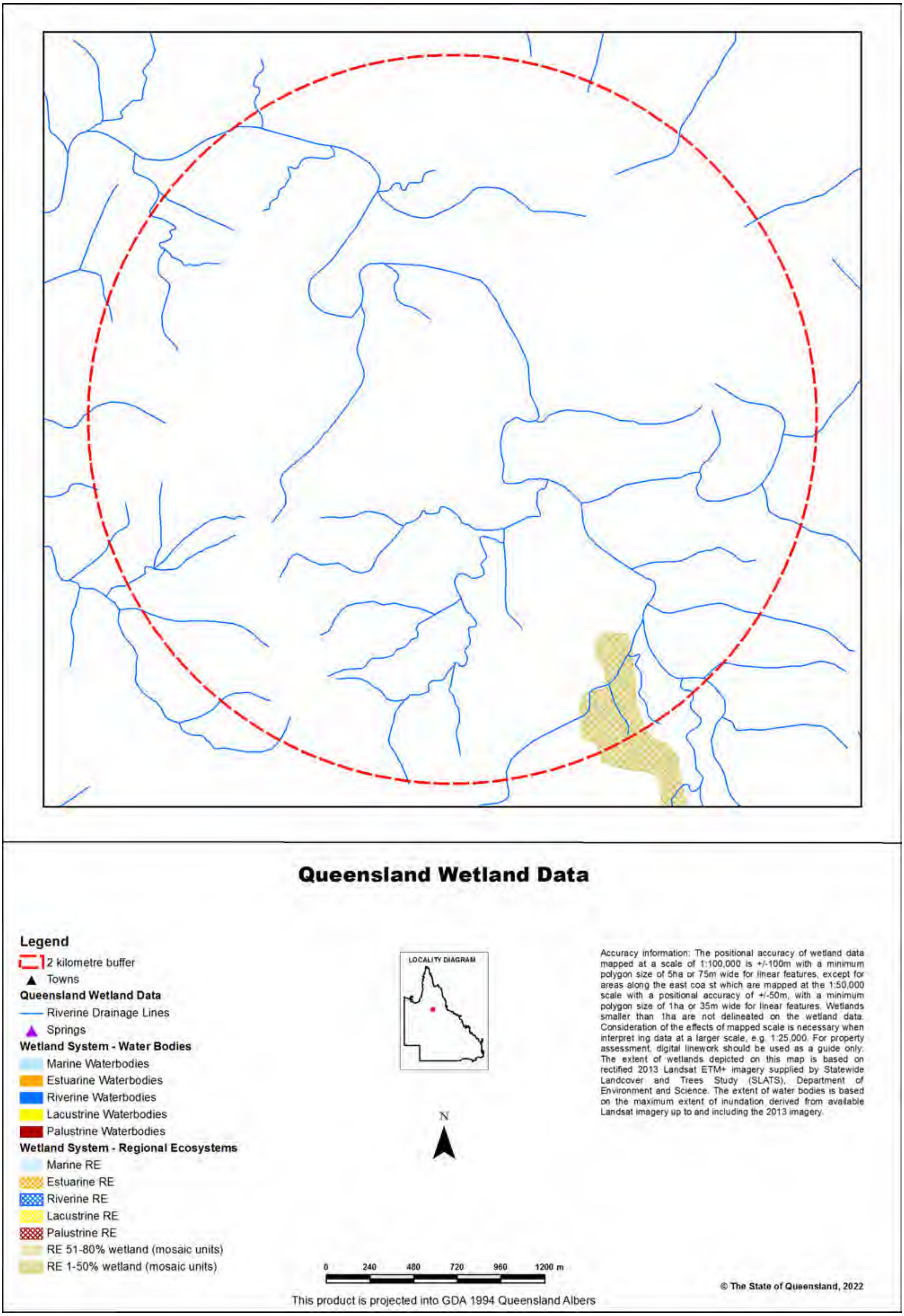
N

0 0.25 0.5 0.75 1 km

This product is projected into GDA 1994 Queensland Albers

Broad Vegetation Groups (BVG) of Queensland are applied by look up table to the regional ecosystem vegetation communities. Each polygon is coloured by the dominant BVG5M and the component regional ecosystems labelled. Where more than one regional ecosystem occurs, the percentage of each is labelled.
Regional ecosystem mapping over the majority of Queensland is produced at a scale of 1:100,000. At this scale, the minimum remnant polygon area is 5 hectares or minimum remnant width of 75 metres. Regional ecosystem linework reproduced at a scale greater than 1:100,000, except in designated areas, should be used as a guide only. The precision of polygon boundaries or positional accuracy of linework is 100 metres.
Regional ecosystems are defined as vegetation communities in a bioregion that are consistently associated with a particular combination of geology, landform and soil.
The label consists of 3 components: bioregion, land zone, and vegetation community – the dominant canopy species. e.g.: RE 12.3.3. Descriptions of REs are found online. Use the search term "Regional Ecosystem Framework".
Regional ecosystem mapping at 1:100,000 map scale is derived from the following sources: 1:80,000 B&W 1960's aerial photography, Landsat TM imagery, geology, soils, land systems data, field survey and historical records.

Map 6 - Wetlands and waterways



Links and Other Information Sources

The Department of Environment and Science's Website -

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/

provides further information on the regional ecosystem framework, including access to links to the Regional Ecosystem Database, Broad Vegetation Group Definitions, Regional Ecosystem and Land zone descriptions.

Descriptions of the broad vegetation groups of Queensland can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

The methodology for mapping regional ecosystems can be downloaded from:

https://publications.qld.gov.au/dataset/redd/resource/

Technical descriptions for regional ecosystems can be obtained from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/technical-descriptions/

Benchmarks can be obtained from:

http://www.qld.gov.au/environment/plants-animals/biodiversity/benchmarks/

For further information associated with the remnant regional ecosystem dataset used by this report, refer to the metadata associated with the Biodiversity status of pre-clearing and Remnant Regional Ecosystems of Queensland dataset (version listed in **Appendix 1**) which is available through the Queensland Government Information System portal,

http://dds.information.qld.gov.au/dds/

The Queensland Globe is a mapping and data application. As an interactive online tool, Queensland Globe allows you to view and explore Queensland maps, imagery (including up-to-date satellite images) and other spatial data, including regional ecosystem mapping. To further view and explore regional ecosystems over an area of interest, access the Biota Globe (a component of the Queensland Globe). The Queensland Globe can be accessed via the following link:

http://www.dnrm.qld.gov.au/mapping-data/queensland-globe

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Sattler, P.S. and Williams, R.D. (eds) (1999). *The Conservation Status of Queensland's Bioregional Ecosystems*. Environmental Protection Agency, Brisbane.

Appendices

Appendix 1 - Source Data

The dataset listed below is available for download from:

http://www.qld.gov.au/environment/plants-animals/plants/ecosystems/download/

- Regional Ecosystem Description Database

The datasets listed below are available for download from:

http://dds.information.qld.gov.au/dds/

- Biodiversity status of pre-clearing and 2019 remnant regional ecosystems of Queensland
- Pre-clearing Vegetation Communities and Regional Ecosystems of Queensland
- Queensland Wetland Data Version - Wetland lines
- Queensland Wetland Data Version - Wetland points
- Queensland Wetland Data Version - Wetland areas

Appendix 2 - Acronyms and Abbreviations

AOI	- Area of Interest
GDA94	- Geocentric Datum of Australia 1994
GIS	- Geographic Information System
RE	- Regional Ecosystem
REDD	- Regional Ecosystem Description Database
VMA	- *Vegetation Management Act 1999*

Appendix B – Fish Photos

Chequered Rainbowfish – *Melanotaenia splendida inornata*

Macleay's Glassfish – *Ambassis macleayi*

Spangled Perch – *Leiopotherapon unicolor*

Hyrtl's Tandan – *Neosilurus hyrtlii*

Appendix K – Hydrogeological Assessment

C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
Contaminated Site and Mine Water Analysis
Environmental Compliance and Monitoring
Estuarine and Marine Water Assessments
Registered Research and Development
Surface and Groundwater Hydrology

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13 October 2022

Mr. Matthew Ayre
Principal Environmental Advisor
Wulguru Technical Services Pty Ltd
PO Box 2553
Idalia, QLD, 4810

Re: Agate Creek Groundwater Monitoring Network

Dear Mr. Ayre,

Wulguru Technical Services Pty Ltd (WTS) contracted C&R Consulting Pty Ltd (C&R) to undertake hydrogeological study of the are encompassed by the Agate Creek Gold Mine (ACGM) to support a major environmental authority (EA) amendment application (C&R, 2022)[1]. C&R completed our report in July 2022 and WTS subsequently submitted the report to the Queensland Department of Environment and Science (DES) as part of the EA application's supporting documentation. It is understood that, following review of C&R's report, DES have questions surrounding the timing of some of the recommended outcomes of the report associated with section '*7.2 – Network Suitability*'.

The last sentence in paragraph 1 of section '*7.2 – Network Suitability*' states:

'Accordingly, it is strongly recommended the monitoring bores drilled in 2020 are decommissioned and redrilled in accordance with the Australian guideline and implemented into the Agate Creek groundwater monitoring programme'

This statement is still fundamentally correct, although it failed to take into consideration the location of the newly established bores (in 2021) with respect to the proposed mine layout/disturbance areas and therefore, the suitability of the remaining network to appropriately monitor potential impacts to groundwater systems from ACGM. Therefore, the following reword, of the last sentence in paragraph 1 of section '*7.2 – Network Suitability*', is recommended:

'*Accordingly, it is recommended that the monitoring bores drilled in 2020 (CCWB517 – CCWB26, Table 9) are decommissioned to reduce the likelihood of aquifer mixing occurring. Further, it is recommended that the remaining monitoring network suitability be reassessed following the acquisition of sufficient data from the 2021 bore network (CCWB27 – CCWB38, Table 9). This assessment should be undertaken in conjunction with a review of the proposed mining footprint and the surrounding environmental values. While focusing on the ability to accurately detect changes within the resident groundwater systems, the assessment should determine which of the 2020 drilled bore network (i.e. CCWB517 – CCWB26) requires redrilling/re-instatement, if at all.'*

[1] C&R (2022). Agate Creek Gold Mine: Stage 2 Major EA Amendment – Hydrogeology. Report prepared for Wulguru Technical Services Pty Ltd.

Therefore, while it is still recommended that the 2020 drilled bores (CCWB517 – CCWB26) be decommissioned, the requirement for their reinstallation is not well understood until additional data from the 2021 drilled bore network has been reviewed against proposed disturbance footprints. Once sufficient data has been collected from the 2021 drilled bores, the site will have a better understanding of the aquifers present and their flow regimes (i.e. flow direction and recharge values) to appropriately guide the requirement of further monitoring bores (if required at all).

If you have any questions regarding these statements or the best way forward to manage the monitoring bore network at AGCM, please do not hesitate to contact me.

Regards,

Sian Kennare

Principal Hydrogeologist
C&R Consulting Pty Ltd

C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
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AGATE CREEK GOLD MINE

Stage 2 Major EA Amendment – Hydrogeology

Report Prepared for:

Date:
July 2022

IMPORTANT NOTE

Christopher Cuff

Dr Chris Cuff
Director

22 July 2022

Date

Cecily Rasmussen

Dr Cecily Rasmussen
Director

22 July 2022

Date

IMPORTANT INFORMATION

1. This report is prepared and written in the context of the proposals stated in the introduction to this report and its contents should not be used out of context. Furthermore, new information, developing practices and changes in legislation may necessitate revised interpretation of the report after its original submission.
2. The copyright in the written materials shall remain the property of C&R Consulting but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to C&R Consulting by the client of the outstanding amounts.
3. The report is provided for sole use by the addressees and is confidential to them and their professional advisors. No responsibility whatsoever for the contents of the report will be accepted to any person other than the addressees.
4. Where data have been supplied by the client or other sources, including data from previous site audits or investigations, it has been assumed that the information is correct, but no warranty is given to that effect. Although reasonable care and skill has been applied in review of these data, no responsibility can be accepted by C&R Consulting for inaccuracies in the data supplied.
5. This report contains only available factual data obtained for the site/s from the sources described in the text. These data were related to the site/s on the basis of the location information made available to C&R Consulting by the client.
6. The assessment of the site/s is based on information supplied by the client, and on-site inspections by C&R Consulting.
7. The report reflects both the information provided to C&R Consulting in documents made available for review and the results of observations and consultations by C&R Consulting staff.

SUMMARY OF RELEVANT INFORMATION

Project Title	Agate Creek Major EA Amendment – Hydrology Assessment
Property Location	Agate Creek Gold Mine
Property Description	Open-cut gold mine
Project Purpose	Complete an assessment of the hydrogeological systems that may potentially be impacted by the advancement of the stage 2 Agate Creek Gold Mine.
Project Number	21108
Client's Details	
Nominated Representative	Scott Hayes Stanley
Title/Position	Director
Company	Wulguru Technical Services
Telephone	0437 799 193
Email	scott@wulgurutechservices.com.au
Author's Details	
Primary Author	Sian Kennare
Qualifications	Graduate Diploma of Science (Groundwater), Master of Environmental Management. Bachelor of Environmental Science.
Experience	10 years in the resource sector
Affiliations	International Association of Hydrogeologists. Environmental Institute of Australia and New Zealand.

DOCUMENT CONTROL

Version	Compiled by	Date issued	Reviewer(s)	Date returned
Draft 1	S. Kennare	13/05/2022	Dr J. Jaffrés	18/05/2022
Draft 2	S. Kennare	19/05/2022	M. Ayre (WTS)	12/07/2022
FINAL	M. Knott	22/07/2022	-	-

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EXECUTIVE SUMMARY

The Agate Creek is an open-cut gold mining operation proposal for a stage 2 expansion of mining activities which are to involve six different open-cut pits. The proposed expansion has been assessed for the level of impact on the surrounding aquifer systems.

The groundwater monitoring network consists of ten monitoring bores within an area of approximately 1.5 km^2 that incorporates all six proposed voids. The network targets a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. Specifically, all bores are screened within metamorphic rocks that have been intruded by Siluro-Devonian-age Robin Hood Granodiorite – and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex.

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range. This was later confirmed – with pump tests completed on each monitoring bore, whereby hydraulic conductivities ranged between 6.57 x 10^{-8} m/sec and 5.06 x 10^{-7} m/sec.

The potentiometric surface suggests that the groundwater flow direction follows the surface topography whereby water moves from high elevation on the western boundary (CCWB519) to low elevation beside Agate Creek (CCWB521). The elevation difference between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

Excluding the designated Agate Creek monitoring bores, no groundwater bores were identified within a 5 km buffer from the mining lease boundary. Further, the closest groundwater-dependent ecosystem is associated with the sandstone aquifer approximately 10 km away. Two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active.

The groundwater across the bore network represents good quality water, with most bores reporting properties below guideline values for drinking water and livestock drinking water, except for fluoride.

The groundwater assessment for the Agate Creek mine expansion found that the risk to groundwater systems was low, with poor hydraulic conductivities restricting the zone of influence to within the mining lease boundary for several decades.

1. INTRODUCTION

C&R Consulting Pty Ltd (C&R) have been engaged to complete the hydrogeological study of the Agate Creek Gold Mine (Agate Creek) stage 2 expansion, on behalf of Wulguru Technical Services (WTS). This study will form part of a major environmental authority (EA) amendment and progressive rehabilitation and closure plan (PRCP) that WTS are currently preparing on behalf of Agate Creek's current owners, Laneway Resources (Laneway). Laneway intends to progress Agate Creek into the stage 2 expansion phase, requiring approval to mine in excess of 250,000 tonnes of ore and a major EA amendment.

Agate Creek is located in north Queensland, approximately 340 km (520 km by road) west of Townsville and 78 km (175 km by road) south of the township of Georgetown (Figure 1). Alluvial gold was reported at Agate Creek in the early 20th century and was followed by various prospecting activities – including panning, shallow digs and regional exploration.

In February 2015, Laneway lodged a mining lease application for the Agate Creek prospect following a successful 5,000 tonne bulk trial pit. Mining lease (ML) 100030 was granted to Laneway on 7 February 2019, allowing Laneway to mine up to 250,000 tonnes of ore at Agate Creek under EA EPSL03068015 (dated 6 September 2021).

Agate Creek is required to assess the level of impact to surrounding groundwater systems due to mining activities. C&R performed the Agate Creek hydrogeological impact assessment in conjunction with the underground water impact report (UWIR). The UWIR is a requirement of the groundwater management framework legislated under Chapter 3 of the Queensland *Water Act 2000* (Water Act).

1.1 UWIR Scope and Structure

The UWIR is a requirement of the groundwater management framework legislated under Chapter 3 of the Water Act. The main purpose of the UWIR is to describe the groundwater take due to mining (and any associated impacts) over a three-year period (the UWIR period). The UWIR has been prepared in accordance with Section 376 of the Water Act and the Department of Environment and Science (DES) guideline (the UWIR guideline), where relevant. The specific scope of the UWIR includes:

- A review of relevant groundwater, project development, geological and environmental reports from the mine site to develop an appreciation of the hydrogeological setting of the project;
- An updated review of hydrogeological data held on the Department of Natural Resources, Mines and Energy (DNRME) groundwater database to identify water supply bores;
- An updated census of water supply bores to confirm the extent of groundwater use in the area and collect relevant groundwater monitoring data;
- Confirmation of the conceptual model of the groundwater regime of the mine site and its surrounds, based on all available data;
- Refinement of the existing numerical groundwater model to allow the mining effects on groundwater levels to be presented for the first three years of mining;
- Confirmation of the groundwater impacts over the first three years of mining;
- Confirmation of the existing, approved EA groundwater monitoring programme and management measures.

The UWIR includes:

- An introduction to the UWIR (Section 1);

- Relevant regulatory UWIR requirements (Section 2);
- Site description (Section 3);
- Assessment methods (Section 4);
- Groundwater regime and sensitive environmental features (Section 5);
- Groundwater impact assessment (Section 6);
- Groundwater monitoring programme (Section 7);
- Directions for reviewing and updating the UWIR (Section 7.3); and
- Conclusions (Section 8).

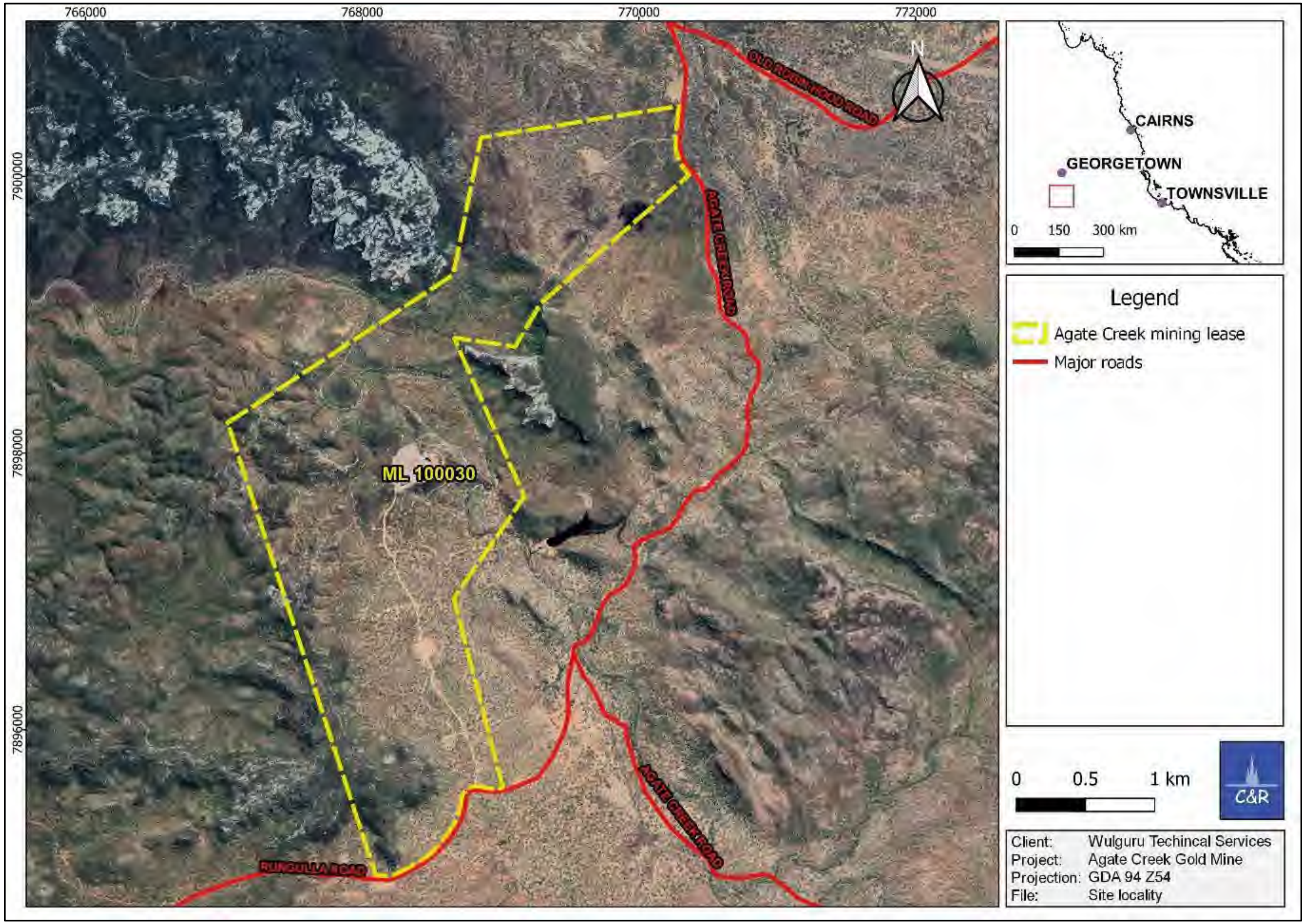

Figure 1: Agate Creek locality.

2. LEGISLATIVE REQUIREMENTS

The activities proposed under the project are regulated by the Water Act and the EP Act. The specific requirements under these regulations are the submission of an UWIR, which is required under The Water Act and a major EA amendment (required under the Queensland *Environmental Protection Act 1994* [EP Act]).

This report addresses the UWIR content requirements for both acts (see Table 1).

2.1.1 ENVIRONMENTAL PROTECTION ACT 1994 (QLD)

The EP Act provides a regulatory framework for the protection and management of the Queensland environment. Under the EP Act, environmentally relevant activities (ERAs) – such as mining – are licensed under EAs, which prescribe specific conditions for conducting ERAs. The objective of the EP Act is to protect Queensland's environment while allowing for sustainable development.

For the purposes of the EP Act, underground water rights refer to the statutory right afforded under the *Mineral Resources Act 1989* of a mining lease holder to "*take or interfere with underground water in the area of the tenure if the taking or interference with that water is necessarily and unavoidably obtained in the process of extracting the resource*" (Department of Environment Heritage Protection [DEHP], 2016).

A guideline from the Department of Environment and Science (DES, formerly DEHP) outlines the groundwater information required for an EA amendment application that involves the exercise of underground water rights under sections 126A and 227AA of the EP Act (DEHP, 2016). Section 126A of the EP Act requires specific information from applicants for a site-specific EA application (a new EA). Section 227AA requires that – if a change in mining activities necessitates changes to the exercise of underground water rights – a major EA amendment application must also fulfil the requirements of section 126A. Thus, the supporting information for Laneway's application to amend EA EPSL03068015 falls under section 227AA of the EP Act (and must therefore also comply with section 126A of the EP Act).

2.1.2 WATER ACT 2000 (QLD)

The Water Act was established primarily to provide a legal framework for the sustainable management of water and the management of impacts on underground water. Section 376 of the Water Act outlines the content of a UWIR. The requirements under section 376 of the Water Act are similar, but not identical, to those from sections 126A and 227AA of the EP Act (see Section 2.1.1).

Table 1: UWIR content requirements.

Water Act section no.	Water Act section content	UWIR cross-reference
376(1)(a)	An underground water impact report must include each of the following—for the area to which the report relates— (i) the quantity of water produced or taken from the area because of the exercise of any previous relevant underground water rights; and (ii) an estimate of the quantity of water to be produced or taken because of the exercise of the relevant underground water rights for a 3-year period starting on the consultation day for the report.	(i) No groundwater has been produced or taken from the mine site due to the exercise of underground water rights to date. (ii) Section 6.1 describes the estimated groundwater take over the UWIR period.
376(1)(b)	For each aquifer affected, or likely to be affected, by the exercise of the relevant underground water rights— (i) a description of the aquifer; and (ii) an analysis of the movement of underground water to and from the aquifer, including how the aquifer interacts with other aquifers; and (iii) an analysis of the trends in water level change for the aquifer because of the exercise of the rights mentioned in paragraph (a)(i); and (iv) a map showing the area of the aquifer where the water level is predicted to decline, because of the taking of the quantities of water mentioned in paragraph (a), by more than the bore trigger threshold within 3 years after the consultation day for the report; and (v) a map showing the area of the aquifer where the water level is predicted to decline, because of the exercise of relevant underground water rights, by more than the bore trigger threshold at any time.	(i) and (ii) Section 5.1 describes the groundwater regime in the relevant aquifers. (iii) There has been no previous exercise of underground water rights. (iv) Figure 11 shows the areas where depressurisation due to mining is predicted to exceed the bore trigger threshold during the UWIR period. (v) Figure 11 shows the areas where depressurisation due to mining is predicted to exceed the bore trigger threshold during the life of the mine.

Water Act section no.	Water Act section content	UWIR cross-reference
376(1)(c)	A description of the methods and techniques used to obtain the information and predictions under paragraph (b).	Section 4 describes the UWIR methodology.
376(1)(d)	A summary of information about all water bores in the area shown on a map mentioned in paragraph (b)(iv), including the number of bores, and the location and authorised use or purpose of each bore.	Sections 5.5, 6.1 and 6.2.2 describe the water bore census undertaken for the UWIR and confirms that there are no water bores within the area of predicted depressurisation.
376(1)(da)	A description of the impacts on environmental values that have occurred, or are likely to occur, because of any previous exercise of underground water rights.	There have been no previous exercise of underground water rights and, hence, no previous groundwater impacts due to groundwater take.
376(1)(db)	An assessment of the likely impacts on environmental values that will occur, or are likely to occur, because of the exercise of underground water rights— (i) during the period mentioned in paragraph (a)(ii); and (ii) (ii) over the projected life of the resource tenure.	Section 6 presents an assessment of potential groundwater impacts due to groundwater take.
	A program for— (i) conducting an annual review of the accuracy of each map prepared under paragraph (b)(iv) and (v); and (ii) giving the chief executive a summary of the outcome of each review, including a statement of whether there has been a material change in the information or predictions used to prepare the maps.	Section 7 describes the UWIR review and reporting process for the affected aquifers.
376(1)(f)	A water monitoring strategy.	Section 7 describes the groundwater monitoring programme.
376(1)(g)	A spring impact management strategy.	There are no springs within the mine site or its surrounds. Hence, a strategy for spring management is not justified.
376(1)(h	If the responsible entity is the office— (i) a proposed responsible tenure holder for each report obligation mentioned in the report; and	Not applicable.

Water Act section no.	Water Act section content	UWIR cross-reference
	(ii) for each immediately affected area—the proposed responsible tenure holder or holders who must comply with any make good obligations for water bores within the immediately affected area.	
376(1)(i)	The information or matters prescribed under a regulation.	No other relevant information or matters have been prescribed under a regulation.
376(2)	However, if the underground water impact report does not show any predicted water level decline in any area of an affected aquifer by more than the bore trigger threshold during the period mentioned in subsection (1)(b)(iv) or at any time as mentioned in subsection (1)(b)(v), the report does not have to include the program mentioned in subsection (1)(e).	Section 7 describes the UWIR review and reporting process for the affected aquifers.

Section 378 of the Water Act lists the content requirements for the water monitoring strategy. Table 2 lists the specific content requirements and provides an explanation of where each requirement is addressed in this UWIR.

Table 2: UWIR water monitoring strategy content requirements.

Water Act section no.	Water Act section content	UWIR cross reference
378(1)	A responsible entity's water monitoring strategy must include the following for each immediately affected area and long-term affected area identified in its underground water impact report or final report— (a) a strategy for monitoring— (i) the quantity of water produced or taken from the area because of the exercise of relevant underground water rights; and (ii) changes in the water level of, and the quality of water in, aquifers in the area because of the exercise of the rights; (b) the rationale for the strategy; (c) a timetable for implementing the strategy; (d) a program for reporting to the office about the implementation of the strategy.	Section 7 describes the groundwater monitoring programme.
378(2)	The strategy for monitoring mentioned in subsection (1)(a) must include— (a) the parameters to be measured; and (b) the locations for taking the measurements; and (c) the frequency of the measurements.	Section 7 describes the groundwater monitoring programme.
378(3)	If the strategy is prepared for an underground water impact report, the strategy must also include a program for the responsible tenure holder or holders under the report to undertake a baseline assessment for each water bore that is— (a) outside the area of a resource tenure; but (b) within the area shown on the map prepared under section 376(b)(v).	Not applicable. Sections 5.5, 6.1 and 6.2.2 describe the water bore census undertaken for the UWIR and confirm that there are no water bores within the area of predicted depressurisation.
378(4	If the strategy is prepared for a final report, the strategy must also include a statement about any matters under a previous strategy that have not yet been complied with.	Not applicable.

2.1.3 WATER PLANS

The project area falls within two water planning areas: the Gulf Water Plan (2007) and the Great Artesian Basin and other regional aquifers water plan (2017). The Gulf Water Plan is only relevant to the project for any proposed surface water take. The Great Artesian Basin and other regional aquifers water plan (2017) and the associated management protocol are relevant to the project.

Table 3: Water plans and other documentation relevant to the project.

Water Plan	Subordinate documents	Groundwater management area	Groundwater management unit	Groundwater sub-area
Gulf Water Plan (2007)	N/A	N/A	N/A	N/A
Great Artesian Basin and other regional aquifers (2017)	Great Artesian Basin and other regional aquifers management protocol (2017)	Great Artesian Basin Groundwater Management Area	Springbok Walloon	Adori Injune Creek

3. SITE DESCRIPTION

Agate Creek is an open-cut gold mining operation located within the Etheridge Shire in north Queensland, approximately 78 km south of the township of Georgetown (Figure 1). Trial mining commenced at Agate Creek in 2013, with a transition to full-scale production in 2019. All mining activities undertaken at Agate Creek are permitted under the current EA EPSL03068015 (dated 6 September 2021).

The stage 2 expansion of the Agate Creek mine involves mining six different open-cut pits. The mine is presently working Pit 6 under the current EA that allows up to 250,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 250,000 tonnes limit – as well mining an additional five satellite pits. This proposed Agate Creek stage 2 expansion comprises 3,774,081 tonnes of waste rock material.

3.1 CLIMATE

Agate Creek is located within the seasonally arid tropics, with the area dominated by intense rainfall events throughout the summer months. These rainfall events are often highly variable in their spatial and temporal distribution, with the majority of the rain falling in distinct, spatially separated cells across the landscape. Rainfall throughout the remainder of the year is generally limited to an occasional shower in June or July and evaporation tends to exceed rainfall for almost all days of the year, with the exception of periods with intense rainfall events.

Climate statistics for Agate Creek have been compiled from the SILO (Scientific Information for Land Owners) database (grid point 19.0°S, 143.55°E; Jeffrey et al., 2001). Figure 2 displays annual rainfall, along with the 10-year rolling average and the long-term median (667.4 mm). A rising trend (in the 10-year rolling average) indicates a change towards wetter conditions, whilst a falling slope indicates a trend towards reduced rainfall. The rainfall pattern for Agate Creek shows an oscillating trend over time, with a steady decline currently observed for the 10-year rolling average.

Based on SILO data, the median annual rainfall experienced in the region is 667.4 mm, with approximately 93.4% of the rain falling between November and April each year (Figure 3). Conversely, the long-term median annual pan evaporation is 2,300.6 mm. Typical of climatic conditions within northwestern Queensland, evaporation significantly exceeds rainfall throughout most of the year. Furthermore, such conditions govern the flow regimes of the receiving environments surrounding Agate Creek, where creeks and rivers express intermittent flow conditions.

Historical temperatures based on SILO data at Agate Creek show marginal variation throughout the year, generally increasing in September and October each year with the ‘build-up’ to the monsoonal wet season, easing after the seasonal rainfall begins (Figure 4).

The closest data from the Bureau of Meteorology (BoM) is the Georgetown airport weather station (30124; BoM, 2022), which is approximately 98 km northwest of the Agate Creek mining lease.

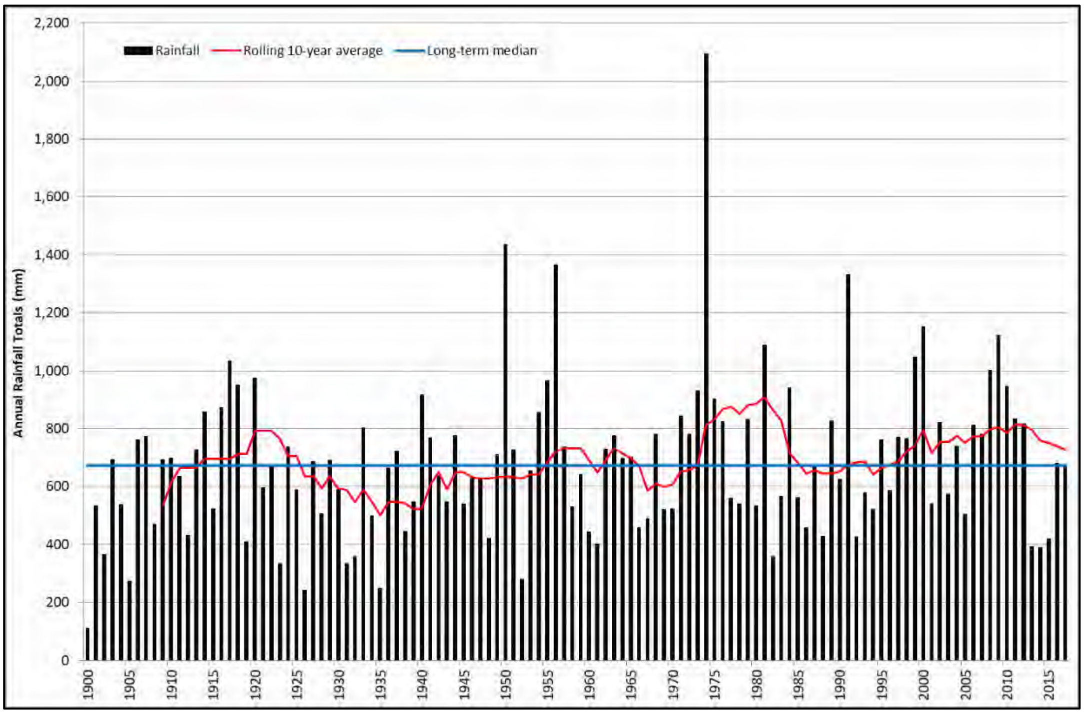

Figure 2: Historical rainfall for Agate Creek derived from SILO.

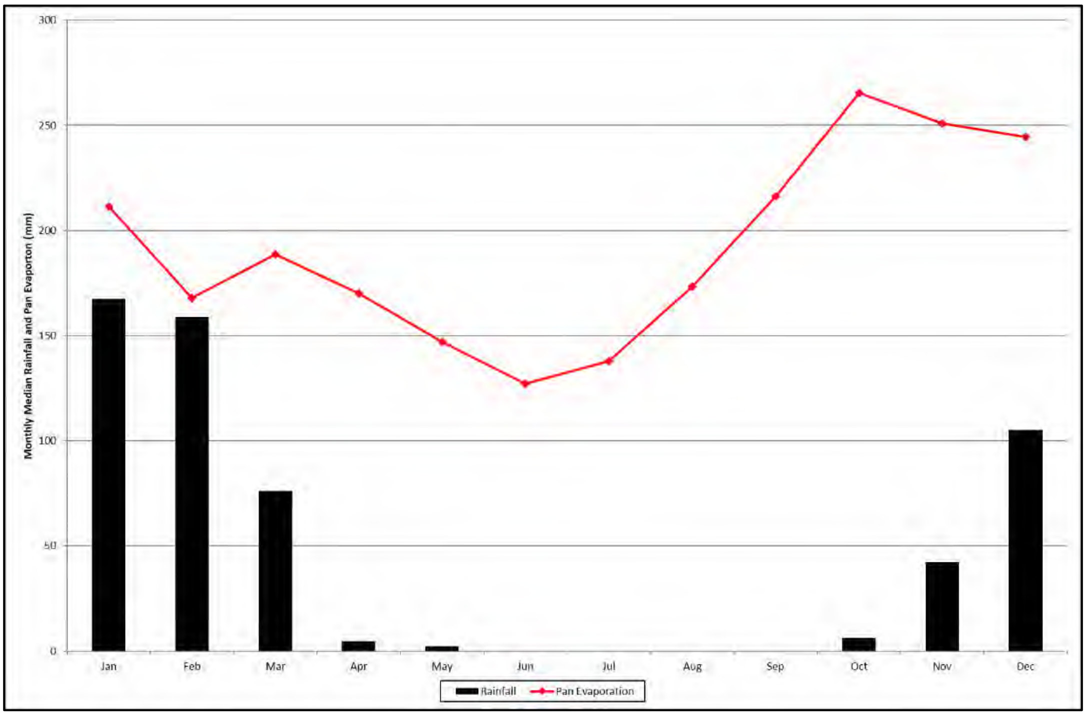

Figure 3: Agate Creek long-term median monthly rainfall and pan evaporation totals (SILO).

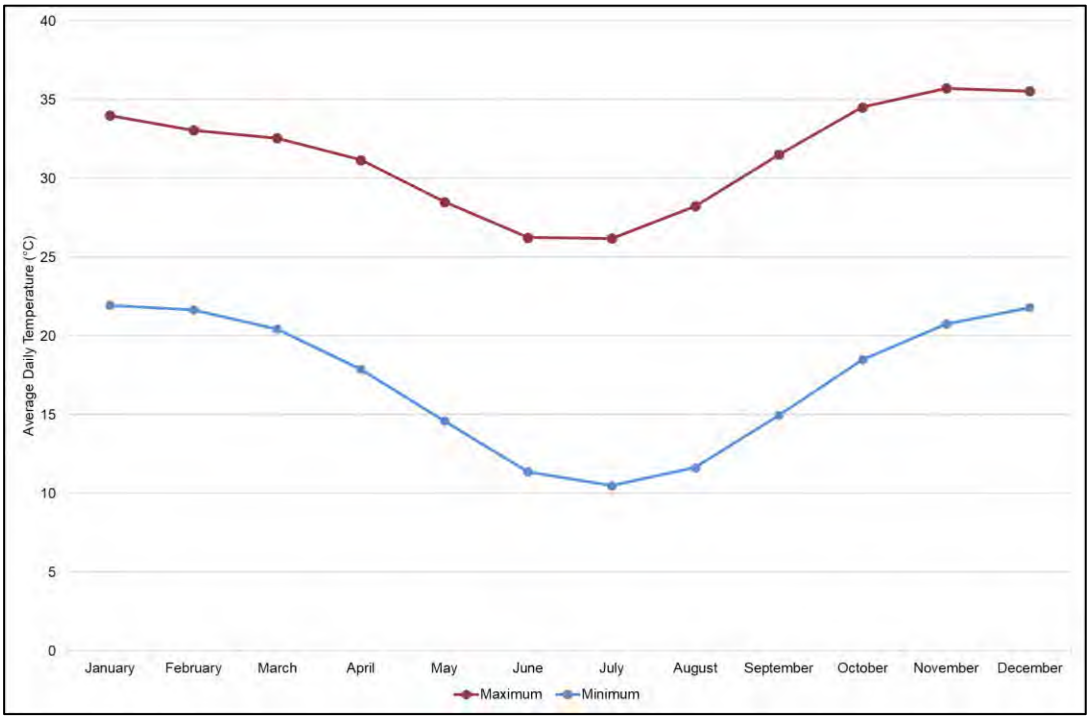

Figure 4: Mean monthly temperature variation typically experienced throughout the year (SILO).

3.2 LOCAL SOILS

The *Atlas of Australian Soils* (https://www.asris.csiro.au/themes/Atlas.html) – compiled by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) – provides a baseline description for regional soils found in and around the Agate Creek mining lease. The primary soil type found around the mine is a tenosol, specifically LL8 (Figure 5), characterised by low-hilly to hilly lands with abundant schistose rock outcrop. Occasional areas of shallow, stony sands also occur. In addition, loamy, red duplex soils with quartz-rich, gravelly A horizons are common on some slopes. Conversely, red friable earths are found on small basic intrusions.

Two other major soil units border the eastern boundary of the mining lease. Ta11 lies within the soil class chromosol. Within the chromosol class, soils typically display strong contextual contrast between the A and B horizons, whereby the B horizon is found to be neither acidic or sodic. Ta11 are typically found in undulating to moderately undulating lands – with long slopes and occasional steep rises with granite outcrop. They are generally associated with moderately deep, sandy duplex soils and often with gravel in the surface. These areas are also linked to red duplex soils and moderately deep, coarse sands. Shallow, coarse sands occur on steeper rises and near granite outcrop.

Fu20 represents the tenosol class. This soil type has typically a skeletal soil profile, with weak pedological organisation. Tenosols are found in low-hilly to hilly ranges, mostly with rounded crests. Massive rock outcrops are very common. Characteristically, all soils are very shallow and usually stony. Bleached loams are dominant but other shallow loams also occur with – less commonly – shallow bleached sands.

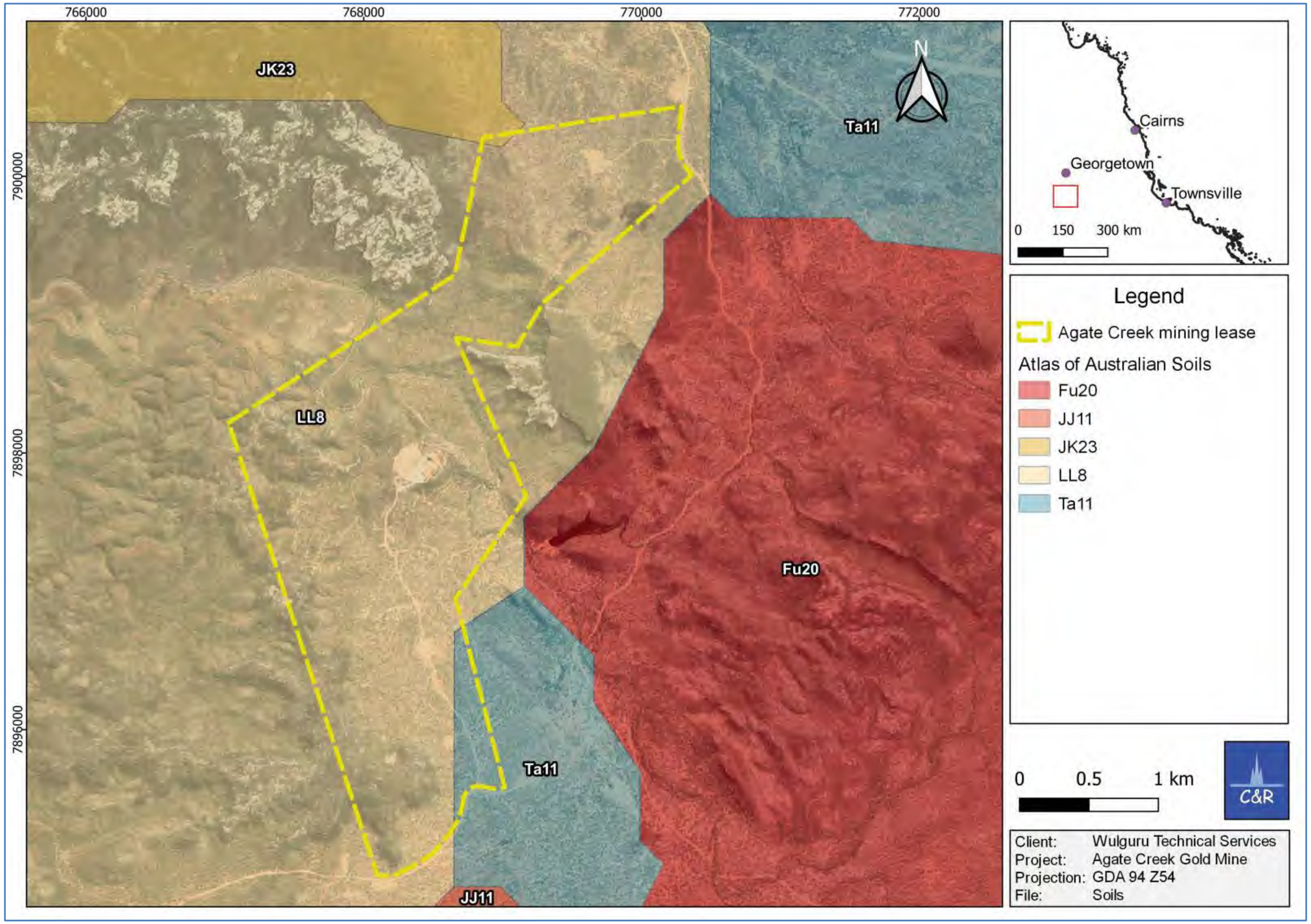

Figure 5: Local soils profile based on the CSIRO *Atlas of Australian Soils*.

3.3 GEOLOGY

The Agate Creek deposit is located in the central portion of the Proterozoic Etheridge Province. The primary identified deposit is known as Sherwood.

The Agate Creek mining lease includes a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. The basement rocks are Proterozoic metasediment, composed of mudstone, sandstone, phyllite, quartzite and meta-basalt (Morrison et al., 2019). The metamorphic rocks have been intruded by Siluro-Devonian-age Robin Hood Granodiorite and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex. The volcanic complex is largely fault-bound and consists of andesitic lavas, rhyolitic tuff and ignimbrite. Jurassic Hampstead Sandstone consisting of basal conglomerate and quartzose sandstone forms plateau-like outliers capping the older rocks (Morrison et al., 2019).

These Proterozoic Etheridge metamorphic rocks were extensively intruded by Silurian to Early Devonian granitoid batholiths, and dominantly felsic Carboniferous to Early Permian magmatic complexes (Morrison et al., 2019). The mineralisation at Agate Creek is related to the emplacement of Permo-Carboniferous porphyritic rhyolite and andesite extrusives and intrusives, commonly referred to as the Agate Creek Volcanic Group.

The mineralisation at the main Sherwood deposit is best developed in breccias and vein networks hosted in shallow-dipping rhyolite dykes that occupy shallow, southeast-dipping thrust faults in the granodiorite. Thrust faults also separate the granodiorite from the metamorphic rocks throughout the prospect area and there are series of north- and northwest-trending, steep, normal faults that bound and disrupt the mineralised zones

The Sherwood gold mineralisation at Agate Creek is hosted by a low sulphidation epithermal system consisting of quartz-chalcedony veining, stockwork and breccia. Host rock lithology is predominantly porphyritic rhyolite or andesite that occupy shallow, southeast-dipping thrust faults in Silurian granodiorite (Morrison et al., 2019). This host rock is principally volcanic in origin.

A series of complex hydrothermal alteration assemblages surround the Agate Creek ore body. These assemblages range from a distal ubiquitous propylitic zone (chlorite +/- carbonate-epidote-pyrite-haematite) grading inwards to a more proximal variably argillic to sericitic zone (clay +/- quartz-sericite-pyrite) and locally phyllic zone (silica +/- pyrite or iron oxide) (Morrison et al., 2019). The hydrothermal alteration in the Agate Creek expansion area is predominantly clay +/- silica, sericite and/or pyrite (now weathered to iron oxide).

Table 4: Agate Creek site geology.

Group / Sub-group	Formation	Age	Description	Lithology Summary	Map Symbol
Qa-QLD		Quaternary	Alluvium	Clay, silt, sand and gravel, flood plain alluvium	Qa
Eulo Queen Group	Hamstead Sandstone	Middle to Late Jurassic	Sandstone	Clayey, commonly pebbly, quartzose sandstone and conglomerate	Jh
Agate Creek Volcanic Group	Black soil andesite	Early Permian	Stratified unit – mafite (lavas, clastics and high-level intrusives)	Greyish-green, locally sparsely porphyritic augite-hypersthene-basaltic andesite with agate-filled amygdales; probably includes intrusive equivalents	Pvab
	Kennedy Province intrusive	Late Carboniferous – Early Permian	Intrusive – felsite (lavas, clastics and high level intrusives)	Mainly buff, pale grey to dark grey or brown, aphyric to highly porphyritic, intrusive rhyolite; commonly flow-banded; locally grades into microgranite	CPir
White Springs Supersuite	Robin Hood Granodiorite	Silurian	Intrusive - granitoid	Pink to grey hornblende-biotite granodiorite with quartz phenocrysts	Sgr
	Pama Province	Silurian	Intrusive - granitoid	Mainly I-type, biotite granite to hornblende-biotite granodiorite and tonalite; some biotite-hornblende and pyroxene-bearing tonalite to diorite and gabbro	Sg
Etheridge Group Robertson River sub-group	Dead Horse meta-basalt	Paleoproterozoic	Stratified unit – mafite (lavas, clastics and high-level intrusives)	Meta-basalt, locally pilled, hyaloclastic and/or amygdaloidal; minor metadolerite and metagabbro (unmapped) and interbedded siltstone	PLd
	Daniel Creek Formation	Paleoproterozoic	Stratified unit (including volcanic and metamorphic) – arenite-mudrock	Mudstone, siltstone, and fine subfeldspathic sandstone, locally calcareous and/or dolomitic. Grades into mica schist, quartzite and minor calc-silicate rocks	PLa
	Corbett Formation	Paleoproterozoic	Pelite – stratified volcanic and metamorphic	Greenish-grey mudstone (+/- chloritoid); grades into mica schist, with metamorphic sequence of staurolite, andalusite, sillimanite, garnet	PLco

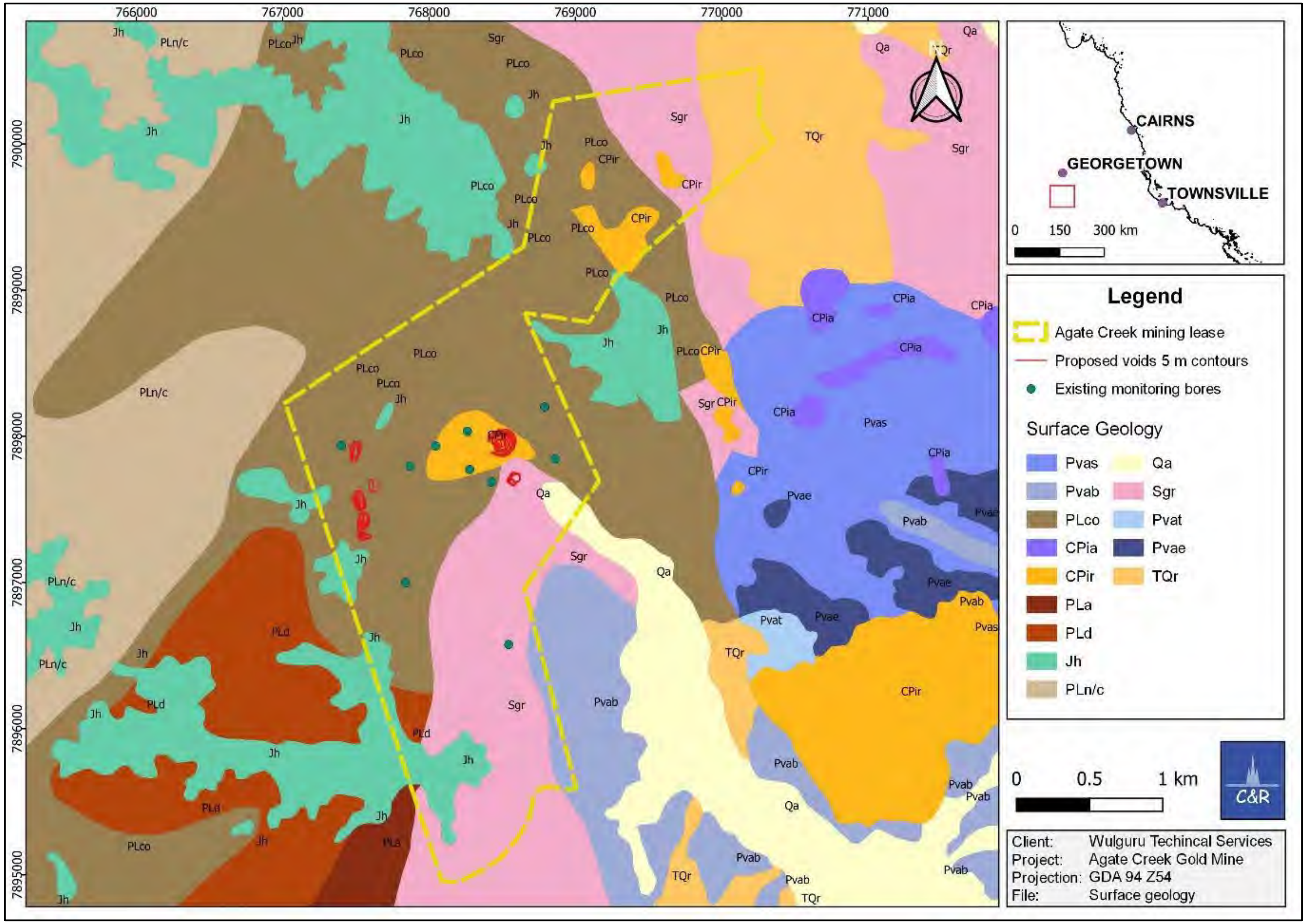

Figure 6: Detailed surface geology.

3.4 RECEIVING ENVIRONMENTS

The mining lease covers an area of approximately 688.86 ha and cuts directly through Agate Creek – a tributary of the Robertson River which flows into the Gilbert River before entering the Gulf of Carpentaria. The mining lease also encompasses several smaller drainage lines branching into Agate Creek (Figure 7) – and north into Cave Creek. Cave Creek joins Agate Creek upstream of the confluence with the Robertson River.

The watercourses throughout the project site are intermittent streams, only flowing for short periods after substantial rainfall events. Although small, semi-permanent pools are known to exist upstream of the project site, there are no naturally occurring, large, permanent waterbodies known within the Agate Creek catchment area upstream of the project site.

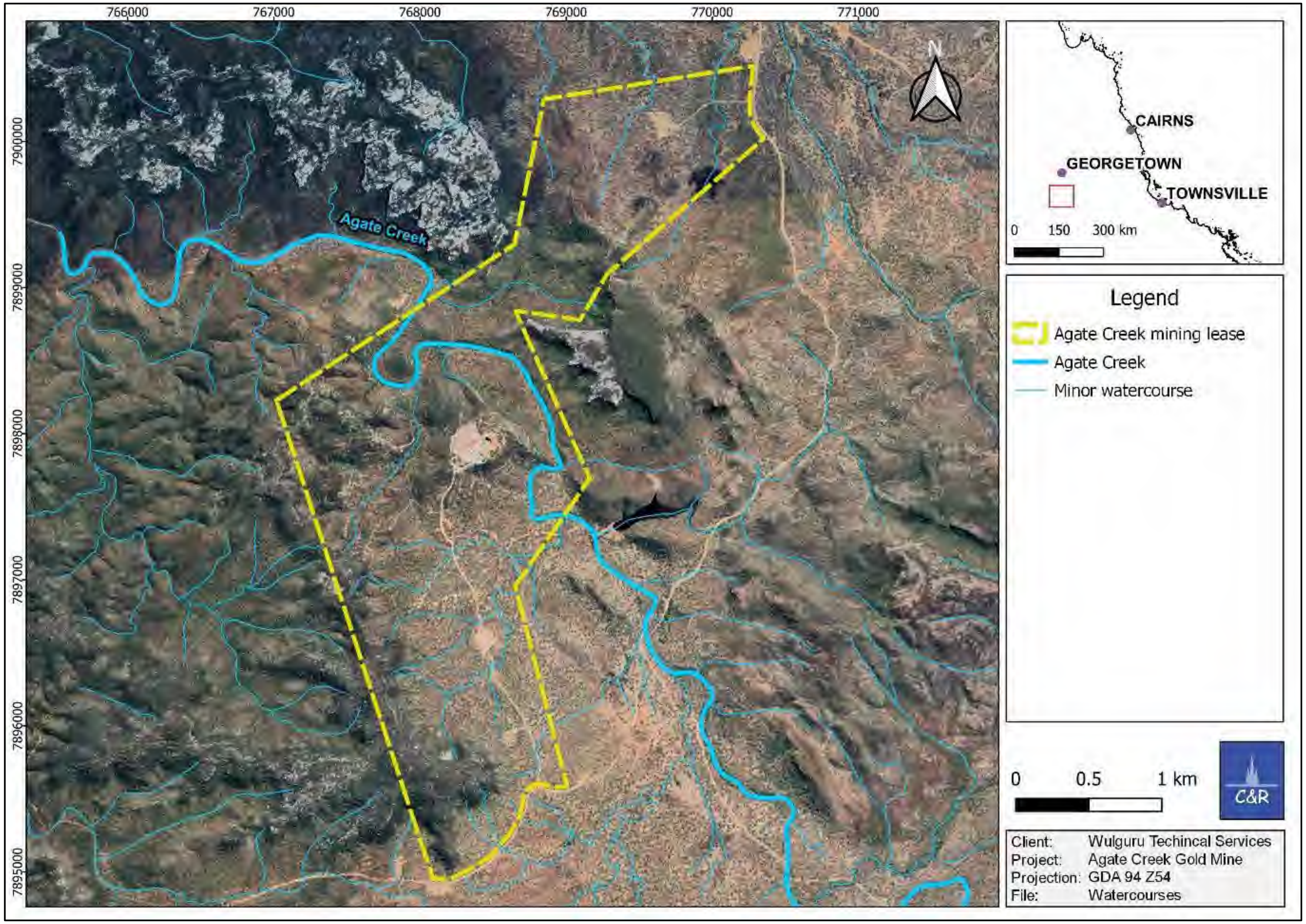

Figure 7: Primary receiving environment of Agate Creek and minor tributaries.

4. ASSESSMENT METHODS

This section describes the methods which have been adopted for the collection of hydrogeological data to inform the Agate Creek UWIR.

4.1 DATABASE SEARCHES FOR GROUNDWATER BORES

A search of relevant Queensland databases was undertaken to identify the presence of current water bores within and surrounding the mine. A water bore is a groundwater supply bore.

The following databases and mapping were searched:

- The DNRME groundwater database of registered water bore data from private water bores and Queensland Government groundwater investigation and monitoring bores: Accessed data include bore location, groundwater levels, construction details, stratigraphic logs, hydrogeological testing and groundwater quality.
- The Queensland Spatial Catalogue (QSpatial), via Queensland Globe: Records of petroleum and coal seam gas (CSG) exploration, production and monitoring wells are contained within this database.

Excluding the 24 groundwater bores installed by Laneway in 2020 and 2021, these searches did not identify any registered bores within 5 km of the project mining area.

4.2 DATABASE SEARCHES FOR SENSITIVE ENVIRONMENTAL FEATURES

The potential for groundwater-dependent ecosystems (GDEs) to be present within the project site was reviewed, with the review consisting of:

- Queensland Springs Database (via Queensland Globe);
- BoM's GDE Atlas; and
- Field investigations.

The Queensland Springs database and BoM GDE Atlas indicated that no springs are located within the project site. However, two springs (SPR1411 and SR1412) were identified within the 10 km buffer from the mining lease centroid. The two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active (based on the BoM GDE Atlas and Queensland Springs Database). No field studies have been completed on either spring within the 10 km buffer from the Agate Creek mining lease.

4.3 PREVIOUS GROUNDWATER STUDIES

The hydrogeology of Agate Creek was initially assessed by Rob Lait and Associates Pty Ltd (Lait) in 2020 to provide advice and complete a preliminary assessment of the hydrogeological regime (Lait, 2020). This assessment included the provision of ten groundwater monitoring bore locations and construction, hydraulic conductivity testing and the preliminary assessment of the groundwater regime at Agate Creek.

4.4 GROUNDWATER MONITORING DATA

All relevant data were collated and analysed to develop a conceptual understanding of the groundwater regime. Groundwater data collected from the mine monitoring bores have been used to inform this groundwater conceptualisation.

4.5 GROUNDWATER MONITORING NETWORK

In June 2020, ten groundwater monitoring bores were drilled and constructed to improve the understanding of the hydrogeological regime at the Agate Creek mine. The locations and construction designs were provided by Lait, whereas all geological descriptions for the individual bores were supplied by Laneway.

The ten monitoring bores were drilled and constructed in June 2020, with water level and water quality monitoring commencing on a monthly basis from October 2020 onwards. Spatially distributed groundwater level data were used to characterise groundwater flow directions, gradients and velocities. In addition, temporal variations in groundwater level were used to interpret the rate and distribution of recharge/discharge, influence from mining, and variability in groundwater level.

Groundwater quality data provide useful information on the hydrogeological regime because they are influenced by interaction with the aquifer matrix, and groundwater recharge/discharge processes.

Twelve additional monitoring bores were installed across the mining lease in December 2021, in preparation for the expansion of mining activities. A further two production bores have also been constructed to provide water for operational activities and camp facilities. However, due to reporting constraints, the limited data from these fourteen bores have not been included within this assessment.

Table 5: Groundwater monitoring bore network constructed in 2020 (MGA: Map Grid of Australia).

Bore ID	RN[1]	Installation date	Easting	Northing	Ground level	Casing above ground	Total depth	Screened interval	Geology unit
			MGA zone 54		m AHD	m	m BGL		
CCWB517	193026	7/06/2020	768399.5	7896463	435.6	0.6	55	49 – 55	Robin Hood Granodiorite
CCWB518	193029	9/06/2020	767768.1	7897706	431.4	0.6	73	67 – 73	Andesite/Rhyolite
CCWB519	193030	9/06/2020	767302	7897863	517.18	0.62	85	79 – 85	Corbett Formation Metasediments
CCWB520	193031	10/06/2020	767947.2	7897838	434.96	0.59	73	67 – 73	Andesite
CCWB521	193027	12/06/2020	768700.6	7898079	420.94	0.6	73	67 – 73	Corbett Formation Metasediments
CCWB522	193032	13/06/2020	768761.9	7897724	434.2	0.6	73	67 – 73	Corbett Formation Metadolerite
CCWB523	193033	14/06/2020	768321.3	7897579	449.6	0.61	73	67 – 73	Robin Hood Granodiorite
CCWB524	193034	15/06/2020	768173.6	7897670	496.06	0.64	91	85 – 91	Robin Hood Granodiorite
CCWB525	193035	16/06/2020	768166.9	7897930	498.77	0.62	103	97 – 103	Corbett Formation Metasediments
CCWB526	193028	17/06/2020	767709.7	7896909	449.4	0.66	73	67 – 73	Corbett Formation Metasediments

[1]Registered Number

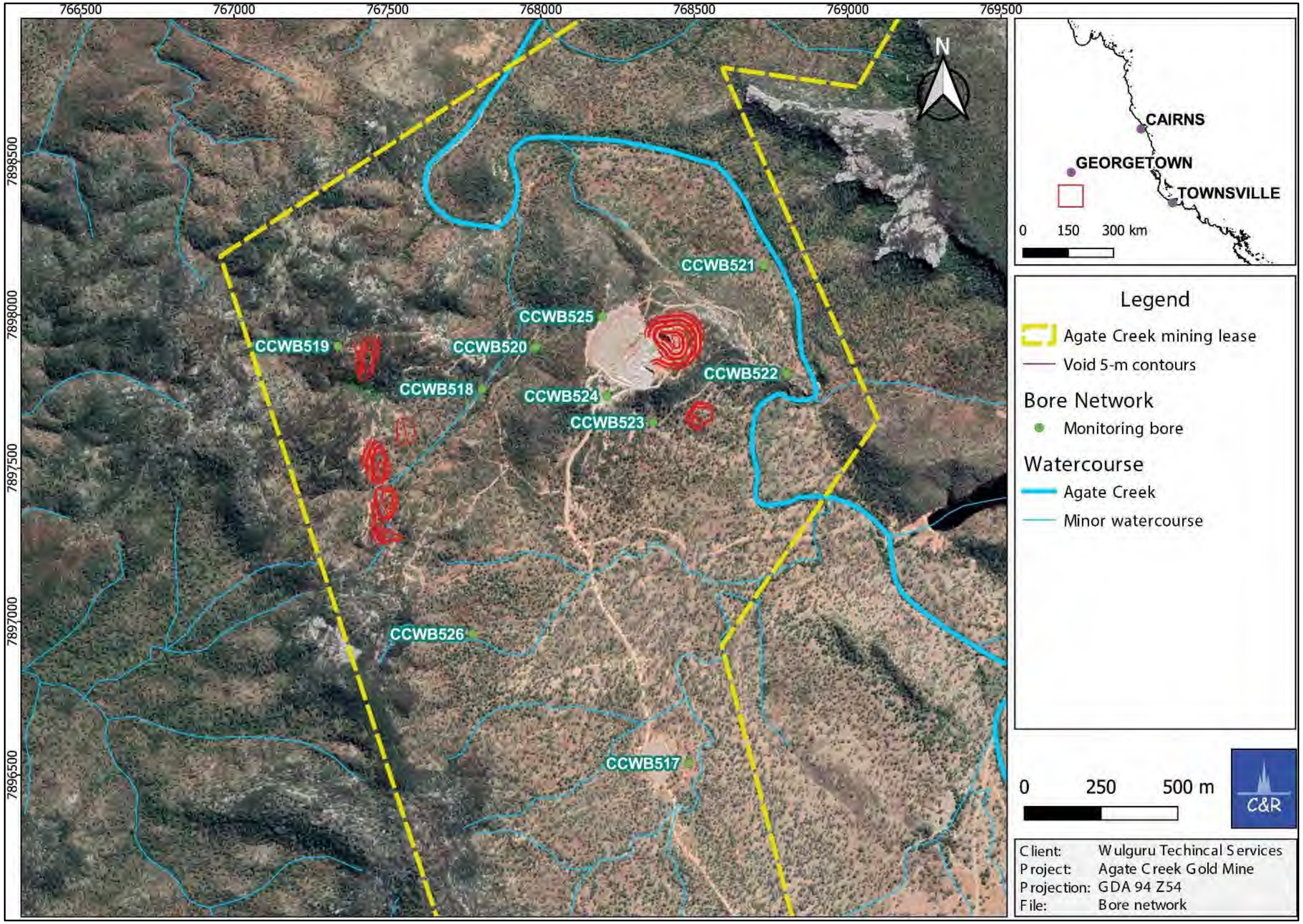

Figure 8: Agate Creek groundwater monitoring bore network and proposed void outlines.

5. GROUNDWATER REGIME

Mapping of aquifers – using the Australian Groundwater Explorer (http://www.bom.gov.au/water/groundwater/explorer/map.shtml) – identified the presence of three aquifers in the area, including an upper, middle and lower aquifer.

- The upper aquifer is associated with Quaternary alluvium that is present on the northeastern section of the ML, linked to Cave Creek, and just off the ML to the south on Agate Creek.
- The middle aquifer is associated with the Mesozoic sandstones. Mesozoic aquifers in this area form part of the Great Artesian Basin groundwater system. Although minor sandstone is represented in the lower part of the ML, mapping indicates that the middle aquifer is absent on the ML.
- The lower aquifer is associated with the weathered and fractured zones of the Palaeozoic and Palaeoproterozoic rocks.

Recent drilling and construction of monitoring bores in 2020 indicate very low hydraulic conductivity of the lower aquifer fractured rock formations. Construction logs for these bores indicate that screens were not set against intervals where groundwater was intersected – but rather at the bottom of the hole (Lait, 2020).

5.1 DISTRIBUTION

Project-scale mapping has identified structural complexity – associated with faulting and zones of brecciation along structures – across the site. The key faults on site include the Agate Creek Fault Zone, Zig Zag Fault and Sherwood West Fault. The primary source of groundwater within the Agate Creek mining lease is held within the fractured and weathered, igneous and metasedimentary rocks. Exploration drilling has reported that groundwater interception most commonly occurs within the zone of oxidation.

During the December 2021 drilling programme, several bores were installed within the alluvial aquifer, although no water was intersected at the time of drilling.

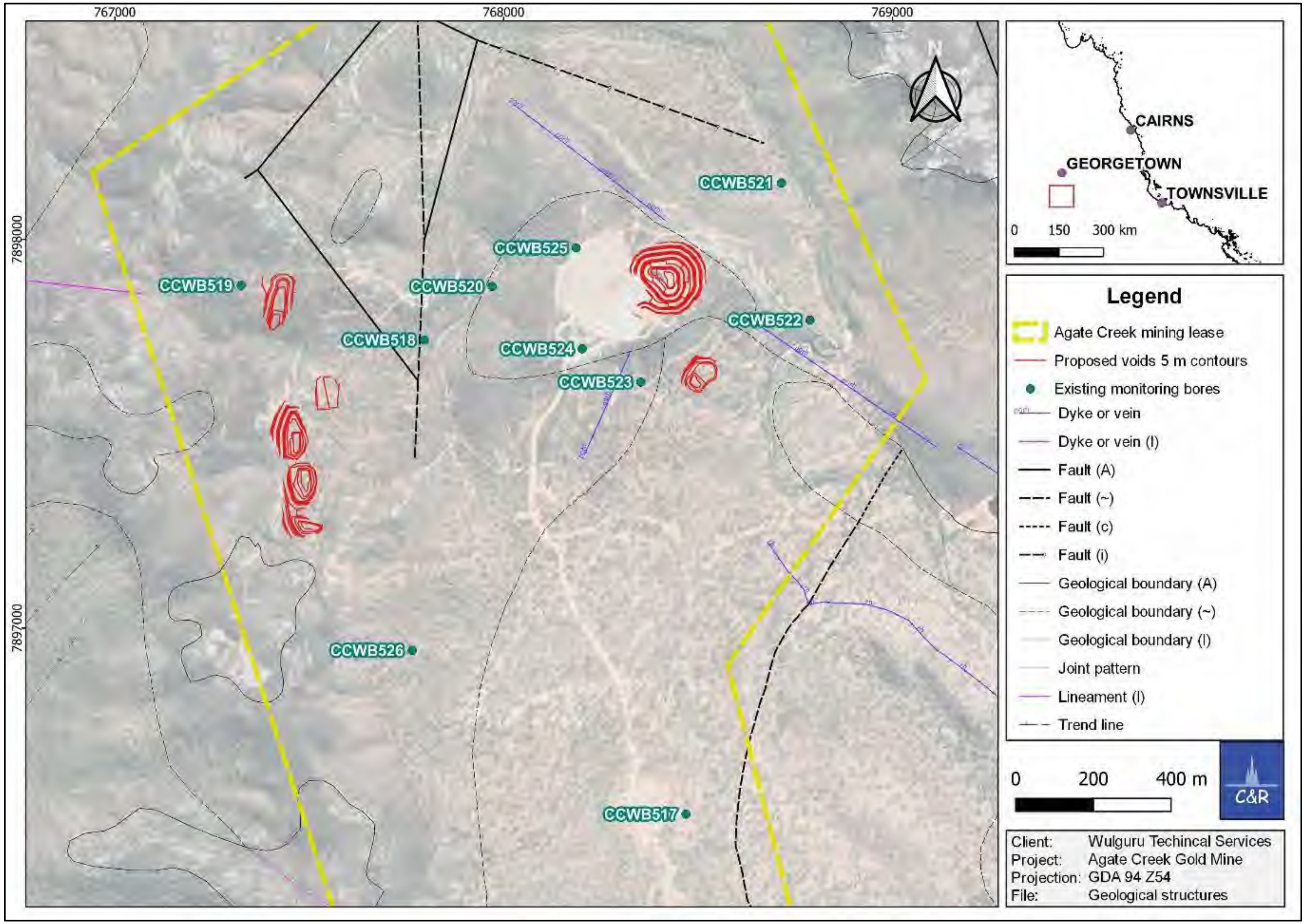

Figure 9: Complex geological structures influencing the Agate Creek deposit and hydrogeological systems.

5.2 HYDRAULIC PARAMETERS

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range.

The prime data for this investigation were taken from Lait (2020) – on slug tests on boreholes CCWB517 to CCWB526 in the Agate Creek ML. In addition, the methodology of Marinelli and Niccoli (2000) was used for the estimation of groundwater inflow to the pits on the mine site.

Based on Lait (2020), hydraulic conductivities range from:

- 6.57×10^{-8} m/sec for CCWB523 to
- 5.06×10^{-7} m/sec for CCWB518.

Distances from individual bores to the main pit range from:

- 50 m to 173 m for CCWB524;
- 150 m for CCWB525;
- 1068 m for CCWB526; and
- 1275 m for CCWB517.

From assessing the range in the hydraulic conductivities (5 orders of magnitude), both linear and logarithmic solutions for inflow rates were obtained for the methodology of Marinelli and Niccoli (2000).

Table 6: Inferred linear and logarithmic inflow rates based on hydraulic tests completed in 2020.

Bore CCWB	Linear Inflow Rate m^3/sec	Log Inflow Rate m^3/sec
CCWB517	4.464×10^{-5}	2.795×10^{-5}
CCWB518	4.825×10^{-5}	3.037×10^{-5}
CCWB519	3.707×10^{-5}	2.348×10^{-5}
CCWB520	–	–
CCWB521	1.756×10^{-5}	1.498×10^{-5}
CCWB522	1.306×10^{-5}	1.351×10^{-5}
CCWB523	1.040×10^{-5}	1.271×10^{-5}
CCWB524	3.570×10^{-5}	2.275×10^{-5}
CCWB525	4.390×10^{-5}	2.735×10^{-5}
CCWB526	1.954×10^{-5}	1.568×10^{-5}

It should be noted that the bore hole design and construction suggest that the screened interval has been placed at the bottom of the hole instead of at water-making beds. Additionally, the aquifers at Agate Creek are believed to be primarily contained within fractured and weathered igneous and metasedimentary rocks – and groundwater was intercepted at depths ranging from 8 m to 68 m below ground level (BGL). Therefore, the indicated, very low conductivity values presented in Table 6 would only be representative of the solid rock formation.

5.3 POTENTIOMETRIC SURFACE, RECHARGE, FLOW AND DISCHARGE

Following the drilling and construction of the ten groundwater monitoring bores at Agate Creek in June 2020, groundwater levels were measured in July 2020 before monthly levels were captured in September and monthly thereafter. No site-specific rainfall data were available for the monitoring period. Therefore, rainfall data from BoM station 30124 (Georgetown airport) has been used to provide an insight into the potential totals recorded on site. However, it should be noted that the spatially heterogeneous nature of rainfall events in the tropics can result in large variations in rainfall totals from one area to the next.

Between December 2020 and February 2021, 765.4 mm of rain fell (Figure 10), comparable to the median annual value (753.2 mm) for the same BoM station between 2005 and 2019. All bores within the Agate Creek network reported a positive change in groundwater elevation, which in most cases represents a recharging of the aquifer. However, the large degree of variability is doubtful. If all values are assumed to be accurate, CCWB517 recorded the smallest positive change (0.6 m), whereas CCWB524 reported a change of 18.9 m. The uncertainty (in data accuracy) is further complicated by the absence of manual depth measurements during the potential recharging period. CCWB519, CCWB524 and CCWB525 were not measured in December 2020 and January 2021.

Conversely, if the difference in groundwater elevations is compared to changes which occurred between November 2020 and April 2021 (wet season), the values appear more plausible. Screened in the Robin Hood Granodiorite and located in the southern reaches of the mining lease, CCWB526 (Figure 8) reported no change in groundwater elevation over the 2020/2021 wet season (Figure 10). Conversely, the greatest variation was recorded in CCWB521 (3.80 m) which is the bore located closest to Agate Creek and screened in the Corbett Formation Metasediments (Figure 8 and Figure 10).

The 12-month period between October 2020 and October 2021 was assessed to determine if any overall trends are occurring within the Agate Creek groundwater monitoring network. Excluding CCWB526, all bores recorded increases, which ranged between 0.17 m (CCWB517) and 3.71 m (CCWB521). An overall average increase of 1.38 m was observed across the entire network. The recorded increases across the network are likely a result of the extremely low hydraulic conductivities, representing a system which is continuing to reach equilibrium. However, it should be noted that groundwater elevations have the potential to be significantly impacted by the bore design and construction. Each bore in the Agate Creek network is screened at the bottom of the whole, with the bentonite seal placed at the bottom of the surface casing. Consequently, water may enter the screened interval from any point below the bentonite seal, therefore skewing the calculated groundwater elevations.

Furthermore, due to the network construction design, a level of uncertainty remains in terms of groundwater elevations and the direct relationship to the screened lithology. A potentiometric surface of groundwater elevations has been created utilising all groundwater monitoring bores within the network – using the median value calculated between July 2020 and October 2021. The water quality assessment undertaken as part of this report suggest that there is some degree of hydraulic continuity across the Agate Creek mining lease. The potentiometric surface shows that groundwater flows follow a similar pathway to the surface topography, with groundwater moving from areas of high elevation (CCWB519 – 454 m AHD) towards Agate Creek (CCWB521 – 414 m AHD) (Figure 11).

The three bores located within the closest proximity to Agate Creek and a smaller tributary (CCWB520, CCWB521 and CCWB522) reflect the areas of lowest groundwater elevations – ranging between 414 and 426 m AHD. Based on 1-m digital elevation models for the region, the banks and bed of Agate Creek are approximately 430 m AHD and 425 m AHD, respectively. The elevation difference between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

Due to aforementioned factors with issues relating to measurements of groundwater elevation, it is difficult to ascertain an accurate value for recharge during the reporting period. Furthermore, field notes suggest that monitoring methods have a significant impact on several bores, which are consequently failing to reach equilibrium between monitoring rounds. Further monitoring and a change of monitoring methodology is required to allow for an accurate assessment of recharge values for individual bores.

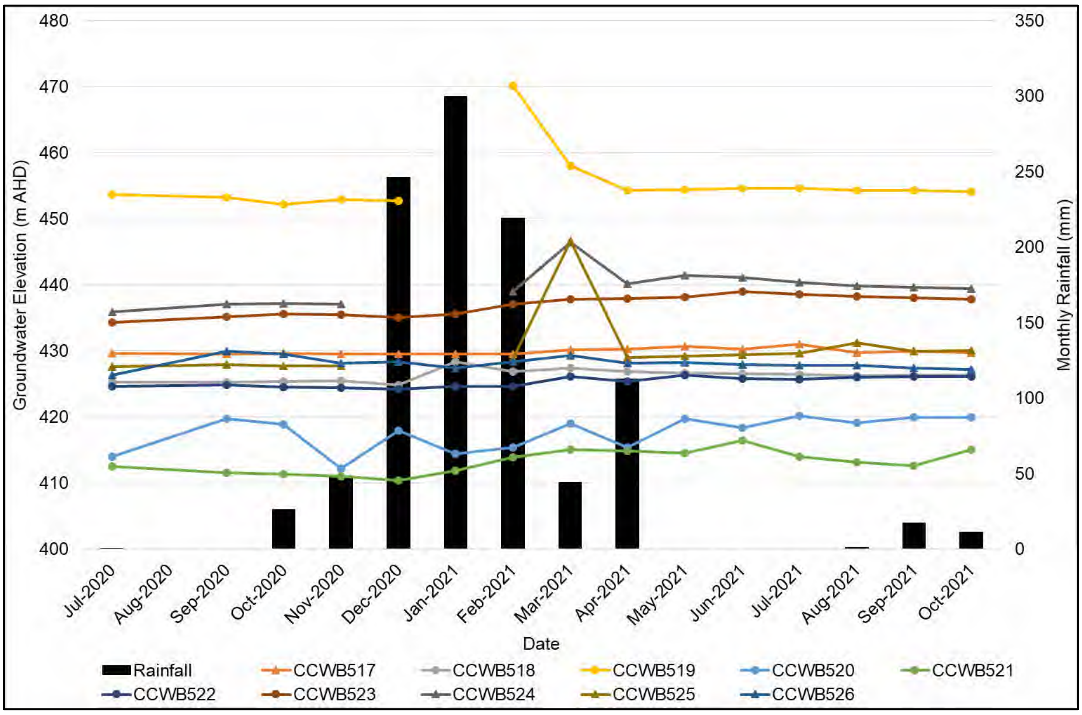

Figure 10: Changes in groundwater elevations in response to rainfall at Agate Creek.

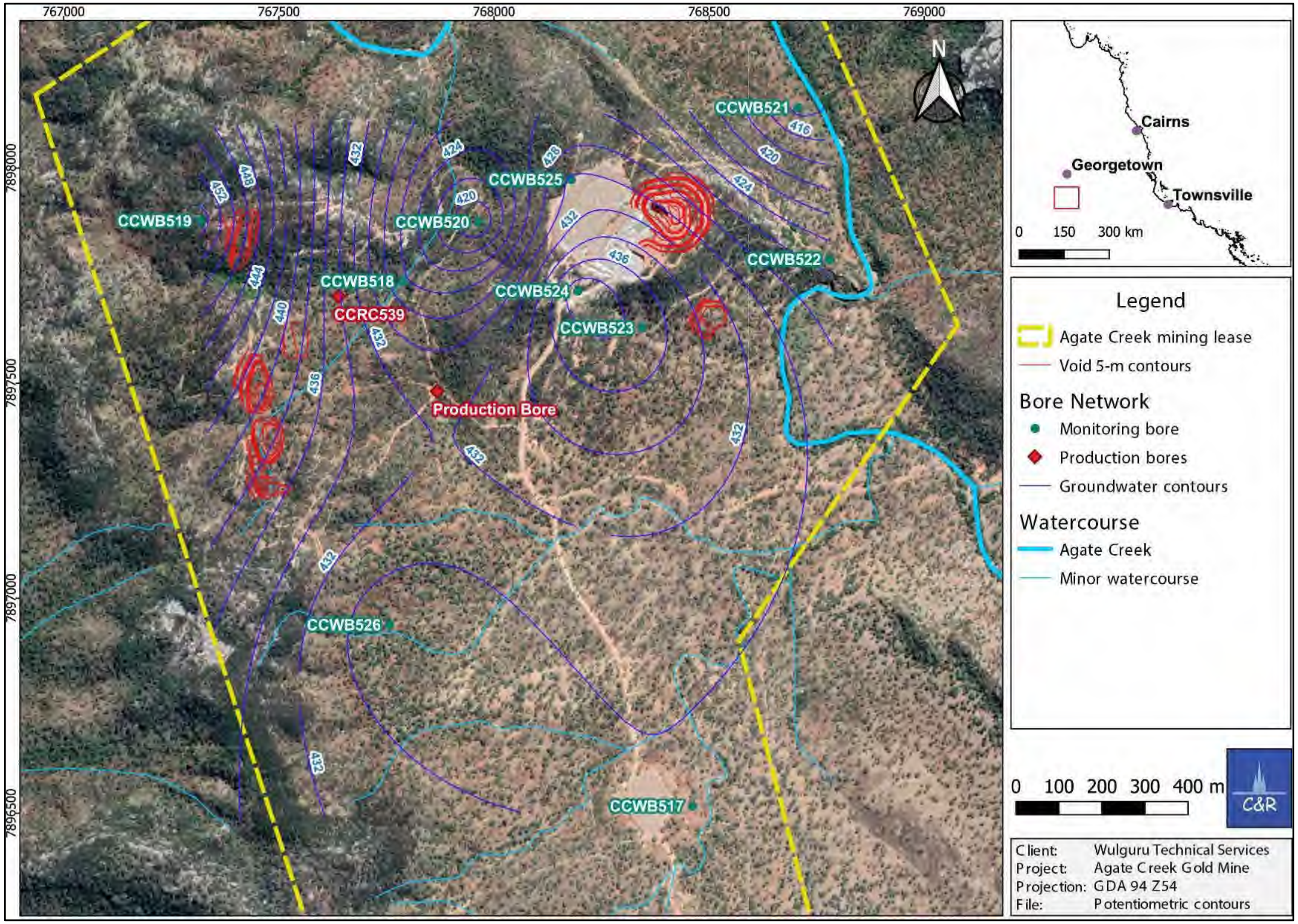

Figure 11: Potentiometric surface contours developed from the median groundwater elevations over the 16-month monitoring period.

5.4 GROUNDWATER QUALITY

Most bores within the Agate Creek groundwater monitoring network reflect mildly alkaline conditions, although – throughout the monitoring period – several bores have trended towards slightly acidic conditions (Figure 12). Screened in the Corbett Formation Metasediment, CCWB521 reflects stable alkaline waters ranging from 8.26 to 8.53, whereas bore CCWB523 – screened in the Robin Hood Granodiorite – reflects acidic conditions, with a median value of 6.5.

Most notably, CCWB525 reported the greatest pH range (6.39 – 7.73). With pH levels of CCWB525 steadily trending downwards over the monitoring period, the September 2021 value of 7.73 appears inconsistent. Although CCWB519 displays a range of 0.82, this value is skewed by the initial reading of 7.24 recorded in July 2020, whereas all remaining pH values range between 6.42 and 6.88.

The changes in pH between July 2020 and October 2021 are likely to reflect the low hydraulic conductivity reported, whereby each bore is gradually reaching equilibrium over the monitoring period. From the current data available, there does not appear to be any correlation with rainfall, with no discernible trend identified for the period between December 2020 and February 2021. All pH values are within ranges reflective of the rock type encountered across the groundwater network.

All pH values across the Agate Creek network remain within the Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) guidelines for livestock drinking water (5 – 9; ANZECC and ARMCANZ, 2000).

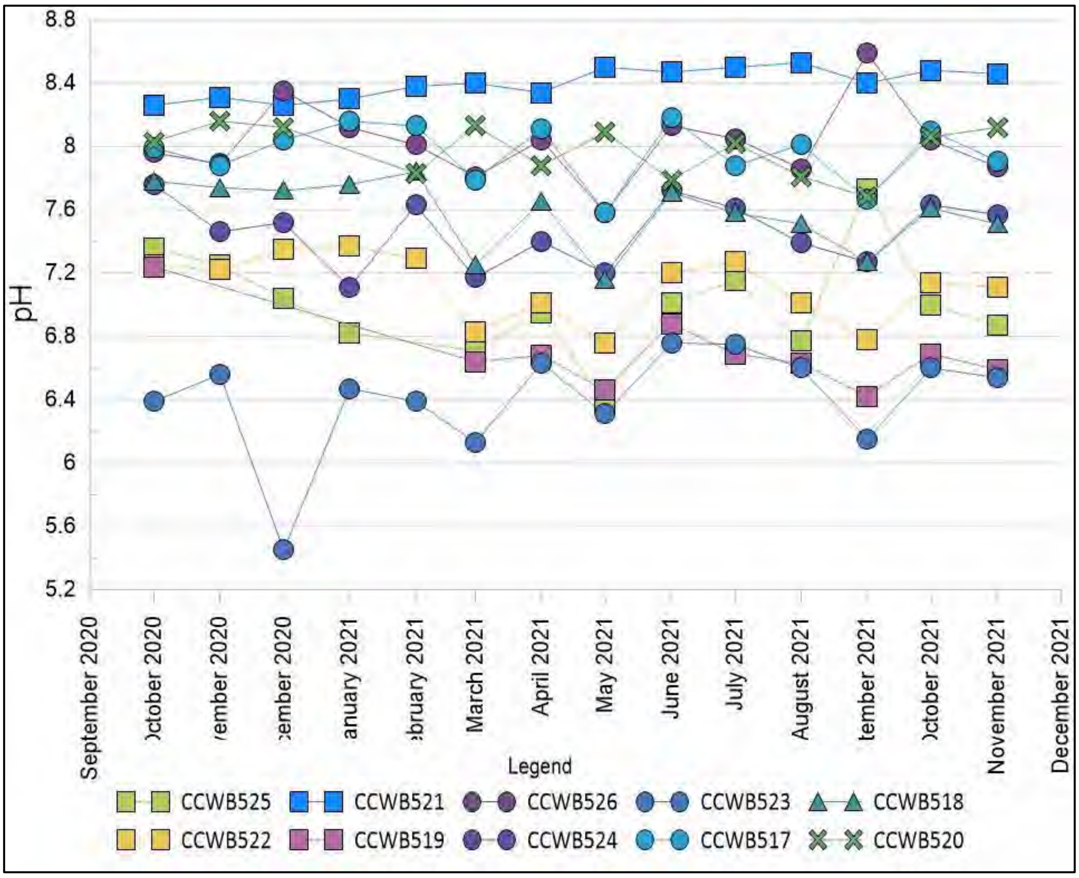

Figure 12: pH values within the Agate Creek groundwater monitoring network.

Excluding CCWB517 and CCWB526, all bores have fresh water quality (<1,560 µS/cm). CCWB517 and to a lesser extent CCWB526 are considered brackish (1,560 – 4,680 µS/cm). All screened formations reflect stable conditions throughout the monitoring period, with small fluctuations detected in CCWB517 following the significant wet season rainfall events between December 2020 and February 2021.

The CCWB517 construction log shows that the bore has been predominantly drilled through differing states of weathered granite within the Robin Hood Granodiorite, whereas CCWB526 is said to be screened in the metasediments within the Corbett Formation. However, from the stratigraphy described within the construction log, CCWB526 appears to drill through the same weathered granite sequence depicted in CCWB517. Due to the absence of bentonite seals above the bores' screened interval, it is considered highly likely the water quality in CCWB526 reflects a mixture of waters. The elevated salinity is attributed to the water present within the weathered granite.

Total dissolved solids (TDS) are a measure of all inorganic salt dissolved in water and is a guide to water quality. Electrical conductivity can be used to approximately calculate the concentration of TDS using the conversion of

Electrical conductivity (µS/cm) x 0.67 = TDS (mg/L)

In accordance with the formula above, all bores excluding CCWB517 and CCWB526 are below the Australian drinking water guideline value of 600 mg/L for TDS. Whereas the water of CCWB526 is regarded as poor quality (900 – 1200 mg/L), CCWB517 is considered to be unacceptable (> 1200 mg/L). However, all bores meet the livestock drinking water guideline value for TDS of 4000 mg/L.

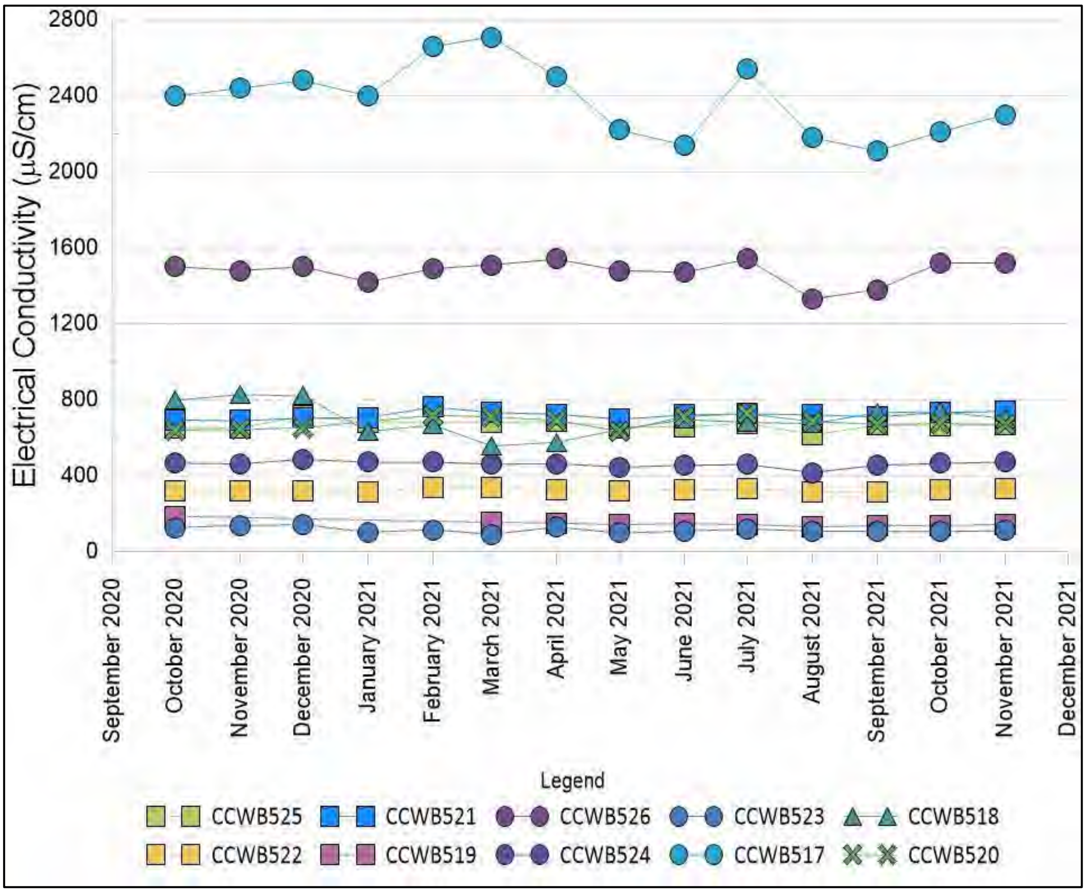

Figure 13: Electrical conductivity values within the Agate Creek groundwater monitoring network.

Table 7 and Figure 14 display the ionic composition of each bore sampled between October 2020 and November 2021. Table 7 expresses the median values calculated from the sixteen monitoring points whereby it has been determined that seven different water types exist within the Agate Creek bore network. The differing water types present are evident in the Piper diagram (Figure 14), with most bores forming individual clusters spatially excluded from one another. The dominant cation for most bores is sodium, whereas bicarbonate is the primary anion in eight of ten bores. CCWB518 and CCWB525 are distinguishably different due to calcium being the primary cation. The dominance of bicarbonate anions also explains the slightly alkaline pH values.

The variation in Figure 14 also visibly expresses the lack of similarities between bores screened within the same lithology. This further supports the understanding that – due to the design and construction of each borehole allowing water to enter from any depth – the expressed water types are mixtures of the various target aquifers present at Agate Creek.

Table 7: Ionic composition percentage based on median value and specified water types.

Bore ID	Calcium	Magnesium	Sodium	Potassium	Carbonate	Bicarbonate	Chloride	Sulphate	Fluoride	Water Type
CCWB517	7%	15%	77%	0%	0%	84%	14%	2%	1%	Na – $CaCO_3$
CCWB518	57%	13%	28%	2%	0%	56%	12%	31%	1%	Ca – $CaCO_3$
CCWB519	22%	34%	36%	7%	1%	59%	23%	16%	1%	Na – Mg – $CaCO_3$
CCWB520	33%	10%	52%	4%	0%	57%	19%	24%	1%	Na – $CaCO_3$
CCWB521	5%	2%	92%	1%	1%	45%	24%	22%	6%	Na – $CaCO_3$ - Cl
CCWB522	19%	5%	70%	6%	0%	64%	14%	17%	4%	Na – $CaCO_3$
CCWB523	21%	12%	41%	25%	1%	61%	24%	14%	1%	Na – Ca - $CaCO_3$
CCWB524	34%	20%	34%	11%	0%	59%	7%	33%	1%	Na – Ca – $CaCO_3$
CCWB525	41%	28%	23%	8%	0%	22%	38%	40%	0%	Ca – Mg – SO_4 – Cl
CCWB526	16%	10%	73%	1%	0%	73%	15%	12%	0%	Na – $CaCO_3$

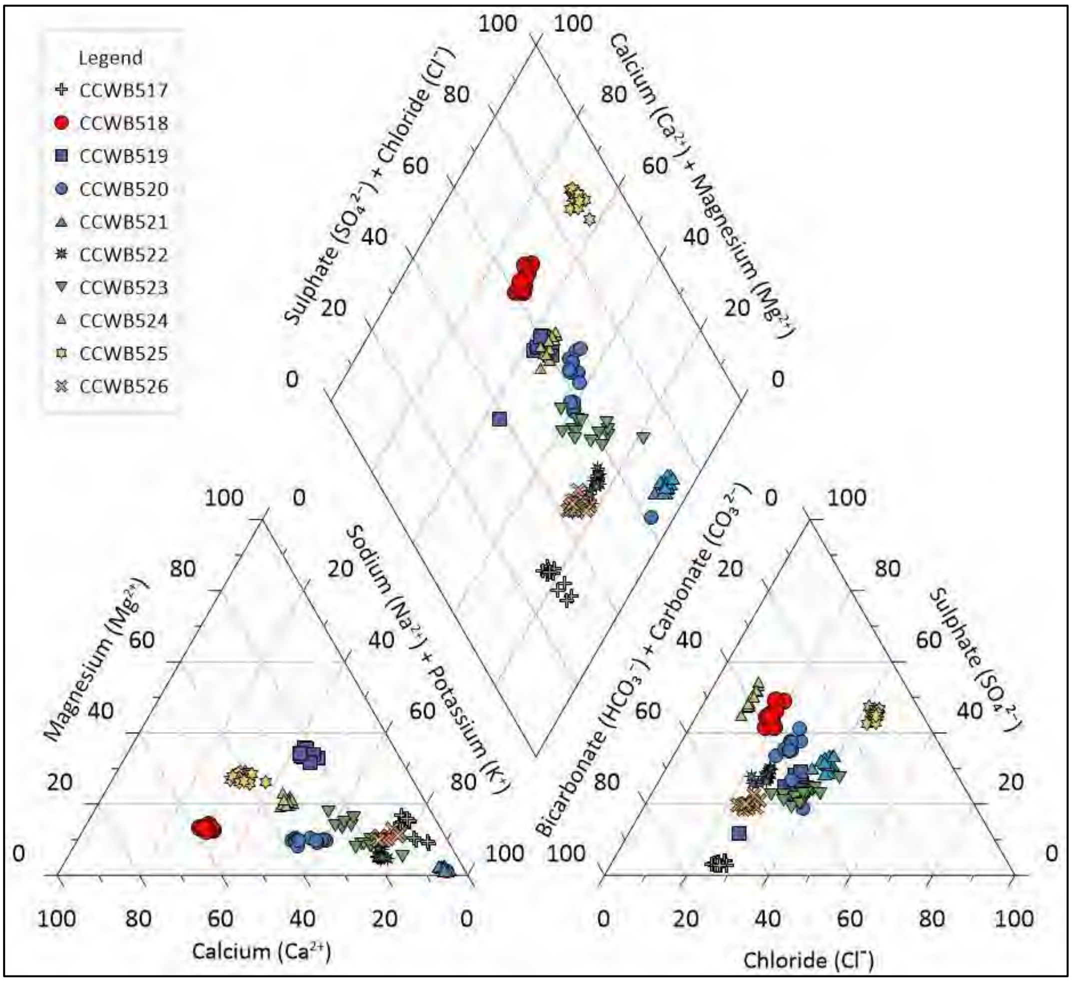

Figure 14: Ionic composition of all groundwater samples collected from the Agate Creek bore network.

ANZECC and ARMCANZ (2000) recommend that the highest level of protection should be provided to underground aquatic ecosystems, given their high conservation value. Where groundwaters are in good condition, the intent is to maintain existing water quality. Where groundwaters interact with surface waters, groundwater quality should not compromise identified environmental values and water quality guidelines for those waters. Due to the good nature of the groundwaters found in Agate Creek, excluding CCWB517 and CCWB526, analytes have been compared against the Australian guidelines for drinking water and ANZECC and ARMCANZ (2000) guidelines for livestock drinking water quality. For the dissolved metals and metalloids, the Australian drinking water guideline values are assessed, whereas total metals and metalloids are compared against guideline values presented in the livestock drinking water guidelines. The mean value calculated from the fourteen rounds of monitoring has been compared against the respective guideline values.

All bores excluding CCWB517 and CCWB526 are below the Australian drinking water guideline value of 600 mg/L for TDS. Whereas the water of CCWB526 is regarded as poor quality (900 – 1200 mg/L), CCWB517 is considered to be unacceptable (> 1200 mg/L). However, all bores meet the livestock drinking water guideline value for TDS of 4000 mg/L.

The guideline limits for fluoride are 1.5 mg/L and 2 mg/L for drinking water and livestock drinking water, respectively. Consequently, only four of the Agate Creek groundwater network report mean values below the human drinking limit, whereas six meet the livestock drinking water limit. Screened in the Corbett Formation Metasediments and positioned within close proximity to Agate Creek, CCWB521 fluoride concentrations are double that of any other bore in the groundwater network (Figure 15). CCWB521 also displays the greatest level of variation over the 18-month moitoring period, ranging between 12.1 mg/L and 16.6 mg/L. Conversely, the southern-most bore (CCWB517) initially reported stable concentrations between October 2020 and February 2021. However, levels appear to have risen during the wet season, with concentrations increasing from 4.4 mg/L to 7 mg/L between February and April 2021. For the remainder of the monitoring period, concentrations have flucuated between 6 mg/L and 8 mg/L. Elevated levels of fluoride are consistent with crystalline rocks (i.e granite) which often contain fluorine-rich minerals that are encountered in most bores at Agate Creek. CCWB518, CCWB520, CCWB522 and CCWB524 also exceeded both drinking water guideline values, although all concentrations remained stable throughout the monitoring period. All fluoride concentrations at Agate Creek are deemed to be naturally occurring.

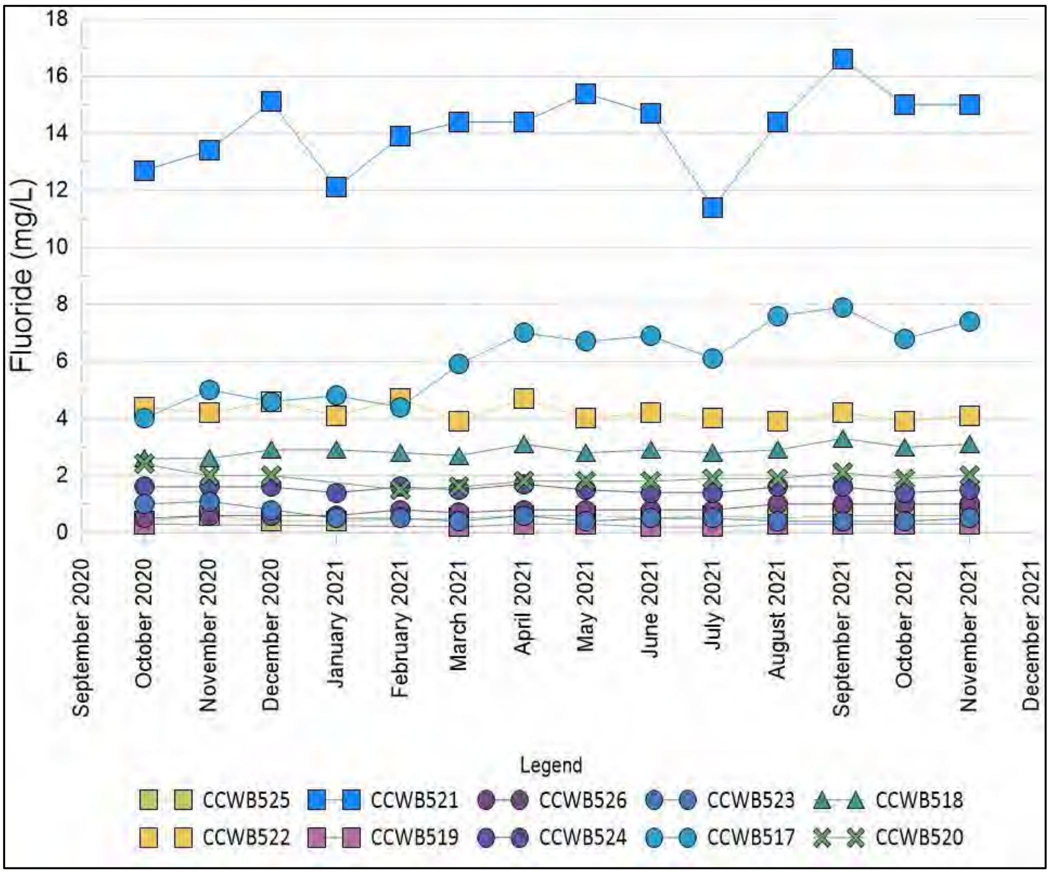

Figure 15: Varying concentrations of fluoride over the monitoring period.

The mean dissolved and total aluminium concentrations (0.1 mg/L and 5 mg/L, respectively) both exceeded the guideline values in CCWB519, CCWB520, CCWB521 and CCWB522, whereas only the mean dissolved aluminium values exceeded the guideline level in CCWB517 and CCWB523. Figure 16 displays the large degree of variation captured in total aluminium concentrations throughout the groundwater network over the monitoring period. No specific explanation has been provided, although it is most likely that the elevated levels are attributable to the sampling techniques and poor recharge. High-flow purging relies on sufficient recharge to remove three casement volumes from each bore prior to sampling. However, from the limited field data provided, it appears as though most bores at Agate Creek do not meet this criterion as per the Australia water sampling guidelines, with poor recharge limiting the purges to a single casement volume. Elevated colloids are often correlated with turbulent conditions or elevated levels of disturbances within the water column, possibly from sampling techniques implemented, which is associated with the large fluctuations in total aluminium (Figure 16).

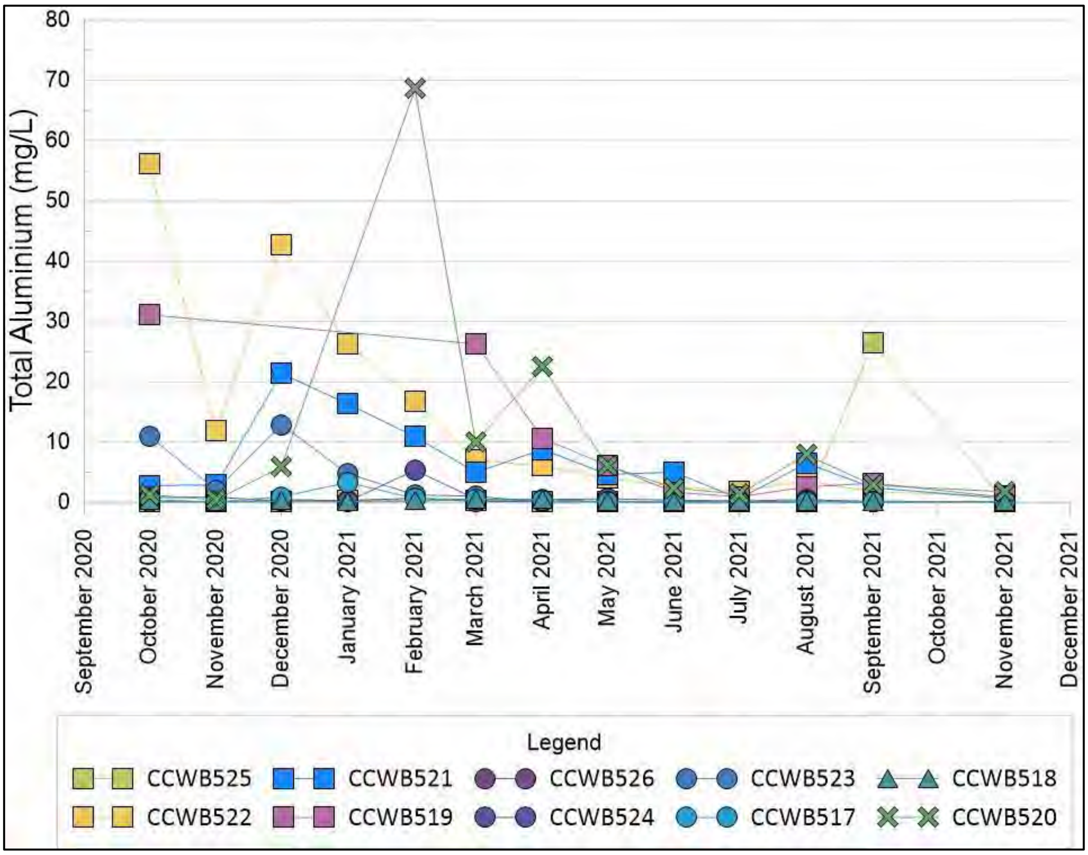

Figure 16: Varying concentrations of total aluminium over the monitoring period.

The mean dissolved arsenic concentrations of three bores (CCWB518, CCWB520 and CCWB521) exceeded the Australian drinking water guideline of 0.001 mg/L, with values ranging between 0.016 mg/L and 0.037 mg/L. CCWB518 is clearly distinguishable in Figure 17, with significantly elevated concentrations above any other bores in the network. Elevated levels of arsenic are attributed to the heavily altered geology intersected by CCWB518, drilling through multiple layers of veins, rhyolite and andesite. Dissolved arsenic concentrations in CCWB518 appear to show that the bore is requiring several months to stabilise following the drilling process, with levels fluctuating between 0.026mg/L and 0.071 mg/L over the initial four monitoring rounds and generally displaying a downward trend. Although elevated, CCWB520 and CCWB521 remained relatively stable through the monitoring period. Conversely, all mean values remained below the livestock drinking water guideline value for total arsenic of 0.5 mg/L.

The drinking water guideline limit for dissolved manganese is 0.5 mg/L. Although most bores do not exceed this limit, three bores have consistently recorded concentrations above that threshold. CCWB519 and CCWB522 had marginally elevated mean values of 0.72 mg/L and 0.55 mg/L, respectively, whereas CCWB525 reported a markedly higher mean value of 3.83 mg/L.

The only other metal or metalloid to exceed either the drinking water guideline or stock drinking water guideline is CCWB525 for dissolved nickel. The drinking water guideline for dissolved nickel is 0.02 mg/L, in comparison to the calculated mean for CCWB525 which equals 0.31 mg/L. The elevated dissolved nickel in CCWB525 correlates with the raised dissolved manganese concentrations. Dissolved manganese has a high adsorption capacity to available metals within the respective system. These naturally elevated levels are consistent with the weathered granite lithology encountered in CCWB525.

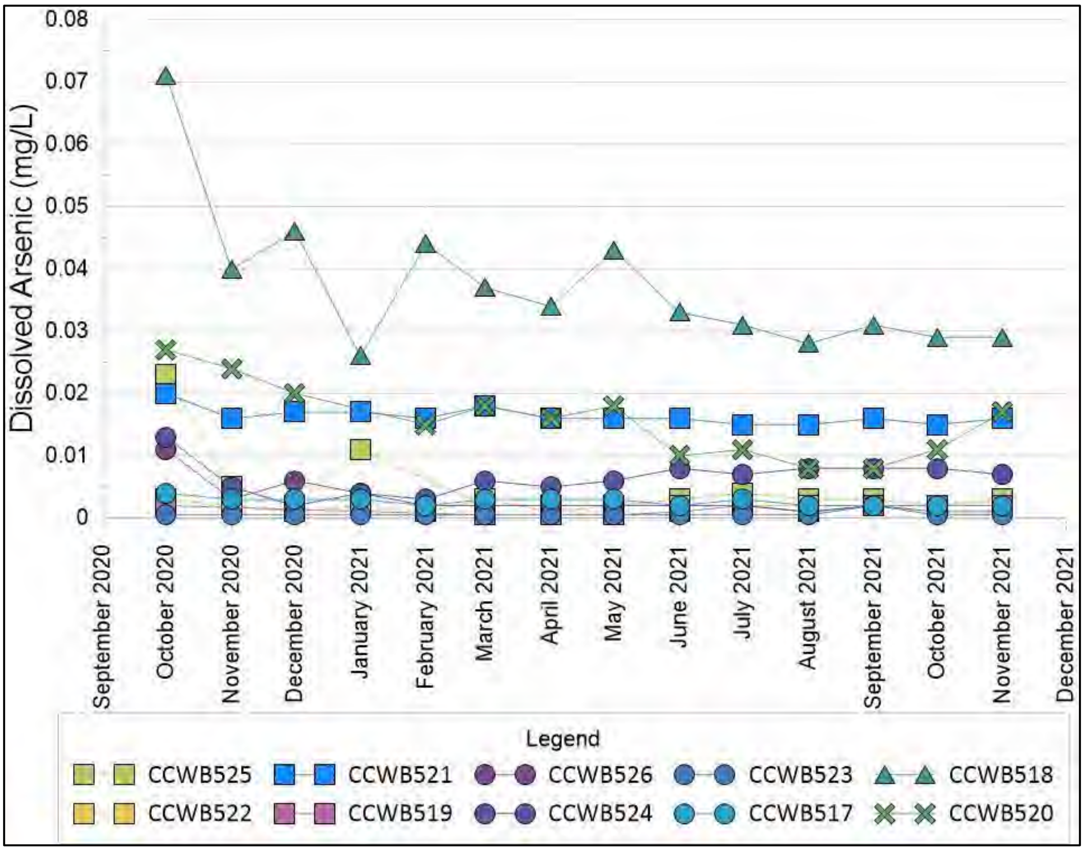

Figure 17: Time series of dissolved arsenic across the groundwater monitoring network.

All analytical times series graphs not presented within this section (i.e. for additional analytes tested) can be reviewed within Appendix A.

5.5 YIELD AND USES

Exploration drilling data captured groundwater intersection depths and indicative airlift yields. Many of the drilled exploration holes intersected very low-yielding water. A number of exploration bores were drilled in the area between Sherwood West Fault and Zig Zag Fault – and areas where no groundwater monitoring bores were drilled. A number of these exploration holes – drilled along an east-west ridge line – indicate yields of 1 L/s to 10 L/s, aligning with a ridge line. Two of these exploration holes provide the production water supply and the camp supply (Figure 11). No further information has been provided regarding the bore holes which supply water for the site's production and camp facilities.

The assessment method for possible impacts from mining operations at Agate Creek included a bore network search whereby no other groundwater users were identified within a 5 km buffer. Therefore, it is concluded that the number of groundwater uses in the vicinity of Agate Creek is minimal.

6. GROUNDWATER IMPACT ASSESSMENT

6.1 Groundwater Take

Distances of the individual bores to the main mine pit were measured. This measurement was generally straightforward – with the exception of CCWB524 where ambiguity existed owing to the presence of a haul road. Furthermore, CCWB519 was assessed in relation to the main pit and proposed pit located within close proximity to the bore.

The inflow rates outlined in Table 6 have been utilised to calculate the relationship between groundwater flows and the main pit, whereby the rate of m^3/sec is converted to m^3/year (by multiplication by 86,400 and 365.25). Assuming all groundwater flows are directed towards the main pit, then:

(a) For the linear case, an inflow of 8,521.31 m^3/year may be predicted (16.20 L/min); and

(b) For the logarithmic case, an inflow of 5,958.51 m^3/year may be predicted (11.329 L/min).

Groundwater flows of CCWB519 into the small pit on the western flank are predicted to impact the void at a rate of 1.410 L/min.

It should be noted that these values must be considered worst-case scenarios.

From the flow rates and distances from the main pit, the individual flows from bores CCWB518, CCWB524 and CCWB525 are those most likely to impact the main pit (Figure 11). Flows from the three bores may all combine to give a flow of 7.686 L/min on a linear model and 4.828 L/min on a logarithmic model. These are considered relatively low flows and are reasonable estimates of likely inflows.

6.2 Environmental Impacts

The stage 2 expansion of the Agate Creek mine involves mining six different open-cut pits. The mine is currently working Pit 6 under the current EA that allows up to 250,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 250,000 tonnes limit – as well mining an additional five satellite pits.

6.2.1 Groundwater Resources

Hydraulic conductivities of all rocks within the Agate Creek site are very low to low (10^{-8} to 10^{-7} m/sec) which implies that inflows into the main pit will also be low – 11.329 L/min to 16.201 L/min on a worst-case scenario or 4.828 to 7.686 L/min on a more likely scenario.

Impact on/from flows from CCWB524, CCWB525 and CCWB518 may occur on the main pit over a 4- to 31.5-year time span. However, it is more likely that this time span will be closer to 10 to 31.5 years. A low-flow impact (1.410 L/min) may occur on a 10-year time span from CCWB519 on the minor pit – and 125 m to the west of this bore. The two distant bores, CCWB517 and CCWB526, may experience an impact over at least an 80-year time span.

Any impacts are predicted to be minor and will remain on the mine lease over at least an 80-year time span. Considering all aforementioned factors, the overall risk to the sampled aquifers – and from the relatively small inflows into both the main pit and the minor pit to the west of CCWB519 – is very low to low.

6.2.2 GROUNDWATER USERS

The groundwater census completed within the 10 km buffer from Agate Creek found no registered groundwater bores. Accordingly, the impact to other groundwater users withing close proximity to Agate Creek is considered to be negligible.

6.2.3 GROUNDWATER-DEPENDENT ECOSYSTEMS

There are no formally identified groundwater-dependant ecosystems or springs within the mining extent. The nearest mapped groundwater-dependent ecosystem is a subterranean aquifer associated with the Hamstead Sandstone aquifer at Cobbold Gorge, downstream of the Agate Creek and Cave Creek confluence. The southern edge of this groundwater-dependent ecosystem is approximately 15 km northwest of the ML boundary. Considering the poor hydraulic conductivity measured and that the modelled minor drawdown will not surpass the mining lease boundary for several decades, it is unlikely that the activities at Agate Creek will interact with the associated groundwater-dependent ecosystems. Additionally, the potentiometric contours and associated difference between the bed of Agate Creek and CCWB521 support the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

6.2.4 GROUNDWATER QUALITY

In general, the Agate Creek groundwater monitoring network currently expresses good quality water, with most bores meeting drinking water quality guidelines for both human and livestock consumption, excluding fluoride. The potential risk to groundwater from the mining operations at Agate Creek relate to the storage and interaction with waste rock. As part of this EA amendment application, Laneway and C&R have completed a waste rock characterisation assessment to determine the environmental implications of producing up to 250,000 tonnes of waste rock. This section summarises the findings of the C&R waste rock assessment to date (refer to C&R, 2022).

The waste rock contains relatively benign lithology, which predominantly consists of felsic volcanics. The analysed pH values are impacted by the testing method (i.e. fluid extracted from crushed samples, with a very high surface area to solution ratio), it is expected that both the low and high pH results in the waste rock are a worst-case scenario. Therefore, it is envisaged that the pH of runoff from the proposed open-cut pits waste rock will not be as low or high as that reflected in the waste rock sample test results. Also, in order for significant runoff to occur at Agate Creek, the rainfall dilution factor should be greater than the 1:5 (sample:water) ratio used in the extract solutions. This, in turn, would counteract the resulting acidity or alkalinity. In general, most waste rock samples are in the neutral to slightly acidic range (Figure 18), indicative of the waste rock lithology (felsic volcanics).

The electrical conductivity of the Agate Creek waste rock samples ranges from from 7 µS/cm to 1,680 µS/cm and has a very low median value of 43.5 µS/cm. Most Agate Creek waste rock samples have low electrical conductivity values (<300 µS/cm). Apart from an outlier in Pit 2 (1,680 µS/cm), EC values in all waste rock samples are below 500 µS/cm (Figure 19). The relatively low electrical conductivity recorded in most waste rock samples correlates with the good quality reported in the groundwater, whereby the highest electrical conductivity is approximately 2,400 µS/cm. It is therefore unlikely that seepage and infiltrations from the waste rock dumps would result in increases in the salinity of the associated groundwater system.

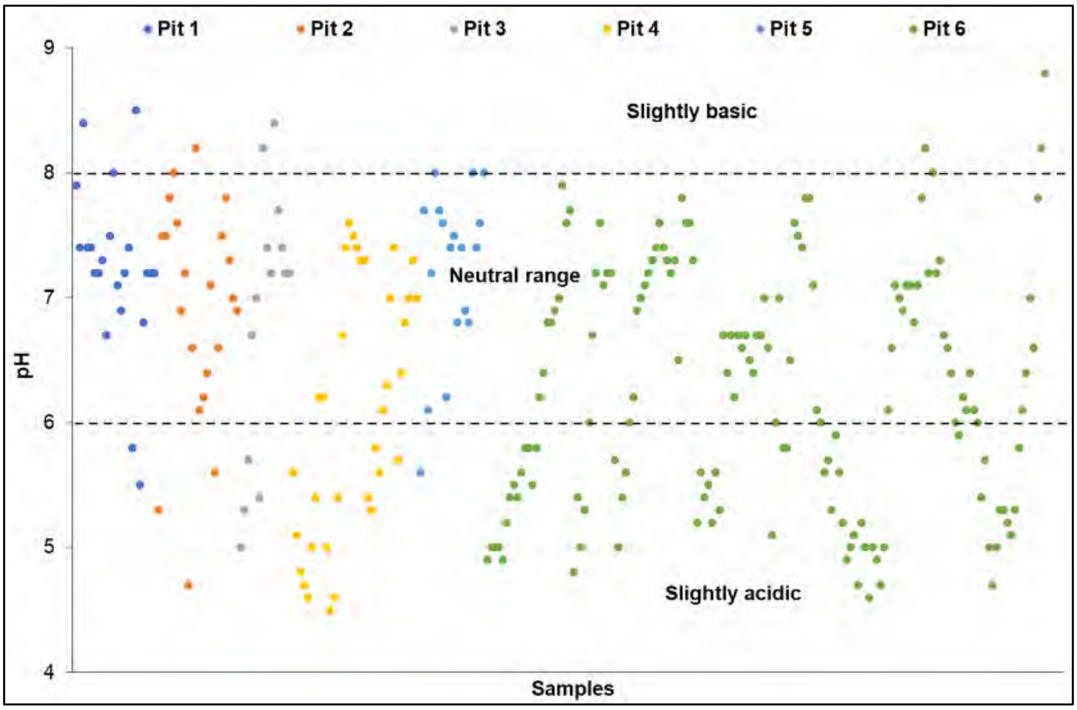

Figure 18: pH values for Agate Creek waste rock samples (extracted from C&R, 2022).

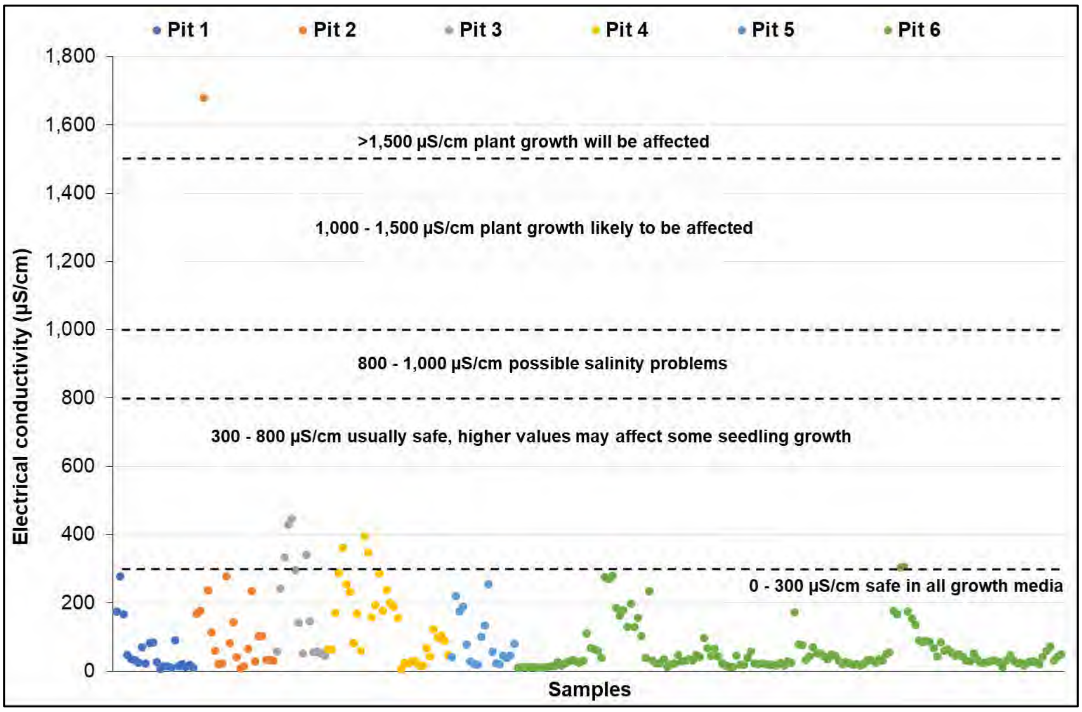

Figure 19: Electrical conductivity for Agate Creek waste rock samples (extracted from C&R, 2022).

The net acid generation (NAG) test is used to directly measure the net amount of acid produced by a waste rock sample.

Figure 20 demonstrates that most Agate Creek waste rock samples have a NAG(pH) greater than 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast, two samples have a NAG(pH) greater than 4.5 and a net acid production potential (NAPP) value above 0 (these are classified as uncertain PAF [potentially acid-forming]), whereas at least one sample is certainly PAF, having a NAG(pH) less than 4.5 and a positive NAPP value (Figure 20).

A summary of the NAG(pH) versus total sulphur geochemical classification criteria for the waste rock samples is presented in Table 8 and Figure 21.

Table 8: Geochemical classification criteria for Agate Creek waste rock samples.

Geochemical Classification	Total Sulphur (%)	$NAG_{(pH)}$	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6
NAF (barren)	≤0.1	-	22	18	14	34	17	142
NAF (very low sulphur)	>0.1 to ≤0.55	≥ 4.5	0	1	0	0	0	1
NAF (low sulphur)	0.55 to 1.5	≥ 4.5	0	0	0	0	0	0
PAF (very low sulphur)	0.1 to ≤0.55	< 4.5	0	2	0	0	1	6
PAF (low sulphur)	0.55 to 1.5	< 4.5	0	0	0	0	0	1
PAF (moderate to high sulphur)	>1.5	< 4.5	0	1	0	0	0	0
Percentage of NAF samples			100%	86.4%	100%	100%	94.4%	95.3%
Percentage of very low sulphur PAF samples			0%	9.1%	0%	0%	6%	4.0%
Percentage of low sulphur PAF samples			0%	0%	0%	0%	0%	0.7%
Percentage of moderate to high sulphur PAF samples – actionable levels			0%	4.5%	0%	0%	0%	0%

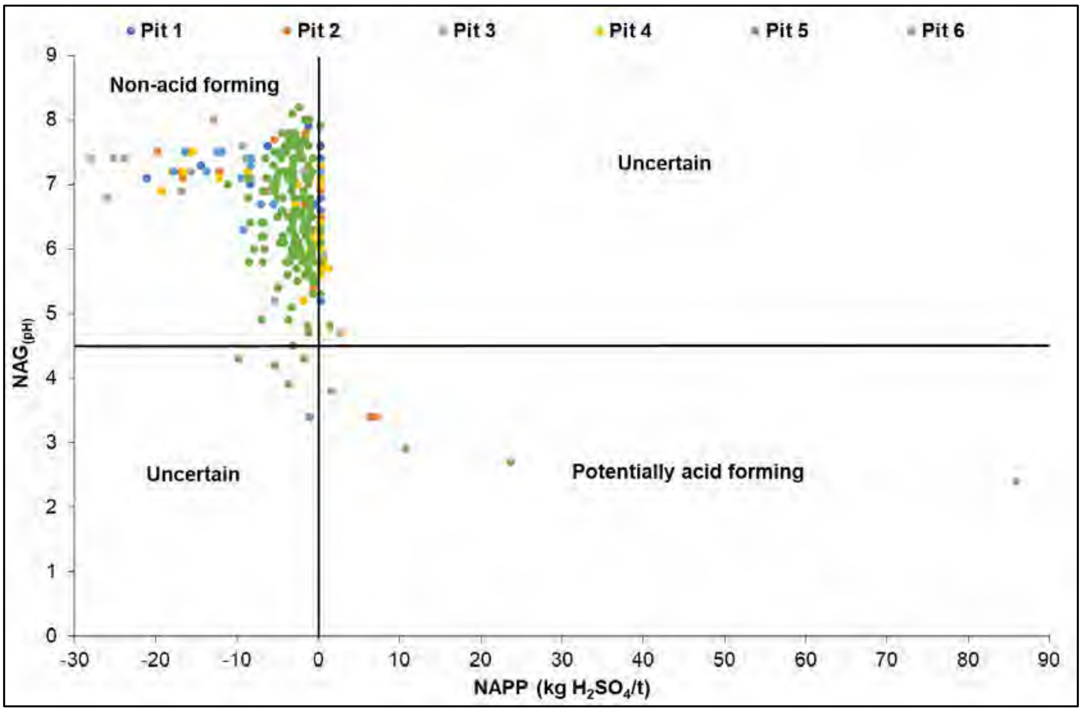

Figure 20: $NAG_{(pH)}$ versus NAPP for Agate Creek waste rock samples (extracted from C&R, 2022).

Applying the NAG(pH) and total sulphur geochemical classification criteria (Table 8), it can be shown that most waste characterisation samples are non-acid forming (NAF) or barren (Figure 21).

Of the 260 Agate Creek waste rock samples, there are only 11 samples that could be categorised as PAF when the NAG(pH) and total sulphur values are considered:

- Three samples in Pit 2;
- One sample in Pit 5; and
- Seven samples in Pit 6.

These samples make up less than 14% of the total sample size for their respective areas – and their sulphur values are still very low to low except for one sample in Pit 2. It is therefore expected that only one of these eleven samples presents an acid drainage issue because:

- The amount of produced acid would be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

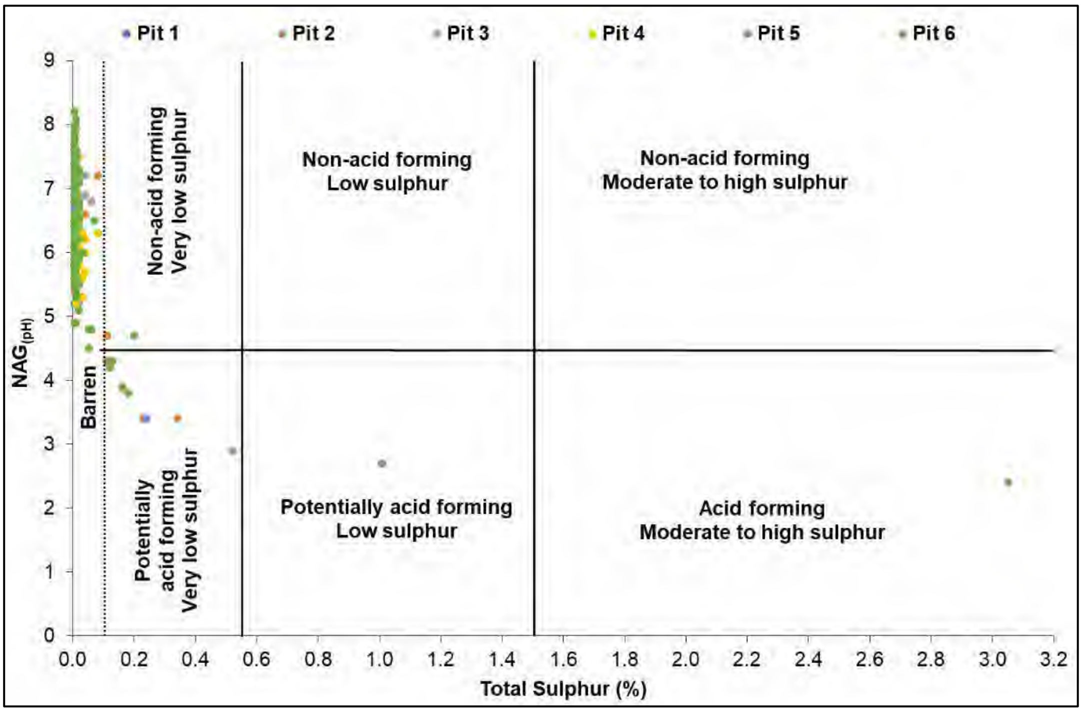

Figure 21: $NAG_{(pH)}$ versus sulphur for Agate Creek waste rock samples (extracted from C&R, 2022).

A broad range of analytes were assessed using both static tests and kinetic leach column (KLC) tests. While irregular exceedances of conservative guideline values (i.e. values not necessarily appropriate for comparison with leachate results) were identified for a number of quality characteristics, including aluminium, boron, copper and zinc, only fluoride was found to be at levels of concern to the associated receiving environments (i.e. regularly above the livestock drinking water guideline value (C&R, 2022). However, fluoride was already noted to be elevated, above livestock drinking water values, in several bores across the project site, with levels recorded greater than 16 mg/L. KLC test results found that while maximum values of 6.6 mg/L were observed in initial leaches, these values quickly became compliant with the livestock drinking water guideline value of 2 mg/L during subsequently leaches. Based on these levels and the levels of fluoride already observed within the groundwater systems across the project site, seepage and infiltration from the waste rock dumps are predicted to have negligible influence on the groundwater quality throughout the area.

7. GROUNDWATER MONITORING PROGRAMME

The Agate Creek operations currently monitor an extensive groundwater bore network which comprises 21 monitoring bores located across the mining lease (Table 9). The purpose of the groundwater monitoring network is to monitor groundwater levels and quality in the primary aquifers potentially impacted by mining activities.

7.1 GROUNDWATER LEVEL AND QUALITY MONITORING

Groundwater levels will be measured and recorded on a monthly basis, which will enable the observation of natural groundwater level fluctuations – such as seasonal responses to rainfall. Standing water level monitoring must be able to distinguish the difference between natural fluctuations and potential mining activities.

Groundwater quality monitoring will be undertaken on a quarterly basis to enhance the existing baseline dataset available prior to commencement of the project. This will be used to detect any changes in groundwater quality during and post-mining. Water quality samples will be analysed for physico-chemical parameters – including pH, electrical conductivity, alkalinity, hardness, major ions (Ca, Mg, Na, K, Cl and SO_4) and dissolved and total metals and metalloids (Al, AS, B, Cd, Cr, Co, Fe, Pb, Mn, Hg, Mo, Ni, Se and Zn).

All samples for groundwater quality shall be collected after the bore is appropriately purged. Groundwater samples will be collected in accordance with the relevant guidelines and conventions specified in the *Monitoring and sampling manual* (DES, 2018), and in compliance with, for example, AS/NZS 5667:11 1998 (Australian/New Zealand standards, 2016). The samples will be preserved and forwarded to a National Association of Testing Authorities (NATA) accredited water laboratory for analysis.

The groundwater monitoring data will be reviewed annually, and the groundwater monitoring programme revised, as necessary. In the event that the monitoring programme identifies a significant departure from the prediction, an investigation will be undertaken to identify the cause and manage any unexpected impacts associated with the project.

7.2 NETWORK SUITABILITY

When assessing the suitability of the groundwater monitoring network, the construction issue – whereby no bentonite seal has been installed above the screens for all bores drilled in 2020 – must be addressed. Affected bores are identified with an asterisk in Table 9. These bores essentially represent open holes and therefore do not meet the minimum construction requirements for water bores in Australia. Accordingly, it is strongly recommended the monitoring bores drilled in 2020 are decommissioned and redrilled in accordance with the Australian guideline and implemented into the Agate Creek groundwater monitoring programme.

Additionally, minimal data have been provided for this assessment regarding the two extraction bores used on site for production and camp purposes. To ensure compliance with the UWIR, each extraction point must be fitted with a flow meter to accurately measure take volumes. This will provide additional scope for assessment when the annual groundwater reviews are completed to determine whether any impact has occurred to water levels and/or quality. Furthermore, specifics relating to the extraction points must be identified to ensure monitoring bores are screened within the same aquifers to accurately assess impacts of drawdown.

Table 9: Current groundwater monitoring programme (MGA: Map Grid of Australia; TBA: to be advised).

Bore ID	Easting	Northing	Ground level	Casing above ground (m)	Total depth	Screened interval
	MGA94 zone 54		m AHD	m	m BGL	
CCWB517*	768400	7896463	435.6	0.6	55	49 – 55
CCWB518*	767768	7897706	431.4	0.6	73	67 – 73
CCWB519*	767302	7897863	517.18	0.62	85	79 – 85
CCWB520*	767947	7897838	434.96	0.59	73	67 – 73
CCWB521*	768701	7898079	420.94	0.6	73	67 – 73
CCWB522*	768762	7897724	434.2	0.6	73	67 – 73
CCWB523*	768321	7897579	449.6	0.61	73	67 – 73
CCWB524*	768174	7897670	496.06	0.64	91	85 – 91
CCWB525*	768167	7897930	498.77	0.62	103	97 – 103
CCWB526*	767710	7896909	449.4	0.66	73	67 –73
CCWB527	767660	7897458	461.50	TBA	31	25 – 31
CCWB528	767955	7898381	415.49	TBA	73	67 – 73
CCWB529	770217	7900144	463.85	TBA	31	25 – 31
CCWB530	767948	7898378	422.80	TBA	7	4 – 7
CCWB531	767997	7898782	420.39	TBA	55	49 – 55
CCWB532	770221	7900138	469.62	TBA	7	4 – 7
CCWB533	769580	7900063	473.09	TBA	25	19 – 25
CCWB534	768655	7895516	454.09	TBA	25	19 – 25
CCWB535	768681	7897248	407.91	TBA	7	4 – 7
CCWB536	768622	7897214	440.68	TBA	19	13 – 19
CCWB537	768005	7898801	420.66	TBA	19	13 – 19
CCWB538	768651	7895513	468.83	TBA	7	4 – 7

7.3 UWIR REVIEW

It is deemed the role and responsibility of Laneway to guarantee the implementation of the UWIR at Agate Creek. The UWIR is designed to align with the site's EA. Therefore, it is recommended that the monitoring programme stipulated in Section 7.1 forms part of the EA amendment for the expansion of mining at Agate Creek.

Furthermore, the recommendation to redrill all 2020 monitoring bores may significantly impact the water quality assessment completed as part of this report. Therefore, following the collection of 12 data points, all hydrochemistry data should be reassessed to ensure the identified environmental values remain applicable.

8. CONCLUSIONS

The Agate Creek is an open-cut gold mining operation proposal for a stage 2 expansion of mining activities which are to involve six different open-cut pits. The proposed expansion has been assessed for the level of impact on the surrounding aquifer systems.

The groundwater monitoring network consists of ten monitoring bores within an area of approximately 1.5 km^2 that incorporates all six proposed voids. The network targets a section of the regional-scale Robertson Fault Zone and the northwest end of the Agate Creek Volcanic Complex. Specifically, all bores are screened within metamorphic rocks that have been intruded by Siluro-Devonian-age Robin Hood Granodiorite – and by early Permian rhyolitic and andesitic dykes and stocks that are related to the Agate Creek Volcanic Complex.

However, the construction of the ten monitoring bores has impinged on the ability to accurately assess the potential impact of mining activities on the local groundwater aquifers. The omission of a bentonite seal above the screened interval has resulted in essentially open boreholes, where water can enter into the bore from any depth.

The geological lithologies present (granite, rhyolite, andesite, metasediment and veins) – and the data provided in numerous sources (including Brassington, 1988) – indicate that the hydraulic conductivities of the lithologies at Agate Creek are in the very low to low range. This was later confirmed – with pump tests completed on each monitoring bore, whereby hydraulic conductivities ranged between 6.57×10^{-8} m/sec and 5.06×10^{-7} m/sec. Although not ideal, the construction of the bores has not significantly impacted on these results because the calculated hydraulic conductivity represents the fastest of all aquifers present. Any impacts are predicted to be minor and will remain on the mine lease over at least an 80-year time span. Therefore, the expansion of mining activities at Agate Creek presents an overall very low to low risk to the aquifers sampled from the relatively small inflows into both the main pit and the minor pit to the west of CCWB519

Additionally, the impact to users is deemed to be negligible. Excluding the designated Agate Creek monitoring bores, no groundwater bores were identified within a 5 km buffer from the mining lease boundary. Further, the closest GDE is associated with the sandstone aquifer approximately 10 km away. Two springs were identified by helicopter and therefore little to no information is known about dynamics of the individual systems – although both springs are considered permanently active.

The potentiometric surface suggests that the groundwater flow direction follows the surface topography whereby water moves from high elevation on the western boundary (CCWB519) to low elevation beside Agate Creek (CCWB521). The elevation difference between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater systems present within the mining lease do not impact or interact with flow in Agate Creek.

The groundwater across the bore network represents good quality water, with most bores reporting properties below guideline values for drinking water and livestock drinking water, except for. The greatest threat to water quality with the expansion of the Agate Creek mining operations comes from the increased volume of waste rock present on the surface. However, most waste rock samples returned pH, electrical conductivity and NAF properties which present low environmental risk to surrounding groundwaters. Typical of the surrounding geology, much of the waste rock is benign, with elevated levels attributed to samples collected from within the ore body.

Based on the available data, this groundwater assessment has determined that the expansion of the Agate Creek mining operations would present a low environmental risk to the hydrogeological systems present.

9. REFERENCES

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Appendix A – Analyte timeseries

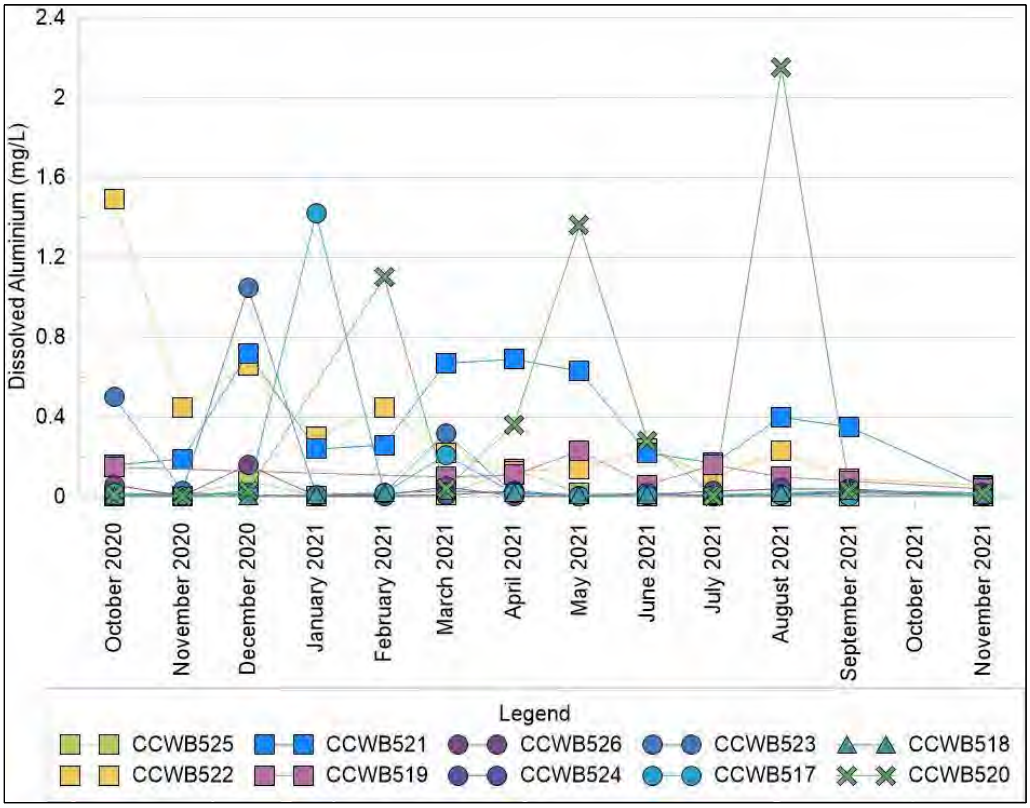

Figure A1: Time series of dissolved aluminium in all groundwater monitoring bores.

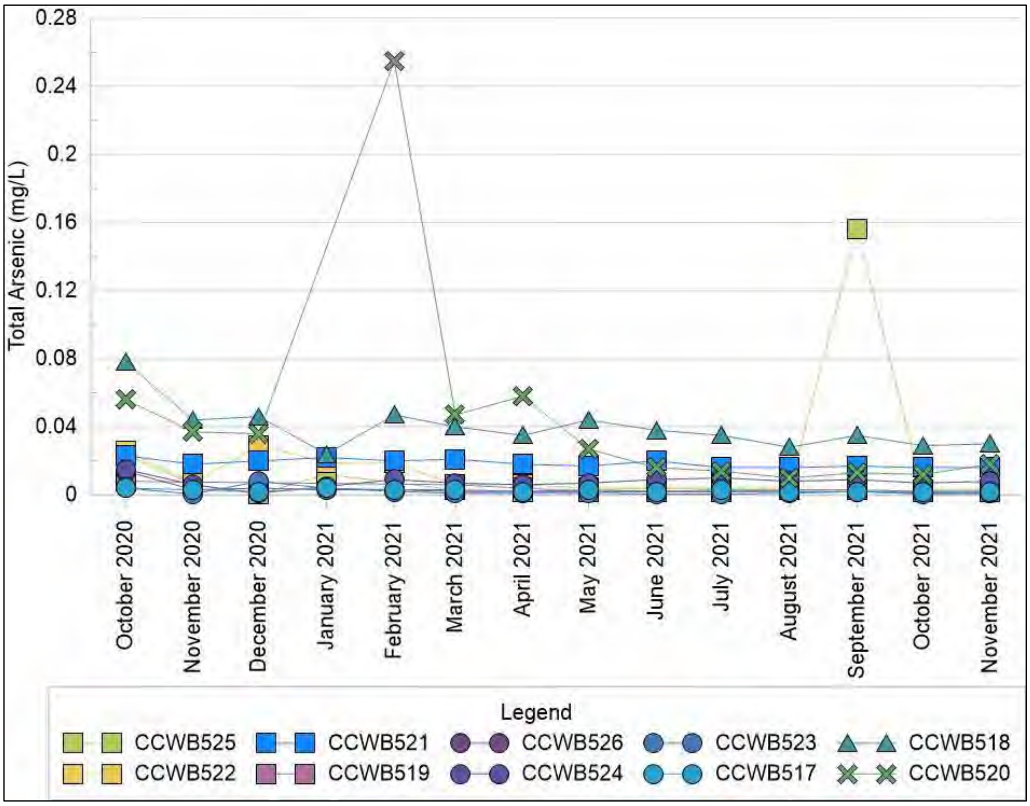

Figure A2: Time series of total arsenic in all groundwater monitoring bores.

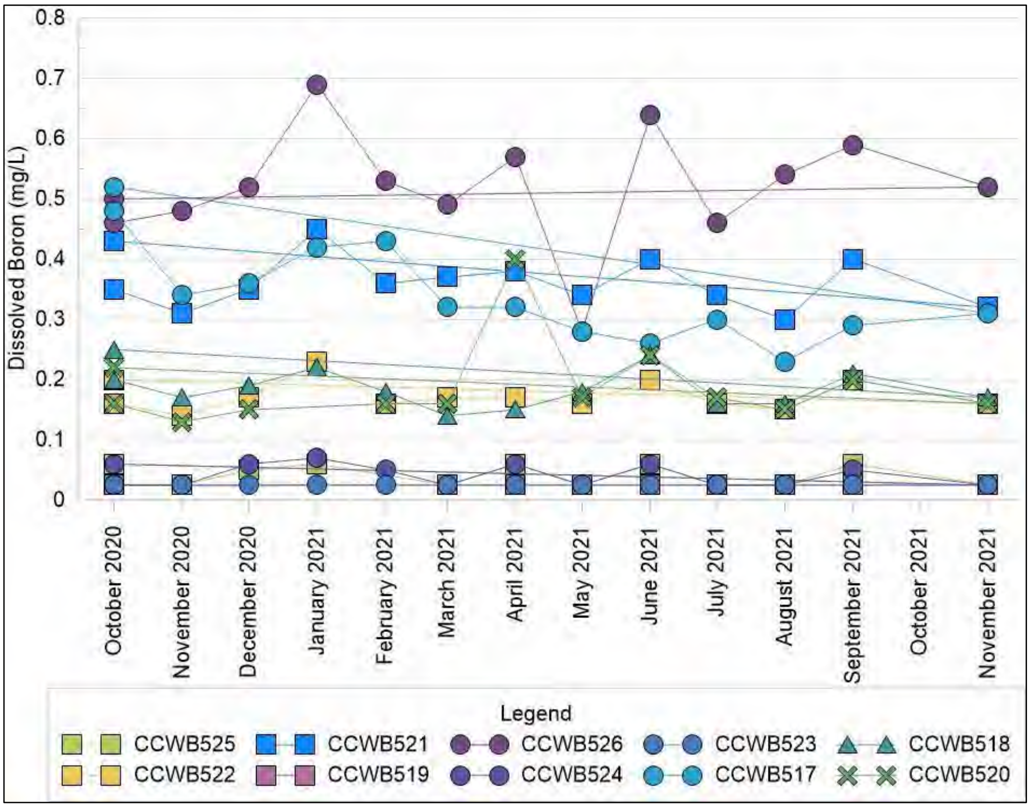

Figure A3: Time series of dissolved boron in all groundwater monitoring bores.

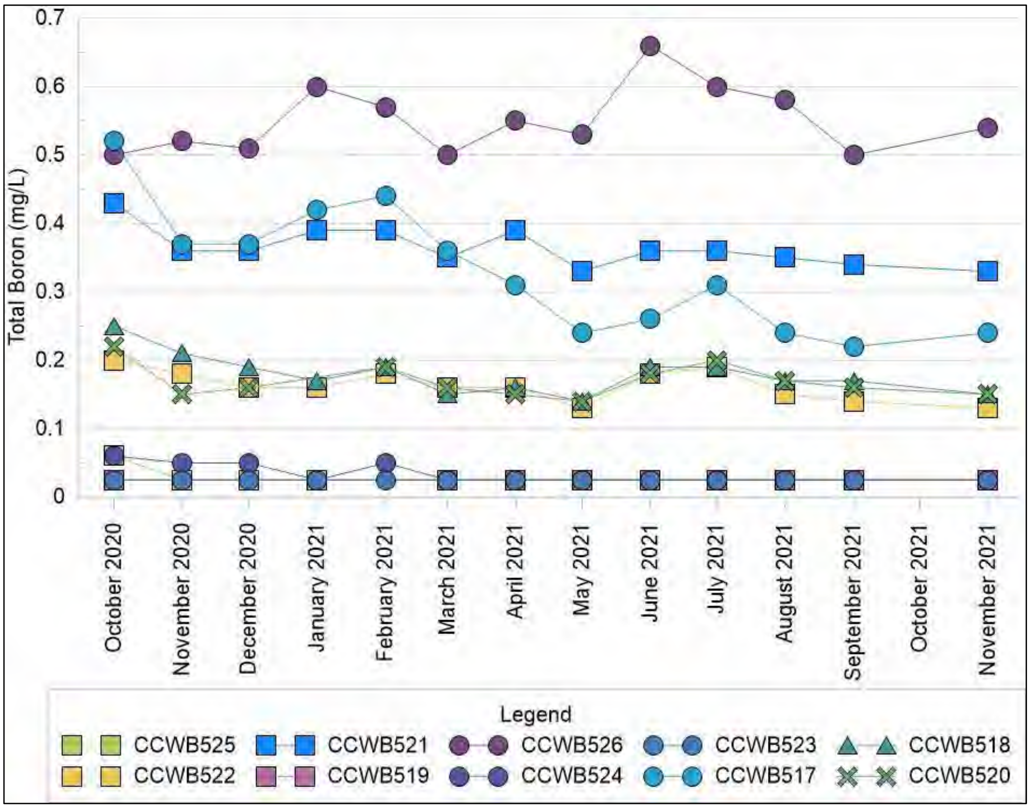

Figure A4: Time series of total boron in all groundwater monitoring bores.

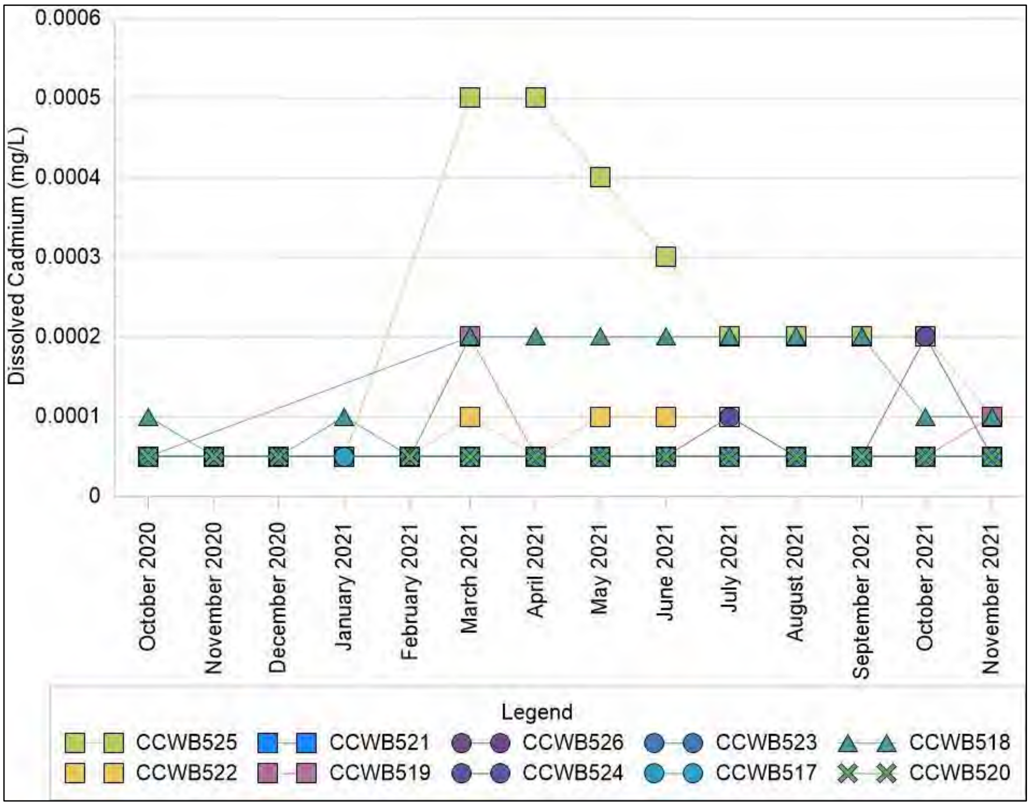

Figure A5: Time series of dissolved cadmium in all groundwater monitoring bores.

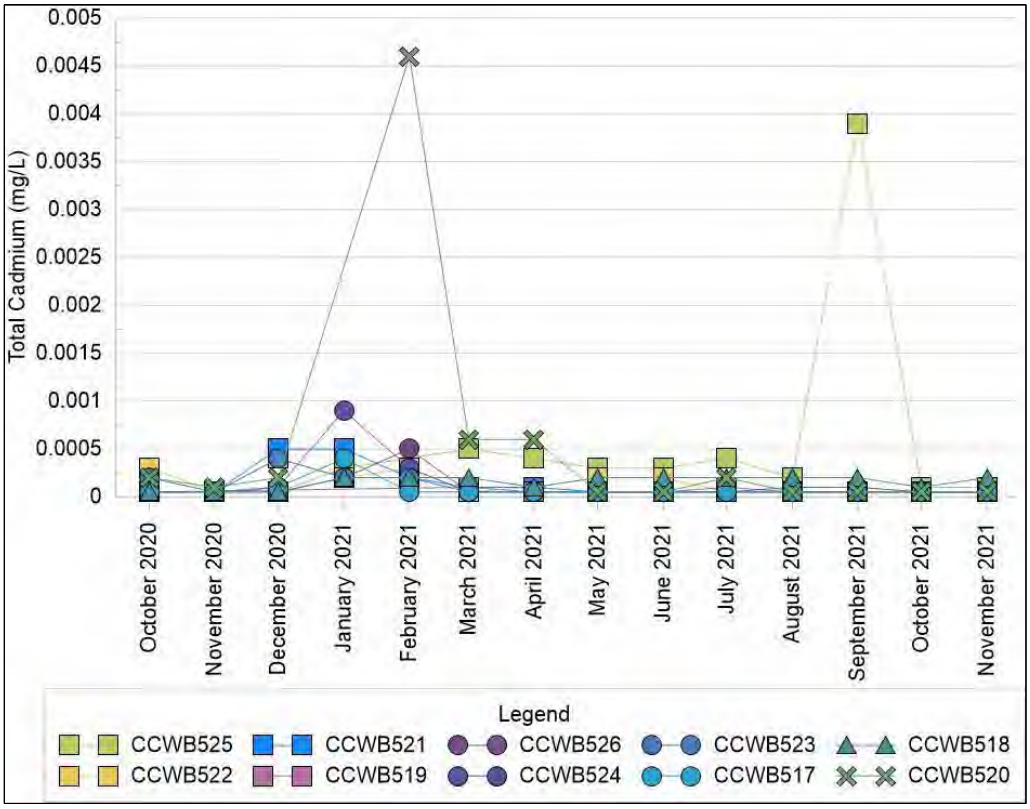

Figure A6: Time series of total cadmium in all groundwater monitoring bores.

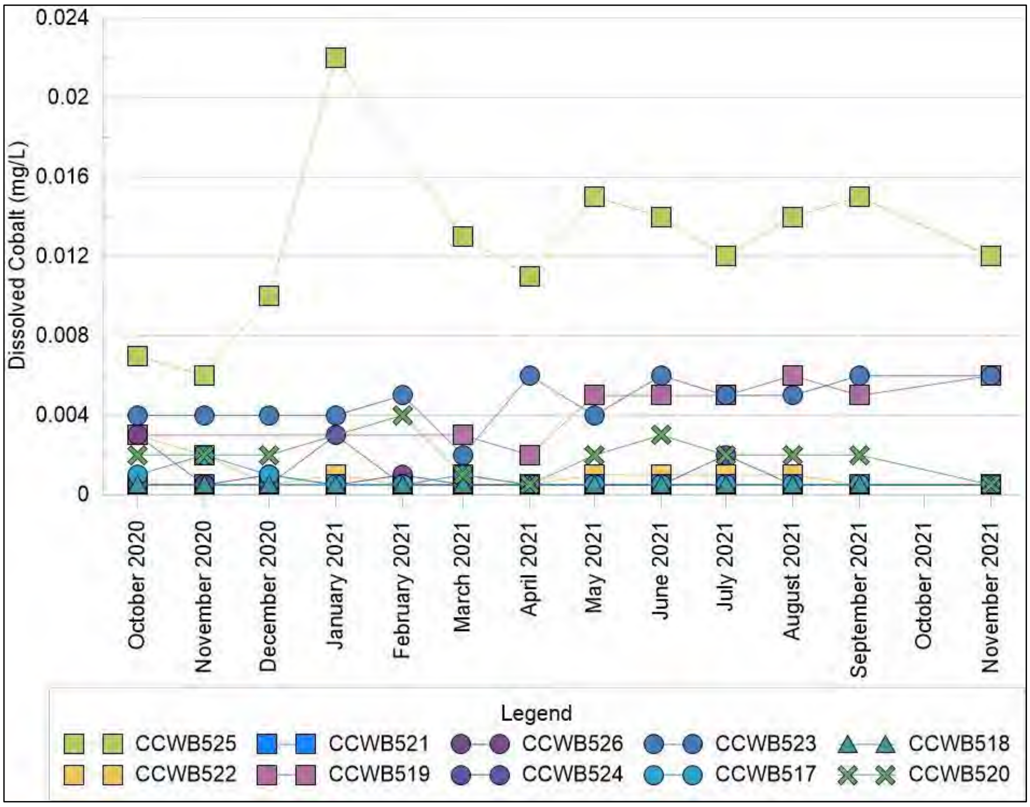

Figure A7: Time series of dissolved cobalt in all groundwater monitoring bores.

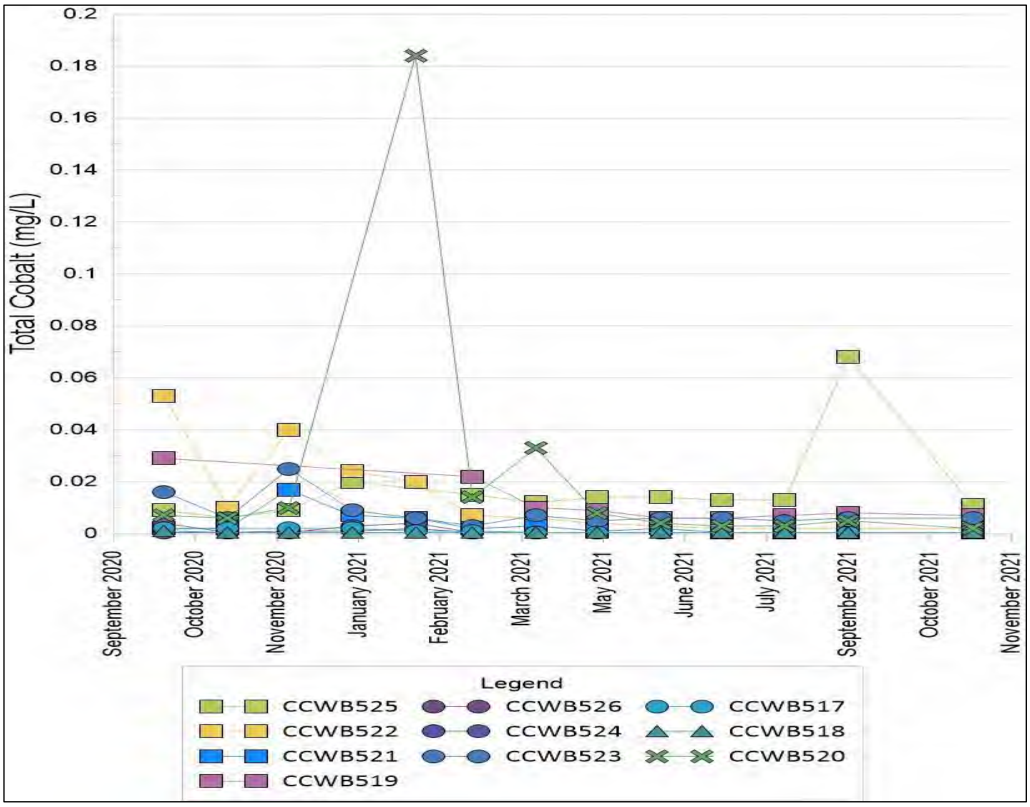

Figure A8: Time series of total cobalt in all groundwater monitoring bores.

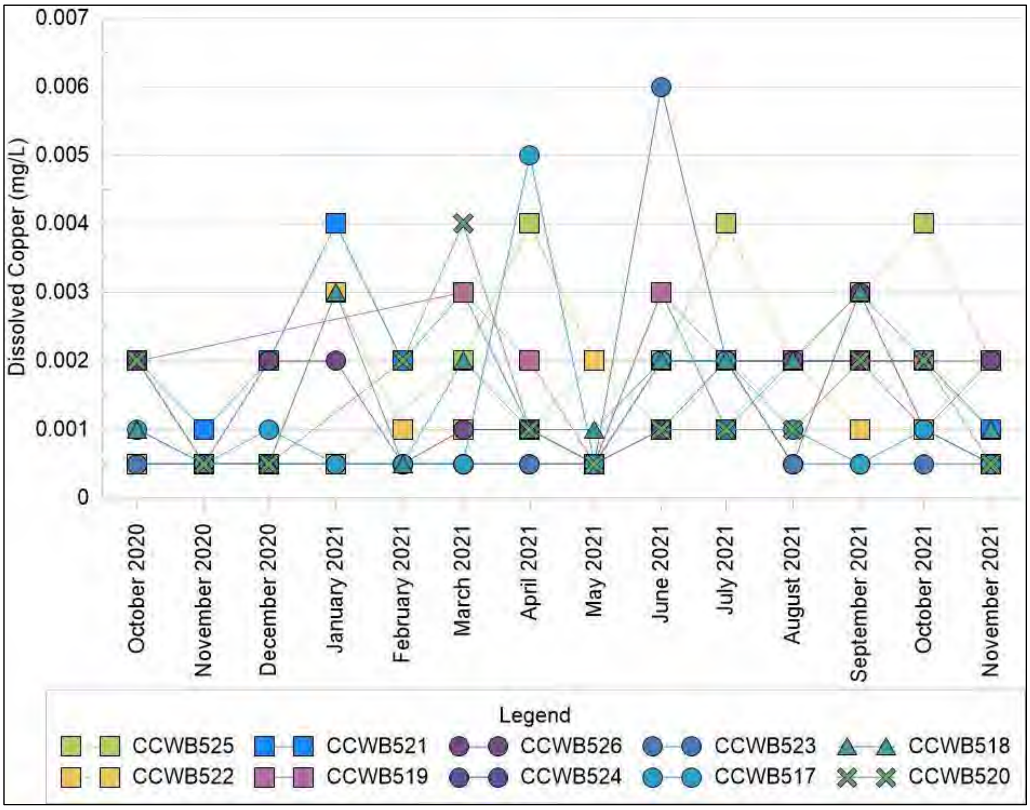

Figure A9: Time series of dissolved copper in all groundwater monitoring bores.

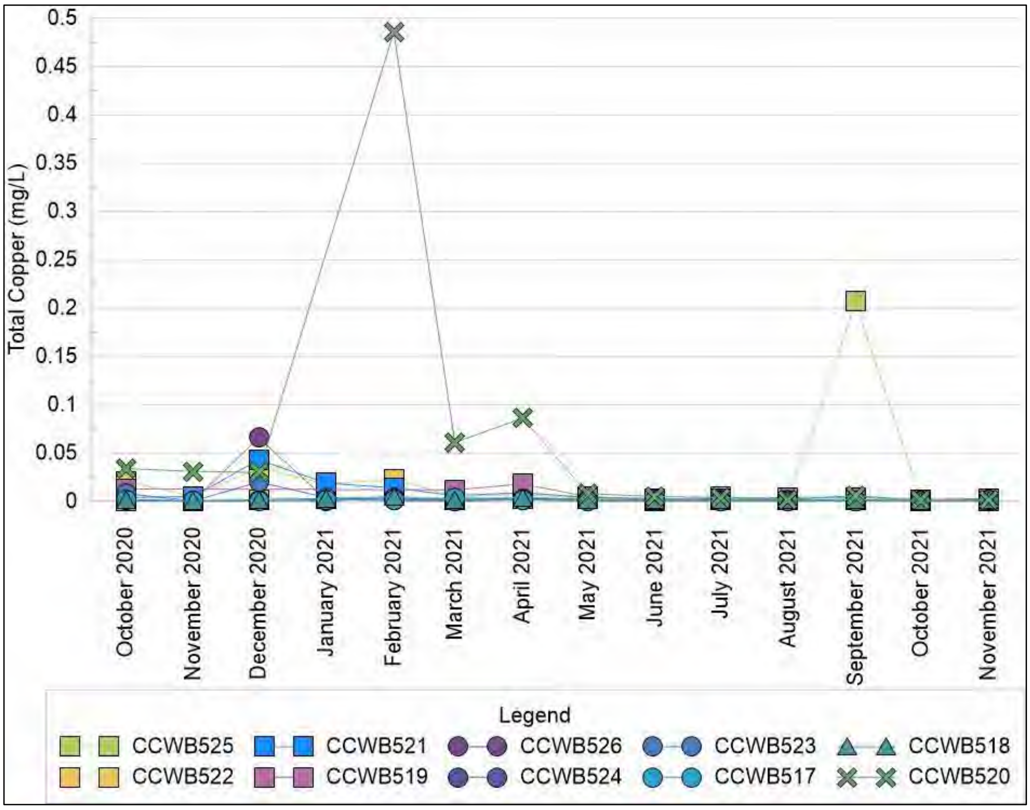

Figure A10: Time series of total copper in all groundwater monitoring bores.

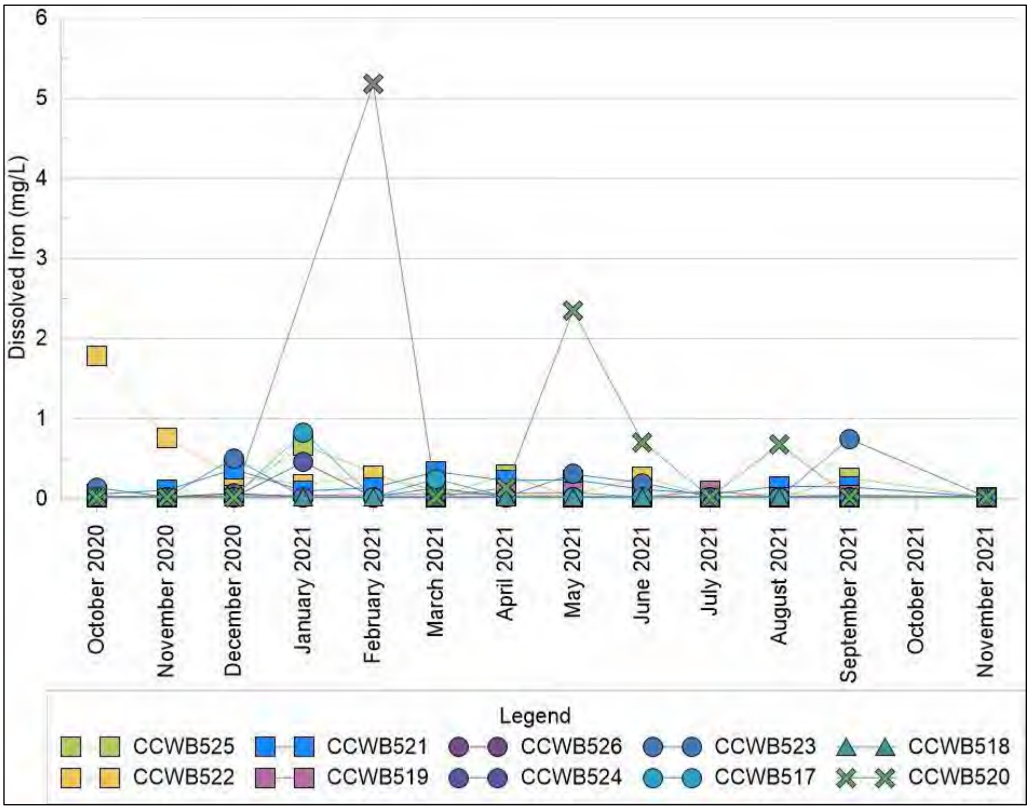

Figure A11: Time series of dissolved iron in all groundwater monitoring bores.

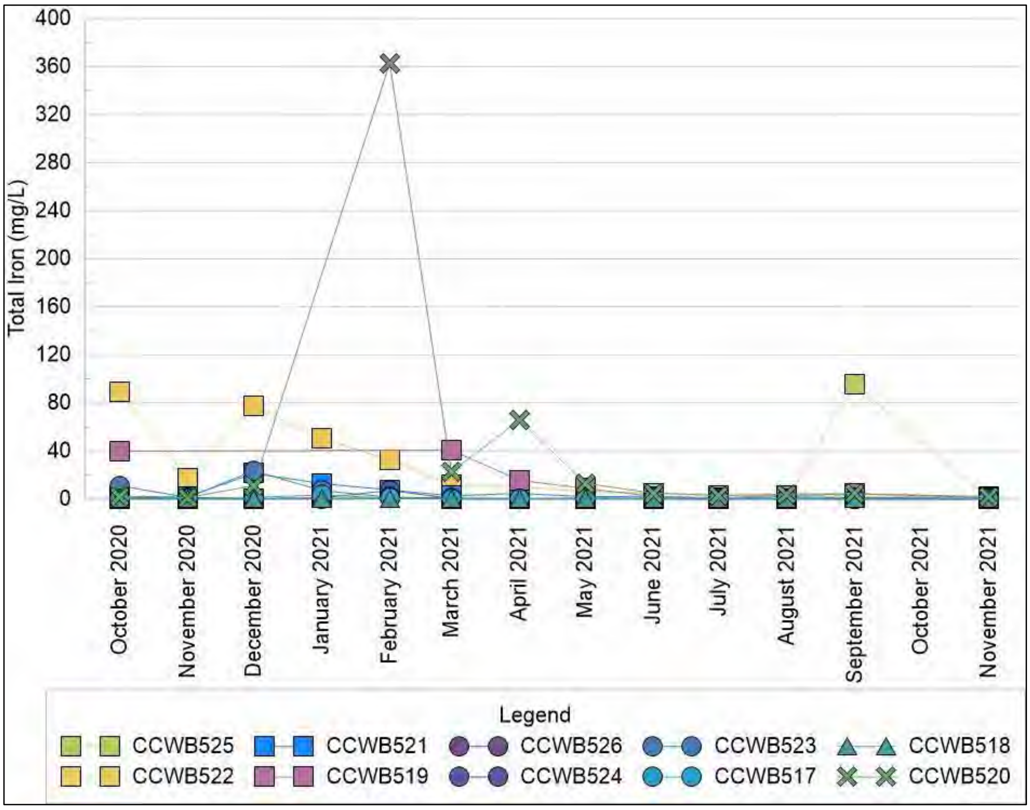

Figure A12: Time series of total iron in all groundwater monitoring bores.

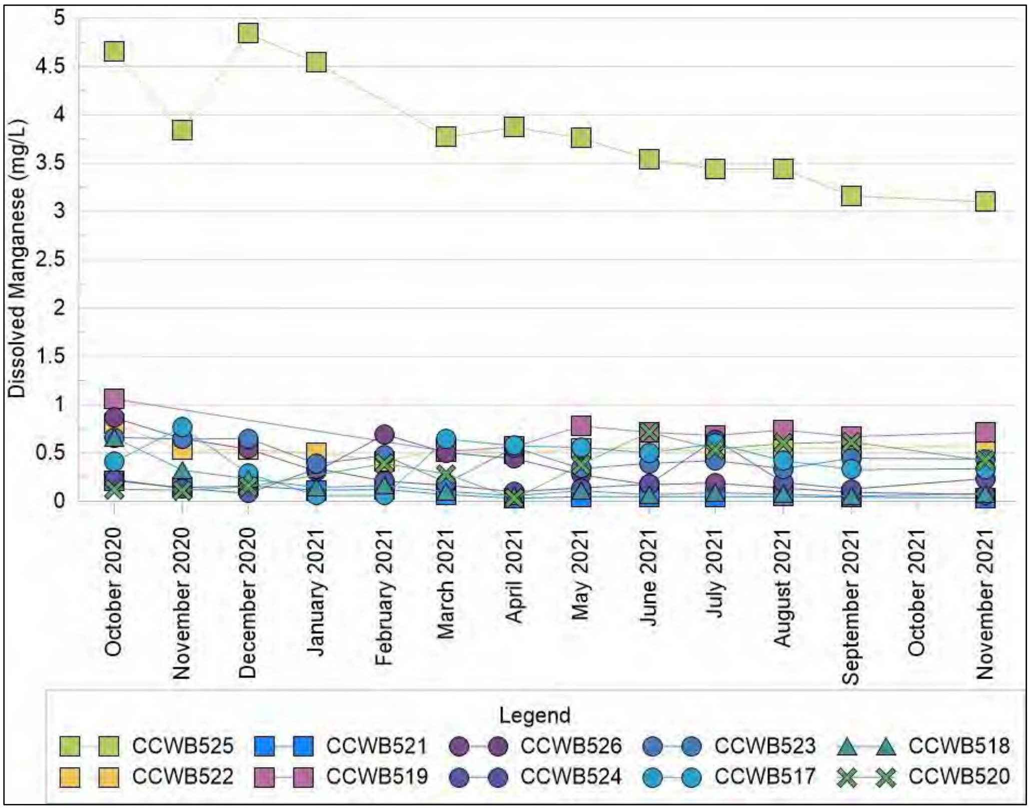

Figure A13: Time series of dissolved manganese in all groundwater monitoring bores.

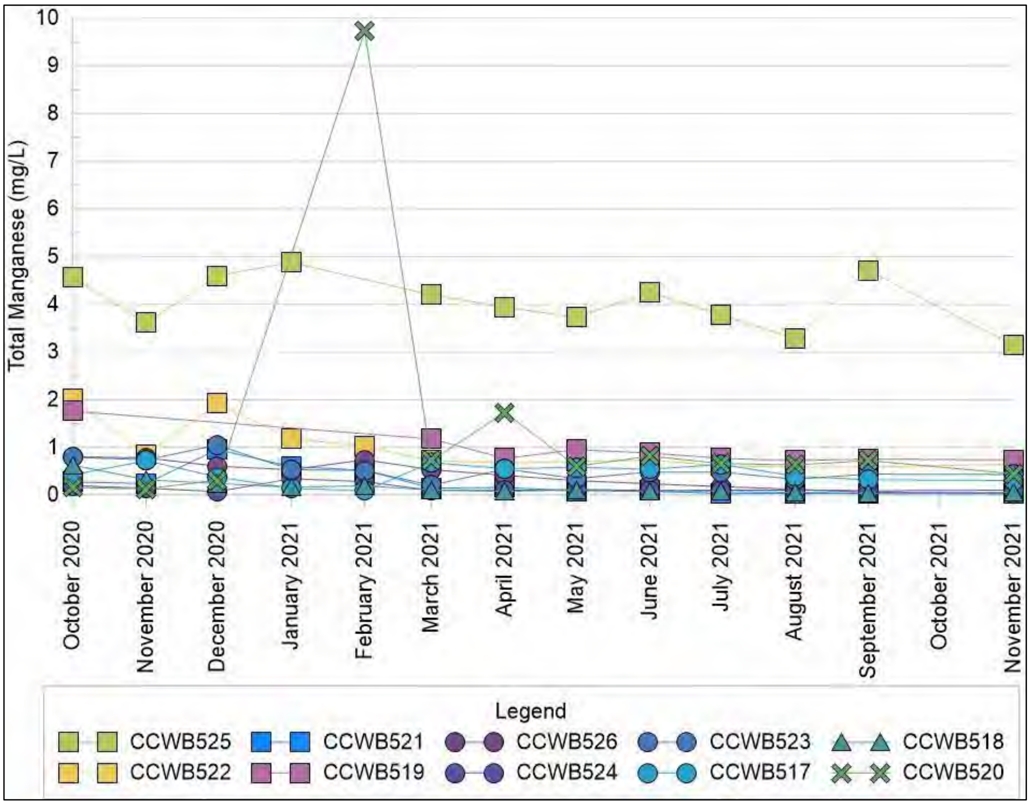

Figure A14: Time series of total manganese in all groundwater monitoring bores.

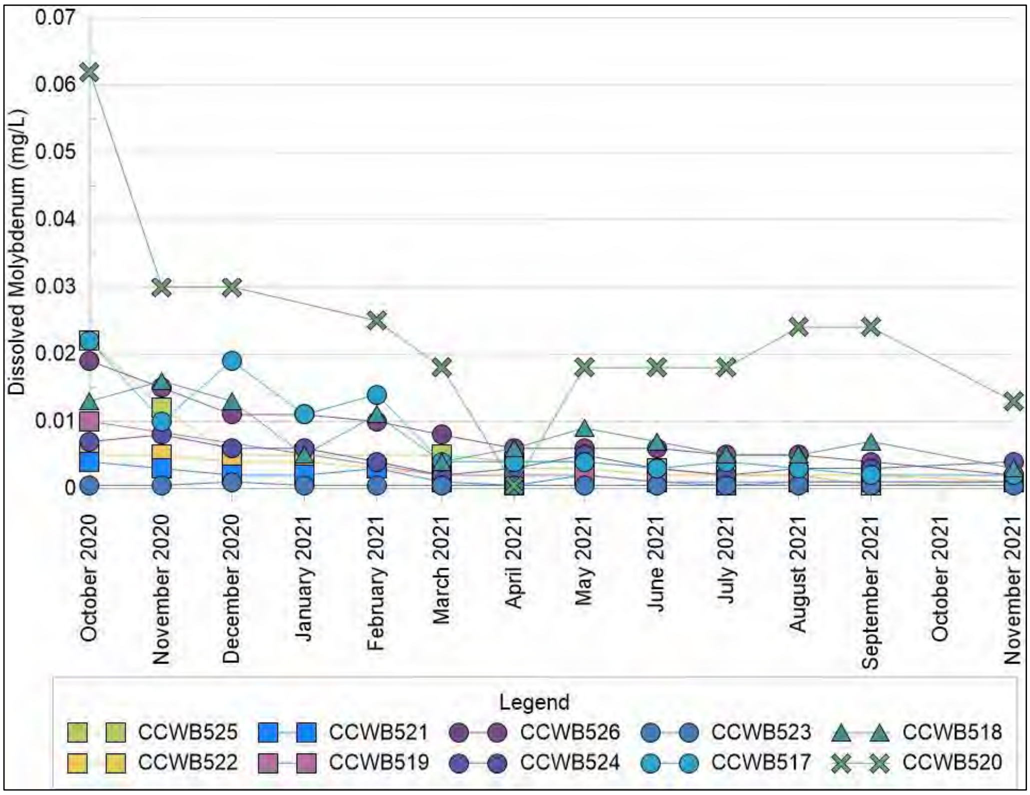

Figure A15: Time series of dissolved molybdenum in all groundwater monitoring bores.

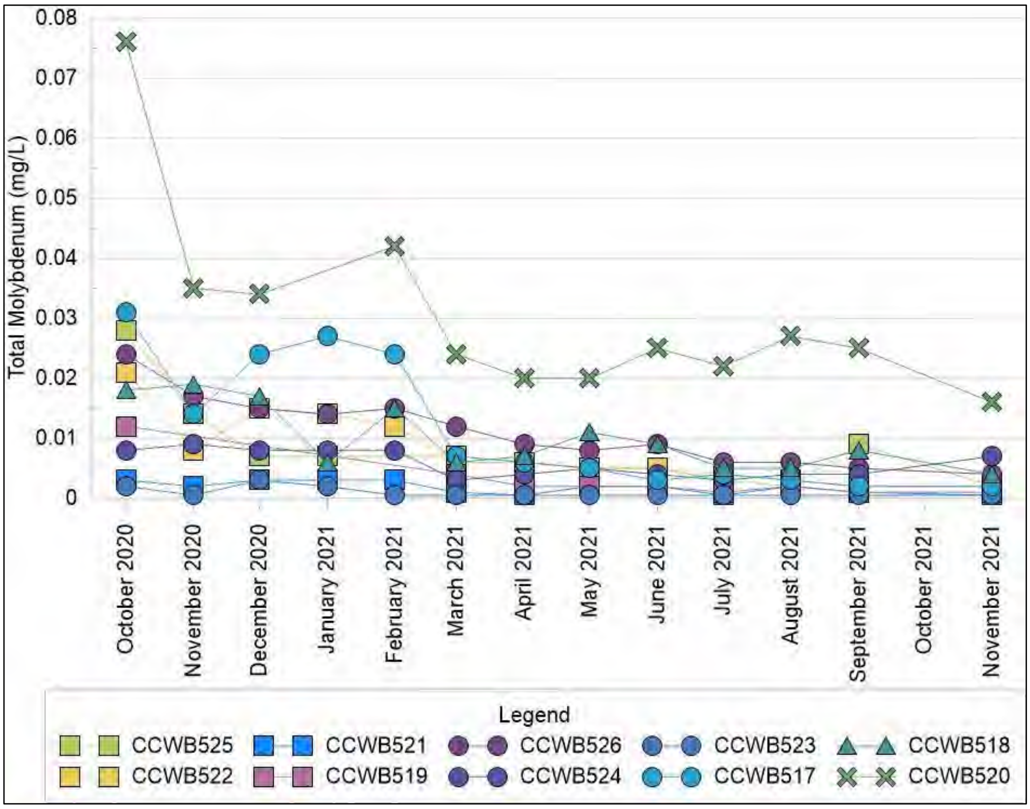

Figure A16: Time series of total molybdenum in all groundwater monitoring bores.

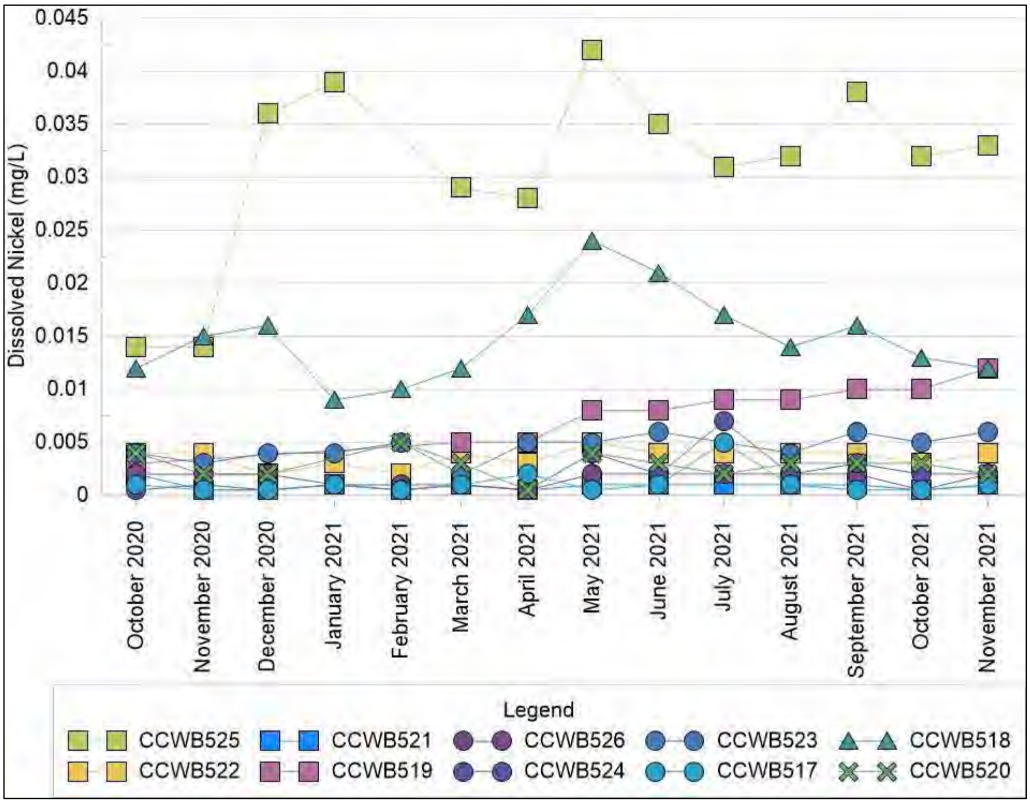

Figure A17: Time series of dissolved nickel in all groundwater monitoring bores.

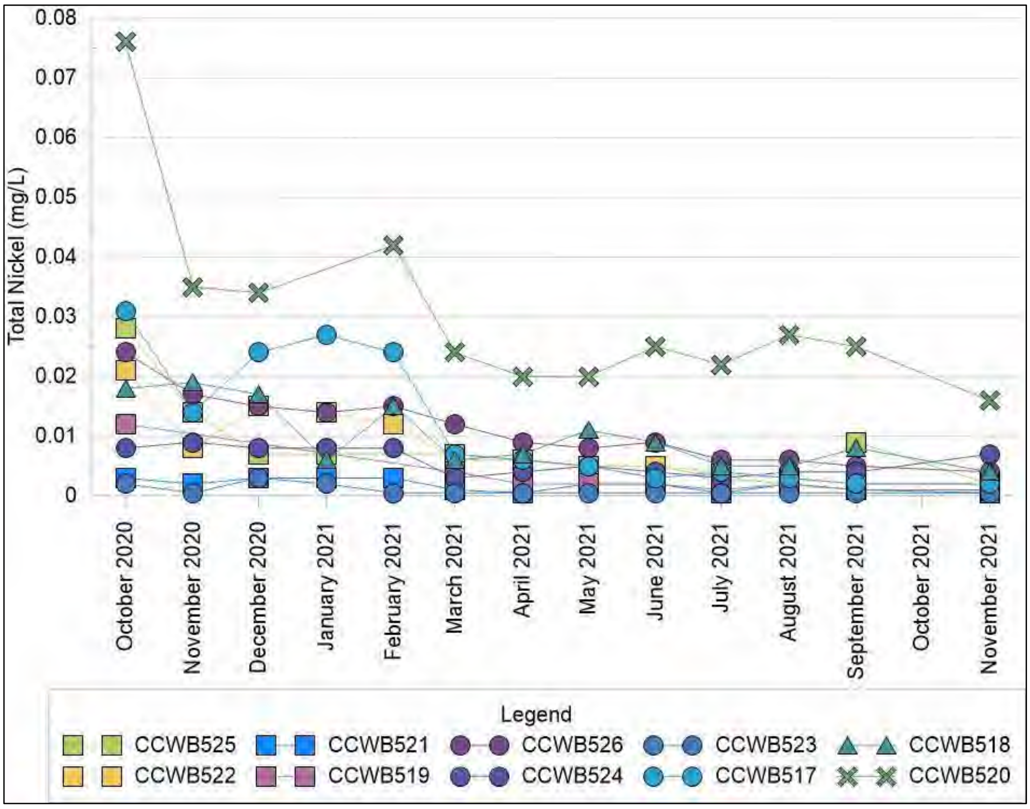

Figure A18: Time series of total nickel in all groundwater monitoring bores.

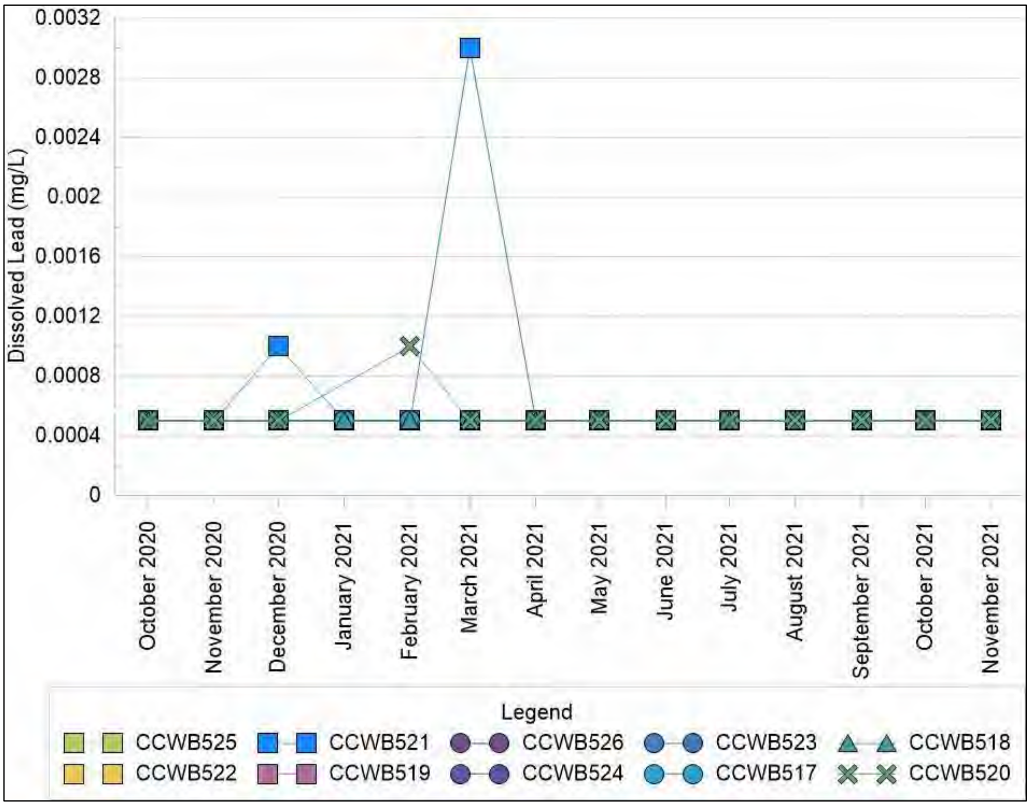

Figure A19: Time series of dissolved lead in all groundwater monitoring bores.

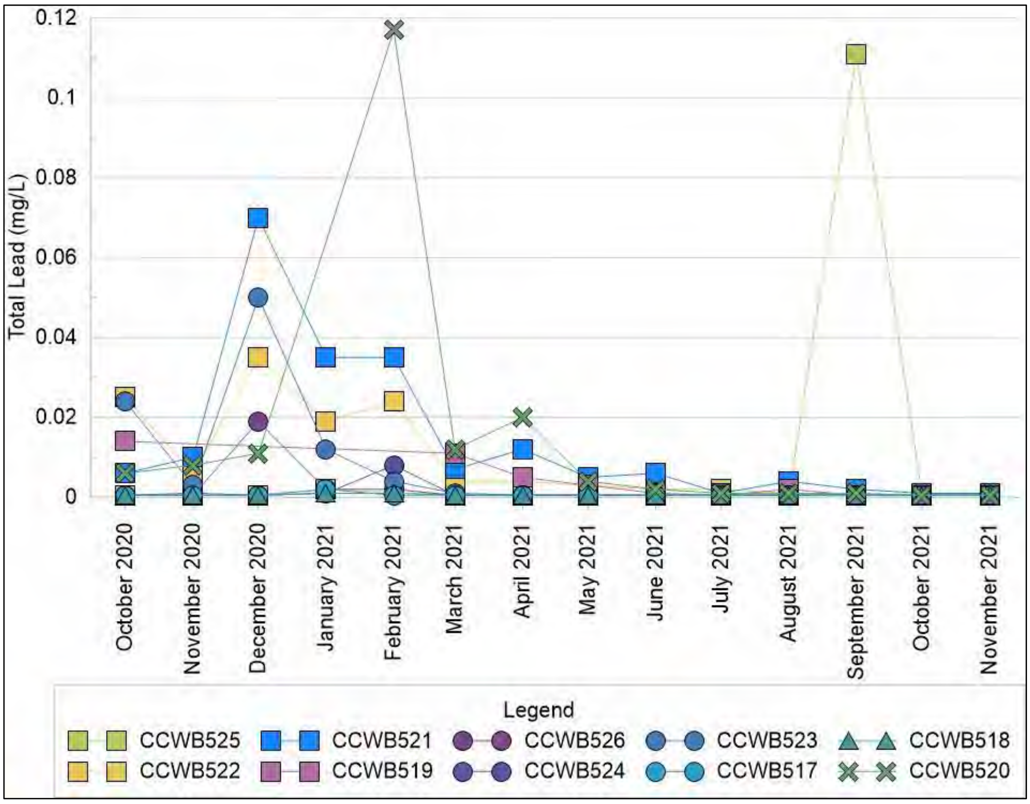

Figure A20: Time series of total lead in all groundwater monitoring bores.

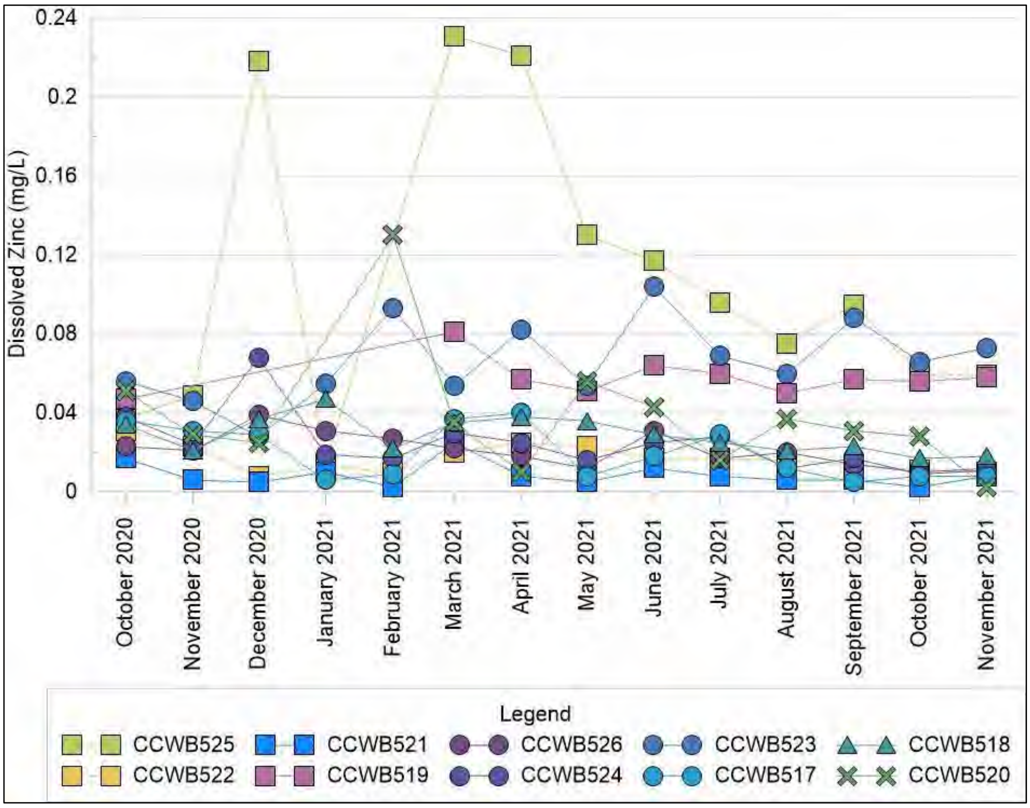

Figure A21: Time series of dissolved zinc in all groundwater monitoring bores.

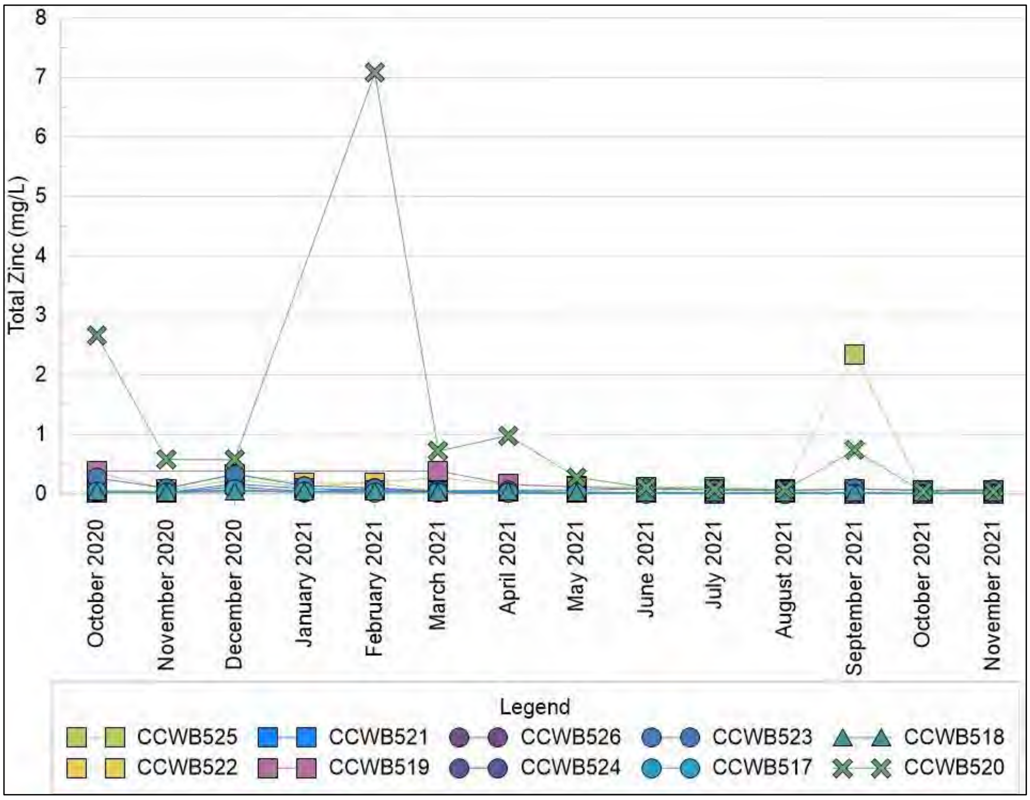

Figure A22: Time series of total zinc in all groundwater monitoring bores.

Appendix L – Receiving Environmental Monitoring Program

RECEIVING ENVIRONMENT MONITORING PROGRAM ANNUAL REPORT
AGATE CREEK GOLD MINE

LANEWAY RESOURCES LTD

JUNE 2022

WULGURU TECHNICAL SERVICES

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Document Control and History

Version	Date	Description	Prepared By	Reviewed By
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Contents

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Definitions

Term	Definition
ANZECC & ARMCANZ	Australian and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and Nez Zealand.
AUSRIVAS	Australian River Assessment System
EA	Environmental Authority
EPP	Environmental Protection Policy
LOR	Limit of Reporting
LWR	Laneway Resources Ltd
ML	Mining Lease
NATA	National Association of Testing Authorities
NRC	Northern Resource Consultants
PET	Plecoptera (stoneflies) Ephemeroptera (mayflies) Trichoptera (caddisflies); sum of taxa from these insect orders
PSD	Particle Size Distribution
QA/QC	Quality Assurance / Quality Control
QWQG	Queensland Water Quality Guidelines (DERM 2009)
REMP	Receiving Environment Monitoring Program
SIGNAL	Stream Invertebrate Grade Number Average Level
SMD	Slightly to Moderately Disturbed
SQO	Sediment Quality Objective
SSGV	Site-Specific Guideline Value
WQO	Water Quality Objective

1. Introduction

Wulguru Technical Services (WTS) was commissioned by Laneway Resources Ltd to implement the Receiving Environment Monitoring Program for Agate Creek Gold Mine (the Project). The Project operates on mining lease (ML 100030), and is owned and operated by Laneway Resources Ltd. The ML is located approximately 45 km south-west of Forsayth, in North Queensland. The lease covers approximately 691 ha. Environmentally relevant activities are regulated by environmental authority (EA) EPSL03068015. The EA does not stipulate a REMP is required, however, under the Environmental Protection Act 1994, the EA holder must comply with the ‘general environmental duty’. A REMP is an important tool in demonstrating potential impacts (or lack of) on the receiving environment. Furthermore, there is an EA Amendment in progress for the Project and it is anticipated that the revised EA will include requirements for a REMP.

The main objective of the REMP is to develop an over-arching plan for all surface receiving water monitoring activities and has been designed with reference to the REMP guidelines developed by the Department of Environment and Science (2014). This report presents the findings for the period March 2021 to February 2022, during which two rounds of sampling were completed (late dry season 2021 and mid-wet season 2022).

1.1. Site Location

The Project is located on the boundary of the Einasleigh Uplands and Gulf Plains Bioregions, and is situated to the north-east of Rungulla National Park (NP), and Rungulla Resource Reserve (RR). The west of the ML is bordered by the Gregory Range, and features steep sandstone escarpments and formations. The remainder of the ML is predominately undulating open woodland, with some steep undulating hills and sheltered gullies. Agate Creek flows from the south-east to the north-west of the site, dissecting the central northern section of the ML, and is a fourth order ephemeral watercourse.

1.2. Background

1.2.1. Current Mining Operations

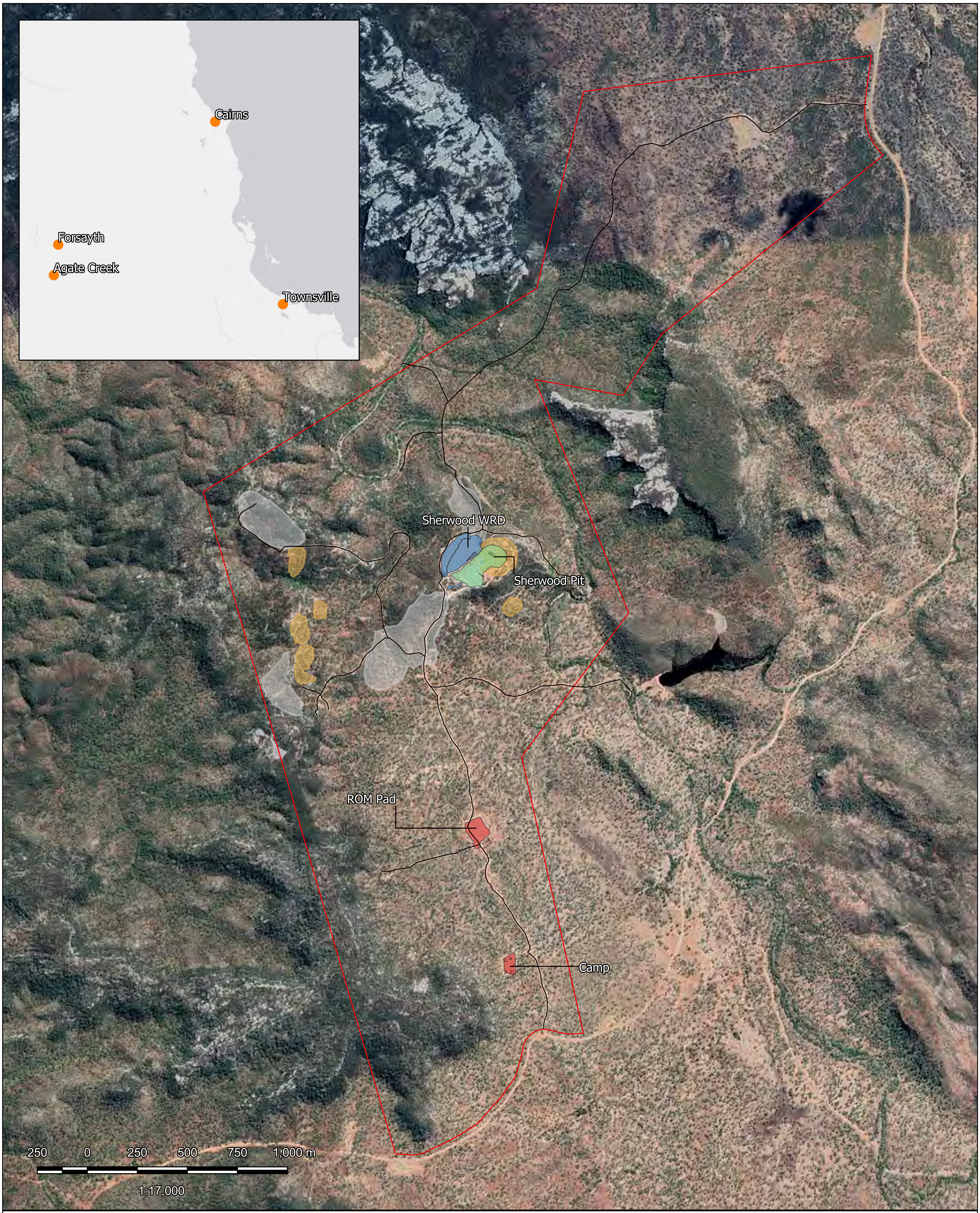
Laneway Resources Ltd (LWR) commenced mining operations soon after the mining lease was granted in February 2019 with ore processed off-site. Agate Creek activities currently encompass the extraction of gold ore and waste rock from the Sherwood Open Cut Pit situated at approximately the midpoint of ML100030. Ore is transported to the ROM pad where it is temporarily stockpiled. Waste rock is transported to the Sherwood Waste Rock Dump WRD. LWR extract up to 45,000t/annum and other current activities include geological exploration at locations across ML100030.

1.2.2. Proposed Expansion

LWR are proposing to expand current operations across the Sherwood and Sherwood West resource areas under ML100030, extracting up to 250,000T/annum across 6 individual open cut pits. The expansion of operations will include the following mine domains:

- Six open cut pits;
- Four Non-Acid Forming (NAF) waste rock dumps;
- Topsoil stockpile areas;
- Expanded administrative buildings and other mining infrastructure (roads, camp etc.);
- Expanded Run of Mine;
- Magazine;
- Two water storages; and
- Multiple sediment ponds.

Ore is to be transported off site to Georgetown for processing. Access to Agate Creek Gold Mine is to remain as Rungulla Road/Agate Creek Road/Cobb Road and onto Georgetown via Forsayth Road. Current and proposed mine domains and are displayed shown in Figure 1.



Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 23 May 2022

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Figure 1. Agate Creek Gold Mine Layout

Legend

Mining Lease
Tracks

Existing Mine Features
Infrastructure
WRD
Pit

Proposed Mine Features
WRD
Pit

Google Satellite

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1.2.3. Environmental Values, Water and Sediment Quality Objectives

The Environmental Protection Policy (Water and Wetland Biodiversity) (EPP Water) details the scheduled water quality basins and their specific management intent. The Site is in the Gilbert River Basin (Basin no. 917), which is not included in the schedule but is within the Water Resource (Gulf) Plan Area. The Water Act 2000 Water Resource (Gulf) Plan 2007 (amended in 2017) applies to watercourses within and surrounding the site. Environmental values and water quality objectives have not been formally documented for the Gilbert River Basin and this region is not included in the Queensland Water Quality Guidelines (DEHP 2009), therefore national guidelines (i.e. ANZECC & ARMCANZ (2000) are applicable.

Based on the location of the Site and surrounding land use, environmental values associated with the Gilbert River Basin are likely to be:

- aquatic ecosystems – slightly to moderately disturbed
- farm use
- stock watering (cattle)
- primary recreation
- secondary recreation
- visual recreation
- raw drinking water
- industrial
- cultural and spiritual values.

The EA does not stipulate specific Water Quality Objectives (WQO) or contaminant trigger values for the Project, therefore given the environmental values for the location, the WQO adopted for this reporting period are ANZECC Guidelines (2000) for Livestock Drinking Water Quality.

Sediment Quality Objectives (SQO) are also not specified in the EA, therefore the ANZECC (2000) Toxicant Default Guideline Values for Sediment Quality were adopted.

In the absence of baseline data for macroinvertebrates or region-specific guidelines, the Central Coast Queensland Region, slightly to moderately disturbed waters (SMD), (DEHP 2009) freshwater macroinvertebrate guidelines were used in the interim.

1.3. Scope and Objectives

REMP monitoring activities focus entirely on surface water receiving environments. Groundwater monitoring is undertaken under via a dedicated Groundwater Monitoring Program (GMP), which is currently in development for the Project.

The REMP has been designed to assess the ecological condition of an aquatic receiving environment and determine whether current site management systems and operations are adequate to protect the environmental values of that system. As such, the REMP not only measures chemical parameters associated with water and sediment quality, but it also directly assesses the biological condition of the receiving environment, which integrates the net ecological effects of all stressors on the system.

The primary aims of the REMP are to:

- Evaluate whether current management practices at the Agate Creek Gold Mine and the regulatory conditions being imposed by EA are effectively protecting and maintaining the environmental values of the receiving waters and associated ecosystems; and
- Fulfil the requirements stipulated in the most recent version of the DEHP REMP guideline (DEHP 2014).

2. Methodology

All monitoring was conducted in accordance with the Agate Creek REMP Design 2021 (WTS 2021); detailed descriptions of methodology are provided in WTS (2021) and are summarised below.

2.1. Temporal Considerations

REMP assessments were undertaken twice per year in the late dry season (September 2021) and mid/late-wet season (March 2022). Ideally, macroinvertebrates should not be sampled within 4-6 weeks of a high flow event, to allow time for populations to recover and re-establish. However, the ephemeral nature of creek systems in North Queensland results in highly variable flows and hence the timing of post-wet season sampling is often restricted to a narrow period of time between the high-flow 'flush' and when flow ceases completely and there is insufficient water to sample. Consequently, the ideal waiting period of 4-6 weeks cannot always be achieved. In the current reporting period, mid/late-wet season sampling was undertaken on 1st and 2nd March 2022, which was three weeks after a high-flow event following rainfall on 5th February 2022.

2.2. Monitoring Sites

Monitoring sites upstream of mining influences were selected as reference sites and the receiving waters downstream from mining disturbance have been classified as impact sites . These sites have been established to provide a comparison with selected reference sites, which are located upstream from mining disturbance. At total of 14 sites comprise the REMP for Agate Creek Gold Mine (6 reference and 8 impact sites) (WTS 2021). Reference and impact sites were compared to assess the severity and extent of any contamination that may be a result of mining disturbance. REMP sites sampled in September 2021 and March 2022 are listed in Table 1 and shown in Figure 2.

Table 1. Description of REMP sites sampled in September 2021 and March 2022.

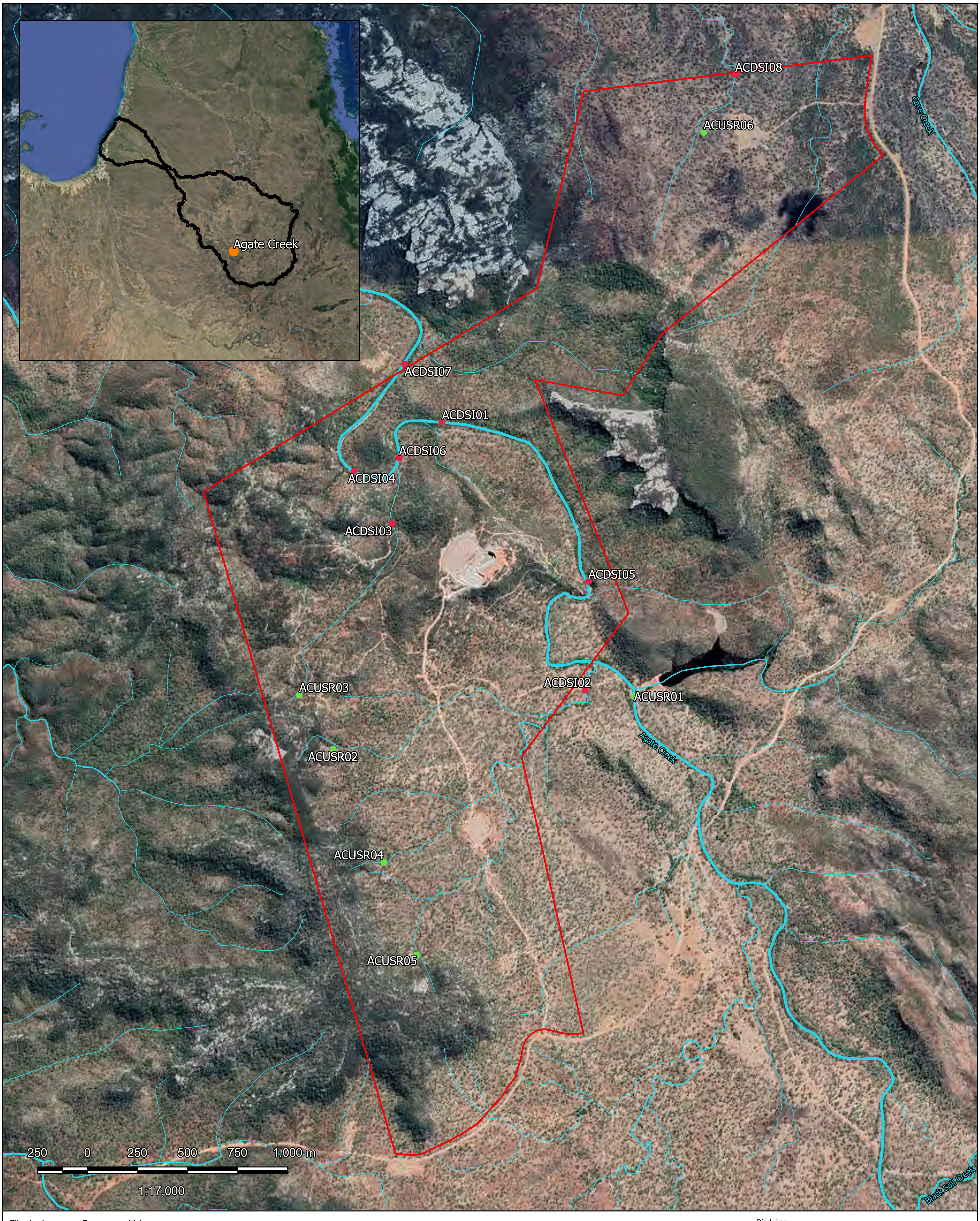
Site	Northing	Easting	Description	Sept 2021	March 2022
ACUSR01	-19.000665	143.555939	**Reference site**. Agate Creek, approx. 250m upstream of the ML boundary (outside boundary) and 50m upstream of a tributary entering Agate Creek from below a dam.	Water^ Sediment Macroinvertebrates^	Water Sediment Macroinvertebrates
ACUSR02*	-19.003242	143.541689	**Reference site**. Unnamed first order tributary of Agate Creek (flowing east), approx. 600m upstream of the crossing along the haul road.	Dry; Sediment only	Dry; Sediment only
ACUSR03	-19.00081	143.540047	**Reference site.** Unnamed first order tributary of Agate Creek (flowing north-east), approx. 1.2km upstream of the confluence with Agate Creek.	Dry; Sediment only	Dry; Sediment only

Site	Northing	Easting	Description	Sept 2021	March 2022
ACUSR04	-19.008306	143.544175	**Reference site**. Unnamed first order tributary of Agate Creek (flowing east-north-east), approx. 600m upstream of the crossing along the haul road, just north of the mine camp.	Dry; Sediment only	Dry; Sediment only
ACUSR05	-19.012478	143.545814	**Reference site**. Unnamed first order tributary of Agate Creek (flowing north-north-east), approx. 700m upstream of the crossing along the haul road, just south of the mine camp.	Dry; Sediment only	Dry; Sediment only
ACUSR06	-18.975161	143.558856	**Reference site**. Unnamed first order tributary of Cave Creek (flowing north-north-east), approx. 450m upstream of ACDSI08; 25m upstream (south) of the crossing along the haul road, west of the ROM.	Dry; Sediment only	Dry; Sediment only
ACDSI01*	-18.988406	143.546636	**Impact site.** Unnamed tributary of Agate Creek (flowing north), approx. 100m upstream of the confluence with Agate Creek; downstream of Sherwood Open Cut pit.	Dry; Sediment only	Water Sediment Macroinvertebrates
ACDSI02	-19.000397	143.553614	**Impact site**. Unnamed first order tributary of Agate Creek (flowing north), approx. 140m upstream of the confluence with Agate Creek; downstream of Sherwood West Open Cut pit.	Dry; Sediment only	Dry; Sediment only
ACDSI03	-18.993019	143.544339	**Impact site.** Unnamed first order tributary of Agate Creek (flowing north-east), approx. 1000 downstream of ACUSR03; 200m upstream of the confluence with Agate Creek; downstream of Sherwood West Open Cut pit.	Dry; Sediment only	Dry; Sediment only
ACDSI04	-18.990672	143.542492	**Impact site.** Agate Creek, approximately 3km downstream of ACUSR01, downstream of all mine operations and tributaries flowing into Agate Creek.	Dry; Sediment only	Water Sediment Macroinvertebrates
ACDSI05	-18.995508	143.553694	**Impact site.** Agate Creek, approximately 1.1km downstream of ACUSR01, downstream of Sherwood West Open Cut pit and mine camp; upstream of Sherwood Open Cut pit.	Dry; Sediment only	Water Sediment Macroinvertebrates

Site	Northing	Easting	Description	Sept 2021	March 2022
ACDSI06	-18.990053	143.544628	**Impact site.** Agate Creek, approximately 300m upstream of ACDSI04, downstream of Sherwood Open Cut pit; upstream of tributaries flowing from Sherwood West Open Cut pit.	Dry; Sediment only	Water Sediment Macroinvertebrates
ACDSI07	-18.985814	143.544825	**Impact site.** Agate Creek, approximately 700m downstream of ACDSI04 (just outside ML boundary), downstream of all mine operations and tributaries flowing into Agate Creek.	Dry; Sediment only	Water Sediment Macroinvertebrates
ACDSI08	-18.972536	143.560317	**Impact site.** Unnamed first order tributary of Cave Creek (flowing north-north-east), approx. 450m downstream of ACUSR06; downstream of ROM (just outside ML boundary).	Dry; Sediment only	Dry; Sediment only

* Site ACUSR02 was originally mapped at -19.0036, 143.5402 and Site ACDSI01 was originally mapped at -18.99097, 143.54748; coordinates shown were updated following dry season sampling.

^ Water and macroinvertebrate samples for ACUSR01 were taken from downstream of the confluence of the tributary flowing from the nearby dam, at location -19.00002, 143.55583 (50m from mapped site location) in Sept 2021



Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 23 May 2022

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Figure 2. Agate Creek Mine Proposed REMP Sites

Legend

- Mining Lease
- Key Features
- Gilbert Basin

Google Satellite

Watercourse - Stream Order

- 0
- 1
- 2
- 3
- 4

REMP Sites

- Impact
- Reference

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2.3. Water Quality

2.3.1. Sampling

Water quality monitoring was undertaken in accordance with DEHP's Monitoring and Sampling Manual 2009 (Department of Environment and Science, 2018) which provides common techniques, methods and standards for sample collection, handling and data management. Water was sampled at all sites where sufficient surface water was present. In September 2021, only one site (ACUSR01) had surface water. Water samples were collected directly from the waterbody into sample containers provided by a National Association of Testing Authorities (NATA) accredited laboratory. Physico-chemical parameters and field observations were also recorded where possible, as described in Table 2. Samples were preserved and stored according to laboratory instructions and delivered to the laboratory within the specified holding times wherever possible.

Table 2. Field readings and observations

Parameter	Units	Comment
pH		Hand-held water quality meter, calibrated daily
Dissolved oxygen	mg/L and or % saturation	Hand-held water quality meter, calibrated daily
Temperature	mg/L	Hand-held water quality meter, calibrated daily
Electrical Conductivity (EC)	µS/cm	Hand-held water quality meter, calibrated daily
Turbidity and/or Total Dissolved Solids (TDS)	FNU or ppm	Hand-held water quality meter, calibrated daily
Water level	m	Maximum at deepest point
Current velocity	cm/sec	At deepest point – measured with flow meter or assigned to four-point scale (nil, <1cm/sec, 1 to 10 cm/sec or >10cm/sec)
Visible flow upstream of site	NA	Yes or No
Visible flow downstream of site	NA	Yes or No
Water surface	NA	Glassy, smooth/minor ripples, turbulent
Water colour	NA	Hue and intensity
Water clarity	NA	Record maximum depth at which bottom can be seen
Visual and olfactory anomalies	NA	Record and photograph any films, foam, slicks, unusual debris or algal blooms and any unusual odours
Weather (current and past 24 hrs)	NA	e.g. current conditions, average cloud cover over past 2 hours; rainfall in last 24 hrs

2.3.2. Laboratory Analysis

Water samples were analysed by a NATA accredited laboratory for the parameters listed in Table 3 and analysed to limits of reporting (LOR).

Table 3. Laboratory parameters for water samples

Parameter	Units
pH	pH units
Electrical Conductivity	µS/cm
Total Dissolved Solids	mg/L
Alkalinity (Hydroxide, Carbonate, Bicarbonate and Total as $CaCO_3$)	mg/L
Sulfate as SO_4	mg/L
Chloride	mg/L
Fluoride	mg/L
Major Cations (Ca, Mg, Na, K)	mg/L
Total Anions and Cations	meq/L
Total Hardness as $CaCO_3$	mg/L
Metals (Total and Dissolved; Aluminium, Arsenic, Boron, Cadmium, Chromium, Copper, Cobalt, Iron, Manganese, Mercury, Molybdenum, Nickel, Lead, Selenium, Zinc)	mg/L

2.4. Sediment Quality

2.4.1. Sampling

Stream sediment sampling is conducted in accordance with DEHP's Monitoring and Sampling Manual 2009 (Department of Environment and Science, 2018) which provides common techniques, methods and standards for sample collection, handling and data management. Sediment samples were collected from the waterbody (if water was present) or from within the main channel, for dry creek beds, and placed in containers provided by the laboratory. Samples were preserved and stored according to laboratory instructions and delivered to the laboratory within the specified holding times.

2.4.2. Laboratory Analysis

Sediment analyses were undertaken for the parameters listed in Table 4. Particle size distribution (PSD) analysis was also undertaken to describe the proportions of stream sediments that occurred across the sediment size classes.

Table 4. Laboratory parameters for sediment samples

Parameter	Units
Moisture content	%
Metals (Total; Antimony, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Zinc)	mg/kg
Particle size distribution for cobble (>60mm), gravel (2-60mm), sand (0.075 to 2mm) and fines (< 0.075mm)	%

2.5. Macroinvertebrates

Macroinvertebrate sampling and monitoring was conducted in accordance with Australia-Wide Assessment of River Health: Queensland Australian River Assessment System (AUSRIVAS) Sampling and Processing Manual (Department of Natural Resources DNR, 2001), and following the detailed methods provided in the REMP Design (WTS 2021).

Macroinvertebrate samples were collected at all sites where surface water and appropriate habitat was present. All samples were collected with a 250 micrometre mesh net. A total of 10 m of habitat was sampled from a bed and an edge habitat (two samples per site). In September 2021, only one site had sufficient surface water to provide macroinvertebrate habitat (ACUSR01), whereas in March 2022, macroinvertebrates were sampled from six sites.

Habitat assessments, including observations regarding the stream flow conditions, substrate, riparian zone and surrounding land use (i.e. based on AUSRIVAS data sheets), were completed at each site using a georeferenced data collection application pre-loaded on field crews' mobile phones and/or tablets. Photos were taken upstream, across the channel and downstream. Macroinvertebrate samples were preserved in the field using 70% ethanol, then processed in the laboratory following AUSRIVAS protocols. Macroinvertebrates were identified to family level (or a lower/higher taxonomic level, as recommended by AUSRIVAS and other literature), by an AUSRIVAS accredited aquatic ecologist using a stereo microscope. The abundance of each taxon was recorded.

2.6. Data Analysis

Water and sediment quality parameters were compared against the WQO to determine if any exceedances were recorded. Data were presented graphically to allow a simple visual comparison between reference and impact sites.

The following indices were calculated from macroinvertebrate samples:

- Taxa richness
- PET richness (i.e. richness of families from the orders Plecoptera [stoneflies], Ephemeroptera [mayflies] and Trichoptera [caddisflies]).
- Total abundance
- SIGNAL2 (Stream Invertebrate Grade Number Average Level version 2, Chessman 2003)
- % tolerant taxa (sensitive taxa are sensitivity grade 8-10; tolerant taxa are grade 1-3; % calculated is number of tolerant taxa out of the total taxa)
- Shannon Diversity Index

Taxa richness, PET richness, SIGNAL2 scores and % tolerant taxa were compared with the macroinvertebrate guidelines for 20^{th} and 80^{th} percentiles for corresponding indices, for SMD waters in the Central Region (DEHP 2009), as shown below in Table 5.

Table 5. Freshwater macroinvertebrate guideline values for SMD waters in the Central Region.

Index	Habitat	20th percentile	80th percentile
Taxa richness	Bed	12	21
	Edge	23	33
PET taxa richness	Bed	2	5
	Edge	2	5
SIGNAL2	Bed	3.33	3.85
	Edge	3.31	4.20
% tolerant taxa	Bed	25	50
	Edge	44	56

^ Composite is a mixture of all bed habitats

Comparisons between macroinvertebrate indices from reference and impact sites, were analysed using permutational ANOVA (PERMANOVA). Community composition was assessed using non-metric multidimensional scaling (nMDS) to ordinate macroinvertebrate groups from biotic similarity matrices using the Bray-Curtis index for square-root transformed abundance data (Clarke and Gorley, 2015). nMDS is particularly suited for use with ecological data because it has minimal assumption regarding data distribution and normality. Differences in macroinvertebrate assemblages among a priori site types (e.g. reference versus impact) can also be tested using PERMANOVA (Clarke and Gorley, 2015). There were insufficient data to analyse seasonal differences; instead, these were assessed visually.

Analyses were undertaken using Primer 7 (Version 7.0.21).

2.7. Quality Assurance and Quality Control

2.7.1. Water and Sediment

All sample bottles not containing preservatives were triple rinsed with water from the sample source, and samplers wore nitrile gloves when sampling, to reduce the risk of contamination. Gloves were changed between sites to reduce the risk of cross-contamination. The water quality meter was triple rinsed with water from the sample source prior to collecting readings and calibrated before each field trip. For water and sediment samples, for every 10 samples taken, a duplicate, field blank, and lab blank were taken and sent to ALS.

A relative percentage difference (RPD) analysis of primary and duplicate samples was used to measure the representativeness and/or precision of duplicate samples. The RPD was calculated from the absolute difference between results of the duplicate pair divided by the mean value of the duplicate pair:

$$\boldsymbol{RPD}\ (\%) = \mathbf{100}\ \boldsymbol{x} \frac{(\boldsymbol{D1} - \boldsymbol{D2})}{\frac{\boldsymbol{D1} + \boldsymbol{D2}}{\mathbf{2}}}$$

where: D1 = primary sample analysis

D2 = duplicate sample analysis

The RPD then uses the limit of reporting (LOR) to identify thresholds for valid reproducibility. These include:

- Mean of sample and replicate <10x LOR: There is no RPD limit (i.e. reproducibility is valid)
- 10x LOR < Mean of sample and replicate <20x LOR: The RPD range limit is 0–50 per cent for a valid duplicate

2.7.2. Macroinvertebrates

Macroinvertebrate samples were collected and processed in the laboratory in accordance with AUSRIVAS guidelines to ensure quality control and ensure integrity of sampling procedures. Macroinvertebrates were identified by an appropriately qualified person (AUSRIVAS accredited). For every 20 samples picked and identified in the laboratory, one sample (5%) was re-identified and counted, with the percentage error recorded.

3. Results

3.1. Climate Conditions in 2021 to 2022

Minimum and maximum daily temperatures in the region (data from Georgetown Airport) during the reporting period were generally close to average. Monthly rainfall was slightly below average in three months prior to sampling in September 2021. Prior to sampling in March 2022, rainfall was average or above average in the early wet season (i.e. November/December 2021), but below average in January and February 2022 (Figure 3). The most significant rainfall event prior to wet season sampling was 52.8 mm on 5th February 2022, approximately three weeks earlier. Consequently, several creeks still had surface water present in early March.

There were no known discharges or contaminant releases from the Agate Creek Gold Mine for the reporting period (i.e. March 2021 to February 2022).

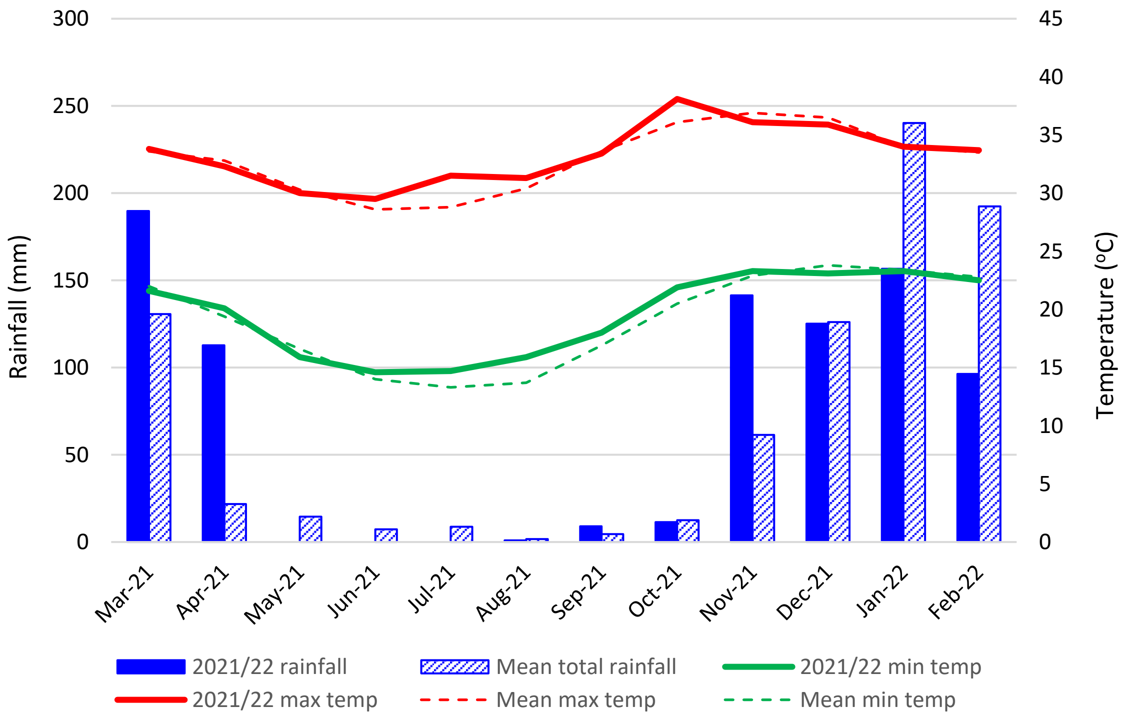


Figure 3. Minimum and maximum temperatures and monthly rainfall during the reporting period 2021 to 2022, in comparison to average conditions, at Georgetown Airport.

3.2. Water Quality

As the first round of REMP sampling occurred at the end of the dry season, there were no recent flow events prior to sampling. Hence, only one site (ACUSR01) had permanent water and was able to be sampled for surface water quality. In the wet season, six sites (one reference and five impact) had surface water present and were sampled. Results are presented in Table 6 and Table 7.

Two parameters (pH and dissolved oxygen) were found to be outside the adopted WQO at all sites. pH levels were higher than the recommended maximum WQO 7.5, and dissolved oxygen (%DO) was below the minimum WQO for SMD waters for Central QLD. Field pH readings were considered to be more accurate than laboratory pH because holding time requirement (analysis within 6 hrs) was unable to be met, given the remote location of the site.

Most metals and metalloids below the limit of reporting (LOR), and low levels of aluminium, arsenic, copper, iron, manganese, and molybdenum were recorded at ACUSR01 in September 2021, and at most sites in March 2022. No WQO for metals/metalloids were exceeded during either sampling period.

Alkalinity was low and almost completely resulting from bicarbonate, which was consistent with the documented alkalinity of waters in this region (i.e. Gulf Zone, DEHP 2009). Other water quality parameters were unremarkable at all sites, in both seasons.

Table 6. Results for physico-chemical measurements and water quality parameters from Site ACUSR01, September 2021.

Analyte	Unit	LOR	WQO	ACUSR01
Physico-chemical				
pH (field)	pH Unit	0.01	6.0-7.5	6.95
pH (lab)	pH Unit	0.01	6.0-7.5	7.96
Temperature	°C	0.01	-	27.54
Electrical Conductivity (field)	µS/cm	1	-	739
Electrical Conductivity (lab)	µS/cm	1	-	173
Total Dissolved Solids @180°C mg/L		10	4000	129
Dissolved Oxygen % saturation		0.1	90-120	58.1
Alkalinity				
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	-	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1	-	<1
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	-	71
Total Alkalinity as $CaCO_3$	mg/L	1	-	71
Dissolved Major Cations				
Calcium	mg/L	1	1000	10
Magnesium	mg/L	1	-	5
Sodium	mg/L	1	-	19
Potassium	mg/L	1	-	3
Ionic Balance				
Total Anions	meq/L	0.01	-	1.71
Total Cations	meq/L	0.01	-	1.81
Other Analytes				
Total Hardness as $CaCO_3$	mg/L	1	-	46
Sulfate	mg/L	1	1000	2
Chloride	mg/L	1	-	9

Analyte	Unit	LOR	WQO	ACUSR01
Fluoride	mg/L	0.1	2	1.8
Dissolved Metals and Metalloids				
Aluminium	mg/L	0.01	5	0.01
Arsenic	mg/L	0.001	0.5	0.002
Boron	mg/L	0.05	5	<0.05
Cadmium	mg/L	0.0001	0.01	<0.0001
Chromium	mg/L	0.001	1	<0.001
Cobalt	mg/L	0.001	1	0.001
Copper	mg/L	0.001	1	<0.001
Iron	mg/L	0.05	-	0.50
Lead	mg/L	0.001	0.1	<0.001
Manganese	mg/L	0.001	-	0.356
Mercury	mg/L	0.0001	0.002	<0.0001
Molybdenum	mg/L	0.001	0.15	0.003
Nickel	mg/L	0.001	1	<0.001
Selenium	mg/L	0.01	0.02	<0.01
Zinc	mg/L	0.005	20	<0.005
Total Metals and Metalloids				
Aluminium	mg/L	0.01	5	0.16
Arsenic	mg/L	0.001	0.5	0.002
Boron	mg/L	0.05	5	<0.05
Cadmium	mg/L	0.0001	0.01	<0.0001
Chromium	mg/L	0.001	1	<0.001
Cobalt	mg/L	0.001	1	0.002
Copper	mg/L	0.001	1	<0.001
Iron	mg/L	0.05	-	1.15
Lead	mg/L	0.001	0.1	<0.001
Manganese	mg/L	0.001	-	0.429
Mercury	mg/L	0.0001	0.002	<0.0001
Molybdenum	mg/L	0.001	0.15	0.003
Nickel	mg/L	0.001	1	<0.001
Selenium	mg/L	0.01	0.02	<0.01
Zinc	mg/L	0.005	20	<0.005

Notes: Exceedances of WQO (ANZECC 2000 Livestock Drinking Water [cattle]) are denoted by yellow highlighting.

Table 7. Results for water quality analysis from reference sites, March 2022.

Analyte	Unit	LOR	WQO	Reference Site	Impact Sites				
				ACUSR01	ACDSI01	ACDSI04	ACDSI05	ACDSI06	ACDSI07
Physico-chemical									
pH (field)	pH Unit	0.01	6.0-7.5	7.32	**9.16**	**8.07**	**8.24**	**7.99**	**9.29**
pH (lab)	pH Unit	0.01	6.0-7.5	**7.78**	**8.62**	**8.14**	**8.07**	**8.13**	**8.79**
Temperature	ºC	0.01	-	25.38	36.36	33.03	34.02	28.14	35.20
Electrical Conductivity (field)	µS/cm	1	-	139	184	199	167	192	194
Electrical Conductivity (lab)	µS/cm	1	-	120	189	199	173	200	197
Total Dissolved Solids @180°C (lab) mg/L			4000	84	105	112	105	113	111
DO % saturation		0.1	90-120	**2.1**	**28.9**	**20.9**	**22.8**	**15.1**	**33.8**
Alkalinity									
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	-	<1	<1	<1	<1	<1	<1
Carbonate Alkalinity as $CaCO_3$	mg/L	1	-	<1	10	<1	<1	<1	15
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	-	49	74	88	73	87	72
Total Alkalinity as $CaCO_3$	mg/L	1	-	49	84	88	73	87	86
Calcium	mg/L	1	1000	8	15	17	13	16	16
Magnesium	mg/L	1	-	2	5	6	4	5	5
Sodium	mg/L	1	-	12	14	14	14	14	14
Potassium	mg/L	1	-	3	4	4	4	4	4
Ionic Balance									
Total Anions	meq/L	0.01	-	1.09	1.87	1.95	1.67	1.93	1.94
Total Cations	meq/L	0.01	-	1.16	1.87	2.05	1.69	1.92	1.92
Other									
Total Hardness as $CaCO_3$	mg/L	1	-	28	58	67	49	60	60

Analyte	Unit	LOR	WQO	Reference Site	Impact Sites				
				ACUSR01	ACDSI01	ACDSI04	ACDSI05	ACDSI06	ACDSI07
Sulfate	mg/L	1	1000	<1	1	1	2	1	1
Chloride	mg/L	1	-	4	6	6	6	6	7
Fluoride	mg/L	0.1	2	1.0	0.8	0.8	1.0	0.7	0.7
Dissolved Metals									
Aluminium	mg/L	0.01	5	0.03	<0.01	0.05	2.76	0.10	0.46
Arsenic	mg/L	0.001	0.5	0.002	<0.001	<0.001	0.003	0.001	0.001
Boron	mg/L	0.05	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Cobalt	mg/L	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	mg/L	0.05	-	0.06	<0.05	<0.05	0.85	0.05	0.24
Lead	mg/L	0.001	0.1	<0.001	<0.001	<0.001	0.001	<0.001	<0.001
Manganese	mg/L	0.001	-	0.016	<0.001	0.010	0.049	0.013	0.012
Mercury	mg/L	0.0001	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	0.15	0.002	0.001	<0.001	0.002	<0.001	<0.001
Nickel	mg/L	0.001	1	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	20	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Total Metals									
Aluminium	mg/L	0.01	5	9.87	0.72	0.04	2.76	0.10	0.46
Arsenic	mg/L	0.001	0.5	0.006	0.001	<0.001	0.003	0.001	0.001
Boron	mg/L	0.05	5	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cadmium	mg/L	0.0001	0.01	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chromium	mg/L	0.001	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001

Analyte	Unit	LOR	WQO	Reference Site	Impact Sites				
				ACUSR01	ACDSI01	ACDSI04	ACDSI05	ACDSI06	ACDSI07
Cobalt	mg/L	0.001	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.001	1	0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Iron	mg/L	0.05	-	2.50	0.38	<0.05	0.85	0.05	0.24
Lead	mg/L	0.001	0.1	0.003	0.002	<0.001	0.001	<0.001	<0.001
Manganese	mg/L	0.001	-	0.380	0.031	0.010	0.049	0.013	0.012
Mercury	mg/L	0.0001	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Molybdenum	mg/L	0.001	0.15	0.002	0.001	<0.001	0.002	<0.001	<0.001
Nickel	mg/L	0.001	1	0.002	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	mg/L	0.01	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc	mg/L	0.005	20	0.012	<0.005	<0.005	<0.005	<0.005	<0.005

Notes: Exceedances of WQO (ANZECC 2000 Livestock Drinking Water [cattle]) are denoted by yellow highlighting.

3.1. Sediment Quality

3.1.1. Particle Size Distribution

All sites were sampled for stream sediments and particle size distribution. The sediment sample for one site (ACUSR06) from the September 2021 sampling period arrived at the laboratory damaged and was unable to be processed. For both seasons, stream sediments were typically coarse, with high proportions (>70%) of sand and gravel. On average, reference sites had a slightly higher proportion of fine sediments (18% in September 2021; 8% in March 2022) than impact sites (4% in both sampling periods) (Figure 4 and Figure 5).

3.1.2. Sediment chemistry

The level of metal contaminants in most sediment samples was low, with many below LOR, for both sampling periods (Table 8 and Table 9). However copper and nickel were found in levels higher than SQO at one reference site, ACUSR03, in September 2021. In March 2022, nickel levels were elevated at the same site. There were no metal exceedances observed in any impact site sediments in September 2021 or March 2022.

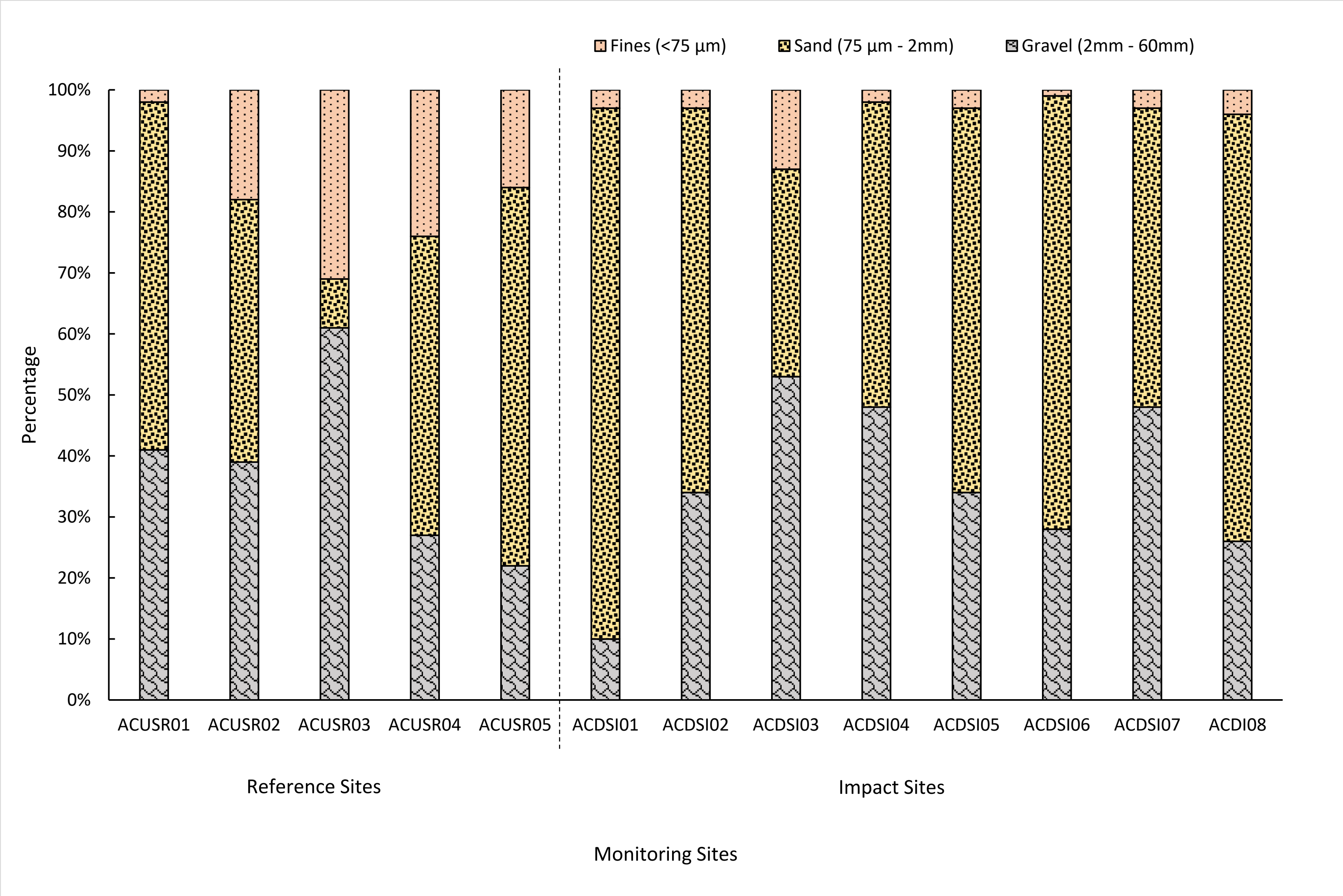


Figure 4: Particle Size Distribution for sediment samples from September 2021

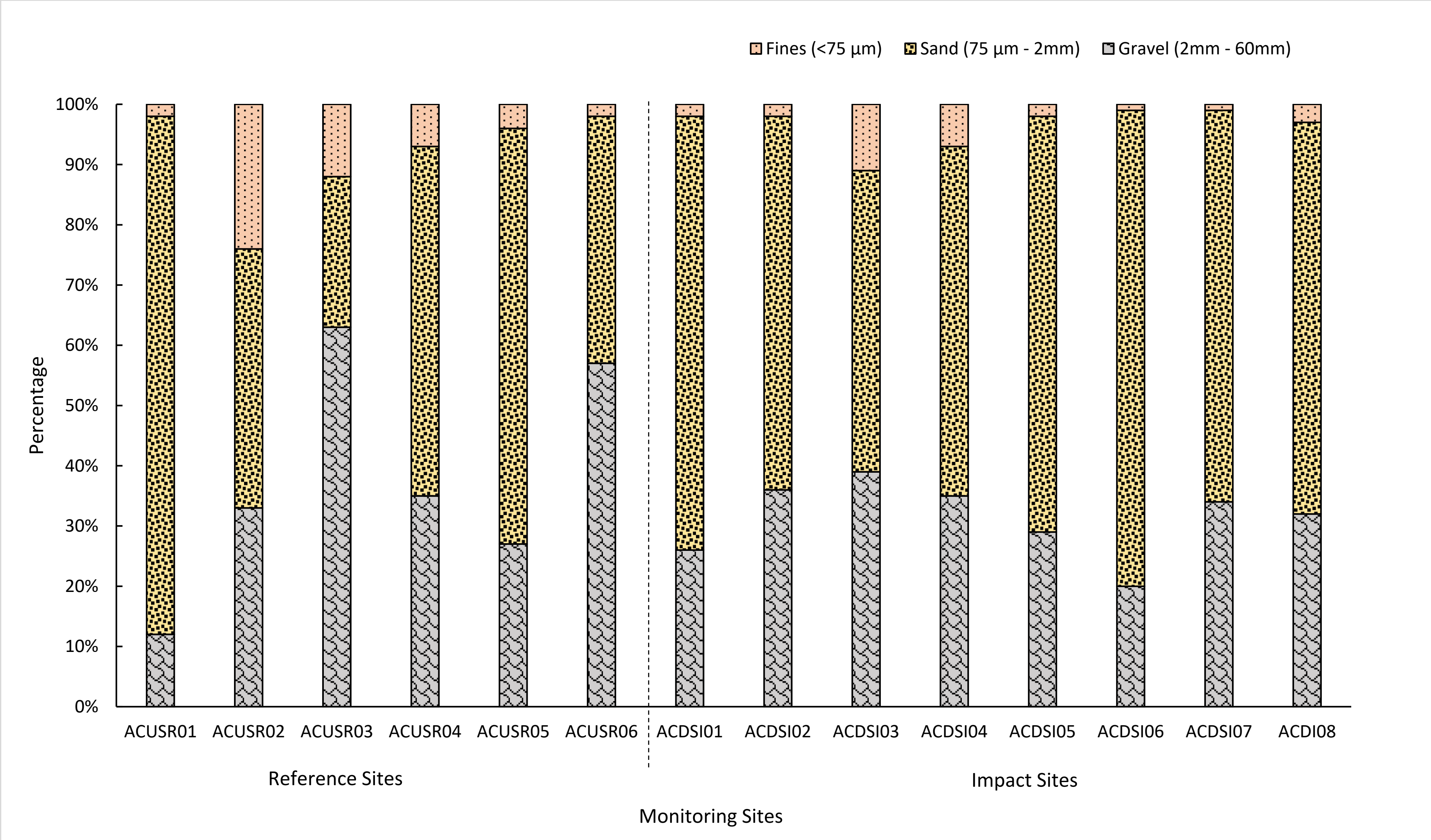


Figure 5: Particle Size Distribution for sediment samples from March 2022

Table 8: Sediment analysis results for total metals from September 2021 and March 2022, for reference sites.

Metal	Unit	LOR	SQO	Reference sites					
				ACUSR01	ACUSR02	ACUSR03	ACUSR04	ACUSR05	ACUSR06
September 2021									
Antimony	mg/kg	5	2	<5	<5	<5	<5	<5	-
Arsenic	mg/kg	5	20	<5	<5	<5	<5	<5	-
Cadmium	mg/kg	1	1.5	<1	<1	<1	<1	<1	-
Chromium	mg/kg	2	80	9	9	30	10	8	-
Copper	mg/kg	5	65	<5	20	118	8	8	-
Lead	mg/kg	5	50	5	30	5	12	7	-
Mercury	mg/kg	0.1	0.15	<0.1	<0.1	<0.1	<0.1	<0.1	-
Nickel	mg/kg	2	21	8	13	73	10	9	-
Zinc	mg/kg	5	200	14	44	58	43	41	-
March 2022									
Antimony	mg/kg	5	2	<5	<5	<5	<5	<5	<5
Arsenic	mg/kg	5	20	<5	<5	8	<5	<5	<5
Cadmium	mg/kg	1	1.5	<1	<1	<1	<1	<1	<1
Chromium	mg/kg	2	80	7	9	22	6	6	7
Copper	mg/kg	5	65	<5	23	35	5	5	5
Lead	mg/kg	5	50	<5	14	<5	6	6	<5
Mercury	mg/kg	0.1	0.15	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	21	6	9	31	6	6	6
Zinc	mg/kg	5	200	12	25	28	24	27	26

Notes: Exceedances of SQO (ANZECC 2000 Sediment Default Guideline Values) are denoted by yellow highlighting.

Table 9: Sediment analysis results for total metals from September 2021 and March 2022, for impact sites.

Metal	Unit	LOR	SQO	Impact sites ACDSI01	ACDSI02	ACDSI03	ACDSI04	ACDSI05	ACDSI06	ACDSI07	ACDSI08
September 2021											
Antimony	mg/kg	5	2	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	mg/kg	5	20	<5	<5	12	<5	<5	<5	<5	<5
Cadmium	mg/kg	1	1.5	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	mg/kg	2	80	8	8	12	8	7	11	7	9
Copper	mg/kg	5	65	<5	<5	17	<5	<5	<5	<5	6
Lead	mg/kg	5	50	<5	<5	7	<5	<5	5	6	6
Mercury	mg/kg	0.1	0.15	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	21	6	6	8	6	6	9	8	8
Zinc	mg/kg	5	200	16	16	16	16	15	21	14	27
March 2022											
Antimony	mg/kg	5	2	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	mg/kg	5	20	<5	<5	12	<5	<5	<5	<5	<5
Cadmium	mg/kg	1	1.5	<1	<1	<1	<1	<1	<1	<1	<1
Chromium	mg/kg	2	80	8	9	14	6	13	5	8	9
Copper	mg/kg	5	65	<5	<5	18	<5	<5	<5	<5	23
Lead	mg/kg	5	50	<5	<5	8	<5	<5	<5	6	14
Mercury	mg/kg	0.1	0.15	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	mg/kg	2	21	7	7	10	5	8	6	6	9
Zinc	mg/kg	5	200	18	18	26	14	14	12	13	25

Notes: Exceedances of SQO (ANZECC 2000 Sediment Default Guideline Values) are denoted by yellow highlighting.

3.2. Macroinvertebrates

3.2.1. Overview

As sampling occurred during the late dry season, only one site, ACUSR01, contained suitable habitat for macroinvertebrate sampling. As per Queensland AUSRIVAS guidelines (Department of Natural Resources DNR, 2001), a bed and an edge sample were collected.

A total of 853 individual macroinvertebrates from 22 taxa were recorded at site ACUSR01 from two samples collected in September 2021 (see Table 12 in Appendix B; **Error! Reference source not found.**). The most diverse group was insects with 20 taxa (dipterans – 5 taxa; odonatans – 4 families; coleopterans and hemipterans – 3 families each; ephemeropterans and trichopterans – 2 families each; and 1 lepidopteran). There were also oligochaete worms and snails from the family Lymnaeidae recorded. More taxa were recorded in the edge than the bed sample, but total abundance was higher in the bed sample. The most abundant taxa were chironomids (subfamilies Chironominae and Tanypodinae), which represented 46% of all individuals. Ephemeropterans were the next most abundant group (28%), and all other groups were less abundant and each represented less than 7% of the total abundance.

In March 2022, twelve samples were collected from six sites and a total of 2081 invertebrates from 35 taxa were recorded (see Table 13 in Appendix B; **Error! Reference source not found.**). Insects were again the most diverse group with 31 taxa (9 dipterans, 6 trichopterans, 5 odonatans, 4 coleopterans, 3 families each for ephemeropterans and hemipterans, and 1 lepidopteran). The other four taxa were oligochaete worms, Planorbidae snails, ostracod crustaceans and hydracarina (water mites). Trends for abundance of particular taxonomic groups was very similar to the samples collected in September 2021, despite there being an additional five sites sampled. Total abundance was again higher in bed samples than edge samples. Chironomids were again the most abundance group, making up 50% of all individuals, followed by ephemeropterans (18%). Remaining taxa each represented less than 7% of total abundance. Cane toad (*Rhinella marina*) tadpoles were found in samples from most impact sites, but not at the reference site (Table 13, Appendix B).

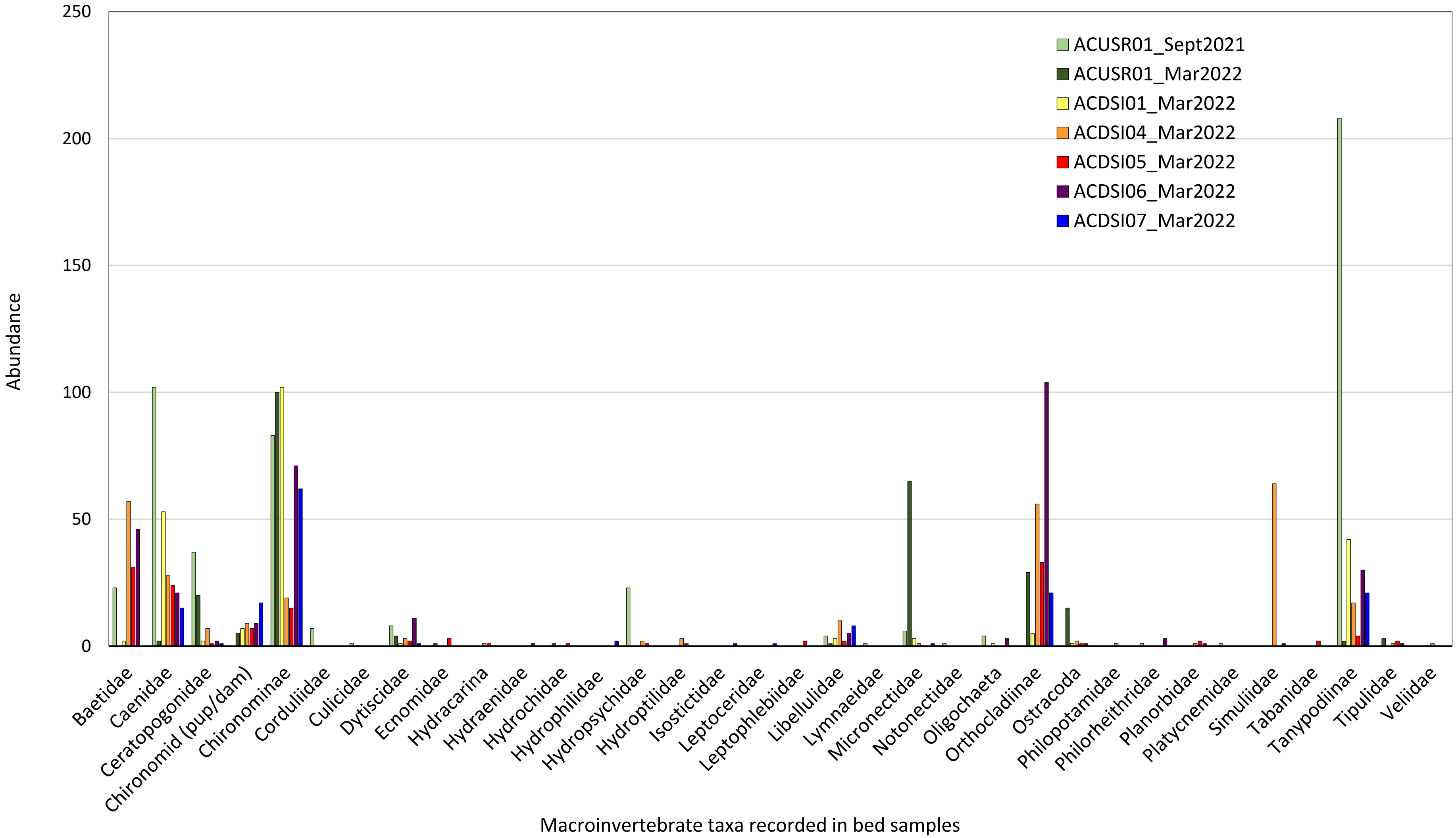


Figure 6. Abundance of macroinvertebrate taxa in bed samples in September 2021 (one site) and March 2022 (six sites).

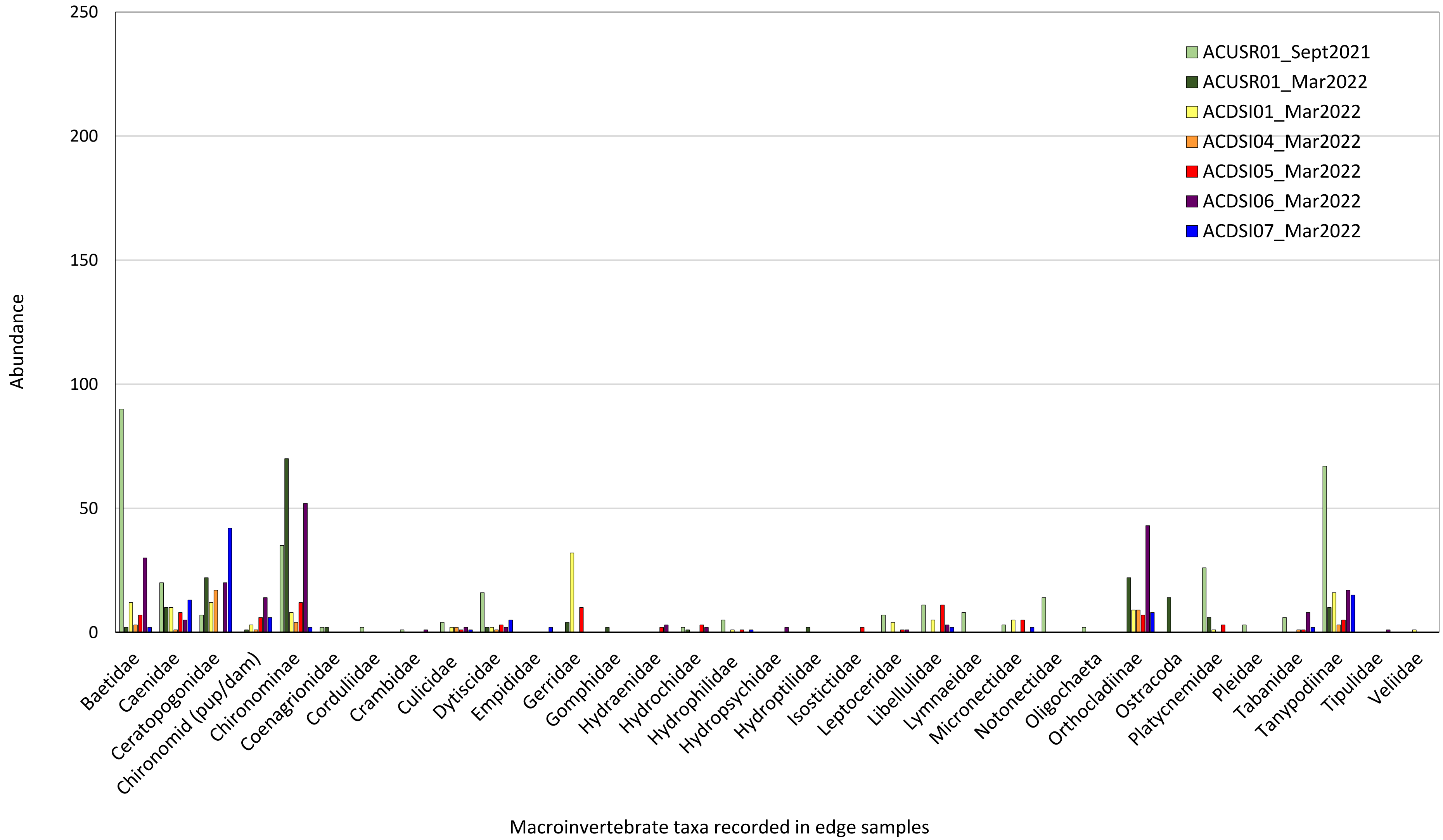


Figure 7. Abundance of macroinvertebrate taxa in edge samples in September 2021 (one site) and March 2022 (six sites).

3.2.2.Habitat Assessment Scores

Habitat assessment scores were recorded at sites where macroinvertebrates were sampled in September 2021 and March 2022. Scores ranged between 39 at impact site ACDSI01 to 70 at impact site ACDSI07. All sites were attributed a rating of 'Fair' (Table 10 and detailed results are provided in Appendix C). These ratings were related to the ephemeral nature of the creeks in the local environment, and notably the low variety of flow habitats and substrate types, which was observed at reference and impact sites. Water at ACUSR01 in September 2021 was not flowing at all, and in March 2022, flow was very low at all sites, with areas of no flow and stagnant water. Minor grazing impact was also noted at most sites.

Table 10. Macroinvertebrate habitat assessment scores at sites sampled in September 2021 and March 2022.

Site	Habitat Assessment Score	Rating
September 2021		
ACUSR01	67	Fair
March 2022		
ACUSR01	63	Fair
ACDSI01	39	Fair
ACDSI04	60	Fair
ACDSI05	60	Fair
ACDSI06	60	Fair
ACDSI07	70	Fair

3.2.3.Macroinvertebrate Indices

The macroinvertebrate indices calculated (taxon richness, total abundance, PET richness, SIGNAL scores and % tolerant taxa) are presented graphically in Figures 8 to 12, below. In comparison to the adopted macroinvertebrate guidelines (i.e. 20th and 80th percentiles for various diversity indices, for SMD waters in the Central Region; EHP 2009), some indices were within the guideline ranges (e.g. PET richness and SIGNAL scores). Taxa richness for most edge samples and a few bed samples was below the 20% guideline value (**Figure 8**). Percentage of tolerant taxa was also lower than the 20% guideline value, however, this was a positive result because the lower the proportion of tolerant taxa, the healthier the macroinvertebrate community (Figure 12). Furthermore, PET richness was higher than the 80% guideline value in the bed sample from impact site ACDSI05, indicating a relatively high diversity of this group of taxa that are regarded as pollution-sensitive (Figure 10).

When data were pooled for both habitats and seasons, analyses found there was no significant difference between reference and impact sites for any index except total abundance, which was higher on reference sites than impact sites ($p<0.05$ – see Table 14 in Appendix D).

There was insufficient data to analyse seasonal differences, and therefore these were assessed visually for the single site sampled in both seasons (ACUSR01). Overall, there was little evidence of seasonal variation in macroinvertebrate indices, with the exception of total abundance (i.e. higher abundance in September 2021 than March 2022) (Figure 9).

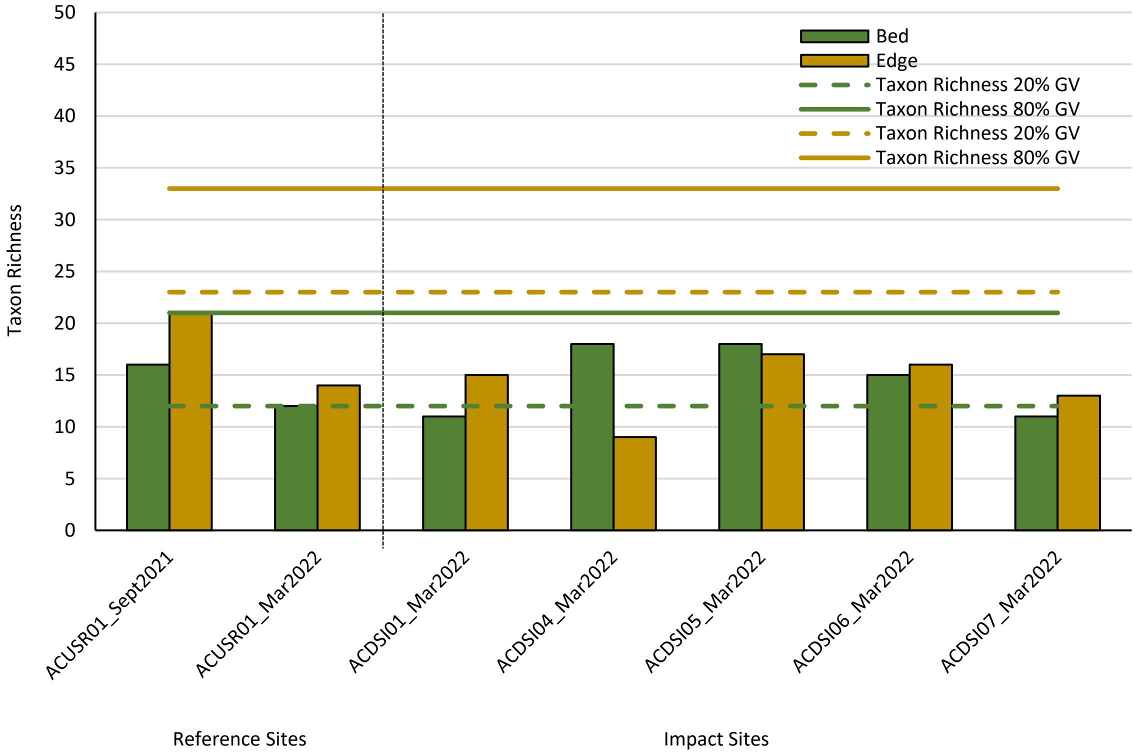


Figure 8. Taxon richness of macroinvertebrates in bed and edge samples from September 2021 and March 2022.

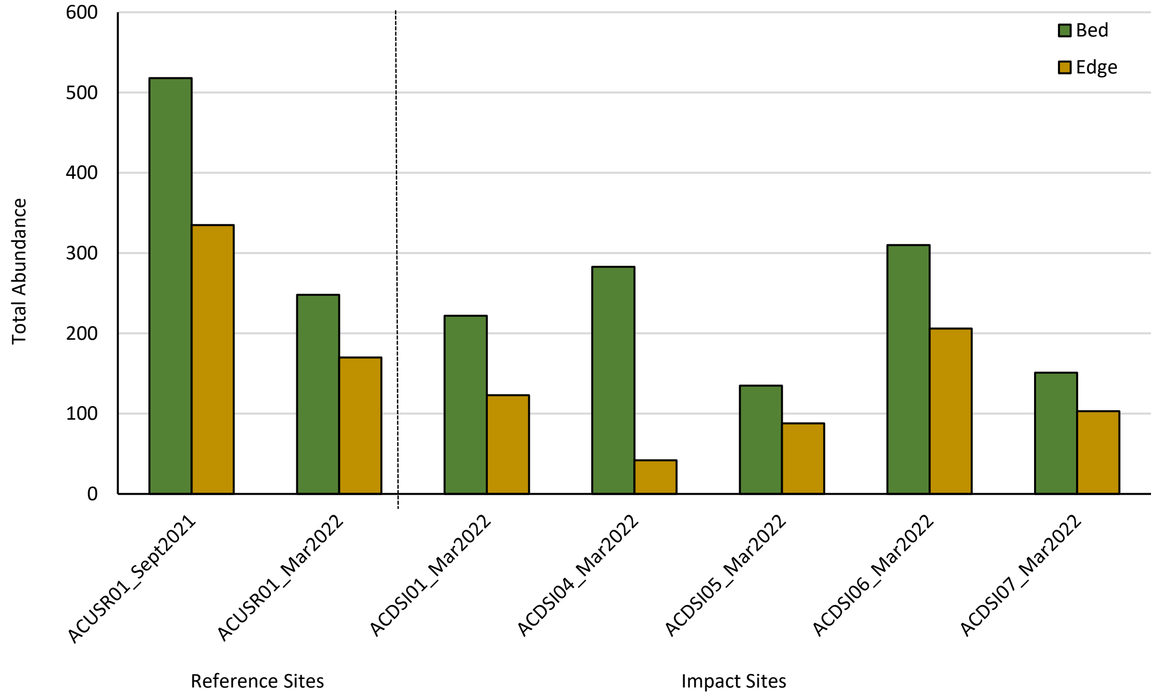


Figure 9. Total abundance of macroinvertebrates in bed and edge samples from September 2021 and March 2022.

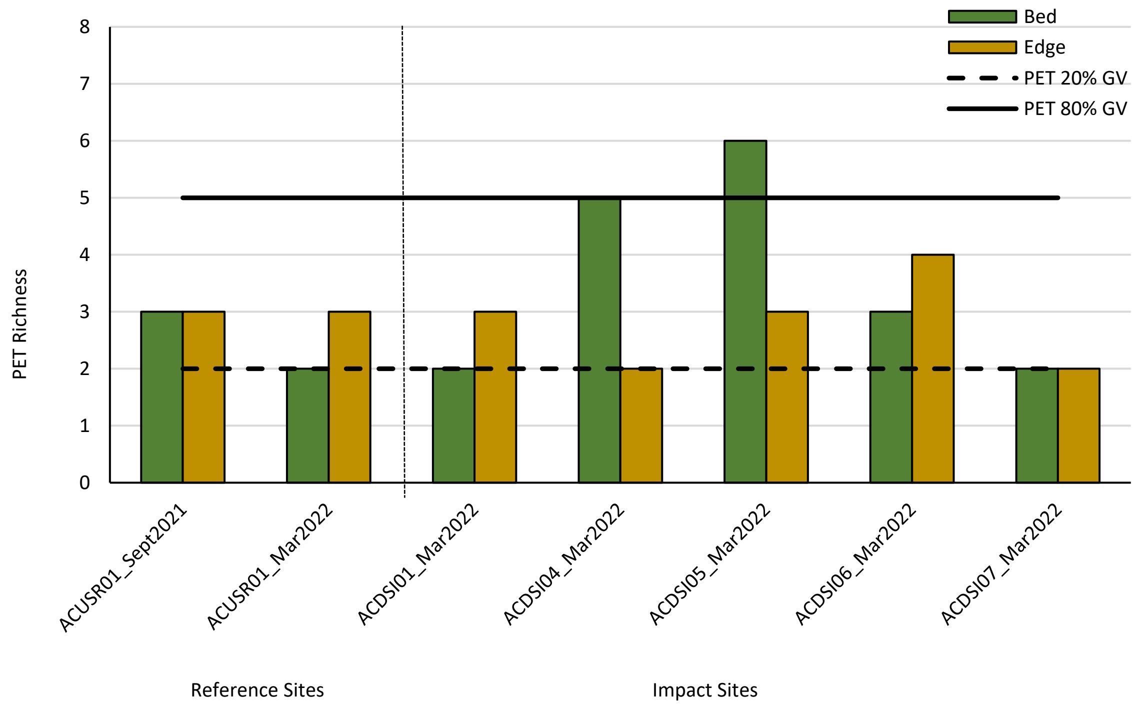


Figure 10. PET richness in bed and edge samples from September 2021 and March 2022.

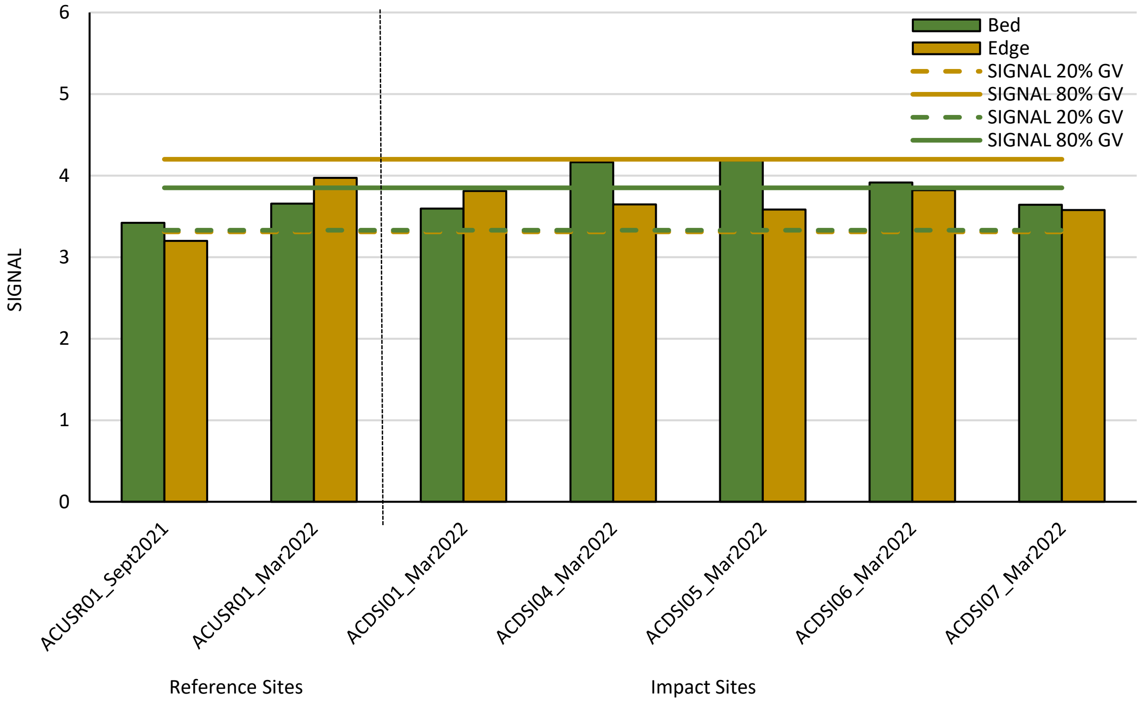


Figure 11. SIGNAL scores for bed and edge samples from September 2021 and March 2022.

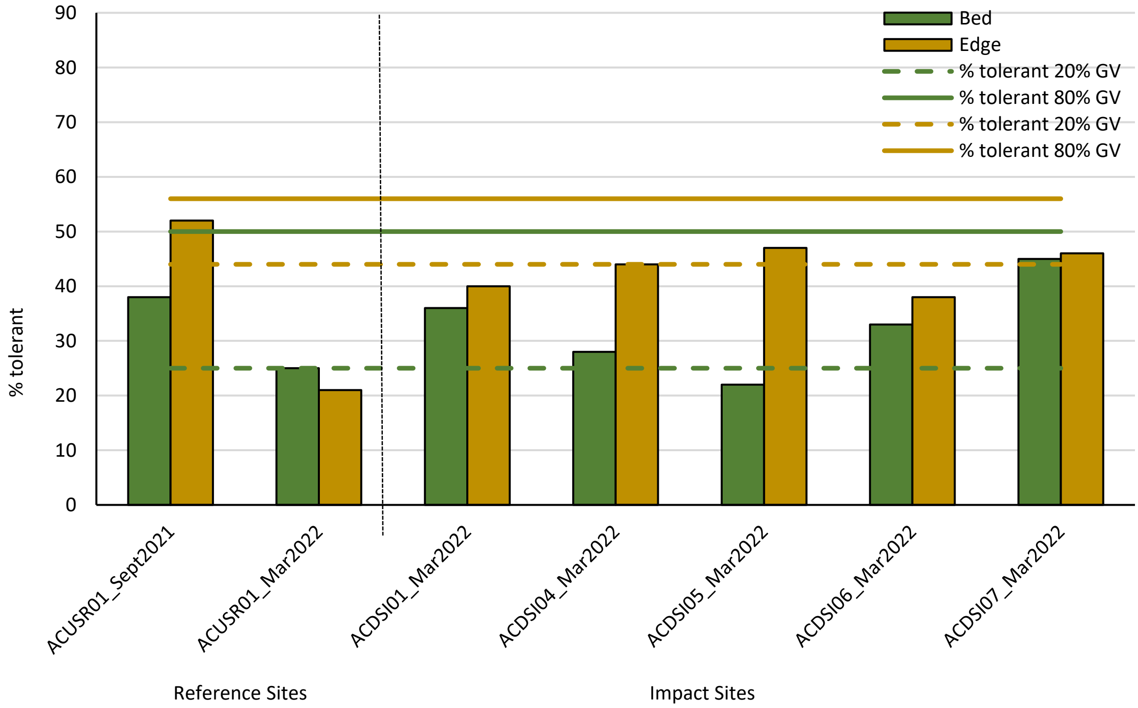


Figure 12. Percentage of tolerant taxa in bed and edge samples from September 2021 and March 2022.

3.2.4. Community Composition

Graphical analysis of macroinvertebrate community composition is presented in Figure 13, in the form of an ordination plot. There was no distinct clustering in relation to site type and PERMANOVA found no statistically significant difference in composition between reference and impact sites (see Table 14 in Appendix D). There was some clustering apparent for season, with samples collected in September 2021 positioned in two-dimensional ordination space more closely to each other than samples from March 2022. However, with only one site able to be sampled in September, there is insufficient data at present to comment on temporal trends with confidence. A review of the taxa present in samples from 2021 versus 2022 (see Figures 6 and 7, and Appendix B) found that the very high abundance of chironomids from the subfamily Tanypodinae recorded in 2021, and various taxa only recorded in 2022 (e.g. Gerridae hemipterans, Libellulidae odonatan and three trichopteran families) contributed to the apparent seasonal variation in community composition.

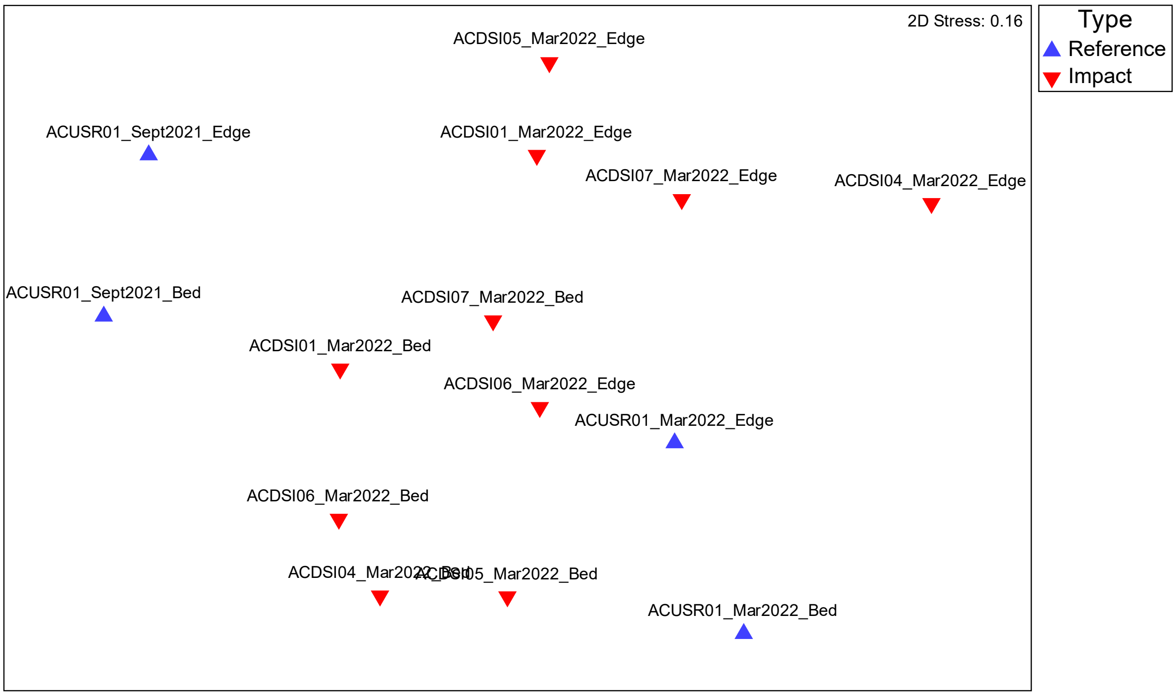


Figure 13. Ordination plot of macroinvertebrate community composition in bed and edge samples from September 2021 and March 2022.

3.3. Quality Assurance and Quality Control

Relative percentage differences (RPD) were calculated for a range of analytes; detailed RPD results are shown in Appendix E. For the water samples from both sampling periods and sediment samples from September 2021, there were no exceedances of the acceptable RPD recorded. For sediment samples from March 2022, one parameter (soil moisture) had an acceptable RPD of 68.8% (above the limit of 20%). This was attributable to natural variations in soil moisture at the sampling site and was not of concern, hence, overall, the RPD results were acceptable.

Complete laboratory reports are provided in Appendix F. Review of laboratory quality control (QC) samples utilised by ALS for the analysis of the following batches - EB2126573 (water/sediment in September 2021), ET2201324 (water in March 2022) and EB2205889 (sediment in March 2022) found that QA/QC results were within the specified requirements. The validity and sufficiency of the data is assumed to meet the objectives of the assessment. In summary, the following compliance outcomes were observed:

- No Method Blank value outliers
- No Duplicate outliers
- No Laboratory Control outliers
- No Matrix Spike outliers
- No surrogate recovery outliers
- No Quality Control Sample Frequency outliers
- Holding Time Outliers for water samples for pH (10 days overdue in September 2021; 2 days overdue in March 2022); no Holding Time Outliers for sediment samples

The holding time outliers for pH were considered minor, particularly as a field pH reading was also obtained from surface water, and was not considered to be critical to the overall assessment. Hence, the QA/QC results indicate that analytical data is acceptable for use and is considered sufficient for the purpose of this investigation.

As the total number of macroinvertebrate samples was less than ten, there were no QA/QC re-identifications undertaken.

4. Discussion

4.1. Water

Surface water quality at the single (reference) site sampled in September 2021 and six sites sampled in March 2022 generally met WQO adopted for Agate Creek Gold Mine, with the exception of elevated pH (indicating alkalinity) and low dissolved oxygen. For remote locations such as this mine, field pH is regarded as more accurate than laboratory pH, because holding time requirements cannot be met. However, the consistently high readings observed in March 2022 and lack of other chemistry indicating high alkalinity, suggests that there may have been an issue with the pH probe on the hand-held water quality meter. The probe has since been replaced, and on-going monitoring will allow characterisation of the pH of waters upstream and downstream of mining activities at Agate Creek Gold Mine.

The low dissolved oxygen levels were not unexpected, given the seasonal factors of very high temperatures and rates of evaporation. Flows were nil in September 2021 (i.e. water was stagnant) and there was little or no flow in March 2022. The QWQG (DEHP, 2009) note that dissolved oxygen is naturally low in ephemeral systems and that WQO for dissolved oxygen should be applied to flowing waters only. Therefore, these exceedances are not considered to be of concern.

Notably, sampling at the single reference site with surface water (ACUSR01) was done at a location downstream from the confluence of a small creek that discharges from a stock dam to the east of the ML and Agate Creek, as this was the only place where field crews found surface water in September 2021, and sampling was simply repeated in March 2022. The nominated location for this reference site was upstream of the confluence, in order to sample water unaffected by the stock dam. Notes regarding the specific location for this site have been updated to make it clear that future sampling should only be upstream of the discharge from the dam. There is a high probability that the nominated location will often be dry, in which case, sediment sampling may be the only option, but this is preferable to sampling water that has potentially been impacted by the stock dam.

4.2. Sediment

Sediment sampling was undertaken at all sites in both seasons. Particle size distribution analysis found that sediments were typically coarse, with high proportions (>70%) of sand and gravel. On average, reference sites had a slightly higher proportion of fine sediments (18% in September 2021; 8% in March 2022) than impact sites (4% in both sampling periods). The level of metal contaminants in most sediment samples was low, with many below LOR, for both sampling periods. The only elevated levels were for copper and nickel, and these were found at one reference site (ACUSR03), in both seasons. The location of this site is upstream from mining activities and therefore unlikely to be associated with mining impact. At present, there is no evidence that mining activities have impacted sediment quality in the receiving environment and on-going monitoring will allow more comprehensive characterisation of sediment chemistry across the site.

4.3. Macroinvertebrates

Assessment of macroinvertebrates at the single site in September 2021, and six sites in March 2022 found no evidence of impact from mining activities at Agate Creek Gold Mine. When data were pooled for both habitats and seasons, analyses found there was no significant difference between reference and impact sites for any index except total abundance, which was higher on reference sites than impact sites. Seasonal differences were noted in macroinvertebrate community composition, with the relative abundance of particular taxa varying between seasons. Macroinvertebrate habitat was rated as ‘Fair’ at all sites (reference and impact), and this was largely because of the ephemeral nature of creeks in this region, which resulted in a low variety of flow conditions and habitat features.

The low dissolved oxygen levels did not appear to be having adverse impacts on macroinvertebrate communities, with the highest taxa richness and abundance recorded at the site with the lowest dissolved oxygen levels. Macroinvertebrates in these environments are likely to be adapted to local conditions, therefore these trends are not unexpected. On-going macroinvertebrate monitoring with careful consideration of the timing of sampling (i.e. to maximise the chance of surface water and macroinvertebrate habitat being present) will provide greater insights into the aquatic ecology of the Agate Creek Gold Mine receiving environment.

5. Conclusions and Recommendations

5.1. Conclusions

Based on results of sampling in September 2021 and March 2022, there was no evidence of disturbance to the receiving environment around the Agate Creek Gold Mine.

5.2. Recommendations

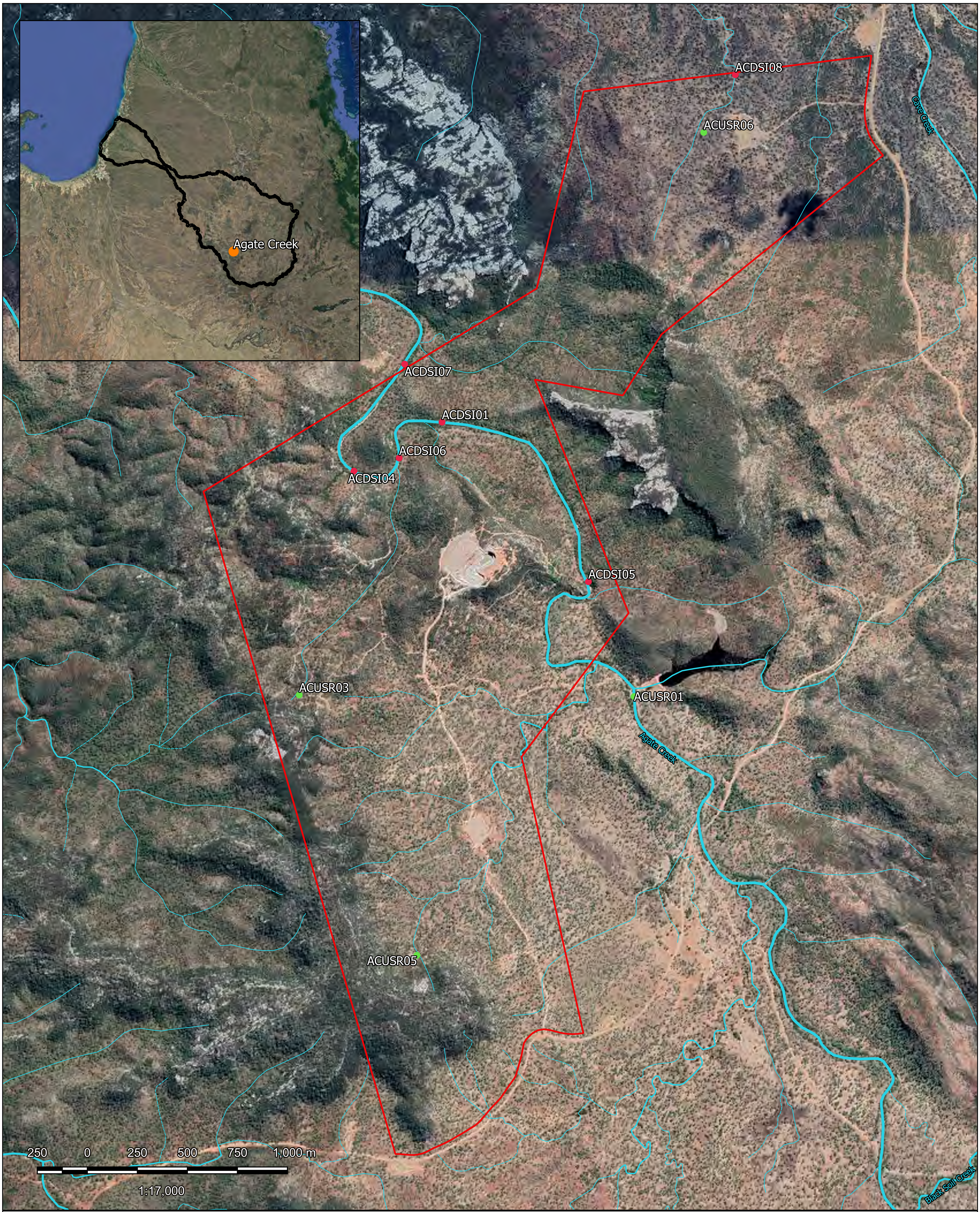
The REMP is recommended to continue at Agate Creek Gold Mine, with the following modifications:

1. Remove the two reference sites (ACUSR02 and ACUSR04) and two impact sites (ACDSI02 and ACDSI03) from the program, as these sites were dry in both seasons, and had poor access;
2. Update the location description for ACUSR01 to emphasise the need for sampling to occur upstream from the creek discharging from the stock down. The revised list of monitoring sites and descriptive notes is provided in Table 11, below, and locations are shown in Figure 14;
3. Sediment quality assessment should be extended to include analyses of contaminants in the fine fraction (<63 μm) and whole sample (<2mm), as the fine sediments are more bioavailable to aquatic organisms. Including analyses of fine sediment fractions will provide important data regarding sediment quality in the absence of water quality and aquatic ecology data, which may be frequently unavailable because of the very short time period that surface water is present in this region (e.g. most creeks are highly ephemeral);
4. Continue monitoring twice per year (dry season and mid-late wet season), using the same methodology as specified in the REMP design (WTS 2021). The WQO and SQO applied in this report remain appropriate in the absence of specific trigger and contaminant limits noted in a revised EA.

Table 11. Summary of recommended future REMP monitoring sites.

Site	Northing	Easting	Description
ACUSR01	-19.000665	143.555939	**Reference site**. Agate Creek, approx. 250m upstream of the ML boundary (outside boundary) and 50m upstream of a tributary entering Agate Creek from below a stock dam.
ACUSR03	-19.00081	143.540047	**Reference site.** Unnamed first order tributary of Agate Creek (flowing north-east), approx. 1.2km upstream of the confluence with Agate Creek.
ACUSR05	-19.012478	143.545814	**Reference site**. Unnamed first order tributary of Agate Creek (flowing north-north-east), approx. 700m upstream of the crossing along the haul road, just south of the mine camp.

Site	Northing	Easting	Description
ACUSR06	-18.975161	143.558856	**Reference site**. Unnamed first order tributary of Cave Creek (flowing north-north-east), approx. 450m upstream of ACDSI08; 25m upstream (south) of the crossing along the haul road, west of the ROM.
ACDSI01*	-18.988406	143.546636	**Impact site.** Unnamed tributary of Agate Creek (flowing north), approx. 100m upstream of the confluence with Agate Creek; downstream of Sherwood Open Cut pit.
ACDSI04	-18.990672	143.542492	**Impact site.** Agate Creek, approximately 3km downstream of ACUSR01, downstream of all mine operations and tributaries flowing into Agate Creek.
ACDSI05	-18.995508	143.553694	**Impact site.** Agate Creek, approximately 1.1km downstream of ACUSR01, downstream of Sherwood West Open Cut pit and mine camp; upstream of Sherwood Open Cut pit.
ACDSI06	-18.990053	143.544628	**Impact site.** Agate Creek, approximately 300m upstream of ACDSI04, downstream of Sherwood Open Cut pit; upstream of tributaries flowing from Sherwood West Open Cut pit.
ACDSI07	-18.985814	143.544825	**Impact site.** Agate Creek, approximately 700m downstream of ACDSI04 (just outside ML boundary), downstream of all mine operations and tributaries flowing into Agate Creek.
ACDSI08	-18.972536	143.560317	**Impact site.** Unnamed first order tributary of Cave Creek (flowing north-north-east), approx. 450m downstream of ACUSR06; downstream of ROM (just outside ML boundary).



Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 23 May 2022

Print as A3

Figure 14. Recommended future REMP sites

Legend

- Mining Lease
- Key Features
- Gilbert Basin
- Google Satellite

Watercourse - Stream Order
- 0
- 1
- 2
- 3
- 4

REMP Sites
- Impact
- Reference

WULGURU TECHNICAL SERVICES

6. References

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7. APPENDIX A – Site photos

Site and Description	Upstream	Across Channel	Downstream
Reference Sites			
ACUSR01 **Reference site** Agate Creek, approx. 250m upstream of the ML boundary (outside boundary) and 50m upstream of a tributary entering Agate Creek from below a dam. Dry Season (Sept 2021): Small amount of surface water (not flowing). Water, sediment and macroinvertebrate samples collected.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

Site and Description	Upstream	Across Channel	Downstream
ACUSR02 **Reference Site** Unnamed first order tributary of Agate Creek (flowing east), approx. 600m upstream of the crossing along the haul road. Mapped location was unsuitable (poor access and creek habitat markedly different from downstream sites). Site moved to -19.00324; 143.54169. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): No surface water (highly ephemeral), sediment sample only. *Site to be removed from the REMP.*			

Site and Description	Upstream	Across Channel	Downstream
ACUSR03 **Reference Site** Unnamed first order tributary of Agate Creek (flowing north-east), approx. 1.2km upstream of the confluence with Agate Creek. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): No surface water (highly ephemeral), sediment sample only.			

Site and Description	Upstream	Across Channel	Downstream
ACUSR04 **Reference Site** Unnamed first order tributary of Agate Creek (flowing east-north-east), approx. 600m upstream of the crossing along the haul road, just north of the mine camp. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): No surface water (highly ephemeral), sediment sample only. *Site to be removed from the REMP.*			

Site and Description	Upstream	Across Channel	Downstream
ACUSR05 **Reference Site** Unnamed first order tributary of Agate Creek (flowing north-north-east), approx. 700m upstream of the crossing along the haul road, just south of the mine camp. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): No surface water (highly ephemeral), sediment sample only.			

Site and Description	Upstream	Across Channel	Downstream
ACUSR06 **Reference site** Unnamed first order tributary of Cave Creek (flowing north-north-east), approx. 450m upstream of ACDSI08; 25m upstream (south) of the crossing along the haul road, west of the ROM. Dry Season (Sept 2021): Sediment sample taken but unable to be analysed in lab.			
Wet Season (March 2022): No surface water (highly ephemeral), sediment sample only.			

Site and Description	Upstream	Across Channel	Downstream
Impact Sites			
ACDSI01 **Impact site** Unnamed tributary of Agate Creek (flowing north), approx. 100m upstream of the confluence with Agate Creek; downstream of Sherwood Open Cut pit. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

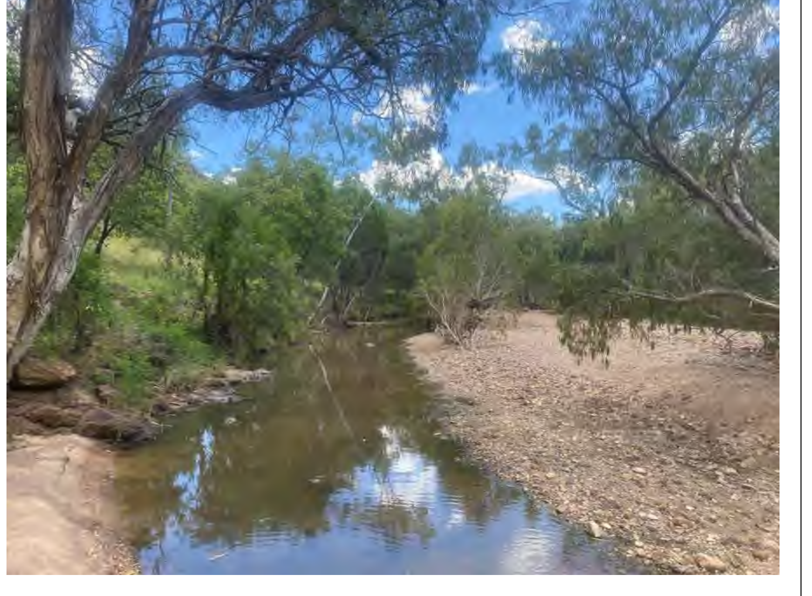
<table>
<tr><th>Site and Description</th><th>Upstream</th><th>Across Channel</th><th>Downstream</th></tr>
<tr><td>ACDSI02
Impact site
Unnamed first order tributary of Agate Creek (flowing north), approx. 140m upstream of the confluence with Agate Creek; downstream of Sherwood West Open Cut pit.

Dry Season (Sept 2021):
No surface water, sediment sample only.</td><td></td><td></td><td></td></tr>
<tr><td>Wet Season (March 2022):
No surface water, sediment sample only.

Site to be removed from the REMP.</td><td></td><td></td><td></td></tr>
</table>

Site and Description	Upstream	Across Channel	Downstream
ACDSI03 **Impact site** Unnamed first order tributary of Agate Creek (flowing north-east), approx. 1000 downstream of ACUSR03; 200m upstream of the confluence with Agate Creek; downstream of Sherwood West Open Cut pit. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): No surface water, sediment sample only. *Site to be removed from the REMP.*			

Site and Description	Upstream	Across Channel	Downstream
ACDSI04 **Impact site** Agate Creek, approximately 3km downstream of ACUSR01, downstream of all mine operations and tributaries flowing into Agate Creek. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

Site and Description	Upstream	Across Channel	Downstream
ACDSI05 **Impact site** Agate Creek, approximately 1.1km downstream of ACUSR01, downstream of Sherwood West Open Cut pit and mine camp; upstream of Sherwood Open Cut pit. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

Site and Description	Upstream	Across Channel	Downstream
ACDSI06 **Impact site** Agate Creek, approximately 300m upstream of ACDSI04, downstream of Sherwood Open Cut pit; upstream of tributaries flowing from Sherwood West Open Cut pit. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

Site and Description	Upstream	Across Channel	Downstream
ACDSI07 **Impact site** Agate Creek, approximately 700m downstream of ACDSI04 (just outside ML boundary), downstream of all mine operations and tributaries flowing into Agate Creek. Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

Site and Description	Upstream	Across Channel	Downstream
ACDSI08 **Impact site** Unnamed first order tributary of Cave Creek (flowing north-north-east), approx. 450m downstream of ACUSR06; downstream of ROM (just outside ML boundary). Dry Season (Sept 2021): No surface water, sediment sample only.			
Wet Season (March 2022): Water present - water, sediment and macroinvertebrate samples collected.			

8. APPENDIX B – Macroinvertebrate Data

Table 12. Macroinvertebrate taxa recorded in September 2021.

Phylum/Class	Class/Order	Family/Subfamily	SIGNAL Grade	Sensitivity[1]	ACUSR01 Bed	ACUSR01 Edge
Annelida	Oligochaeta	Oligochaeta	2	tolerant	4	2
Mollusca	Gastropoda	Lymnaeidae	1	tolerant	1	8
Insecta	Coleoptera	Dytiscidae	2	tolerant	8	16
		Hydrochidae	4			2
		Hydrophilidae	2	tolerant	23	5
		Unident. (terrestrial)[2]	NA			1
	Diptera	Ceratopogonidae	4		37	7
		Chironomidae (Chironominae)	3	tolerant	83	35
		Chironomidae (Tanypodiinae)	4		208	67
		Chironomidae (pupae or damaged)[3]	3		8	3
		Culicidae	1	tolerant	1	4
		Tabanidae	3	tolerant		6
		Unident. (pupae or damaged)^	3			1
	Ephemeroptera	Baetidae	5		23	90
		Caenidae	4		102	20
	Hemiptera	Micronectidae	2	tolerant	6	3
		Notonectidae	1		1	14
		Pleidae	2	tolerant		3
		Unident. (terrestrial)[2]	NA			2
	Lepidoptera	Crambidae	2	tolerant		1
	Odonata (Epiprocta)	Corduliidae	5		7	2
		Libellulidae	4		4	11
	Odonata (Zygoptera)	Coenagrionidae	2	tolerant		2
		Platycnemidae	4		1	26
	Trichoptera	Leptoceridae	6			7
		Philorheithridae	8	sensitive	1	
Total abundance					**518**	**335**
Total Taxa Richness					**16**	**21**
Total PET Richness					**3**	**3**
SIGNAL2					**3.42**	**3.20**
% tolerant of total taxa					**38**	**52**

1. Sensitivity ratings are sensitive = SIGNAL Grade 8-10; tolerant = SIGNAL Grade 1-3
2. Excluded from richness and abundance total
3. Excluded from richness total only

Table 13. Macroinvertebrate taxa recorded in March 2022.

Phylum/Class	Class/Order	Family (Subfamily)	SIGNAL Grade	Sensitivity[1]	ACUSR01 Bed	ACUSR01 Edge	ACDSI01 Bed	ACDSI01 Edge	ACDSI04 Bed	ACDSI04 Edge	ACDSI05 Bed	ACDSI05 Edge	ACDSI06 Bed	ACDSIU06 Edge	ACDSI07 Bed	ACDSI07 Edge
Annelida	Oligochaeta	Oligochaeta	2	tolerant			1						3			
Mollusca	Gastropoda	Planobidae	2	tolerant					1		2		1			
Crustacea	Ostracoda	Ostracoda	5.5		15	14	1		2		1		1			
Acarina	Hydracarina	Hydracarina	6						1		1					
Arachnidae	Araneae	Terrestrial spider[2]	NA	NA		1		2								
Insecta	Coleoptera	Dytiscidae	2	tolerant	4	2	1	2	3	1	2	3	11	2	1	5
		Hydaenidae	3	tolerant								2	1	3		
		Hydrochidae	4		1	1					1	3		2		
		Hydrophilidae	2	tolerant				1				1			2	1
	Diptera	Ceratopogonidae	4		20	22	2	12	7	17	1		2	20	1	42
		Chironomidae (Chironominae)	3	tolerant	100	70	102	8	19	4	15	12	71	52	62	2
		Chironomidae (Orthocladiinae)	4		29	22	5	9	56	9	33	7	104	43	21	8
		Chironomidae (Tanypodiinae)	4		2	10	42	16	17	3	4	5	30	17	21	15
		Chironomidae [pupae or damaged][3]	3	tolerant	5	1	7	3	9	1	7	6	9	14	17	6
		Culicidae	1	tolerant				2		2		1		2		1
		Empididae	5													2
		Simuliidae	5						64				1			
		Tabanidae	3	tolerant						1	2	1		8		2
		Tipulidae	5		3				1		2		1	1		
	Ephemeroptera	Baetidae	5			2	2	12	57	3	31	7	46	30		2
		Caenidae	4		2	10	53	10	28	1	24	8	21	5	15	13
		Leptophlebiidae	8	sensitive							2					
	Hemiptera	Gerridae	4			4		32				10				
		Micronectidae	2	tolerant	65		3	5	1			5			1	2
		Veliidae	3	tolerant				1	1							
	Hymenoptera	Terrestrial ant[2]	NA	NA								2				
	Lepidoptera	Crambidae	2	tolerant										1		
	Odonata (Epiprocta)	Gomphidae	5			2										
		Libellulidae	4		1		3	5	10		2	11	5	3	8	2
	Odonata (Zygoptera)	Coenagrionidae	2	tolerant		2										
		Isostictidae	3	tolerant								2			1	
		Platycnemidae	4			6		1				3				
	Orthoptera	Terrestrial grasshopper[2]						1								
	Trichoptera	Ecnomidae	4		1						3					
		Hydropsychidae	6						2		1			2		
		Hydroptilidae	4			2			3		1					
		Leptoceridae	6					4				1		1	1	
		Philorheithridae	8	sensitive									3			
		Philopotamidae	8	sensitive					1							
Other	Actinopterygii	Juvenile ray-finned fish[2]	NA	NA				3	7			2		2		1
	Amphibia	Cane toad tadpole	NA	NA					1		6					
Total abundance					248	170	222	123	283	42	135	88	310	206	151	103
Total Taxa Richness					12	14	11	15	18	9	18	17	15	16	11	13
Total PET Richness					2	3	2	3	5	2	6	3	3	4	2	2
SIGNAL2					3.66	3.97	3.60	3.81	4.16	3.65	4.19	3.58	3.91	3.82	3.64	3.58
% tolerant of total taxa					25	21	36	40	28	44	22	47	33	38	45	46

1. Sensitivity ratings are sensitive = SIGNAL Grade 8-10; tolerant = SIGNAL Grade 1-3
2. Terrestrial taxa excluded from richness, abundance and other indices
3. Excluded from richness total only

9. APPENDIX C – Macroinvertebrate Habitat Assessments

Dry Season 2021

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Creek REMP	**Collected by:**	KG
Project Number:	2021.08003		
Site Number:	ACUSR01		

Date:	14/09/2021
Time:	13:45

Rain in past week:	no	**Weather comments:**	NA
Current Weather:	fine		

SITE HABITAT ASSESSMENT

Habitat Variable	Score	Rating
Bottom substrate / available cover (0-20)	10	Fair
Embeddedness (0-20)	6	Fair
Velocity / depth category (0-20)	5	Poor
Channel alteration (0-15)	14	Excellent
Bottom scouring and deposition (0-15)	10	Good
Pool / Riffle, Run / Bend ratio (0-15)	3	Poor
Bank stability (0-10)	4	Fair
Bank vegetative stability (0-10)	7	Good
Streamside cover (0-10)	8	Good
Total Score: (max 135)	67	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	0
Mean depth (m):	0.2
Mean channel width (m):	1.2
Flow Level	Nil
Percentage bars above normal water level	0%

Reach Orientation:	NW
Variety of habitiats:	macrophytes,pool, shallow
Percentage of each habitat in 100m reach	
Riffle	0%
Run	0%
Pool (rocky)	0%
Pool (sandy)	40%
Dry	50%
Edge	5%
Macrophyte	0%
Other………..	0%

RIPARIAN ZONE

Canopy Cover %	75%
Width: Left Bank (m)	5
Width: Right Bank (m)	5
Native %	90%
Exotic %	10%
Bare %	70%
Grass %	10%
Herbs %	5%
Shrubs %	5%
Trees <10m %	5%
Trees >10m %	5%
Evidence of poor tree condition	no
Details….	NA
Disturbance in riparian zone	Grazing

LAND USE and IMPACTS

Human impact:	Low (1-10%)
Pastoral animal impact:	Some (11-50%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	Grazing
Adjacent landuse:	Grazing
Local catchment erosion:	Low (1-10%)

WATER and SEDIMENT

Water colour:	Murky	Sediment deposits:	None
Water surface condition:	Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Low	Algae on substrate:	Some (11-50%)
Algae in water column:	Low (1-10%)		

Macroinvertebrate Sample 1:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	Multiple kick or edge (sum 10m)	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	0%	Periphyton	None
Boulder (>256mm):	5%	Moss	None
Cobble (64-256mm):	10%	Filamentous algae	Low (1-10%)
Pebble (16-64mm):	10%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	30%	Detritus (leaves/twigs)	Some (11-50%)
Sand (1-4mm):	40%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	5%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	Low (1-10%)
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (sandy/silty)
Method:	Multiple kick or edge (sum 10m)	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	0%	Periphyton	None
Boulder (>256mm):	0%	Moss	None
Cobble (64-256mm):	5%	Filamentous algae	Low (1-10%)
Pebble (16-64mm):	15%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	35%	Detritus (leaves/twigs)	Some (11-50%)
Sand (1-4mm):	40%	Sticks (<2cm diam)	None
Silt/clay (<1mm):	5%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	Low (1-10%)
		Trailing bank vegetation	None

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	Low (1-10%)	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

Wet Season 2022

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Ck REMP	**Collected by:**	JC DY	**Date:**	1/03/2022	**Rain in past week:**	no	**Weather comments:**	NA
Project Number:	2021.08003			**Time:**	07:00	**Current Weather:**	fine		
Site Number:	ACUSR01								

SITE HABITAT ASSESSMENT

Habitat Variable	**Score**	**Rating**
Bottom substrate / available cover (0-20)	8	Fair
Embeddedness (0-20)	5	Poor
Velocity / depth category (0-20)	16	Excellent
Channel alteration (0-15)	3	Poor
Bottom scouring and deposition (0-15)	6	Fair
Pool / Riffle, Run / Bend ratio (0-15)	7	Fair
Bank stability (0-10)	3	Fair
Bank vegetative stability (0-10)	8	Good
Streamside cover (0-10)	7	Good
Total Score: (max 135)	63	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	2
Mean depth (m):	0.4
Mean channel width (m):	7
Flow Level	Low,Moderate
Percentage bars above normal water level	90%

Reach Orientation:	NW
Variety of habitiats:	macrophytes,pool,riffle,run, shallow,snags/woody debris,undercut bank
Percentage of each habitat in 100m reach	
Riffle	5%
Run	10%
Pool (rocky)	0%
Pool (sandy)	3%
Dry	75%
Edge	5%
Macrophyte	0%
Other..........	0%

RIPARIAN ZONE

Canopy Cover %	30%
Width: Left Bank (m)	3
Width: Right Bank (m)	7
Native %	80%
Exotic %	20%
Bare %	10%
Grass %	55%
Herbs %	5%
Shrubs %	15%
Trees <10m %	5%
Trees >10m %	10%
Evidence of poor tree condition	no
Details....	NA
Disturbance in riparian zone	cattle

LAND USE and IMPACTS

Human impact:	Some (11-50%)
Pastoral animal impact:	Some (11-50%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	dam, grazing
Adjacent landuse:	grazing, WRD
Local catchment erosion:	Some (11-50%)

WATER and SEDIMENT

Water colour:	Clear	Sediment deposits:	Sand
Water surface condition:	Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Minimal	Algae on substrate:	Low (1-10%)
Algae in water column:	None		

Macroinvertebrate Sample 1:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (sandy/silty),Riffle,Run
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	5%	Periphyton	Some (11-50%)
Boulder (>256mm):	0%	Moss	None
Cobble (64-256mm):	5%	Filamentous algae	Low (1-10%)
Pebble (16-64mm):	5%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	5%	Detritus (leaves/twigs)	Some (11-50%)
Sand (1-4mm):	75%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	5%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	Multiple kick or edge (sum 10m)	Comments:	Very sandy sample
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	20%	Periphyton	Some (11-50%)
Boulder (>256mm):	0%	Moss	None
Cobble (64-256mm):	0%	Filamentous algae	Low (1-10%)
Pebble (16-64mm):	10%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	0%	Detritus (leaves/twigs)	Some (11-50%)
Sand (1-4mm):	60%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	10%	Branches (<15cm diam)	Low (1-10%)
Total	100%	Logs (>15cm diam)	Moderate (51-75%)
		Bank overhang vegetation	None
		Trailing bank vegetation	Low (1-10%)

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	None	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Ck REMP	**Collected by:**	JC DY	**Date:**	1/03/2022	**Rain in past week:**	no
Project Number:	2021.08003			**Time:**	14:26	**Current Weather:**	fine
Site Number:	ACDSI01					**Weather comments:**	NA

SITE HABITAT ASSESSMENT

Habitat Variable	Score	Rating
Bottom substrate / available cover (0-20)	3	Poor
Embeddedness (0-20)	3	Poor
Velocity / depth category (0-20)	5	Poor
Channel alteration (0-15)	4	Fair
Bottom scouring and deposition (0-15)	4	Fair
Pool / Riffle, Run / Bend ratio (0-15)	3	Poor
Bank stability (0-10)	2	Poor
Bank vegetative stability (0-10)	8	Good
Streamside cover (0-10)	7	Good
Total Score: (max 135)	39	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	1
Mean depth (m):	0.3
Mean channel width (m):	7
Flow Level	Low
Percentage bars above normal water level	70%

Reach Orientation:	W
Variety of habitiats:	macrophytes,pool,run ,snags/woody debris,undercut bank
Percentage of each habitat in 100m reach	
Riffle	0%
Run	20%
Pool (rocky)	0%
Pool (sandy)	2%
Dry	70%
Edge	8%
Macrophyte	0%
Other………..	0%

RIPARIAN ZONE

Canopy Cover %	15%
Width: Left Bank (m)	7
Width: Right Bank (m)	5
Native %	70%
Exotic %	30%
Bare %	20%
Grass %	30%
Herbs %	20%
Shrubs %	5%
Trees <10m %	10%
Trees >10m %	5%
Evidence of poor tree condition	no
Details….	NA
Disturbance in riparian zone	nil

LAND USE and IMPACTS

Human impact:	Low (1-10%)
Pastoral animal impact:	Low (1-10%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	mining, grazing
Adjacent landuse:	mining, grazing
Local catchment erosion:	Low (1-10%)

WATER and SEDIMENT

Water colour:	Clear	Sediment deposits:	Sand
Water surface condition:	Foaming, Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Minimal	Algae on substrate:	Moderate (51-75%)
Algae in water column:	Moderate (51-75%)		

Macroinvertebrate Sample 1:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (sandy/silty),Run
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	0%	Periphyton	Moderate (51-75%)
Boulder (>256mm):	0%	Moss	None
Cobble (64-256mm):	0%	Filamentous algae	Moderate (51-75%)
Pebble (16-64mm):	0%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	10%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	90%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	0%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	0%	Periphyton	Moderate (51-75%)
Boulder (>256mm):	0%	Moss	None
Cobble (64-256mm):	0%	Filamentous algae	Moderate (51-75%)
Pebble (16-64mm):	0%	Macrophytes	Some (11-50%)
Gravel (4-16mm):	5%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	80%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	15%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	Some (11-50%)
		Trailing bank vegetation	Some (11-50%)

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	None	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Ck REMP	**Collected by:**	JC DY	**Date:**	1/03/2022	**Rain in past week:**	no
Project Number:	2021.08003			**Time:**	10:19	**Current Weather:**	fine
Site Number:	ACDSI04					**Weather comments:**	NA

SITE HABITAT ASSESSMENT

Habitat Variable	Score	Rating
Bottom substrate / available cover (0-20)	5	Poor
Embeddedness (0-20)	7	Fair
Velocity / depth category (0-20)	15	Good
Channel alteration (0-15)	4	Fair
Bottom scouring and deposition (0-15)	3	Poor
Pool / Riffle, Run / Bend ratio (0-15)	7	Fair
Bank stability (0-10)	5	Fair
Bank vegetative stability (0-10)	8	Good
Streamside cover (0-10)	6	Good
Total Score: (max 135)	60	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	1
Mean depth (m):	0.3
Mean channel width (m):	10
Flow Level	Low,Moderate
Percentage bars above normal water level	80%

Reach Orientation:	WNW
Variety of habitiats:	woody debris,undercut
Percentage of each habitat in 100m reach	
Riffle	1%
Run	5%
Pool (rocky)	0%
Pool (sandy)	3%
Dry	90%
Edge	0%
Macrophyte	0%
Other…….....	0%

RIPARIAN ZONE

Canopy Cover %	5%
Width: Left Bank (m)	7
Width: Right Bank (m)	5
Native %	90%
Exotic %	10%
Bare %	5%
Grass %	45%
Herbs %	10%
Shrubs %	20%
Trees <10m %	15%
Trees >10m %	5%
Evidence of poor tree condition	no
Details….	NA
Disturbance in riparian zone	nil

LAND USE and IMPACTS

Human impact:	Low (1-10%)
Pastoral animal impact:	Low (1-10%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	mining, grazing
Adjacent landuse:	mining, grazing
Local catchment erosion:	Low (1-10%)

WATER and SEDIMENT

Water colour:	Clear	Sediment deposits:	Sand
Water surface condition:	Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Minimal	Algae on substrate:	Low (1-10%)
Algae in water column:	Some (11-50%)		

Macroinvertebrate Sample 1:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (rocky/gravely),Pool
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	0%	Periphyton	Some (11-50%)
Boulder (>256mm):	5%	Moss	None
Cobble (64-256mm):	0%	Filamentous algae	Moderate (51-75%)
Pebble (16-64mm):	50%	Macrophytes	Some (11-50%)
Gravel (4-16mm):	20%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	30%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	0%	Branches (<15cm diam)	None
Total	105%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	0%	Periphyton	Some (11-50%)
Boulder (>256mm):	0%	Moss	None
Cobble (64-256mm):	0%	Filamentous algae	Moderate (51-75%)
Pebble (16-64mm):	10%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	20%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	50%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	20%	Branches (<15cm diam)	Low (1-10%)
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	Some (11-50%)
		Trailing bank vegetation	Some (11-50%)

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	None	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Ck REMP	**Collected by:**	JC DY	**Date:**	1/03/2022	**Rain in past week:**	no
Project Number:	2021.08003			**Time:**	12:19	**Current Weather:**	fine
Site Number:	ACDSI05					**Weather comments:**	NA

SITE HABITAT ASSESSMENT

Habitat Variable	**Score**	**Rating**
Bottom substrate / available cover (0-20)	6	Fair
Embeddedness (0-20)	7	Fair
Velocity / depth category (0-20)	9	Fair
Channel alteration (0-15)	6	Fair
Bottom scouring and deposition (0-15)	6	Fair
Pool / Riffle, Run / Bend ratio (0-15)	7	Fair
Bank stability (0-10)	5	Fair
Bank vegetative stability (0-10)	7	Good
Streamside cover (0-10)	7	Good
Total Score: (max 135)	60	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	1
Mean depth (m):	0.7
Mean channel width (m):	10
Flow Level	Low
Percentage bars above normal water level	70%

Reach Orientation:	NNW
Variety of habitiats:	riffle,run,shallow,snags/ woody debris
Percentage of each habitat in 100m reach	
Riffle	10%
Run	10%
Pool (rocky)	0%
Pool (sandy)	5%
Dry	60%
Edge	15%
Macrophyte	0%
Other..........	0%

RIPARIAN ZONE

Canopy Cover %	10%
Width: Left Bank (m)	3
Width: Right Bank (m)	4
Native %	80%
Exotic %	20%
Bare %	15%
Grass %	63%
Herbs %	2%
Shrubs %	10%
Trees <10m %	8%
Trees >10m %	2%
Evidence of poor tree condition	no
Details....	NA
Disturbance in riparian zone	nil

LAND USE and IMPACTS

Human impact:	Low (1-10%)
Pastoral animal impact:	Low (1-10%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	Track/crossing, mining, grazing
Adjacent landuse:	mining, grazing
Local catchment erosion:	Some (11-50%)

WATER and SEDIMENT

Water colour:	Clear	Sediment deposits:	Sand
Water surface condition:	Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Minimal	Algae on substrate:	Low (1-10%)
Algae in water column:	Some (11-50%)		

Macroinvertebrate Sample 1:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (sandy/silty),Run
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	20%	Periphyton	Moderate (51-75%)
Boulder (>256mm):	5%	Moss	None
Cobble (64-256mm):	10%	Filamentous algae	Some (11-50%)
Pebble (16-64mm):	10%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	20%	Detritus (leaves/twigs)	Some (11-50%)
Sand (1-4mm):	35%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	0%	Branches (<15cm diam)	Low (1-10%)
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	Multiple kick or edge (sum 10m)	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	20%	Periphyton	Moderate (51-75%)
Boulder (>256mm):	5%	Moss	None
Cobble (64-256mm):	5%	Filamentous algae	Some (11-50%)
Pebble (16-64mm):	10%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	10%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	40%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	10%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	Low (1-10%)	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Ck REMP	**Collected by:**	JC	**Date:**	1/03/2022	**Rain in past week:**	no
Project Number:	2021.08003			**Time:**	09:24	**Current Weather:**	fine
Site Number:	ACDSI06					**Weather comments:**	NA

SITE HABITAT ASSESSMENT

Habitat Variable	Score	Rating
Bottom substrate / available cover (0-20)	6	Fair
Embeddedness (0-20)	6	Fair
Velocity / depth category (0-20)	16	Excellent
Channel alteration (0-15)	3	Poor
Bottom scouring and deposition (0-15)	3	Poor
Pool / Riffle, Run / Bend ratio (0-15)	9	Good
Bank stability (0-10)	3	Fair
Bank vegetative stability (0-10)	9	Excellent
Streamside cover (0-10)	5	Fair
Total Score: (max 135)	60	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	2
Mean depth (m):	0.3
Mean channel width (m):	10
Flow Level	Moderate
Percentage bars above normal water level	90%

Reach Orientation:	SSW
Variety of habitiats:	macrophytes,pool,riffle,run,snags/woody debris
Percentage of each habitat in 100m reach	
Riffle	2%
Run	4%
Pool (rocky)	0%
Pool (sandy)	2%
Dry	90%
Edge	0%
Macrophyte	0%
Other..........	0%

RIPARIAN ZONE

Canopy Cover %	30%
Width: Left Bank (m)	3
Width: Right Bank (m)	5
Native %	80%
Exotic %	20%
Bare %	5%
Grass %	60%
Herbs %	5%
Shrubs %	10%
Trees <10m %	20%
Trees >10m %	0%
Evidence of poor tree condition	no
Details....	NA
Disturbance in riparian zone	nil

LAND USE and IMPACTS

Human impact:	Low (1-10%)
Pastoral animal impact:	Low (1-10%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	mining, grazing
Adjacent landuse:	track, mining, grazing
Local catchment erosion:	Low (1-10%)

WATER and SEDIMENT

Water colour:	Clear	Sediment deposits:	Sand
Water surface condition:	Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Minimal	Algae on substrate:	Moderate (51-75%)
Algae in water column:	Moderate (51-75%)		

Macroinvertebrate Sample 1:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (rocky/gravely),Pool (sandy/silty),Riffle,Run
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	10%	Periphyton	Some (11-50%)
Boulder (>256mm):	20%	Moss	None
Cobble (64-256mm):	2%	Filamentous algae	Some (11-50%)
Pebble (16-64mm):	0%	Macrophytes	Some (11-50%)
Gravel (4-16mm):	3%	Detritus (leaves/twigs)	Some (11-50%)
Sand (1-4mm):	65%	Sticks (<2cm diam)	Some (11-50%)
Silt/clay (<1mm):	0%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	Multiple kick or edge (sum 10m)	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	20%	Periphyton	Some (11-50%)
Boulder (>256mm):	15%	Moss	None
Cobble (64-256mm):	5%	Filamentous algae	Some (11-50%)
Pebble (16-64mm):	5%	Macrophytes	Moderate (51-75%)
Gravel (4-16mm):	20%	Detritus (leaves/twigs)	Moderate (51-75%)
Sand (1-4mm):	25%	Sticks (<2cm diam)	Some (11-50%)
Silt/clay (<1mm):	10%	Branches (<15cm diam)	None
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	Low (1-10%)

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	None	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

MACROINVERTEBRATE HABITAT ASSESSMENT

Project Name:	Agate Ck REMP	**Collected by:**	JC DY
Project Number:	2021.08003		
Site Number:	ACDSI07		

Date:	1/03/2022
Time:	13:28

Rain in past week:	no	**Weather comments:**	NA
Current Weather:	fine		

SITE HABITAT ASSESSMENT

Habitat Variable	Score	Rating
Bottom substrate / available cover (0-20)	10	Fair
Embeddedness (0-20)	11	Good
Velocity / depth category (0-20)	15	Good
Channel alteration (0-15)	4	Fair
Bottom scouring and deposition (0-15)	5	Fair
Pool / Riffle, Run / Bend ratio (0-15)	7	Fair
Bank stability (0-10)	5	Fair
Bank vegetative stability (0-10)	5	Fair
Streamside cover (0-10)	8	Good
Total Score: (max 135)	70	**Fair**

CHANNEL, FLOW and REACH OBSERVATIONS

Velocity (m/sec) - min:	0
Velocity (m/sec) - max:	2
Mean depth (m):	0.5
Mean channel width (m):	10
Flow Level	Low,Moderate
Percentage bars above normal water level	80%

Reach Orientation:	NNE
Variety of habitiats:	macrophytes,pool,riffle, run,snags/woody debris
Percentage of each habitat in 100m reach	
Riffle	10%
Run	2%
Pool (rocky)	5%
Pool (sandy)	5%
Dry	75%
Edge	0%
Macrophyte	0%
Other..........	0%

RIPARIAN ZONE

Canopy Cover %	10%
Width: Left Bank (m)	2
Width: Right Bank (m)	5
Native %	90%
Exotic %	10%
Bare %	10%
Grass %	50%
Herbs %	5%
Shrubs %	10%
Trees <10m %	2%
Trees >10m %	23%
Evidence of poor tree condition	no
Details....	NA
Disturbance in riparian zone	nil

LAND USE and IMPACTS

Human impact:	Low (1-10%)
Pastoral animal impact:	Low (1-10%)
Non-pastoral animal impact:	Low (1-10%)
Upstream landuse:	Track/crossing, mining, grazing
Adjacent landuse:	mining, grazing
Local catchment erosion:	Some (11-50%)

WATER and SEDIMENT

Water colour:	Clear	Sediment deposits:	Sand
Water surface condition:	Normal	Sediment odour:	no
Water odour:	no	Sediment oils:	no
Plume:	Minimal	Algae on substrate:	Moderate (51-75%)
Algae in water column:	Some (11-50%)		

Macroinvertebrate Sample 1:

Sample Habitat:	Bed	Bed Habitat Type:	Pool (rocky/gravely),Riffle, Run
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	50%	Periphyton	Moderate (51-75%)
Boulder (>256mm):	15%	Moss	None
Cobble (64-256mm):	5%	Filamentous algae	Moderate (51-75%)
Pebble (16-64mm):	5%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	5%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	5%	Sticks (<2cm diam)	Low (1-10%)
Silt/clay (<1mm):	0%	Branches (<15cm diam)	Low (1-10%)
Total	85%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	None

Macroinvertebrate Sample 2:

Sample Habitat:	Edge	Bed Habitat Type:	NA
Method:	1x10m kick or edge	Comments:	NA
Substrate Description (%)		**Substrate and Habitat Attributes:**	
Bedrock:	20%	Periphyton	Moderate (51-75%)
Boulder (>256mm):	10%	Moss	None
Cobble (64-256mm):	10%	Filamentous algae	Moderate (51-75%)
Pebble (16-64mm):	5%	Macrophytes	Low (1-10%)
Gravel (4-16mm):	5%	Detritus (leaves/twigs)	Low (1-10%)
Sand (1-4mm):	50%	Sticks (<2cm diam)	Some (11-50%)
Silt/clay (<1mm):	0%	Branches (<15cm diam)	Low (1-10%)
Total	100%	Logs (>15cm diam)	None
		Bank overhang vegetation	None
		Trailing bank vegetation	Low (1-10%)

MACROPHYTES

Native		**Exotic**	
Water Primrose (*Ludwigia*)	None	Water Hyacinth	None
Sedge (*Cyperus*)	None	Salvinia	None
Common Rush (Juncus)	None	Para Grass	None
Cumbungi (*Typha*)	None	Hymenachne	None
Slender Knotweed (*Persicaria*)	None	Other Exotic sp.	None
Other Native sp.	None		

10. APPENDIX D – Statistical Analyses Results

Table 14. PERMANOVA results for macroinvertebrate indices in samples (pooled for habitat and season), comparing 'type' (Reference versus Impact). Statistically significant results (p<0.05) are denoted by boldface.

Source	df	SS	MS	Pseudo-F	P(perm)
Taxon Richness					
Type	1	6.01	6.01	0.53	0.51
Residual	12	134.85	11.24		
Total	13	140.86			
Total Abundance					
Type	**1**	**71.24**	**71.24**	**5.36**	**0.04**
Residual	12	159.52	13.29		
Total	13	230.76			
PET Richness					
Type	1	0.58	0.58	0.38	0.68
Residual	12	18.35	1.53		
Total	13	18.93			
SIGNAL Scores					
Type	1	0.15	0.15	2.28	0.15
Residual	12	0.81	0.07		
Total	13	0.96			
% Tolerant Taxa					
Type	1	43.46	43.46	0.43	0.53
Residual	12	1208.90	100.74		
Total	13	1252.36			
Community Composition					
Type	1	1792	1792	1.56	0.12
Residual	12	13769	1147		
Total	13	15561			

11. APPENDIX E – QA/QC

RPD was calculated using the methods described in Section 2.7.1. Summary tables for water and sediment quality analysis RPD are presented in Tables 15 to 18, below.

Table 15. RPD report for water quality analyses for September 2021.

Analyte	Units	LOR	Original Results (ACUSR01)	Duplicate	RPD %	Acceptable RPD %
pH Value	pH Unit	0.01	7.91	7.96	0.6	<50%
Electrical Conductivity @ 25°C	µS/cm	1	172	173	0.6	<50%
Total Dissolved Solids @180°C	mg/L	10	127	129	1.6	<20%
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	<1	<1	NA	NA
Carbonate Alkalinity as $CaCO_3$	mg/L	1	<1	<1	NA	NA
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	77	71	8.1	<50%
Total Alkalinity as $CaCO_3$	mg/L	1	77	71	8.1	<50%
Sulfate as SO_4	mg/L	1	2	2	0	no limit
Chloride	mg/L	1	9	9	0	no limit
Calcium	mg/L	1	10	10	0	<20%
Magnesium	mg/L	1	5	5	0	no limit
Sodium	mg/L	1	20	19	5.1	<20%
Potassium	mg/L	1	3	3	0	no limit
Total Hardness as $CaCO_3$	mg/L	1	46	46	0	<50%
Fluoride	mg/L	0.1	1.7	1.8	5.7	<20%
Total Anions	meq/L	0.01	1.83	1.71	6.8	<50%
Total Cations	meq/L	0.01	1.86	1.81	2.7	<50%
Aluminium (dissolved)	mg/L	0.01	0.01	0.01	0	no limit
Aluminium (total)	mg/L	0.01	0.19	0.16	17.1	<20%
Arsenic (dissolved)	mg/L	0.001	0.002	0.002	0	no limit
Arsenic (total)	mg/L	0.001	0.002	0.002	0	no limit
Boron (dissolved)	mg/L	0.05	<0.05	<0.05	NA	NA
Boron (total)	mg/L	0.05	<0.05	<0.05	NA	NA
Cadmium (dissolved)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Cadmium (total)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Chromium (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Chromium (total)	mg/L	0.001	<0.001	<0.001	NA	NA
Cobalt (dissolved)	mg/L	0.001	0.001	0.001	0	no limit
Cobalt (total)	mg/L	0.001	0.002	0.002	0	no limit
Copper (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Copper (total)	mg/L	0.001	<0.001	<0.001	NA	NA
Iron (dissolved)	mg/L	0.05	0.52	0.5	3.9	<20%
Iron (total)	mg/L	0.05	1.14	1.15	0.9	<50%
Lead (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Lead (total)	mg/L	0.001	<0.001	<0.001	NA	NA
Manganese (dissolved)	mg/L	0.001	0.364	0.356	2.2	<50%

Analyte	Units	LOR	Original Results (ACUSR01)	Duplicate	RPD %	Acceptable RPD %
Manganese (total)	mg/L	0.001	0.432	0.429	0.7	<50%
Mercury (dissolved)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Mercury (total)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Molybdenum (dissolved)	mg/L	0.001	0.002	0.003	40	no limit
Molybdenum (total)	mg/L	0.001	0.003	0.003	0	no limit
Nickel (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Nickel (total)	mg/L	0.001	<0.001	<0.001	NA	NA
Selenium (dissolved)	mg/L	0.01	<0.01	<0.01	NA	NA
Selenium (total)	mg/L	0.01	<0.01	<0.01	NA	NA
Zinc (dissolved)	mg/L	0.005	<0.005	<0.005	NA	NA
Zinc (total)	mg/L	0.005	<0.005	<0.005	NA	NA

Table 16. RPD report for water quality analyses for March 2022.

Analyte	Units	LOR	Original Results (ACUSR01)	Duplicate	RPD %	Acceptable RPD %
pH Value	pH Unit	0.01	7.78	7.72	0.8	<50%
Electrical Conductivity @ 25°C	µS/cm	1	120	119	0.8	<50%
Total Dissolved Solids @180°C	mg/L	10	84	88	4.7	no limit
Hydroxide Alkalinity as $CaCO_3$	mg/L	1	<1	<1	NA	NA
Carbonate Alkalinity as $CaCO_3$	mg/L	1	<1	<1	NA	NA
Bicarbonate Alkalinity as $CaCO_3$	mg/L	1	49	49	0.0	<50%
Total Alkalinity as $CaCO_3$	mg/L	1	49	49	0.0	<50%
Sulfate as SO_4	mg/L	1	<1	<1	NA	NA
Chloride	mg/L	1	4	4	0.0	no limit
Calcium	mg/L	1	8	7	13.3	no limit
Magnesium	mg/L	1	2	2	0.0	no limit
Sodium	mg/L	1	12	12	0.0	<20%
Potassium	mg/L	1	3	4	28.6	no limit
Total Hardness as $CaCO_3$	mg/L	1	28	26	7.4	<50%
Fluoride	mg/L	0.1	1	1	0.0	<20%
Total Anions	meq/L	0.01	1.09	1.09	0.0	<50%
Total Cations	meq/L	0.01	1.16	1.14	1.7	<50%
Aluminium (dissolved)	mg/L	0.01	0.03	0.03	0.0	no limit
Aluminium (total)	mg/L	0.01	9.82	7.97	20.8	no limit
Arsenic (dissolved)	mg/L	0.001	0.002	0.002	0.0	no limit
Arsenic (total)	mg/L	0.001	0.006	0.006	0.0	no limit
Boron (dissolved)	mg/L	0.05	<0.05	<0.05	NA	NA
Boron (total)	mg/L	0.05	<0.05	<0.05	NA	NA
Cadmium (dissolved)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Cadmium (total)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Chromium (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Chromium (total)	mg/L	0.001	0.002	<0.001	NA	NA
Cobalt (dissolved)	mg/L	0.001	<0.001	<0.001	NA	no limit
Cobalt (total)	mg/L	0.001	0.002	0.002	0.0	no limit
Copper (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Copper (total)	mg/L	0.001	0.001	0.002	NA	NA
Iron (dissolved)	mg/L	0.05	0.06	0.05	18.2	no limit
Iron (total)	mg/L	0.05	2.5	2.34	6.6	<50%
Lead (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Lead (total)	mg/L	0.001	0.003	0.003	NA	NA
Manganese (dissolved)	mg/L	0.001	0.016	0.077	131.2	<50%
Manganese (total)	mg/L	0.001	0.38	0.396	4.1	<50%
Mercury (dissolved)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Mercury (total)	mg/L	0.0001	<0.0001	<0.0001	NA	NA
Molybdenum (dissolved)	mg/L	0.001	0.002	0.002	0.0	no limit
Molybdenum (total)	mg/L	0.001	0.002	0.002	0.0	no limit
Nickel (dissolved)	mg/L	0.001	<0.001	<0.001	NA	NA
Nickel (total)	mg/L	0.001	0.002	0.002	NA	NA

Analyte	Units	LOR	Original Results (ACUSR01)	Duplicate	RPD %	Acceptable RPD %
Selenium (dissolved)	mg/L	0.01	<0.01	<0.01	NA	NA
Selenium (total)	mg/L	0.01	<0.01	<0.01	NA	NA
Zinc (dissolved)	mg/L	0.005	<0.005	<0.005	NA	NA
Zinc (total)	mg/L	0.005	0.012	0.01	NA	no limit

Table 17. RPD report for sediment quality analyses for September 2021.

Analyte	Units	LOR	Original Results (ACDSI07)	Duplicate	RPD %	Acceptable RPD %
Moisture Content	%	1.0	<1.0	<1.0	NA	NA
Antimony	mg/kg	5	<5	<5	NA	NA
Arsenic	mg/kg	5	<5	<5	NA	NA
Cadmium	mg/kg	1	<1	<1	NA	NA
Chromium	mg/kg	2	**7**	**7**	0	no limit
Copper	mg/kg	5	<5	**6**	NA	NA
Lead	mg/kg	5	**6**	<5	NA	NA
Mercury	mg/kg	0.1	<0.1	<0.1	NA	NA
Nickel	mg/kg	2	8	**7**	13	no limit
Zinc	mg/kg	5	14	**30**	73	no limit

Table 18. RPD report for sediment quality analyses for March 2022.

Analyte	Units	LOR	Original Results (ACUSR01)	Duplicate	RPD %	Acceptable RPD %
Moisture Content	%	1.0	12.5	25.6	**68.8**	<20%
Antimony	mg/kg	5	<5	<5	NA	NA
Arsenic	mg/kg	5	<5	<5	NA	NA
Cadmium	mg/kg	1	<1	<1	NA	NA
Chromium	mg/kg	2	7	8	13.3	no limit
Copper	mg/kg	5	<5	<5	NA	NA
Lead	mg/kg	5	<5	<5	NA	NA
Mercury	mg/kg	0.1	6	8	28.6	no limit
Nickel	mg/kg	2	12	13	8	no limit
Zinc	mg/kg	5	<0.1	<0.1	NA	NA

Note: orange shading denotes an unacceptable RPD%

12. APPENDIX F – Laboratory Reports

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2126573**	Page	: 1 of 7
Client	: **WULGURU TECHNICAL SERVICES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: SCOTT HAYES-STANLEY	Contact	: Customer Services EB
Address	: 17 MUELLER ST WULGURU QLD WULGURU 4811	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Agate Creek REMP	Date Samples Received	: 17-Sep-2021 08:40
Order number	: ----	Date Analysis Commenced	: 21-Sep-2021
C-O-C number	: ----	Issue Date	: 29-Sep-2021 15:39
Sampler	: JESSICA CRABB, KEELY GLASS		
Site	: ----		
Quote number	: TV/135/21 v2		
No. of samples received	: 19		
No. of samples analysed	: 18		

ilac-MRA NATA

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the method.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ACUSR01	ACUSR02	ACUSR03	ACUSR04	ACUSR06
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EB2126573-001	EB2126573-002	EB2126573-003	EB2126573-004	EB2126573-006
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**7.0**	<1.0	**1.9**	**1.5**	<1.0
EA150: Particle Sizing								
+75µm	----	1	%	**98**	**82**	**69**	**76**	**84**
+150µm	----	1	%	**98**	**81**	**69**	**71**	**81**
+300µm	----	1	%	**96**	**76**	**68**	**60**	**71**
+425µm	----	1	%	**91**	**72**	**68**	**54**	**64**
+600µm	----	1	%	**81**	**65**	**67**	**47**	**54**
+1180µm	----	1	%	**58**	**48**	**65**	**34**	**33**
+2.36mm	----	1	%	**33**	**35**	**60**	**23**	**17**
+4.75mm	----	1	%	**15**	**24**	**49**	**13**	**5**
+9.5mm	----	1	%	**9**	**12**	**15**	**3**	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	**2**	**18**	**31**	**24**	**16**
Sand (>75 µm)	----	1	%	**57**	**43**	**8**	**49**	**62**
Gravel (>2mm)	----	1	%	**41**	**39**	**61**	**27**	**22**
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**9**	**9**	**30**	**10**	**8**
Copper	7440-50-8	5	mg/kg	<5	**20**	**118**	**8**	**8**
Lead	7439-92-1	5	mg/kg	**5**	**30**	**5**	**12**	**7**
Nickel	7440-02-0	2	mg/kg	**8**	**13**	**73**	**10**	**9**
Zinc	7440-66-6	5	mg/kg	**14**	**44**	**58**	**43**	**41**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ACDSI01	ACDSI02	ACDSI03	ACDSI04	ACDSI05
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00
Compound	CAS Number	LOR	Unit	EB2126573-007	EB2126573-008	EB2126573-009	EB2126573-010	EB2126573-011
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	**1.0**
EA150: Particle Sizing								
+75µm	----	1	%	**97**	**97**	**87**	**98**	**97**
+150µm	----	1	%	**94**	**95**	**85**	**98**	**95**
+300µm	----	1	%	**83**	**86**	**81**	**96**	**82**
+425µm	----	1	%	**73**	**76**	**76**	**93**	**67**
+600µm	----	1	%	**56**	**65**	**72**	**87**	**54**
+1180µm	----	1	%	**19**	**46**	**62**	**65**	**39**
+2.36mm	----	1	%	**7**	**29**	**49**	**40**	**31**
+4.75mm	----	1	%	**2**	**13**	**32**	**16**	**25**
+9.5mm	----	1	%	<1	<1	**16**	**7**	**15**
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	**3**	**3**	**13**	**2**	**3**
Sand (>75 µm)	----	1	%	**87**	**63**	**34**	**50**	**63**
Gravel (>2mm)	----	1	%	**10**	**34**	**53**	**48**	**34**
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	**12**	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**8**	**8**	**12**	**8**	**7**
Copper	7440-50-8	5	mg/kg	<5	<5	**17**	<5	<5
Lead	7439-92-1	5	mg/kg	<5	<5	**7**	<5	<5
Nickel	7440-02-0	2	mg/kg	**6**	**6**	**8**	**6**	**6**
Zinc	7440-66-6	5	mg/kg	**16**	**16**	**16**	**16**	**15**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	ACDSI06	ACDSI07	DUP1	ACDI08	----
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	----
Compound	CAS Number	LOR	Unit	EB2126573-012	EB2126573-013	EB2126573-014	EB2126573-018	--------
				Result	Result	Result	Result	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	----
EA150: Particle Sizing								
+75µm	----	1	%	**99**	**97**	**96**	**96**	----
+150µm	----	1	%	**98**	**96**	**96**	**95**	----
+300µm	----	1	%	**96**	**92**	**94**	**86**	----
+425µm	----	1	%	**90**	**86**	**91**	**75**	----
+600µm	----	1	%	**77**	**78**	**84**	**62**	----
+1180µm	----	1	%	**45**	**60**	**62**	**36**	----
+2.36mm	----	1	%	**21**	**44**	**42**	**22**	----
+4.75mm	----	1	%	**9**	**28**	**23**	**12**	----
+9.5mm	----	1	%	**3**	**20**	<1	**2**	----
+19.0mm	----	1	%	<1	<1	<1	<1	----
+37.5mm	----	1	%	<1	<1	<1	<1	----
+75.0mm	----	1	%	<1	<1	<1	<1	----
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	**1**	**3**	**4**	**4**	----
Sand (>75 µm)	----	1	%	**71**	**49**	**48**	**70**	----
Gravel (>2mm)	----	1	%	**28**	**48**	**48**	**26**	----
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	----
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	----
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	----
Chromium	7440-47-3	2	mg/kg	**11**	**7**	**7**	**9**	----
Copper	7440-50-8	5	mg/kg	<5	<5	**6**	**6**	----
Lead	7439-92-1	5	mg/kg	**5**	**6**	<5	**6**	----
Nickel	7440-02-0	2	mg/kg	**9**	**8**	**7**	**8**	----
Zinc	7440-66-6	5	mg/kg	**21**	**14**	**30**	**27**	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	LB	FB	DUP1	ACUSR01	----
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	----
Compound	*CAS Number*	*LOR*	*Unit*	EB2126573-015	EB2126573-016	EB2126573-017	EB2126573-019	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	5.75	6.57	7.91	7.96	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	<1	<1	172	173	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	<10	<10	127	129	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	<1	<1	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	5	4	77	71	----
Total Alkalinity as CaCO3	----	1	mg/L	5	4	77	71	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	<1	2	2	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	<1	<1	9	9	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	<1	<1	10	10	----
Magnesium	7439-95-4	1	mg/L	<1	<1	5	5	----
Sodium	7440-23-5	1	mg/L	<1	<1	20	19	----
Potassium	7440-09-7	1	mg/L	<1	<1	3	3	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	<1	<1	46	46	----
EG020F: Dissolved Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	0.01	0.01	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.002	0.002	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.001	0.001	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.364	0.356	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	0.002	0.003	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Sample ID	LB	FB	DUP1	ACUSR01	----
			Sampling date / time	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	14-Sep-2021 00:00	----
Compound	CAS Number	LOR	Unit	EB2126573-015	EB2126573-016	EB2126573-017	EB2126573-019	--------
				Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued								
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	**0.52**	**0.50**	----
EG020T: Total Metals by ICP-MS								
Aluminium	7429-90-5	0.01	mg/L	<0.01	<0.01	**0.19**	**0.16**	----
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	**0.002**	**0.002**	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	**0.002**	**0.002**	----
Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	<0.005	<0.005	----
Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	**0.432**	**0.429**	----
Molybdenum	7439-98-7	0.001	mg/L	<0.001	<0.001	**0.003**	**0.003**	----
Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	<0.05	<0.05	----
Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	**1.14**	**1.15**	----
EG035F: Dissolved Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator								
Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	**1.7**	**1.8**	----
EN055: Ionic Balance								
ø Total Anions	----	0.01	meq/L	**0.10**	**0.08**	**1.83**	**1.71**	----
ø Total Cations	----	0.01	meq/L	<0.01	<0.01	**1.86**	**1.81**	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2205889**	Page	: 1 of 5
Client	: **WULGURU TECHNICAL SERVICES PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: JESSICA CRABB	Contact	: Customer Services EB
Address	: 17 MUELLER ST WULGURU QLD WULGURU 4811	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Agate Creek REMP	Date Samples Received	: 04-Mar-2022 08:10
Order number	: ----	Date Analysis Commenced	: 15-Mar-2022
C-O-C number	: ----	Issue Date	: 22-Mar-2022 18:06
Sampler	: JESSICA CRABB		
Site	: ----		
Quote number	: TV/135/21 v2		
No. of samples received	: 15		
No. of samples analysed	: 15		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD
Mark Hallas	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

Analytical Results

Sub-Matrix: **SEDIMENT** (Matrix: **SOIL**)			Sample ID	ACDSI03	ACUSR04	ACDSI04	DUP	ACUSR03
			Sampling date / time	01-Mar-2022 08:50	01-Mar-2022 15:30	01-Mar-2022 10:15	01-Mar-2022 06:45	01-Mar-2022 07:00
Compound	CAS Number	LOR	Unit	EB2205889-001	EB2205889-002	EB2205889-003	EB2205889-004	EB2205889-005
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	4.6	<1.0	25.0	25.6	1.0
EA150: Particle Sizing								
+75µm	----	1	%	89	93	99	98	88
+150µm	----	1	%	87	92	98	98	86
+300µm	----	1	%	81	85	96	95	83
+425µm	----	1	%	75	78	87	85	82
+600µm	----	1	%	67	69	73	61	80
+1180µm	----	1	%	50	50	51	21	74
+2.36mm	----	1	%	35	29	36	2	58
+4.75mm	----	1	%	22	14	20	<1	34
+9.5mm	----	1	%	14	6	9	<1	10
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	11	7	1	2	12
Sand (>75 µm)	----	1	%	50	58	59	90	25
Gravel (>2mm)	----	1	%	39	35	40	8	63
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	12	<5	<5	<5	8
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	14	6	6	8	22
Copper	7440-50-8	5	mg/kg	18	5	<5	<5	35
Lead	7439-92-1	5	mg/kg	8	6	<5	<5	<5
Nickel	7440-02-0	2	mg/kg	10	6	5	8	31
Zinc	7440-66-6	5	mg/kg	26	24	14	13	28
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: **SEDIMENT**
(Matrix: **SOIL**)

			Sample ID	ACUSR05	ACUSR02	ACDSI08	ACUSR06	ACDSI06
			Sampling date / time	01-Mar-2022 09:00	01-Mar-2022 08:00	01-Mar-2022 17:20	01-Mar-2022 17:15	01-Mar-2022 09:20
Compound	*CAS Number*	*LOR*	*Unit*	EB2205889-006	EB2205889-007	EB2205889-008	EB2205889-009	EB2205889-010
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	**1.5**	**1.1**	<1.0	**21.7**
EA150: Particle Sizing								
+75µm	----	1	%	**96**	**76**	**97**	**98**	**99**
+150µm	----	1	%	**95**	**69**	**96**	**97**	**98**
+300µm	----	1	%	**85**	**56**	**88**	**97**	**97**
+425µm	----	1	%	**74**	**50**	**78**	**95**	**91**
+600µm	----	1	%	**60**	**45**	**67**	**91**	**77**
+1180µm	----	1	%	**40**	**37**	**45**	**75**	**38**
+2.36mm	----	1	%	**22**	**31**	**26**	**49**	**12**
+4.75mm	----	1	%	**8**	**23**	**9**	**21**	**4**
+9.5mm	----	1	%	<1	**16**	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	**4**	**24**	**3**	**2**	**1**
Sand (>75 µm)	----	1	%	**69**	**43**	**65**	**41**	**79**
Gravel (>2mm)	----	1	%	**27**	**33**	**32**	**57**	**20**
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**6**	**9**	**9**	**7**	**5**
Copper	7440-50-8	5	mg/kg	**5**	**23**	**6**	**5**	<5
Lead	7439-92-1	5	mg/kg	**6**	**14**	**7**	<5	<5
Nickel	7440-02-0	2	mg/kg	**6**	**9**	**8**	**6**	**6**
Zinc	7440-66-6	5	mg/kg	**27**	**25**	**28**	**26**	**12**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Analytical Results

Sub-Matrix: SEDIMENT (Matrix: SOIL)			Sample ID	ACDSI05	ACDSI01	ACUSR01	ACDSI02	ACDSI07
			Sampling date / time	01-Mar-2022 12:15	01-Mar-2022 14:25	01-Mar-2022 06:45	01-Mar-2022 08:00	01-Mar-2022 13:30
Compound	CAS Number	LOR	Unit	EB2205889-011	EB2205889-012	EB2205889-013	EB2205889-014	EB2205889-015
				Result	Result	Result	Result	Result
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	24.2	28.8	12.5	2.4	27.2
EA150: Particle Sizing								
+75µm	----	1	%	98	98	98	98	99
+150µm	----	1	%	98	98	98	98	99
+300µm	----	1	%	94	89	97	91	98
+425µm	----	1	%	89	75	92	81	96
+600µm	----	1	%	76	61	75	69	88
+1180µm	----	1	%	40	37	34	50	50
+2.36mm	----	1	%	25	22	2	30	26
+4.75mm	----	1	%	17	11	<1	11	8
+9.5mm	----	1	%	<1	<1	<1	<1	<1
+19.0mm	----	1	%	<1	<1	<1	<1	<1
+37.5mm	----	1	%	<1	<1	<1	<1	<1
+75.0mm	----	1	%	<1	<1	<1	<1	<1
EA150: Soil Classification based on Particle Size								
Fines (<75 µm)	----	1	%	2	2	2	2	<1
Sand (>75 µm)	----	1	%	69	72	86	62	65
Gravel (>2mm)	----	1	%	29	26	12	36	34
Cobbles (>6cm)	----	1	%	<1	<1	<1	<1	<1
EG005(ED093)T: Total Metals by ICP-AES								
Antimony	7440-36-0	5	mg/kg	<5	<5	<5	<5	<5
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	13	8	7	9	8
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	6
Nickel	7440-02-0	2	mg/kg	8	7	6	7	6
Zinc	7440-66-6	5	mg/kg	14	18	12	18	13
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1

Appendix M – Progressive Rehabilitation and Closure Plan

PROGRESSIVE REHABILITATION AND CLOSURE PLAN

AGATE CREEK GOLD MINE

LANEWAY RESOURCES LTD

ENVIRONMENTAL AUTHORITY: EPSL03068015
MINING LEASE: ML100030

SEPTEMBER 2022

PREPARED FOR: DEPARTMENT OF ENVIROMENT AND SCIENCE
PREPARED BY: WULGURU TECHNICAL SERVICES
DOCUMENT ID: 2021.0001
VERSION:2.0
DATE OF SUBMISSION: 13/10/2022
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Disclaimer

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Document Control and History

Version	Date	Description	Prepared By	Reviewed By
0.1	18/08/2022	Draft – Client Review	Jessica Crabb/Madison Jackson	Matthew Ayre
1.0	23/08/2022	Final	Madison Jackson	Matthew Ayre
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Citation

Wulguru Technical Services, 2022, Progressive Rehabilitation and Closure Plan, Prepared by Wulguru Technical Services Pty Ltd for Laneway Resources Pty Ltd.

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1. Introduction

Agate Creek Gold Mine (Agate Creek) is owned by Laneway Resources Limited (Laneway). Agate Creek operates under Environmental Authority (EA) EPSL03068015. Laneway is currently seeking to gain approval from the Department of Environment and Science (DES) for an expansion of Agate Creek for the mining of 250,000 tonnes per annum (tpa) of gold ore. The expansion will result in Agate Creek being regulated under a site-specific EA.

Wulguru Technical Services Pty Ltd (WTS) has been engaged by Laneway to prepare a Progressive Rehabilitation and Closure Plan (PRCP) for the expanded 250,000 tpa mine expansion. This PRCP provides for rehabilitation and land management for Mining Lease (ML) ML100030.

This document summarises the technical components and supporting information relating to rehabilitation and closure of the Project and has considered the following Department of Environment and Science (DES) guidelines:

- Guideline ESR/2019/4964 – *Progressive rehabilitation and closure plans (PRC plans)*, Version 2.00 – 17 March 2021.

The PRCP outlines the Project planning and post-closure requirements, community consultation, post-mining land use, rehabilitation methods, risk assessment, monitoring and maintenance, and rehabilitation schedule.

2. Purpose of Plan

The purpose of this document is to assess the existing environmental values and provide for rehabilitation and closure planning based on current disturbances. This PRCP will:

- Outline how Laneway will meet landholder expectations for final land use;
- Outline how Laneway will achieve a decommissioned site that is safe, fit for purpose, and non-polluting;
- Outline how Laneway eliminates residual impact or liability for community and future land holders following rehabilitation;
- Outline how Laneway restores agreed areas of the mine footprint to either grazing or native habitat; and
- Outline how Laneway returns the landform to an agreed or pre-mine condition.

3. Rehabilitation Planning

3.1 Project Description

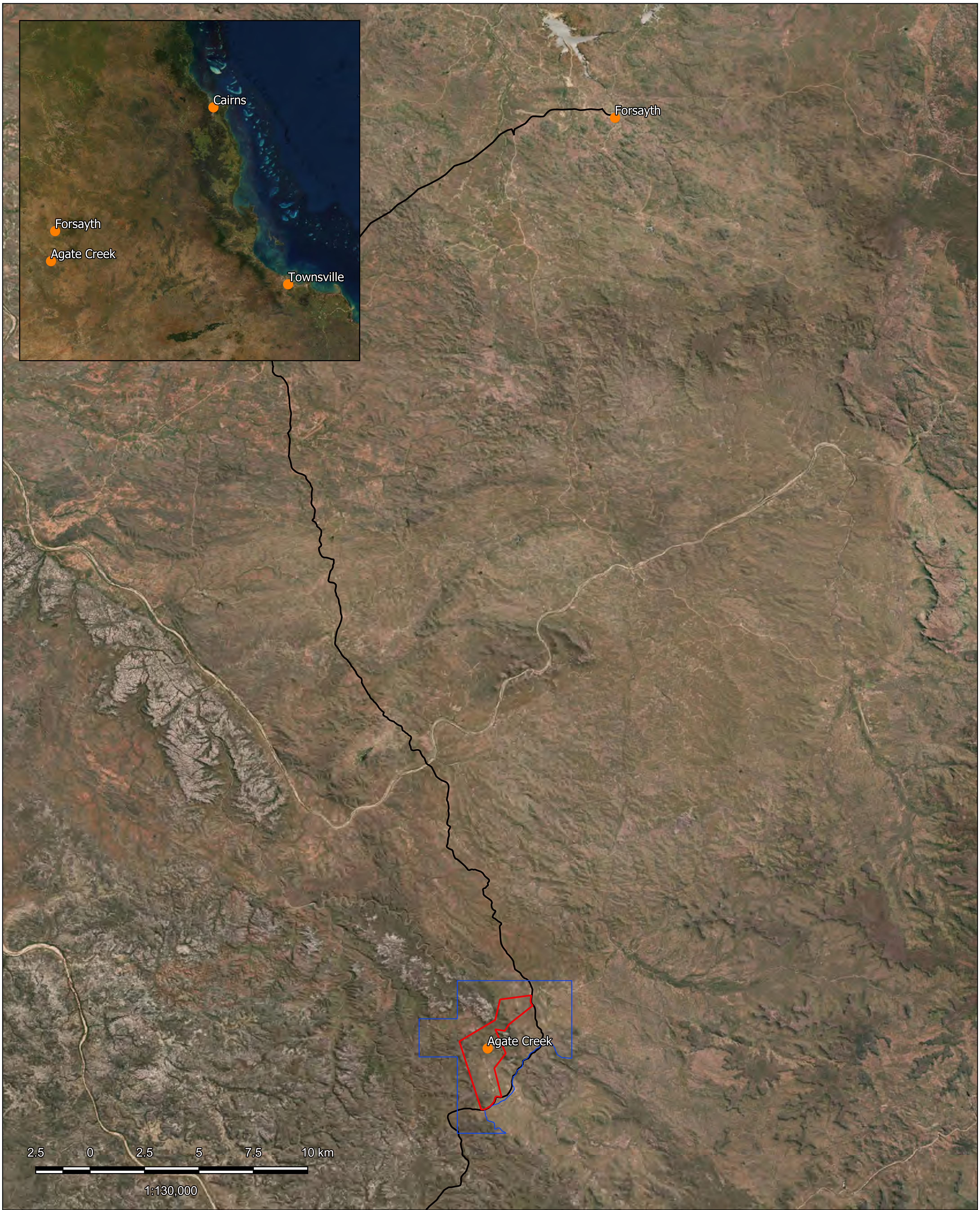
Agate Creek is in northwest Queensland, approximately 40 km southwest of Forsayth within the Etheridge Shire Council.

Agate Creek commenced production in 2019 with the establishment of the Sherwood open cut pit within the Sherwood Resource area. Ore mined is transported to the Run of Mine (ROM) pad prior to being exported offsite for processing. Associated mining domains includes the Sherwood open cut waste rock dump, and other Mine Infrastructure Areas (MIA) including haul roads/access tracks, camp, administration facilities and core shed.

To ensure the longevity of Agate Creek project, an expansion of mining is proposed. The expansion will consist of:

- Six open cut pits;
- Four Non-Acid Forming (NAF) Waste Rock Dumps (WRDs);
- Topsoil stockpile areas;
- 0.4 Ha expanded Run of Mine;
- Water storage dam; and
- Sediment ponds.

Ore is to be transported off site to the Kempton Minerals Pty Ltd (a subsidiary of Laneway) Georgetown gold processing plant. Planned activities for the Progressive Rehabilitation and Closure Plan (PRCP) term will involve the mining of 250,000 t of gold ore annually.



Client: Laneway Resources Ltd
Project number: 2021.09001
CRS: GDA2020 EPSG: 7844
Date: 11 July 2022

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Figure 1. Agate Creek Gold Project Locality

Legend

- Key Features
- Access Road
- Mineral Development Licence
- Mining Lease

ESRI Satellite

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3.2 Mining Tenements

Agate Creek is located off Rungulla Road, 40km south-west of Forsayth and is bound by the LWR owned Mine Development License (MDL402). Land covered under MDL402 is used for cattle pasture. Directly west of ML 100030 is the Rungulla Resource Reserve The property details are provided in Table 1.

Table 1 Property Description

Company Name - ABN	Laneway Resources Pty Ltd – 75 003 049 714
Lot on Plan	Lot 2 on SP242983 and Lot 7 on SP275179
Mining Lease	ML100030
Property Size	689.3 ha
Local Government Area	Etheridge Shire Council
Zoning Information	Rural

3.3 Primary Mine Features and Infrastructure

Then primary mine features are defined in Table 2.

Table 2. Domains of the Project.

Domain	Subdomain	Subdomain Area
Exploration	Exploration tracks	1.44 ha
	Rehabilitated Exploration tracks	1.90 ha
Infrastructure	Haul Road	4.79 ha
	Landowner tracks	7.28 ha
	Other tracks	0.19 ha
	Accommodation Village	0.51 ha
	Administration Buildings	
	Core Shed	
	Workshop and Maintenance Area	
	Run of Mine Pad	0.98 ha
	Northwest Waste Rock Dump	5.61 ha
	North Waste Rock Dump	5.88 ha
	Southwest Waste Rock Dump	3.04 ha
	South Waste Rock Dump	11.35 ha
Water Storage and Management	Water Storage Dam	4.50 ha

Domain	Subdomain	Subdomain Area
	Sediment Pond A	0.21 ha
	Sediment Pond B	0.15 ha
	Sediment Pond C	0.34 ha
	Sediment Pond D	0.43 ha
	Sediment Pond E	0.28 ha
	Sediment Pond F	0.34 ha
	ROM Pad Pond	0.24 ha
Open Cut Pits	Pit 1	1.37 ha
	Pit 2	1.03 ha
	Pit 3	0.49 ha
	Pit 4	0.94 ha
	Pit 5	0.64 ha
	Pit 6	4.46 ha

3.4 Pre-mining Land Use

Agate Creek is located on Howlong Station pastoral lease. Prior to the development of the operation, the area was used for cattle grazing.

3.5 Communities

The nearest residential area is Old Robin Hood Station occupied by Dave and Dot Terry.

Agate Creek is located within the Etheridge Goldfields which is characterised by mineral exploration, mining and pastoral activities. Forsayth is the closest township, located ~40km northeast of Agate Creek. Forsayth has a small population of 129 people with the primary industries being cattle grazing. The nearest regional centre is Georgetown located 80km north of Agate Creek. Georgetown has a population of 348 and is the largest township within the Etheridge Shire.

Agate Creek ML area does not contain areas of regional interest (priority living areas, priority agricultural areas, strategic cropping land and strategic environmental areas) protected under the Regional Planning Interests Act 2014 (QLD, 2021).

3.6 Type of Operations

Agate Creek is an open cut gold operation in the Sherwood and Sherwood West Resource areas. Agate Creek uses conventional haul truck and shovel operations supported by traditional drill and blast activities. Ore mined is graded and stored as low or high grade on the ROM prior to being transported to Georgetown for processing.

Exploration drilling also occurs within the mining leases and on the mineral development lease. There is no other mining activity conducted on the mineral development lease.

3.7 Duration Of Operation

Agate Creek has a current Life of Mine (LOM) estimated to be 3 years (i.e., 2025). It is anticipated that exploration will increase this LOM.

Progressive rehabilitation is expected to be opportunistic, where mining domains or areas of disturbance from construction activities become obsolete or are no longer required for mining.

Where opportunistic progressive rehabilitation occurs, it is expected that at least one wet season will be needed to establish vegetation. As such each rehabilitation campaign is to be completed, at the latest, by October of each year to allow for vegetation establishment prior to the wet season and to minimise erosion potential.

3.8 Native Title

The Ewamian People are the traditional owners of land occupied by the Site, whose country occupies the Gulf of Carpentaria savannah lands in the upper Gilbert and Einasleigh River catchments (Ewamian Aboriginal Corporation, 2021).

All Native Title matters for the Ewamian People are now managed by Ewamian Limited. Laneway has successfully negotiated and registered a Cultural Heritage Management Agreement (CHMA) and an Indigenous Land Use Agreement (ILUA) which covers the existing Agate Creek Project area along with any other areas held by Laneway and designated as being traditional landholdings of the Ewamian People. Laneway maintains a good working relationship with Traditional owners which includes employment opportunities where possible (Laneway Resources Limited, 2021).

Previously, artefacts have been identified within the ML. These artefacts are outside of the proposed disturbance areas. LWR will continue to ensure the artefacts remain safe from mining activities.

4. Existing Environmental Context

4.1 Climate

4.1.1 Rainfall and temperature

Agate Creek is located in the dry tropics region and experiences hotter and wetter periods during the summer months (wet season) and drier, cooler periods during the winter months (dry season). The nearest Bureau of Meteorology (BOM) weather station with long-term climate statistics is the Georgetown Post Office station (ID – 030018).

The mean maximum temperatures are 33.4 °C–34.4 °C from January to March and 28.2 °C–30.0 °C from June to August. Mean minimum temperatures are 21.5 °C–22.9 °C from January to March and 12.0 °C–13.1 °C from June to August. Mean annual rainfall recorded at Georgetown Post Office is 820 mm with mean rainfall peaking in January at 224.9 mm (Figure 2).

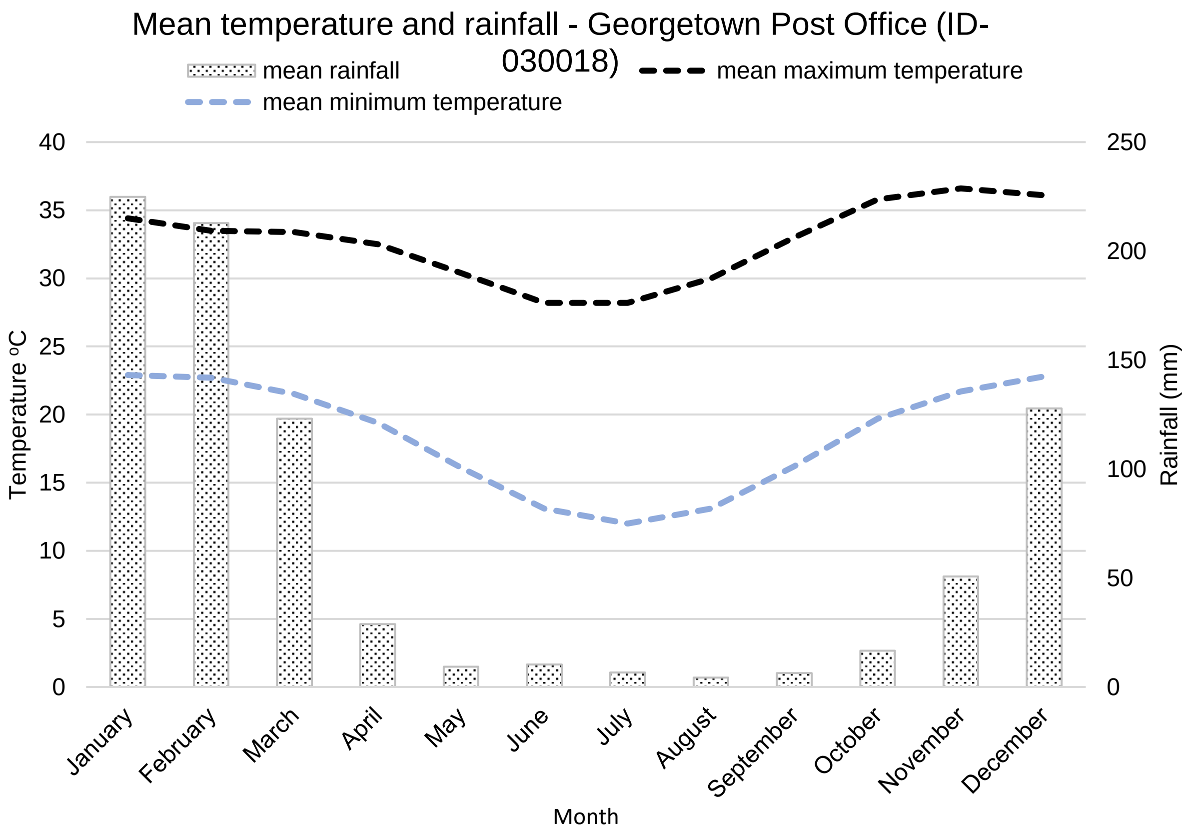


Figure 2. Mean Temperature and Rainfall at Georgetown Post Office (BOM station ID 030018)

The predominant wind direction during the year is to the east (SEG, 2022).

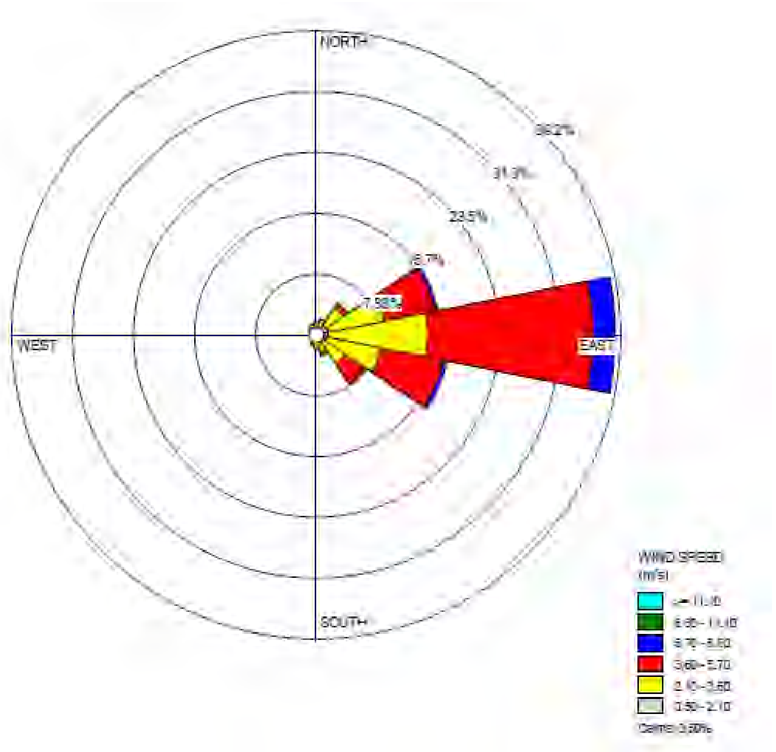


Figure 3. Wind Rose for Agate Creek - All Hours (SEG, 2022).

4.1.2 Long-term Climate Projections

The 2020 State of the Climate Report (Commonwealth Scientific and Industrial Research Organisation and Bureau of Meteorology, 2020) has predicted that air temperature will continue to rise with increased occurrence of extreme heat days. Dry season rainfall is predicted to reduce however with an increased likelihood of more intense events across the year. Collectively, these two factors will continue to increase bushfire risk indicated by the change in dangerous fire weather days as illustrated in Figure 4.

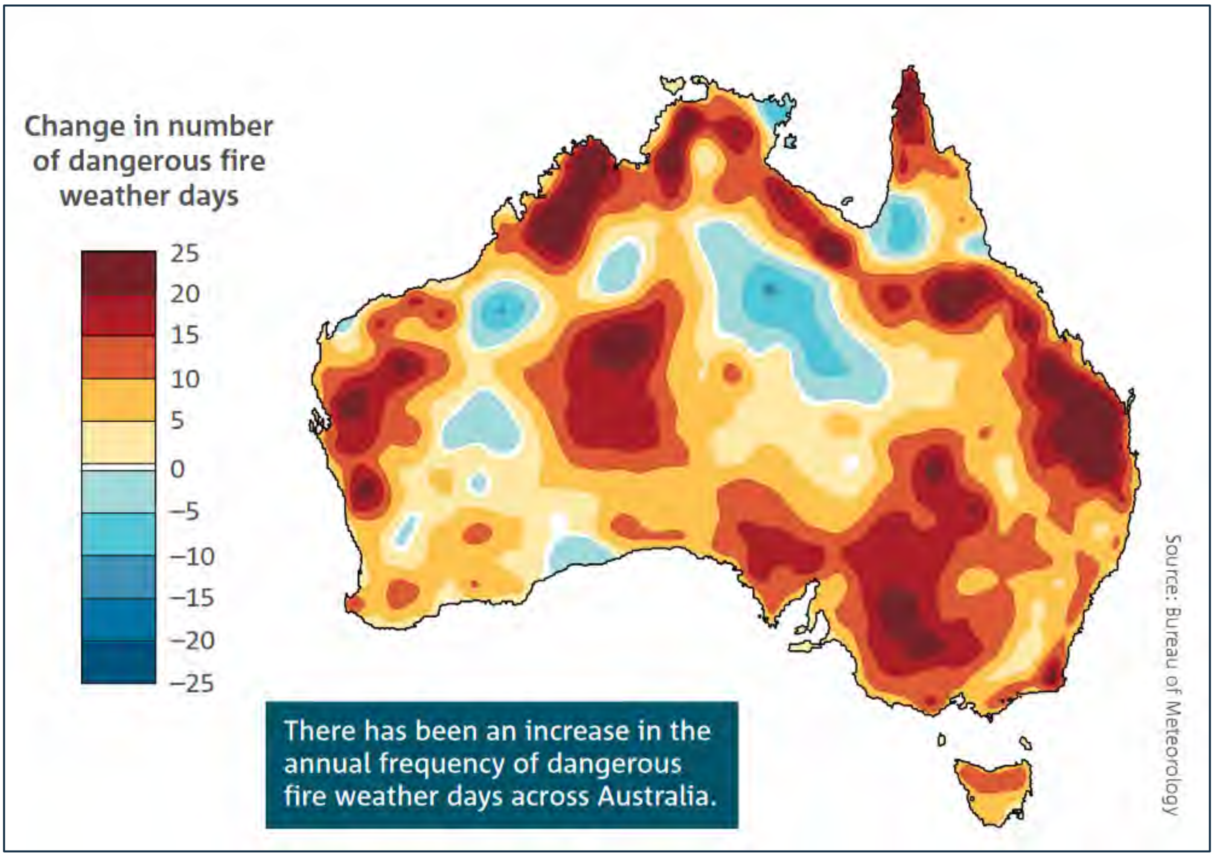


Figure 4. Excerpt from the 2020 State of the Climate Report Illustrating Change in Dangerous Fire Weather Days (CSIRO & BOM 2020).

4.2 Topography

The topography of Agate Creek includes steep sandstone scarps and formations to the west and steeply undulating hills to gently undulating terrain on the ML. The Project is between 420 m and 550 m Australian Height Datum (AHD) (Queensland Government, 2021).

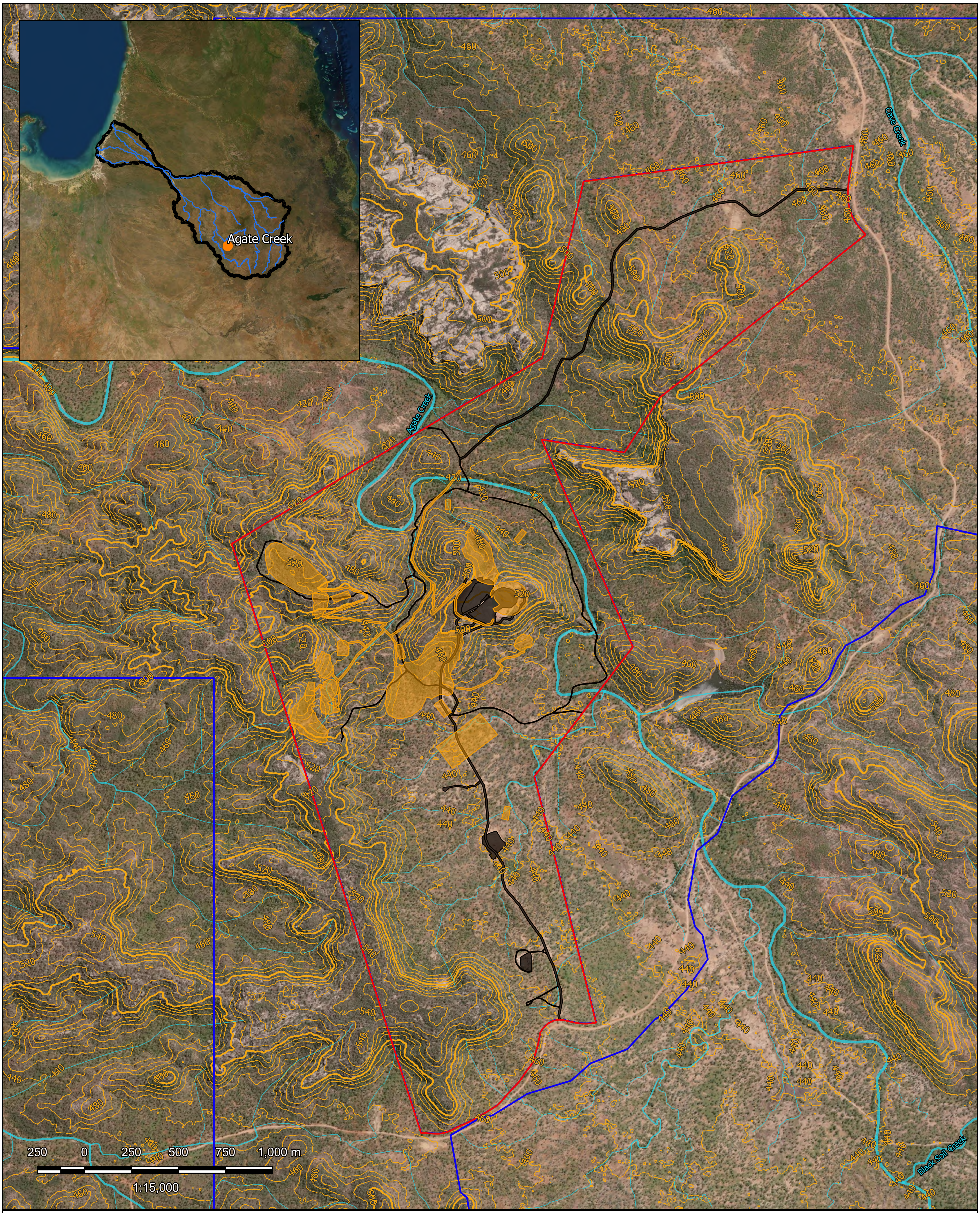
4.3 Hydrology

Agate Creek is situated in the Gilbert River Basin (917) and the Gilbert River Sub-basin (9170). The basin generally flows from the south-east to the north-west ending at the Gulf of Carpentaria.

Locally, there are ephemeral watercourses/shallow drainage depressions (unnamed 1st and 2nd order creeks) that flow across the Mine. Most surface water eventually flows into Agate Creek, a 4th order stream that flows approximately south-east to north-west though the central part of the Site (Figure 5). Agate Creek connects to the Robertson River and Gilbert River to the north-west of the Agate Creek locale. A summary of watercourses within Agate Creek and direct surrounds is detailed in Table 3.

Table 3. Watercourses within the ML.

ID	Watercourse	Perennially	Hierarchy	Stream order	Comment
1	Unnamed	Ephemeral	Minor	1	Joins 2nd order stream off the ML eventually discharging into Agate Creek.
2	Unnamed	Ephemeral	Minor	1	Joins 2nd order stream off the ML eventually discharging into Agate Creek.
3	Unnamed	Ephemeral	Minor	1	Joins 2nd order stream on the ML eventually discharging into Agate Creek.
4	Unnamed	Ephemeral	Minor	1	Joins 2nd order stream off the ML eventually discharging into Agate Creek.
5	Agate Creek	Ephemeral	Minor	4	Snakes through the central section of the ML flowing south-east to north-west.
6	Unnamed	Ephemeral	Minor	1	Runs off the hill in the centre of the ML into the northern section discharging into Cave Creek off the ML.
7	Unnamed	Ephemeral	Minor	1	Runs off the hill in the centre of the ML into the northern section discharging into Cave Creek off the ML.
8	Unnamed	Ephemeral	Minor	1	Runs off the hill in the centre of the ML into the northern section discharging into Cave Creek off the ML.



Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 1 June 2022

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Figure 5. Topography and Hydrology

Legend

- Mineral Development Licence
- Mining Lease
- Existing Mine Features
- Proposed Mine Features
- Gilbert Basin
- Major Rivers
- 10m Contour

Watercourse - Stream Order

- 0
- 1
- 2
- 3
- 4

ESRI Satellite

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4.3.1 Surface Water Environmental Values

The Environmental Protection Policy (Water and Wetland Biodiversity) (EPP Water) details the water quality basins and their specific management intent. The Agate Creek is situated in the Gilbert Drainage Basin (Basin no. 917), which is not included in the EPP Water. Environmental values and water quality objectives have not been formally documented for the Gilbert River Basin, therefore ANZECC Guidelines are applicable. Based on the location and surrounding land use, the environmental values associated with the Gilbert River Basin are:

- **Aquatic ecosystems:** The intrinsic value of aquatic ecosystems, habitat and wildlife in waterways and riparian areas, for example, biodiversity, ecological interactions, plants, animals, key species (such as turtles, platypus, seagrass and dugongs) and their habitat, food and drinking water. Waterways include perennial and intermittent surface waters, groundwaters, tidal and non-tidal waters, lakes, storages, reservoirs, dams, wetlands, swamps, marshes lagoons, canals, natural and artificial channels and the bed and banks of waterways.
- **Farm water supply/use** : Suitability of domestic farm water supply, other than drinking water. For example, water used for laundry and produce preparation.
- **Stock watering**: Suitability of water supply for production of healthy livestock.
- **Primary recreation:** Health of humans during recreation which involves direct contact and a high probability of water being swallowed, for example, swimming, surfing, windsurfing, diving and water-skiing. Primary recreational use, of water, means full body contact with the water, including, for example, diving, swimming, surfing, waterskiing and windsurfing.
- **Secondary recreation**: Health of humans during recreation which involves indirect contact and a low probability of water being swallowed, for example, wading, boating, rowing and fishing. Secondary recreational use, of water, means contact other than full body contact with the water, including, for example, boating and fishing.
- **Visual recreation**: Amenity of waterways for recreation which does not involve any contact with water—for example, walking and picnicking adjacent to a waterway. Visual recreational use, of a water, means viewing the water without contact with it.
- **Drinking water supply:** Suitability of raw drinking water supply. This assumes minimal treatment of water is required, for example, coarse screening and/or disinfection
- **Industrial use**: Suitability of water supply for industrial use, for example, food, beverage, paper, petroleum and power industries, mining and minerals refining/processing. Industries usually treat water supplies to meet their needs.
- **Cultural and spiritual values:** Indigenous and non-indigenous cultural heritage, for example:
    - custodial, spiritual, cultural and traditional heritage, hunting, gathering and ritual responsibilities

- symbols, landmarks and icons (such as waterways, turtles and frogs)
- lifestyles (such as agriculture and fishing).

4.3.2 Surface Water Trigger Limits

The EA does not stipulate specific Water Quality Objectives (WQO) or contaminant trigger values for the Agate Creek, therefore given the environmental values for the location, the WQO adopted are ANZECC Guidelines (2000) for Livestock Drinking Water Quality. The proposed water quality and contaminant limits for the project site are outlined in Table 4.

Table 4. Receiving Environment Trigger and Contaminant Limits

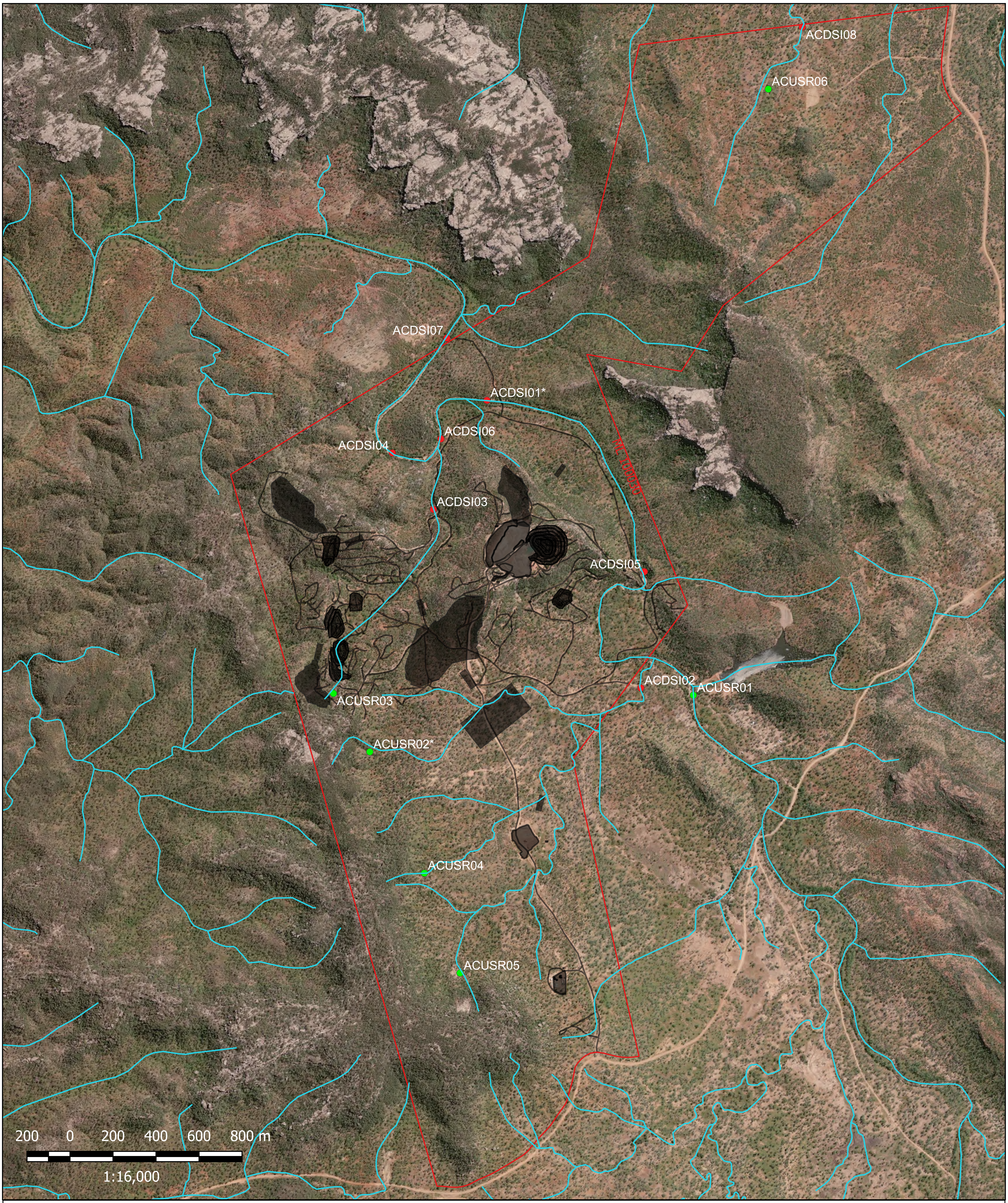
Analyte	Unit	WQO	WQO (Dissolved)
pH (field)	pH Unit	6.0-7.5	-
Total Dissolved Solids @180°C	mg/L	4000	-
Dissolved Oxygen saturation	%	90-120	-
Calcium	mg/L	1000	-
Sulfate	mg/L	1000	-
Aluminium	mg/L	5	5
Arsenic	mg/L	0.5	0.5
Boron	mg/L	5	5
Cadmium	mg/L	0.01	0.01
Chromium	mg/L	1	1
Cobalt	mg/L	1	1
Copper	mg/L	1	1
Lead	mg/L	0.1	0.1
Mercury	mg/L	0.002	0.002
Molybdenum	mg/L	0.15	0.15
Nickel	mg/L	1	1
Selenium	mg/L	0.02	0.02
Zinc	mg/L	20	20

4.3.3 Receiving Environment Monitoring Program

Laneway implements a receiving environment monitoring program (REMP), that encompasses event-based surface water sampling, stream sediment sampling and macroinvertebrate sampling. REMP data collected is characteristic of the ephemeral nature of streams in north Queensland, with limited habitat opportunities for most aquatic organisms. Waterholes dry out too quickly to allow the establishment of sustained aquatic plant, macroinvertebrate communities. Ephemeral waterholes are also too small and transient to have recreational value or provide watering points for terrestrial fauna.

4.3.4 Surface Water Quality

A summary of surface water chemistry is provided in Table 5.



Client: Laneway Reources
Project number: LWR
Coordinate Reference System: GDA 2020 Z54
Date: 2022-08-15

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Figure 6. Surface Water Sampling Locations

Legend

Mine Lease

Mine Features

Surface Water Monitoring

Impact

Reference

Stream Order

1

2

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Table 5. Surface Water Summary

Parameters							Dissolved Major Cations				Total Metals															
Site ID		pH	EC (µS/cm)	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Pb (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	Zn (mg/L)	B (mg/L)	Fe (mg/L)	Total Mercury (mg/L)	Fluoride (mg/L)
SWA01	Number of records	9																								
	Maximum	8.04	334	217	2	21	30	9	30	5	2.21	0.004	0.000	0.001	0.001	0.001	0.001	0.413	0.002	0.002	0.005	0.01	0.025	1.3	0.000	1.8
	Minimum	7.13	115	75	0.5	4	8	2	10	3	0.03	0.001	0.000	0.001	0.001	0.001	0.001	0.022	0.001	0.001	0.005	0.0025	0.025	0.18	0.000	0.4
	Mean	7.639	187	121.571	1.222	7.667	15.444	4.889	16.111	3.333	0.391	0.002	0.000	0.001	0.001	0.001	0.001	0.146	0.002	0.001	0.005	0.005	0.025	0.573	0.000	1.171
	Median	7.63	203	132	1	6	14	5	13	3	0.22	0.002	0.000	0.001	0.001	0.001	0.001	0.106	0.002	0.001	0.005	0.0025	0.025	0.38	0.000	1
SWA02	Number of records	6																								
	Maximum	8.37	304	198	3	8	37	12	15	4	0.62	0.002	0.000	0.001	0.001	0.001	0.001	0.196	0.002	0.001	0.005	0.008	0.025	0.66	0.000	0.9
	Minimum	7.34	159	103	0.5	5	15	4	11	3	0.01	0.001	0.000	0.001	0.001	0.001	0.001	0.017	0.0005	0.001	0.005	0.003	0.025	0.05	0.000	0.4
	Mean	7.782	225.333	146.333	1.417	6	24.667	7.667	12.667	3.833	0.192	0.001	0.000	0.001	0.001	0.001	0.001	0.066	0.001	0.001	0.005	0.004	0.025	0.232	0.000	0.683
	Median	7.77	225.5	146.5	0.75	5.5	23	7	12	4	0.075	0.001	0.000	0.001	0.001	0.001	0.001	0.052	0.001	0.001	0.005	0.003	0.025	0.09	0.000	0.75
SWA04	Number of records	2																								
	Maximum	6.87	83	54	3	8	3	5	7	2	1.4	0.002	0.000	0.001	0.001	0.004	0.001	0.053	0.001	0.002	0.005	0.003	0.025	1.39	0.000	0.3
	Minimum	6.71	53	34	2	4	2	2	5	2	0.11	0.001	0.000	0.001	0.001	0.002	0.001	0.01	0.001	0.001	0.005	0.003	0.025	0.28	0.000	0.3
	Mean	6.79	68	44	2.5	6	2.5	3.5	6	2	0.755	0.001	0.000	0.001	0.001	0.003	0.001	0.032	0.001	0.001	0.005	0.003	0.025	0.835	0.000	0.3
	Median	6.79	68	44	2.5	6	2.5	3.5	6	2	0.755	0.001	0.000	0.001	0.001	0.003	0.001	0.032	0.001	0.001	0.005	0.003	0.025	0.835	0.000	0.3
SWA05	Number of records	4																								
	Maximum	9.39	210	136	1	7	22	7	14	4	2.1	0.001	0.000	0.001	0.001	0.001	0.002	0.016	0.001	0.002	0.005	0.006	0.025	1.37	0.000	0.7
	Minimum	7.48	130	84	0.5	4	12	4	9	4	0.07	0.001	0.000	0.001	0.001	0.001	0.001	0.006	0.001	0.0005	0.005	0.003	0.025	0.08	0.000	0.4
	Mean	8.345	175.75	114	0.75	5.5	17.5	5.5	12	4	0.608	0.001	0.000	0.001	0.001	0.001	0.001	0.009	0.001	0.001	0.005	0.003	0.025	0.517	0.000	0.55
	Median	8.255	181.5	118	0.75	5.5	18	5.5	12.5	4	0.13	0.001	0.000	0.001	0.001	0.0005	0.0005	0.007	0.001	0.0005	0.005	0.003	0.025	0.1	0.000	0.55
SWA06	Number of records	2																								
	Maximum	6.98	147	96	8	9	7	10	8	3	0.45	0.001	0.000	0.001	0.001	0.003	0.001	0.054	0.001	0.001	0.005	0.003	0.025	0.37	0.000	0.7
	Minimum	6.76	115	75	7	4	5	6	6	3	0.03	0.001	0.000	0.001	0.001	0.001	0.001	0.014	0.001	0.001	0.005	0.003	0.025	0.07	0.000	0.6
	Mean	6.87	131	85.5	7.5	6.5	6	8	7	3	0.24	0.001	0.000	0.001	0.001	0.002	0.001	0.034	0.001	0.001	0.005	0.003	0.025	0.22	0.000	0.65
	Median	6.87	131	85.5	7.5	6.5	6	8	7	3	0.24	0.001	0.000	0.001	0.001	0.002	0.001	0.034	0.001	0.001	0.005	0.003	0.025	0.22	0.000	0.65
SWA07	Number of records	2																								

Parameters							Dissolved Major Cations				Total Metals															
Site ID		pH	EC (µS/cm)	TDS (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Calcium (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Al (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Co (mg/L)	Cu (mg/L)	Pb (mg/L)	Mn (mg/L)	Mo (mg/L)	Ni (mg/L)	Se (mg/L)	Zn (mg/L)	B (mg/L)	Fe (mg/L)	Total Mercury (mg/L)	Fluoride (mg/L)
	Maximum	6.39	119	77	2	23	2	2	16	4	4.23	0.004	0.000	0.002	0.002	0.004	0.004	0.065	0.001	0.003	0.005	0.014	0.025	3.66	0.000	0.2
	Minimum	5.57	96	62	2	20	1	2	13	3	0.45	0.001	0.000	0.001	0.001	0.001	0.001	0.016	0.001	0.001	0.005	0.003	0.025	0.4	0.000	0.2
	Mean	5.98	107.5	69.5	2	21.5	1.5	2	14.5	3.5	2.34	0.002	0.000	0.001	0.001	0.003	0.002	0.041	0.001	0.002	0.005	0.008	0.025	2.03	0.000	0.2
	Median	5.98	107.5	69.5	2	21.5	1.5	2	14.5	3.5	2.34	0.002	0.000	0.001	0.001	0.003	0.002	0.041	0.001	0.002	0.005	0.008	0.025	2.03	0.000	0.2
SWA08	Number of records	2																								
	Maximum	7.17	138	90	5	13	9	6	10	4	2.68	0.002	0.000	0.001	0.001	0.002	0.002	0.013	0.001	0.002	0.005	0.008	0.025	2.22	0.000	0.3
	Minimum	6.72	102	66	5	9	5	3	8	4	0.31	0.001	0.000	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.005	0.003	0.025	0.13	0.000	0.2
	Mean	7.17	138	90	5	13	9	6	10	4	0.31	0.001	0.000	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.005	0.003	0.025	0.13	0.000	0.2
	Median	6.945	120	78	5	11	7	4.5	9	4	1.495	0.001	0.000	0.001	0.001	0.001	0.001	0.012	0.001	0.001	0.005	0.005	0.025	1.175	0.000	0.25
SWA09	Number of records	1																								
	Maximum	7.87	238	155	2	8	24	5	21	3	0.22	0.0005	0.00005	0.0005	0.0005	0.001	0.0005	0.004	0.0005	0.0005	0.005	0.0025	0.025	0.12	0.00005	0.3
	Minimum	7.87	238	155	2	8	24	5	21	3	0.22	0.0005	0.00005	0.0005	0.0005	0.001	0.0005	0.004	0.0005	0.0005	0.005	0.0025	0.025	0.12	0.00005	0.3
	Mean	7.87	238	155	2	8	24	5	21	3	0.22	0.0005	0.00005	0.0005	0.0005	0.001	0.0005	0.004	0.0005	0.0005	0.005	0.0025	0.025	0.12	0.00005	0.3
	Median	7.87	238	155	2	8	24	5	21	3	0.22	0.0005	0.00005	0.0005	0.0005	0.001	0.0005	0.004	0.0005	0.0005	0.005	0.0025	0.025	0.12	0.00005	0.3

4.4 Groundwaters

4.4.1 Environmental Values

There are currently no Environmental Values provided in guidelines relating to the Gilbert Drainage Basin. The most relevant environmental values were derived from the EPP (Water and Wetland Biodiversity) 2019 which include:

- For waters that may be used for agricultural purposes – the suitability of the water for agricultural purposes
- For waters that may be used for recreation or aesthetic purposes – the suitability of water for -
    - Primary recreational use; or
    - Secondary recreational use; or
    - Visual recreational use
- For water that may be used for drinking water – the suitability of the water for supply as drinking water having regard to the level of treatment of the water
- For waters that may be used for industrial purposes – the suitability of the water for industrial use
- The cultural and spiritual values of the water.

4.4.2 Groundwater Monitoring Network

Groundwater bore details for the Project are in Table 6 .

Table 6. Groundwater Monitoring Network

	Easting	Northing	Ground Level	Casing Above Ground	Total Depth	Screened Interval
	MGA94 Zone 54		m AHD	m	m BGL	m BGL
CCWB517	768400	7896463	435.6	0.6	55	49 – 55
CCWB518	767768	7897706	431.4	0.6	73	67 – 73
CCWB519	767302	7897863	517.18	0.62	85	79 – 85
CCWB520	767947	7897838	434.96	0.59	73	67 – 73
CCWB521	768701	7898079	420.94	0.6	73	67 – 73
CCWB522	768762	7897724	434.2	0.6	73	67 – 73
CCWB523	768321	7897579	449.6	0.61	73	67 – 73
CCWB524	768174	7897670	496.06	0.64	91	85 – 91
CCWB525	768167	7897930	498.77	0.62	103	97 – 103
CCWB526	767710	7896909	449.4	0.66	73	67 –73
CCWB527	767660	7897458	461.50	0.55	31	25 – 31
CCWB528	767955	7898381	415.49	0.57	73	67 – 73
CCWB529	770217	7900144	463.85	0.54	31	25 – 31
CCWB530	767948	7898378	422.80	0.67	7	4 – 7
CCWB531	767997	7898782	420.39	0.66	55	49 – 55
CCWB532	770221	7900138	469.62	0.55	7	4 – 7
CCWB533	769580	7900063	473.09	0.6	25	19 – 25
CCWB534	768655	7895516	454.09	0.52	25	19 – 25
CCWB535	768681	7897248	407.91	0.6	7	4 – 7
CCWB536	768622	7897214	440.68	0.57	19	13 – 19
CCWB537	768005	7898801	420.66	0.62	19	13 – 19
CCWB538	768651	7895513	468.83	0.6	7	4 – 7

4.4.3 Groundwater Quality

Ten established groundwater bores (CCWB517 – CCWB526) were monitored over 13 monitoring events at Agate Creek. Summaries of monitoring results is provided in Table 7.

Table 7. Summary of Groundwater Monitoring

	pH Value	EC (mg/L)	Total Dissolved Solids (mg/L)	Sulfate (mg/L)	Aluminium (mg/L)	Arsenic (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Cobalt (mg/L)	Copper (mg/L)	Lead (mg/L)	Manganese (mg/L)	Molybdenum (mg/L)	Nickel (mg/L)	Selenium (mg/L)	Zinc (mg/L)	Boron (mg/L)	Iron (mg/L)	Mercury (mg/L)	Fluoride (mg/L)
CCWB517																				
Min	7.58	2110	1370	16	0.04	0.002	0.00005	0.0005	0.0005	0.0005	0.0005	0.09	0.002	0.0005	0.0025	0.0025	0.22	0.08	0.00005	4.4
Max	8.18	2710	1760	28	3.28	0.004	0.0004	0.002	0.002	0.004	0.002	0.721	0.027	0.002	0.005	0.07	0.44	3.37	0.00005	7.9
Mean	7.96	2376	1545	22	0.51	0.003	0.0001	0.0007	0.0010	0.0011	0.0006	0.447	0.0103	0.0010	0.0048	0.0182	0.32	0.58	0.00005	6.24
Med	8.01	2400	1560	23	0.11	0.002	0.00005	0.0005	0.0005	0.0005	0.0005	0.469	0.0055	0.0005	0.005	0.013	0.31	0.145	0.00005	6.7
CCWB518																				
Min	7.16	556	361	78	0.04	0.024	0.00005	0.0005	0.0005	0.0005	0.0005	0.042	0.004	0.008	0.005	0.014	0.14	0.025	0.00005	2.6
Max	7.84	827	538	147	0.48	0.047	0.0002	0.0005	0.0005	0.005	0.001	0.322	0.019	0.025	0.005	0.038	0.21	0.38	0.00005	3.3
Mean	7.56	687	447	105	0.15	0.037	0.00016	0.0005	0.0005	0.0020	0.0006	0.127	0.0093	0.0158	0.0050	0.0245	0.17	0.090	0.00005	2.91
Med	7.61	680	442	100	0.075	0.035	0.0002	0.0005	0.0005	0.002	0.0005	0.092	0.0075	0.016	0.005	0.024	0.17	0.065	0.00005	2.9
CCWB519																				
Min	6.42	130	84	10	0.82	0.002	0.00005	0.001	0.006	0.002	0.0005	0.723	0.001	0.01	0.005	0.056	0.025	1.01	0.00005	0.2
Max	6.88	154	100	13	26.3	0.006	0.0001	0.035	0.022	0.018	0.011	1.18	0.004	0.062	0.005	0.385	0.025	40.9	0.00005	0.3
Mean	6.63	143	93	11	6.52	0.003	0.00006	0.0082	0.0094	0.0059	0.0027	0.847	0.0019	0.02	0.005	0.1181	0.025	9.64	0.00005	0.27
Med	6.64	143	93	11	2.87	0.002	0.00005	0.004	0.0075	0.004	0.001	0.77	0.002	0.013	0.005	0.075	0.025	3.66	0.00005	0.3
CCWB520																				
Min	7.68	634	412	46	0.41	0.01	0.00005	0.0005	0.002	0.001	0.0005	0.134	0.016	0.001	0.005	0.032	0.14	1.13	0.00005	1.5
Max	8.16	725	471	101	68.6	0.255	0.0046	0.056	0.184	0.486	0.117	9.73	0.042	0.16	0.02	7.08	0.2	363	0.00005	2.1
Mean	7.97	682	444	78	11.78	0.045	0.00055	0.0067	0.0247	0.0601	0.0148	1.502	0.0264	0.0216	0.0064	0.9382	0.16	45.04	0.00005	1.86
Med	8.04	680	441.5	81	5.86	0.023	0.00008	0.0005	0.006	0.007	0.003	0.662	0.025	0.0055	0.005	0.426	0.16	4.88	0.00005	1.9
CCWB521																				
Min	8.26	689	448	60	0.6	0.016	0.00005	0.0005	0.0005	0.0005	0.001	0.026	0.0005	0.0005	0.005	0.0025	0.33	0.3	0.00005	11.4
Max	8.53	761	495	78	21.4	0.022	0.0005	0.019	0.017	0.043	0.07	0.955	0.003	0.024	0.005	0.167	0.39	21.4	0.00005	16.6

Mean	8.41	719	468	70	7.08	0.018	0.00014	0.0037	0.0035	0.0084	0.0145	0.245	0.0017	0.0047	0.005	0.0370	0.36	4.91	0.000 05	14. 29
Med	8.4	720	468	70	4.98	0.018	0.00005	0.002	0.002	0.004	0.006	0.118	0.002	0.002	0.005	0.016	0.36	2.165	0.000 05	14. 4
CCWB522																				
Min	6.76	313	203	24	1	0.002	0.00005	0.001	0.002	0.001	0.0005	0.59	0.002	0.003	0.005	0.011	0.13	1.6	0.000 05	3.9
Max	7.37	339	220	28	42.7	0.029	0.0004	0.05	0.04	0.035	0.035	1.92	0.015	0.101	0.005	0.326	0.19	77.6	0.000 05	4.7
Mean	7.10	324	211	26	10.45	0.008	0.00013	0.0115	0.0102	0.0081	0.0078	0.856	0.0068	0.0235	0.005	0.0754	0.16	18.36	0.000 05	4.1 9
Med	7.14	326	212	26	4.98	0.004	0.00005	0.004	0.005	0.003	0.003	0.714	0.0055	0.012	0.005	0.028	0.16	8.185	0.000 05	4.1
CCWB523																				
Min	5.45	91	59	6	0.02	0.0005	0.00005	0.0005	0.003	0.0005	0.0005	0.206	0.0005	0.003	0.005	0.05	0.025	0.23	0.000 05	0.4
Max	6.76	142	92	9	12.9	0.008	0.0004	0.018	0.025	0.02	0.05	1.05	0.003	0.035	0.005	0.329	0.025	23.5	0.000 05	1.1
Mean	6.41	113	74	7	1.87	0.002	0.0001	0.0025	0.0075	0.0025	0.0057	0.510	0.0008	0.0082	0.005	0.0974	0.025	3.206	0.000 05	0.5 4
Med	6.54	108	70	7	0.145	0.001	0.00005	0.0005	0.006	0.0005	0.0005	0.484	0.0005	0.006	0.005	0.071	0.025	0.855	0.000 05	0.5
CCWB524																				
Min	7.11	416	270	64	0.12	0.001	0.00005	0.0005	0.0005	0.0005	0.0005	0.074	0.003	0.0005	0.005	0.006	0.025	0.09	0.000 05	1.4
Max	7.72	486	316	83	5.33	0.01	0.0009	0.005	0.004	0.004	0.008	0.344	0.009	0.006	0.005	0.097	0.05	7.13	0.000 05	1.7
Mean	7.44	460	299	70	0.78	0.007	0.00015	0.0008	0.001	0.0012	0.0012	0.139	0.0056	0.0015	0.005	0.0257	0.031	1.046	0.000 05	1.5 2
Med	7.46	462	300	69	0.40	0.007	0.00005	0.0005	0.0005	0.0005	0.0005	0.104	0.0045	0.001	0.005	0.015	0.025	0.46	0.000 05	1.5
CCWB525																				
Min	6.39	615	400	108	0.01	0.0005	0.00005	0.0005	0.006	0.0005	0.0005	3.14	0.002	0.013	0.005	0.051	0.025	0.025	0.00005	0.4
Max	7.73	713	463	128	26.4	0.156	0.0039	0.043	0.068	0.207	0.111	4.88	0.014	0.208	0.005	2.34	0.025	95.8	0.00005	0.6
Mean	6.97	668	434	120	2.50	0.0167	0.00055	0.0041	0.0177	0.0188	0.0098	4.01	0.006	0.0474	0.005	0.3074	0.025	8.96	0.00005	0.5 4
Med	6.975	666	433	120	0.11	0.0035	0.0003	0.0005	0.013	0.001	0.0005	3.94	0.006	0.034	0.005	0.115	0.025	0.2	0.00005	0.6
CCWB523																				

Min	7.58	1330	864	87	0.05	0.001	0.00005	0.0005	0.0005	0.0005	0.0005	0.038	0.004	0.0005	0.005	0.006	0.5	0.025	0.00005	0.6
Max	8.59	1540	1000	101	0.66	0.004	0.0005	0.0005	0.002	0.066	0.019	0.781	0.017	0.002	0.005	0.119	0.66	0.67	0.00005	1
Mean	8.03	1475	9596	93	0.19	0.002	0.0001	0.0005	0.0007	0.0062	0.0022	0.379	0.01	0.0012	0.005	0.025	0.555	0.175	0.00005	0.81
Med	8.04	1490	968	93	0.13	0.002	0.00005	0.0005	0.0005	0.001	0.0005	0.359	0.009	0.001	0.005	0.012	0.545	0.12	0.00005	0.8

4.5 Hydrogeology

The 12-month period of monitoring between October 2020 and October 2021 was assessed to determine trends within the Agate Creek groundwaters. Standing Water Levels (SWLs) during the assessment period showed all bores (excluding CCWB526) recorded SWL increases which ranged between 0.17 m (CCWB517) and 3.71 m (CCWB521). An overall average increase of 1.38 m was observed across the network. Increases across the network are likely a result of the extremely low hydraulic conductivities, and the groundwater system is continuing to reach equilibrium (C&R Consulting, 2022).

Between December 2020 and February 2021, 765.4 mm of rain fell in the region. All bores within the Agate Creek recorded a positive change in SWL, representing a recharging of the aquifer. This indicates that groundwaters readily respond to rainfall events (C&R Consulting, 2022).

A potentiometric surface of groundwater elevations has been prepared from the groundwater monitoring bore network. It is thought that there is some degree of hydraulic continuity across Agate Creek. The potentiometric surface shows that groundwater flows follow loosely follows topography, with groundwater moving from areas of high elevation towards Agate Creek (C&R Consulting, 2022).

The three bores located in proximity to Agate Creek reflect the areas of lowest groundwater elevations. Elevation differences between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater system does not impact or interact with flow in Agate Creek.

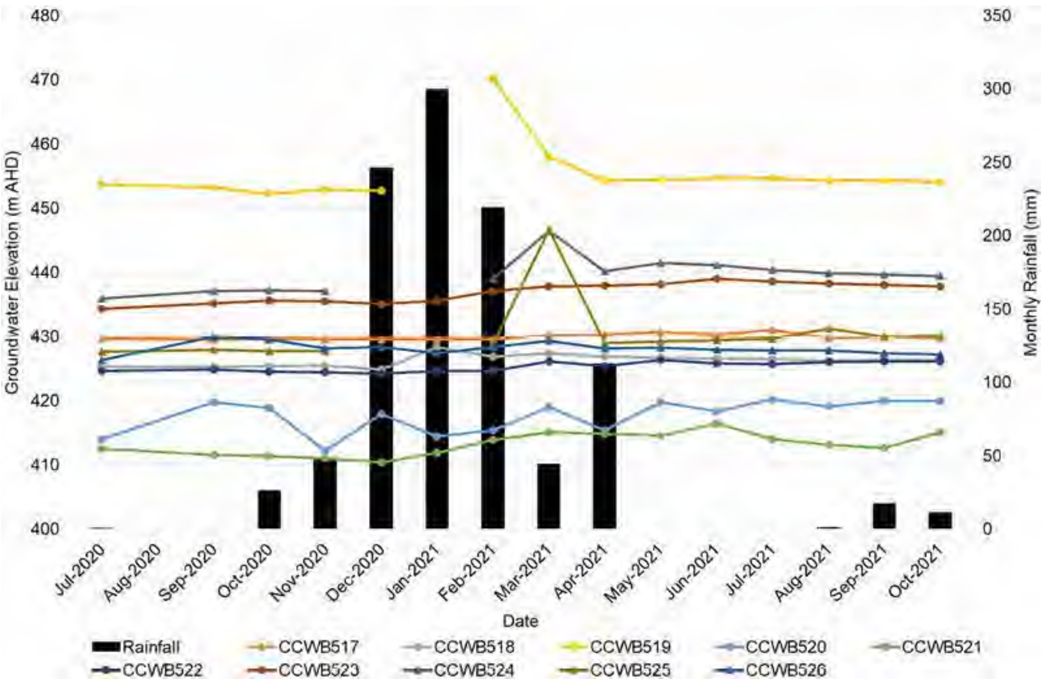

Figure 7. Groundwater Elevations

Figure 8. Potentiometric surface contours

Legend

- Agate Creek mining lease
- Void 5-m contours

Bore Network

- Monitoring bore
- Production bores
- Groundwater contours

Watercourse

- Agate Creek
- Minor watercourse

Client: Laneway Reources Ltd
Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

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Source: C&R Consulting Pty Ltd
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4.6 Geology

Agate Creek is situated within the Etheridge Goldfield. The region's gold mineralisation is described as predominantly epithermal and meso thermal systems within quartz veining, stockworks and breccias associated with the felsic volcanic units of the Permian Kennedy Igneous Group and the Proterozoic Forsayth Batholith.

State mapping details the surface geologies present within the ML (Queensland Globe, 2021):

- Corbett Formation: Greenish grey mudstone (+/- chloritoid); grades into mica schist (+/- staurolite, andalusite, sillimanite, garnet)
- Hampstead Sandstone: Clayey, commonly pebbly, quartzose sandstone and conglomerate
- Qa-QLD: Clay, silt, sand and gravel; flood-plain alluvium
- Black Soil Andesite: Greyish-green locally sparsely porphyritic augite-hypersthene-basaltic andesite with agate-filled amygdales; probably includes intrusive equivalents
- Cpir-Kennedy Province: Mainly buff, pale grey to dark grey or brown, aphyric to highly porphyritic, intrusive rhyolite; commonly flow-banded; locally grades into microgranite
- Dead Horse Metabasalt: Metabasalt, locally pillowed, hyaloclastic and/or amygdaloidal; minor metadolerite, and metagabbro (unmapped) and interbedded siltstone
- TQr-QLD: Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)
- Robin Hood Granodirorite: Pink to grey hornblende-biotite granodiorite with quartz phenocrysts
- Daniel Creek Formation: Mudstone, siltstone, and fine subfeldspathic sandstone, locally calcareous and/or dolomitic. Grades into mica schist, quartzite, and minor calc-silicate rocks

4.7 Soil Types, Properties and Suitability

4.7.1 Soil types and Properties

WTS was engaged to undertake a soils and land suitability assessment (SLSA) of the ML to inform components of the PRCP (WTS, 2022). The SLSA focused on areas of minimal disturbance to previously undisturbed land, evaluating resources such as topsoil material availability, suitability for use in rehabilitation and potential constraints to plant growth.

WTS (2022) identified four soil map units across the ML. Representative soil profiles are described in Table 8.

Table 8. Representative Soil Profiles Soil Management Unit

Soil Management Unit	Reference Site	Area (ha)	Area (%)
Brown Mellic Kandosol	S1	232.58	34.86
Red Massive Gypsic Vertosol	S3	63.97	9.32
Brown Bleached Kandosol	S4	83.51	12.18
Brown Lithsolic Rudosol	S5	299.13	43.62

Laboratory analysis of several soil parameters has been summarised for each soil management unit (Table 9). The soil types currently support native vegetation communities and there are no detrimental elements in the soil expected to limit that capacity in future.

Table 9. Soil Chemical Properties

Soil Type	Depth (cm)	pH	EC (µS/cm)	Nitrite + Nitrate as N (NOx)	TKN (mg/kg)	TN (mg/kg)	TP (mg/kg)	TOC (%w/w)	Colwell K (mg/kg)	Exc. Na (meq/ 100g)	Exc. K (meq/100g)	Exc. Ca (meq/100g)	Exc. Mg (meq/100g)	Cation Exc. Capacity (meq/100g)	ESP (%)	Ca:Mg Ratio	S (mg/kg)
1	0 - 10	6.2	20	1.0	190	190	144	0.23	921	<0.1	0.4	1.9	0.6	2.9	1.2	3.2	<10
	10 - 20	6.1	5	1.4	150	150	173	0.16	575	<0.1	0.3	1.0	0.6	1.9	0.8	1.7	<10
	20 - 30	5.9	4	0.8	140	140	155	0.19	437	<0.1	0.2	0.8	0.4	1.4	0.8	2.0	<10
	30 - 60	5.9	4	0.2	110	110	129	0.14	349	<0.1	0.2	0.5	0.7	1.6	3.2	0.7	<10
	60 - 90	6.0	4	0.2	110	110	146	0.13	280	0.1	0.2	0.5	0.9	2.4	6.2	0.6	<10
2	0-10	7.0	42	0.2	780	780	169	1.76	1170	<0.1	1.4	13.0	7.4	21.7	0.1	1.8	<10
	10-20	6.6	10	0.3	700	700	138	1.29	522	<0.1	0.8	9.8	7.0	17.6	0.2	1.4	<10
	20-30	6.8	5	<0.2	430	430	117	0.76	278	<0.1	0.4	10.6	7.8	19.0	0.3	1.4	<10
	30-40	6.8	6	<0.2	880	880	294	0.60	162	<0.1	0.3	10.4	7.8	18.6	0.3	1.3	<10
	40-60	6.8	4	<0.2	820	820	219	0.47	129	<0.1	0.2	9.3	7.1	16.7	0.4	1.3	<10
3	0-10	6.5	18	292	630	630	168	0.96	292	<0.1	0.4	3.2	0.8	4.4	<0.1	4.0	292
	10-20	6.7	12	277	390	390	164	0.54	277	<0.1	0.4	2.2	0.6	3.1	0.3	3.7	277
	20-30	6.5	11	270	210	210	116	0.32	270	<0.1	0.4	2.1	0.6	3.0	0.3	3.5	270
	30-50	6.4	8	222	150	150	126	0.18	222	<0.1	0.3	1.9	0.5	2.7	0.4	3.8	222
	50-80	6.4	6	193	120	120	142	0.15	193	<0.1	0.2	2.1	0.8	3.1	0.8	2.6	193

	80-120	6.5	17	308	140	140	125	0.23	308	<0.1	0.4	3.6	2.1	6.2	1.2	1.7	308
4	0 - 10	5.3	6	0.7	510	510	256	0.90	224	<0.1	0.3	0.5	0.5	2.1	1.2	1.0	<10
	10 - 20	5.3	4	0.5	360	360	169	0.60	115	<0.1	0.1	0.2	0.4	2.3	2.6	0.5	<10
	20 - 30	5.0	3	0.4	280	280	325	0.34	109	<0.1	0.2	0.2	0.4	1.9	2.4	0.5	<10
	30 - 40	5.3	2	0.4	190	190	359	0.22	<100	<0.1	0.1	<0.1	0.4	1.3	2.0	<0.1	<10

1 = Brown Mellic Kandosol

2 = Red Massive Gypsic Vertosol

3 = Brown Bleached Kandosol

4 = Brown Lithsolic Rudosol

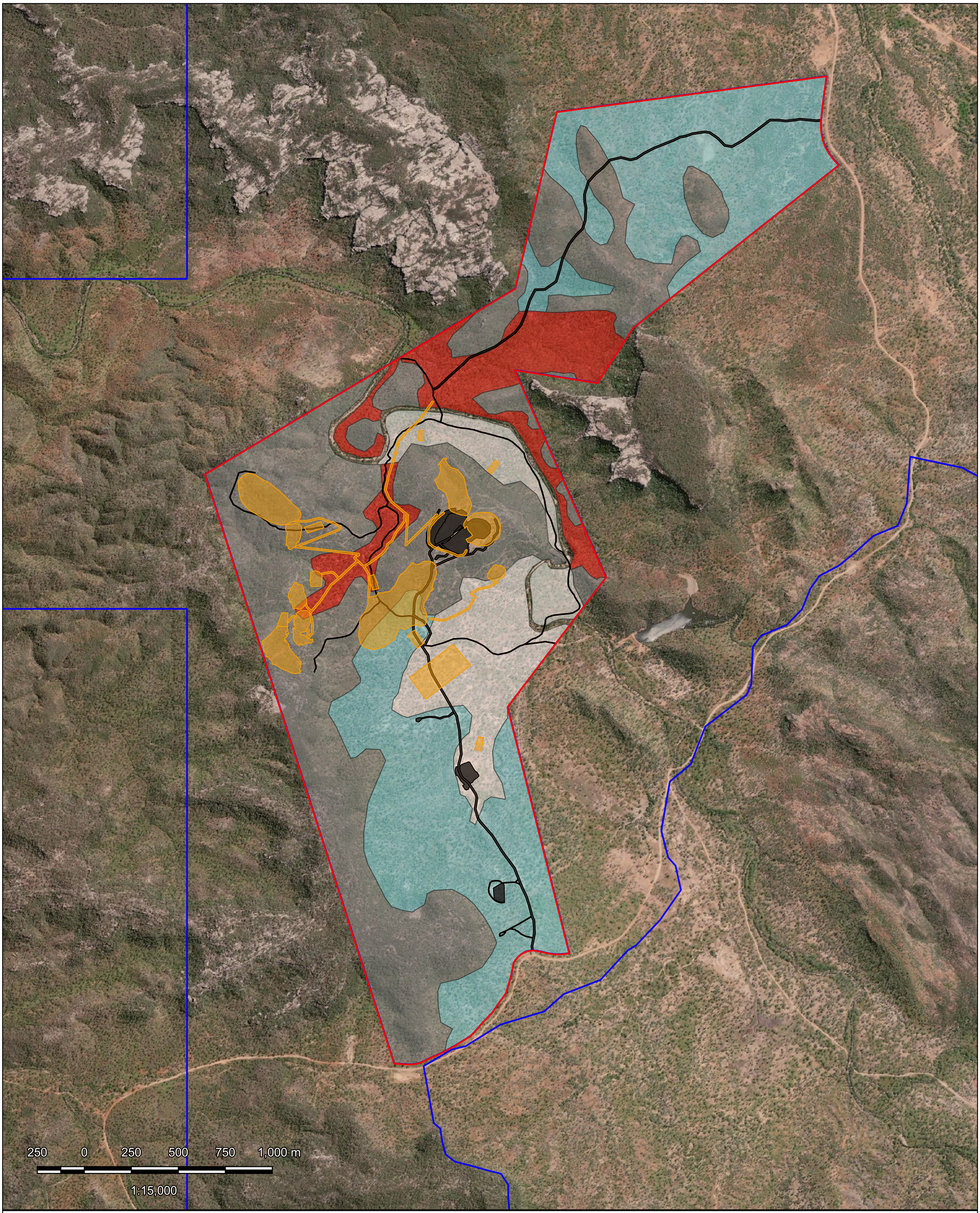

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Figure 9. Ground-truthed Soils

Legend

Mine Tenure
- Mineral Development Licence
- Mining Lease
- Existing Mine Features
- Proposed Mine Features

Ground-truthed Soils
- Brown Bleached Kandosol
- Brown Lithsolic Rudosol
- Brown Mellic Kandosol
- Red Massive Gypsic Vertosol

ESRI Satellite

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4.7.2 Land Suitability Assessment

Land Suitability has been assessed using the methods and criteria provided in the Guideline for Agricultural Land Evaluation (Department of Science Information Technology and Innovation and Department of Natural Resources and Mines, 2015) and Guideline for Land Suitability Assessment Techniques (Department of Mines and Energy, 1995). This assesses how suitable an area of land is for two major rural agricultural enterprises: rainfed broadacre cropping and beef cattle grazing.

The Land Suitability assessment cross-references each soil unit's characteristics with suitability criteria from Department of Mines and Energy (1995). The Land Suitability assessment uses a five-class system, where Class 1 indicates that the land is most suitable for the enterprise and Class 5 the least suitable. The overall land suitability ranking for each specific soil unit is determined by the most severe limitation, or a combination of the varying limitations. Land is considered less suitable as the severity of limitations for a land use increases. The increasing limitations may reflect any combination of:

- Reduced potential for production;
- Increased inputs to achieve an acceptable level of production; and/or
- Increased inputs required to prevent land degradation.

The Land Suitability Classes are described in Table 10.

Table 10. Land Suitability Classes

Class	Suitability	Limitations	Description
1	Suitable	Negligible	Highly productive land requiring only simple management practices to maintain economic production.
2	Suitable	Minor	Land with limitations that either constrain production or require more than the simple management practices of class 1 land to maintain economic production.
3	Suitable	Moderate	Land with limitations that either further constrain production or require more than those management practices of class 2 land to maintain economic production.
4	Unsuitable	Severe	Currently unsuitable land. The limitations are so severe that the sustainable use of the land in the proposed manner is precluded. In some circumstances, the limitations may be surmountable with changes to knowledge, economics, or technology.
5	Unsuitable	Extreme	Land with extreme limitations that preclude any possibility of successful sustained use of the land in the proposed manner.

The land use suitability for the 4 soil types is summarised in Table 11.

Table 11. Summary of Land Suitability

Soil Type	Beef Cattle Grazing	Broadacre Cropping	Limitations	Area
Brown Mellic Kandosol	4	4	Severe to Extreme Limitations in plant available water capacity (PAWC), vegetation.	232.58
Red Massive Gypsic Vertosol	5	5	Severe to Extreme Limitations in plant available water capacity (PAWC), vegetation.	63.97
Brown Bleached Kandosol	3	3	Limitations that constrain production (flooding)	83.51
Brown Lithsolic Rudosol	5	5	Severe to Extreme Limitations in plant available water capacity (PAWC), topography and rockiness.	299.13

4.7.3 Land Stability

An assessment of soil erosion susceptibility is given in Table 12, which lists influencing factors for all soil types that have been identified.

Table 12. Soil Erosion Susceptibility

Soil Type	Depth (cm)	Texture	ECEC (meq/100g)	Rating	ESP (%)	Rating	Landform	Vegetation Cover	Erosion Susceptibility
Brown Mellic Kandosol	0 - 10	Loam	1.2	Low	1.2	Non-Sodic	Gently undulating.	Sparse *Eucalyptus microneura +/- Terminalia spp. low woodland*	Moderate susceptibility due sparse erosion protection
	10-60	Loam	1.5	Low	1.6	Non-Sodic			
	60-90	Loam	2.4	Low	6.2	Slightly Sodic			
Red Massive Gypsic Vertosol	0-20	Clay Loam	20	Moderate	0.15	Non-Sodic	Flat to gently undulating	Sparse *Eucalyptus crebra and/or E. whitei +/- Corymbia erythrophloia open woodland*.	Moderate susceptibility due sparse erosion protection
	20-30	Clay	19	Moderate	0.3	Non-Sodic			
	30-60	Clay	17.6	Moderate	0.35	Non-Sodic			
Brown Bleached Kandosol	0-10	Loam	4.4	Low	0.1	Non-Sodic	Flat to gently undulating.	Sparse *Eucalyptus microneura +/- Terminalia spp. low woodland*.	Moderate susceptibility due sparse erosion protection
	10-50	Sandy Loam	2.9	Low	0.35	Non-Sodic			
	50-80	Sandy Loam	3.1	Low	0.8	Non-Sodic			
	80-120	Sandy Loam	6.2	Low	1.2	Non-Sodic			
Brown Lithsolic Rudosol	0 -20	Loam	2.2	Low	1.8	Non-Sodic	Slight to steeply undulated terrain	*Eucalyptus crebra* woodland, +/- *Corymbia pocillum*.	Moderate susceptibility due sparse erosion protection

4.7.4 Erosion Hazard (Average Rainfall)

The International Erosion Control Association's (IECA) Best Practice Erosion and Sediment Control Guidelines (IECA 2008) sets erosion hazard based on average rainfalls for regions around Australia. IECA erosion hazard for Forsayth region is detailed in Table 13.

Table 13. Erosion Hazard (IECA, 2008)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
H	M	M	VL	VL	VL	VL	VL	VL	VL	VL	M

Note: H=High, M = Moderate, L = Low, VL = Very Low.

4.8 Vegetation Communities and Ecological Data

4.8.1 Vegetation Communities

Agate Creek is located on the boundary of the Gulf Plains and Einasleigh Uplands bioregion and northeast of the Rungulla National Park and Rungulla Resource Reserve. The ML is covered predominantly by open woodlands of Gilbert River Box and Narrow-Leaved Ironbark with a sparse shrub and grass understory (SLR Consulting, 2021). SLR Consulting (2021) ground-truthed Regional Ecosystems (REs) across the ML which all have a 'least concern' status under the *Vegetation Management Act 1999* (VM Act) and a 'no concern at present' biodiversity status under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), except for REs 9.3.13 and 9.3.26, which both have an 'of concern' biodiversity status. The ground-truthed REs are detailed in Table 14. SLR Consulting (2021) noted minor to moderate cattle grazing and agriculture impacts in all vegetation communities concentrating along watercourses and riparian zones.

Small sections of non-remnant vegetation occur on previously cleared areas for mining operations.

Table 14. Ground-truthed Regional Ecosystems (SLR Consulting, 2021).

RE	VM Act Status	Biodiversity Status	Description	Presence relative to Project location
2.10.5a	Least Concern	No Concern at Present	Dominated by sandstone scarps, outcrops, and plateaus. Vegetation dominated by Paperbark Gums and Lancewood. The sub-canopy and shrub layers dominated by Acacia spp.	Western edges of the ML
9.3.13	Least Concern	Of Concern	Canopy included *Eucalyptus camaldulensis, Melaleuca fluviatilis,* and *Lophostemon grandiflorus.*	Occurs along several of the State mapped watercourses including Agate Creek within the ML.
9.3.26	Least Concern	Of Concern	Abundance of black soil. Sparse canopy (primarily Gilbert River Box), woody shrub layers, and variety of grasses. Increased grazing pressure.	South-east of pit.
9.5.10a	Least Concern	No Concern at Present	Canopy dominated by Gilbert River Box. Density of sub-canopy varied. Shrub layer was generally sparse, dominated by *Cassia lanceolata.* Significant grazing occurring.	Lower flood plains of ML.
9.11.16	Least Concern	No Concern at Present	Dominated by Narrow-leaved Ironbark with variable sub-canopy and shrub layer.	North-eastern portion of ML on steep slopes, low

			Groundcover typically dominated by *Aristida spp.* On folded metamorphic surface geology.	undulations, and hill crests.
9.12.11	Least Concern	No Concern at Present	Dominated by Narrow-leaved Ironbark with variable sub-canopy and shrub layer. Groundcover typically dominated by *Aristida spp.*	Southern and central areas on igneous rocks on steep slopes, low undulations, and hill crests.

4.8.2 Threatened Flora

No threatened flora species as listed under the *Nature Conservation Act 1992* (NC Act) or EPBC Act were identified by SLR Consulting (2021) to occur within the ML.

4.8.3 Threatened Fauna

During SLR Consulting's (2021) Flora and Fauna survey, the species observed were mostly common in the region. One Endangered, Vulnerable, or Near Threatened (EVNT) species, *Acanthophis antarcticus* (common death adder), was recorded by SLR Consulting (2021); the exact location the species was spotted is unknown. The common death adder is listed as Vulnerable under the *Nature Conservation Act 1992* (NC Act). There were 14 microbat species identified which are listed as 'least concern' under the NC Act.

All other species identified during the survey are not listed as EVNT species.

The Gilbert Gecko and Silver-eyed Velvet Gecko were identified at Agate Creek, however, both species were described in recent years, poorly known, and have restricted distributions thus are currently not evaluated under the NC Act or EPBC Act.

4.8.4 Matters of National Environmental Significance (MNES)

While none were identified during the SLR Consulting (2021) Flora and Fauna survey, desktop analysis indicated some species listed as a MNES may occur within the ML.

Table 15. MNES Fauna Potentially Occurring within the Project (SLR Consulting, 2021).

Species	NC Act Listing	EPBC Act Listing	Likelihood of occurrence (SLR Consulting, 2021)	Description
Ghost Bat *Macroderma gigas*	Endangered	Vulnerable	Moderate	ML contains suitable foraging habitat. No suitable roost habitat was ground-truthed. Not detected during survey.
Koala *Phascolarctos cinereus*	Vulnerable	Vulnerable	Moderate	Not detected during survey. Potentially suitable habitat Desktop analysis indicated records within 20 km.
Large-eared horseshoe bat *Rhinolophus robertsi*	Endangered	Vulnerable	Moderate	ML contains some potentially suitable foraging and roosting habitat. No evidence of the species was identified during the survey.

4.8.5 Matters of State Environmental Significance

The Rungulla National Park and Resource Reserve, neighbouring the ML, is considered a Matter of State Environmental Significance (MSES) as well as the riverine ecosystems along the watercourses through the Project (Queensland Globe 2022; SLR Consulting, 2021). No other MSES were identified by SLR Consulting (2021) to occur within the Project.

MSES at the Project are displayed in Figure 11.

4.8.6 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESA) were ground-truthed to occur within the Project area. One Category A ESA, the Rungulla National Park, is State mapped to the southwest of the study area and one Category C ESA, is also State mapped to the southwest of the Project (SLR Consulting, 2021).

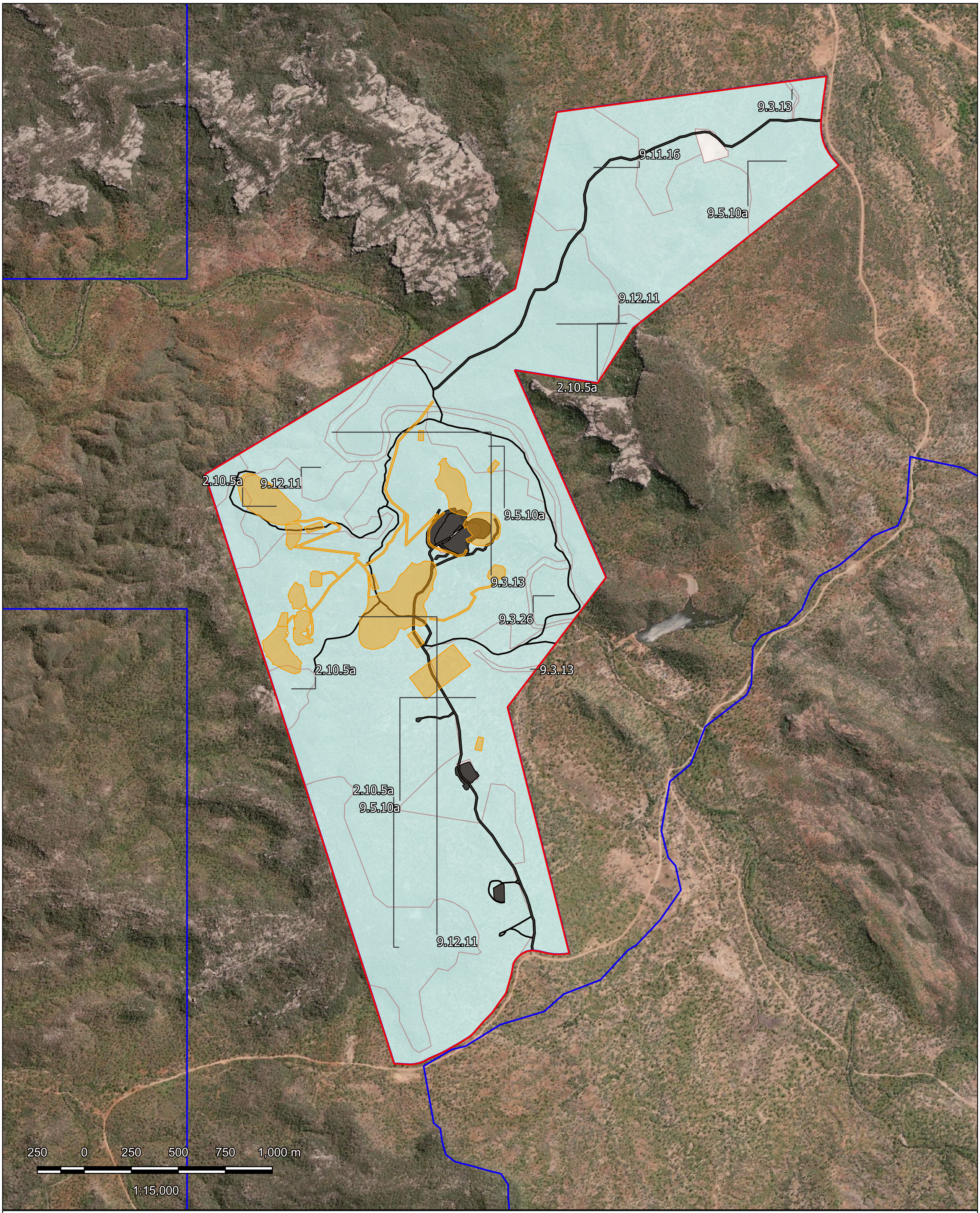

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Figure 10. Ground-truthed Regional Ecosystems

Legend

Mine Tenure
- Mineral Development Licence
- Mining Lease
- Mine Features
- Proposed Mine Features

Groundtruthed REs
- Least Concern
- Non-Remnant

ESRI Satellite

Digital data for this report is available on the Queensland Government Spatial Portal at https://qldspatial.information.qld.gov.au.

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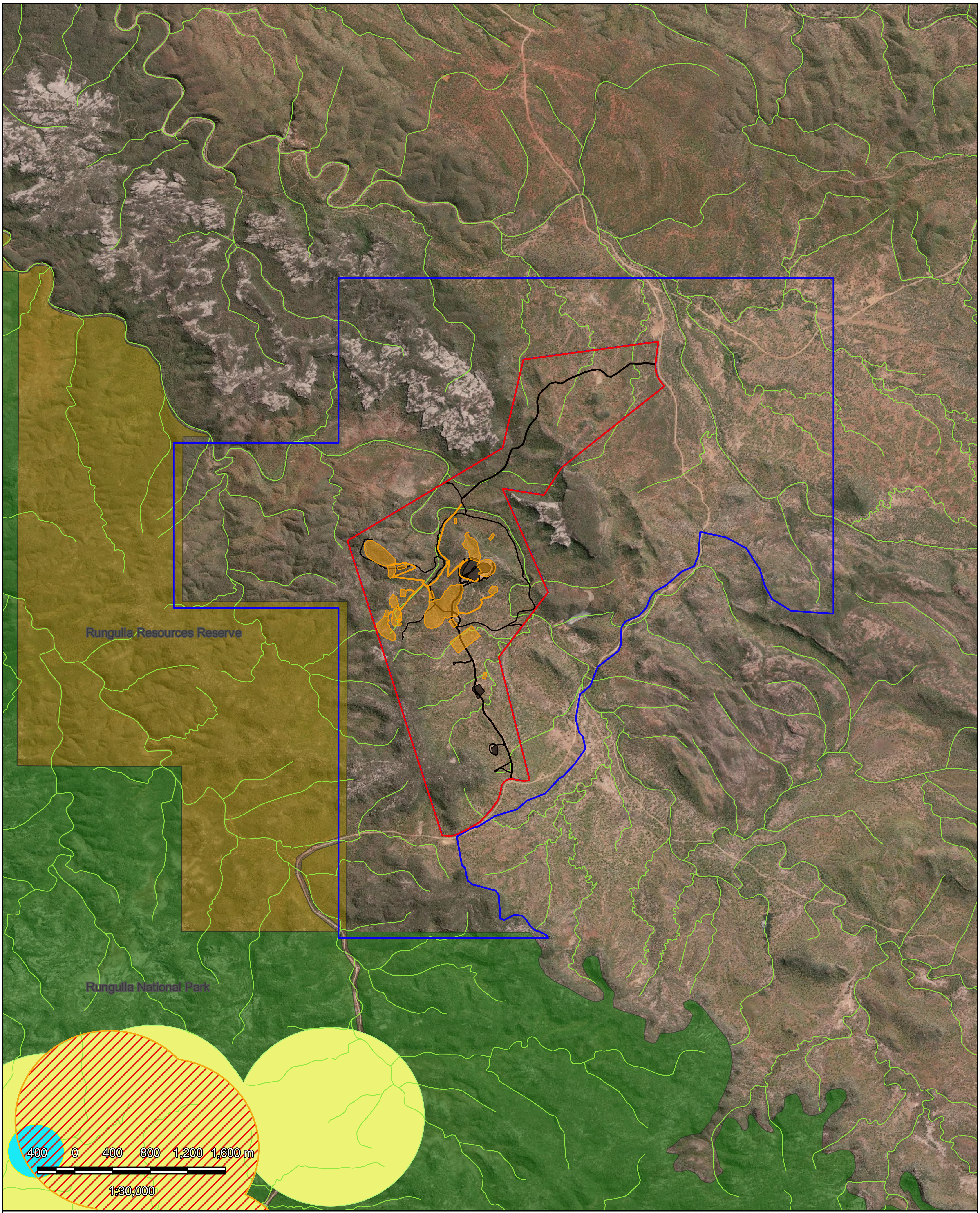

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Figure 11. Matters of State Environmental Significance

Legend

- Mineral Development Licence
- Mining Lease
- Existing Mine Features
- Proposed Mine Features

ESRI Satellite

State Significant Matters

- WH - END or VUL
- RV - 100m from Wetland
- RV - Defined Watercourse
- RV - Essential Habitat
- PA - Rungulla National Park
- PA - Rungulla Resources Reserve

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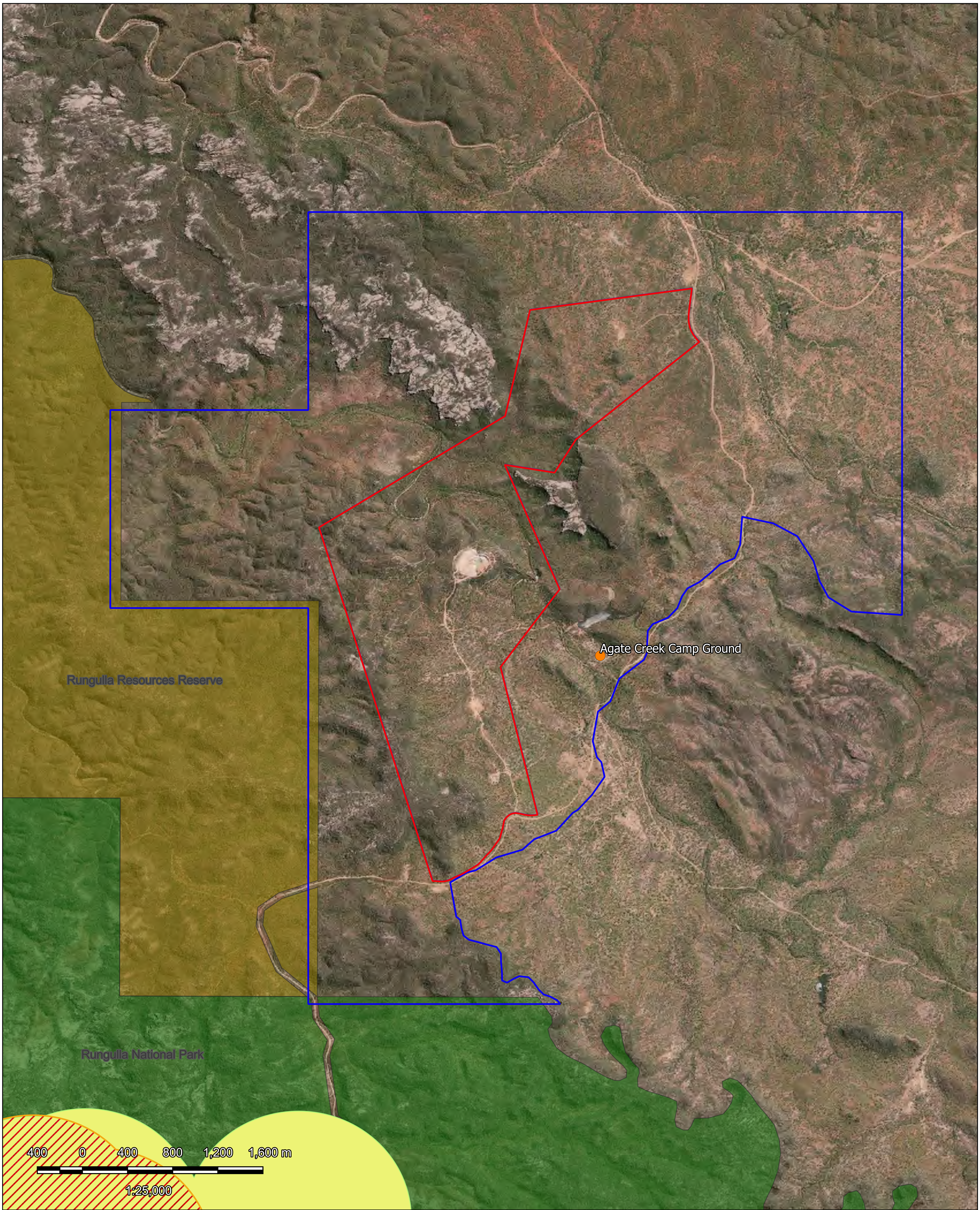

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Figure 12. Environmentally Sensitive Areas

Legend

- Mineral Development Licence
- Mining Lease

ESRI Satellite

Sensitive Receptors

- WH - END or VUL
- RV - Essential Habitat
- Rungulla National Park (Cat A ESA)
- Rungulla Resources Reserve (Cat C ESA)
- Tourist Area

WULGURU TECHNICAL SERVICES

5. Design for Closure

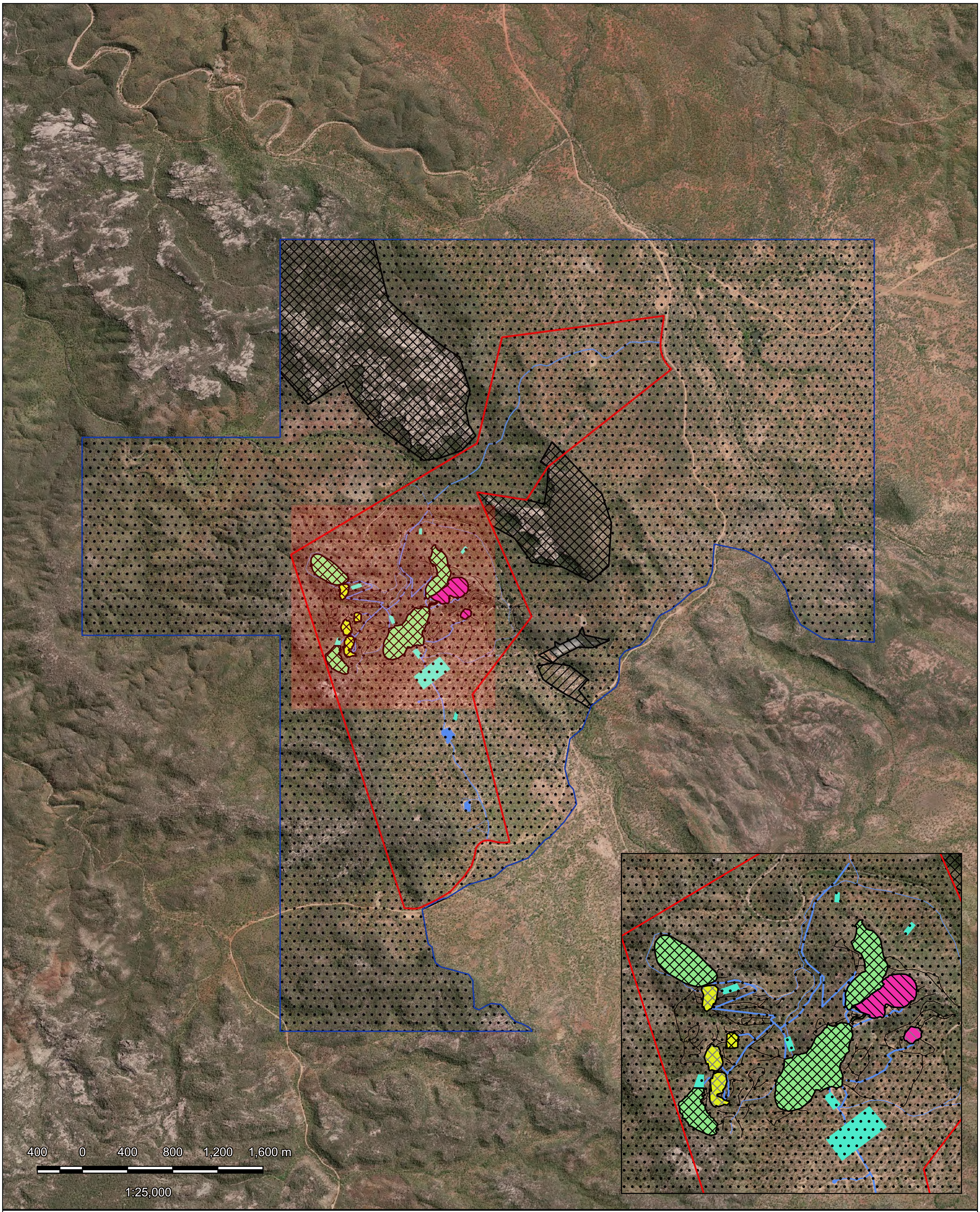
5.1 Rehabilitation Areas and Milestones

Project activities are grouped in this PRCP by Rehabilitation Areas (RAs), defined under the Progressive Rehabilitation and Closure Plans guideline as "*an area of land in the PMLU to which a rehabilitation milestone for the post-mining use relates".* Each RA will have assigned Rehabilitation Milestones (RMs) defined as *each significant event or step necessary to rehabilitate the land to a stable condition* (Department of Environment and Science, 2021).

The RAs and RMs for the Agate Creek Gold Mine are detailed in Table 16.

Table 16. Rehabilitation Areas and Rehabilitation Milestones

Rehabilitation Area		Rehabilitation Milestone	
RA1	Open cut pits 1 - 4	RM1	Infrastructure decommissioning and removal
RA2	Open cut pits 5 - 6	RM2	Remediation of contaminated land
RA3	Waste Rock Dumps	RM3	Landform development and reshaping (RA1)
RA4	Mine Infrastructure Area	RM4	Landform development and reshaping (RA2)
RA5	Water Storages	RM5	Landform development and reshaping (RA3)
RA6	Exploration	RM6	Landform development and reshaping (RA4)
		RM7	Landform development and reshaping (RA5)
		RM8	Surface preparation
		RM9	Revegetation (native ecosystem)
		RM10	Revegetation (grazing)
		RM11	Achievement of surface requirements (native ecosystem)
		RM12	Achievement of surface requirements (grazing)
		RM13	Achievement of post-mining land use to a stable condition (native ecosystem)
		RM14	Achievement of post-mining land use to a stable condition (grazing)
		RM15	Achievement of post-mining land use to a stable condition (water storage)



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Date: 11 October 2022

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Figure 13. Rehabilitation Areas

Legend

Mine Tenure
- MDL
- Mining Lease

ESRI Satellite

Rehabilitation Areas
- RA1
- RA2
- RA3
- RA4
- RA5
- RA6

Post Mine Land Use
- Low intensity Grazing
- Native Ecosystem
- Recreation
- Water Storage

WULGURU TECHNICAL SERVICES

5.2 Existing Rehabilitation

Exploration disturbance is rehabilitated, within 12 months of disturbance activities, in accordance with the Code of Environmental Compliance for Exploration and Mineral Development.

5.3 Community

5.3.1 Community Profile

The Etheridge Shire Council (the Council) is in far north Queensland in the Savannah gulf region. Forsayth is the closest township to Agate Creek, located approximately 40 km to the north. The 2016 Census recorded 129 people in the population, 51.6 % male and 48.4 % female with a median age of 48. The labour force was recorded to be 58 people, 70.7 % working full time. Beef Cattle Farming (specialised) was the largest employment industry at 58.4 % of the working population (ABS, 2016).

Georgetown is the main township of the Etheridge Shire and is located approximately 80 km north of the Project. As of the 2016 Census, the population was 301, with a median age of 36 with 48.7 % male and 51.3 % female. The largest employment industry was Beef Cattle Farming (specialised) followed by Local Government Administration (ABS, 2016).

The Ewamian People are the traditional owners of land the country that occupies the Gulf of Carpentaria savannah lands in the upper Gilbert and Einasleigh River catchments (Ewamian Aboriginal Corporation, 2021). As of the 2016 Census 5.5% of Etheridge shire identifies as Aboriginal and/or Torres Strait Islander (ABS, 2016).

With operations set to expand in 2022, Agate Creek presents an employment opportunity for locals, as well as potentially boosting local economy through increased demand for basic amenities (food supply, fuel supply etc.), and increased traffic through the region by DIDO workers.

5.3.2 Community Consultation Plan

A dedicated Community Consultation Plan (CCP) will be prepared for Agate Creek. The CCP will document the consultation process to be followed to enable ongoing engagement with relevant stakeholders. The community consultation plan will be prepared in accordance with Section 126C(1)(c)(iv) of the EP Act and include details of how Laneway will carry out ongoing consultation.

A community consultation register will be developed and will continue to be updated throughout the life of mine.

6. Post Mining Land Use

Land must be rehabilitated to a stable condition as defined in section 11A of the EP Act. Land is in a stable condition if:

- the land is safe and structurally stable, and
- there is no environmental harm being caused by anything on or in the land, and
- the land can sustain a Post Mining Land Use (PMLU).

A PMLU is defined under the EP Act as the purpose for which the land will be used after all relevant activities have ceased. The PMLU must be consistent with the outcome of consultation with the community and any strategies for the land of a local government, the State or Commonwealth (Department of Environment and Science, 2021).

6.1 Assessment of PMLU Options

As part of the assessment of PMLUs it is acknowledged that the EP Regulation requires that each

PMLU:

a) Is viable having regard to the use of land in the surrounding region, and

b) satisfies at least one of the following:

   a. a. the use is consistent with how the land was used before a mining activity was carried out on the land

   b. the use is consistent with a development approval relating to the land –

   c. the use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016

   d. the use will deliver, or is aimed at delivering, a beneficial environmental outcome.

The most suitable PMLU for each RA is shown in Table 17. The PMLUs were determined by considering the environmental, economic, and social benefits of each PMLU.

Table 17. Mine Domains and Agreed PMLU Land Classes

	Mine Domain	PMLU
RA1	Open Cut Pits (Pits 1 – 4)	Native ecosystem
RA2	Open Cut Pits (Pits 5 – 6)	Water storage
RA3	Waste Rock Dumps	Native ecosystem
RA4	Mine Infrastructure Area	Low intensity grazing
RA5	Water Storages	Water storage
RA6	Exploration	Low intensity grazing

Table 18 describes how these PMLU's meet the requirements of the EP Regulation.

Table 18. Requirements of a PMLU

Requirement of the PMLU	Justification
The land is safe and structurally stable, and	Final landforms will be designed and certified by suitably qualified persons. After initial rehabilitation, structures will continue to be monitored by suitably qualified persons to assess stability. Erosion monitoring will be conducted to assess stability. The slopes of the project will be made safe to support cattle grazing. Fencing will be constructed to prevent cattle ingress to WRDs. Pits 1-4 will be backfilled with waste rock material and returned to native ecosystem. During rehabilitation, areas may be fenced to prevent cattle grazing until vegetation has established and the landform is unlikely to cause erosion and sedimentation.
There is no environmental harm being caused by anything on or in the land, and	All contaminants will be removed from domains and encapsulated within the WRDs. A contaminated land assessment will be conducted following rehabilitation activities to verify the removal of contaminants. All infrastructure will be removed from site during the demolition phase of rehabilitation. The site will be revegetated to reduce the possibility of erosion. Ongoing surface and groundwater monitoring will be conducted to assess the potential for environmental harm.
The land can sustain a Post Mining Land Use (PMLU).	The proposed PMLUs of low intensity grazing and native ecosystem is consistent with surrounding land uses. Water dams and residual voids (Pits 5 – 6) will remain as water storages, suitable for stock, consistent with the surrounding PMLU.

Requirement of the PMLU	Justification
The PMLU is viable having regard to the use of land in the surrounding region, and	The Etheridge Shire is a significant beef producing region. The proposed PMLU of low intensity cattle grazing is consistent with previous and current land uses in the area. The PMLU of native ecosystem for RA1 and RA3 is consistent with the pre-mining land use of the area. Water dams and residual voids (Pits 5 – 6) will remain as water storages, suitable for stock, consistent with the surrounding proposed PMLU.
The PMLU satisfies at least one of the following: a. the use is consistent with how the land was used before a mining activity was carried out on the land b. the use is consistent with a development approval relating to the land – c. the use is consistent with a use of the land, other than a use that is mining, permitted under a State or Commonwealth Act, including, for example, a planning instrument under the Planning Act 2016 d. the use will deliver, or is aimed at delivering, a beneficial environmental outcome.	The proposed PMLUs of low intensity cattle grazing and native ecosystem are consistent with how the land was used before a mining activity was carried out on the land.

6.1.1 Community Consultation

The proposed PMLUs of native ecosystem and grazing are consistent with the community consultation conducted to date, in that they are:

- Consistent with the land use prior to the commencement of mining activities
- Consistent with the surrounding land use; and
- Compatible with, and beneficial to, the current underlying landholder activities.

A Landholder agreement is in place with Howlong Station to retain Pit 5, Pit 6, and water management structures for water storage, as well as some access tracks. A copy of the agreement is provided in Appendix D.

6.1.2 Regional Planning Integration

Under the Etheridge Shire Planning Scheme, Agate Creek is within the Rural Zone. The purpose of the Rural zone is to:

- *provide for rural uses and activities;*
- *provide for other uses and activities that are compatible with—*
    - *existing and future rural uses and activities;*
    - *the character and environmental features of the zone;*
- *maintain the capacity of land for rural uses and activities by protecting and managing significant natural resources and processes* (Etheridge Shire Council,2020).

Etheridge Shire Council's intended purpose for the Rural zone is to also:

- *ensure the productive capacity of agricultural and associated rural industries is maximised and maintained, while protecting biodiversity values and allowing for farm diversification and value adding industries to occur in the rural area;*
- *recognise the importance of agricultural land identified as Class A or B as shown on SPP mapping - Economic Growth, Agricultural land classification – class A and B whilst balancing environmental considerations;*
- *maintain the character and amenity of the rural and natural environment;*
- *include recognised environmental areas such as national parks and reserves, and give protection to the shire's biodiversity;*
- *encourage tourism development where it can value-add to the viability of rural enterprises, does not diminish biodiversity values and avoids impacts of flooding and bushfire;*
- *ensure that the functional connectivity of the stock route network is maintained and any development within or adjacent to stock routes or reserves provides for their continued function;*
- *ensure development protects extractive industry or potential resource sites for future development, and also protects existing rural uses from impacts of proposed extractive industry and associated activities;*
- *allow for the development of renewable energy facilities, whilst protecting agricultural and environmental interests;*
- *protect existing electricity, telecommunications and emergency services infrastructure* (Etheridge Shire Council,2020).

The proposed PMLUs of native ecosystem and grazing are compatible with the planning scheme.

6.2 Proposed PMLUs

6.2.1 RA1 – Open Cut Pits (Pits 1-4)

6.2.1.1 Overview

This RA includes Open Cut Pits 1 – 4 and is situated on undulated terrain of the Sherwood and Sherwood West resource areas. RA1 will be backfilled with waste rock and vegetated to a PMLU of native ecosystem.

6.2.1.2 Outcome

The proposed post mine land use for the Open Cut Pits post closure is to native ecosystem.

6.2.1.3 Environmental Benefit

Pits 1-4 are located on the western boundary of the mining lease. Returning this RA to native ecosystem will provide connectivity to the surrounding environment. Additionally, native ecosystem will have less impact on the rehabilitated landform, ensuring long term stability of the structure.

6.2.1.4 Economic Benefit

Native ecosystem will have less impact on the rehabilitated landform, reducing the need for ongoing maintenance of the structure. This will reduce ongoing rehabilitation costs and ensure stability of the landform.

6.2.1.5 Social Benefit

The social benefit of re-establishing native ecosystem is the visually amenity and cohesion to the surrounding environment.

6.2.2 RA2 – Open Cut Pits (Pits 5-6)

6.2.2.1 Overview

This RA includes Open Cut Pits 5 and 6 and is situated on undulated terrain of the Sherwood and Sherwood West resource areas. RA2 will be utilised as water storage on closure and will have fencing installed to prevent cattle/human ingress.

6.2.2.2 Outcome

The proposed post mine land use for the Open Cut Pits post closure is to be water storage, which additionally may provide highwall habitat for some native species.

6.2.2.3 Environmental Benefit

The mean annual rainfall for the project is approximately 820 mm with most rainfall occurring during January. Long term outlooks predict rainfall to reduce however with an increased likelihood of more intense events across the year. This seasonal rainfall impacts on water security for the surrounding land use of cattle grazing. Landholders largely rely upon small farmers dams as well as groundwater resources to support grazing activities.

The PMLU of water storage will support the surrounding PMLU and provide a more consistent water source, throughout the year. It will also reduce the amount of groundwater accessed by graziers.

With the completion of the open cut pits, there is a potential for the residual void highwalls to be used as highwall habitat for fauna. Particularly, the highwalls and benches of the pit maybe be utilised by birds, bats and potentially macropods who can scale the pit benches. The following species have the potential to use the open cut pit high walls as habitat:

- *Falco cenchroides* (Nankeen Kestrel);
- *Falco peregrinus* (Peregrine Falcon);
- *Chalinolobus gouldii* (Gould’s Wattled Bat);
- *Chalinolobus picatus* (Little Pied Bat);
- *Miniopterus orianae oceanensis* (Bentwing Bat);
- *Ozimops lumsdenae* (Northern Free-tailed Bat);
- *Scotorepens greyii/sanborni* (Northern Broad-nosed Bat);
- *Setirostris eleryi* (Hairy-nosed Free-tailed Bat); and
- *Vespadelus troughtoni* (Eastern Cave Bat).

The most likely species to utilise the high wall are the Peregrine Falcon and Nankeen Kestrel. Both species are known to use cliff faces/ highwalls as habitat and have been recorded in the region (Atlas of Living Australia, 2021). The Bentwing Bat, Northern Free-tailed Bat, Northern Broad-nosed Bat, and Eastern Cave Bat were all identified at the Project during the SLR Consulting (2021) Flora and Fauna Survey.

6.2.2.4 Economic Benefit

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the open cut pits to water storages will provide an alternative water source, leading to a direct economic benefit to the future landholder.

6.2.2.5 Social Benefit

Future landholders will likely be pastoral holdings. Providing a water source suitable for stock would result in a PMLU that is consistent with surrounding land uses.

6.2.3 RA3 – Waste Rock Dumps

6.2.3.1 Overview

The proposed activities include four WRDs within the ML. On closure, material from the WRDs will be backfilled into Pits 1- 4. Any residual material will be reshaped on the WRD to form a stable landform which reflects the surrounding landscape. The WRDs will be topsoiled, and the landform will be left for vegetation to naturally re-establish.

6.2.3.2 Outcome

The proposed PMLU for the RA3 is native ecosystem.

6.2.3.3 Landform Design

The preferred PMLU for WRDs is native ecosystem and is to be reflective of the current pre-mining landform characterised by undulated terrain.

To achieve the final landform:

- Contaminated material identified in contaminated land assessments will be disposed of and encapsulated within the WRD
- WRDs will be shaped to drain similarly to the pre-mining landform;
- Subsoil will be spread where required to assist in achieving a free draining, low gradient landform;
- Topsoil will be spread to a thickness of 0.20cm for vegetation establishment.
- WRDs will be fenced off to prevent cattle ingress.

Native grasses and groundcover species will be allowed to self-establish. Where self-establishment is not achieved, seeding will occur.

6.2.3.4 Geometrical Design

The WRDs are designed as a low-profile structure located in valleys. The WRDs require access ramps to allow dumping of waste rock and maintenance access to the structure. Access ramps are located from ridges to limit the road lengths and ramp grades (ATC Williams, 2022).

Any unexpected PAF material will be encapsulated by NAF material. A NAF base is proposed to be constructed to provide a platform upon which any PAF material can be placed to prevent contaminant migration into the receiving environment (ATC Williams, 2022).

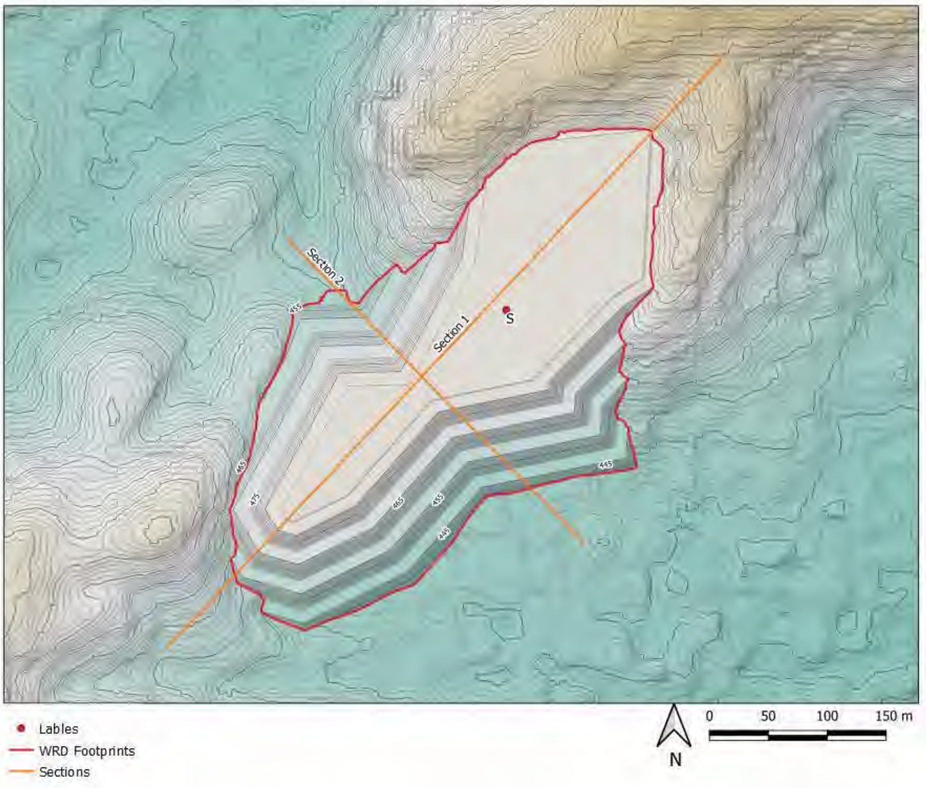


Figure 14. Waste Rock Dump (South) Cross Section Example (ATC Williams, 2022)

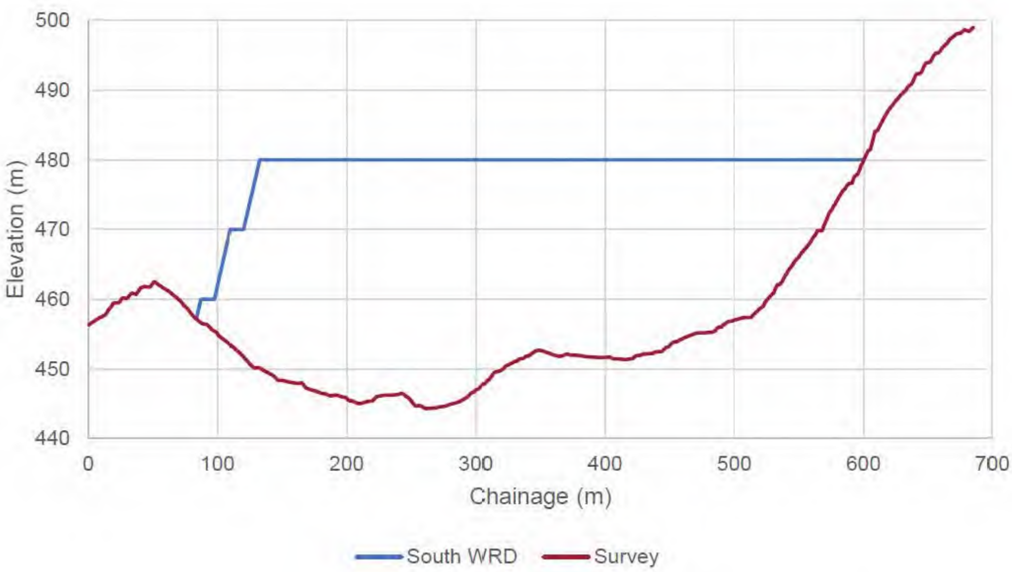


Figure 15. Waste Rock Dump (South) Cross Section 1 (ATC Williams, 2022)

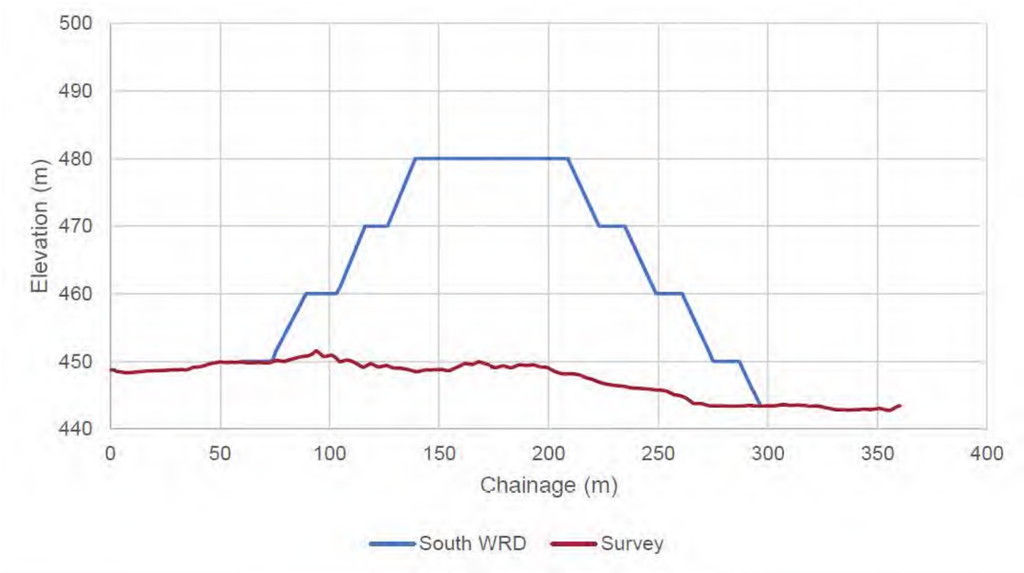


Figure 16. Conceptual WRD Design Cross Section 2

6.2.3.5 Environmental Benefit

The pre mining land use includes native ecosystem. Establishment of native vegetation (groundcover) on the WRD as the PMLU is reflective of the current pre-mining land use.

Native vegetation will result in an increase in plant biodiversity and in turn, the habitat for native fauna which would subsequently increase the biodiversity of the region. Habitat consists of groundcover species will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform.

6.2.3.6 Economic Benefit

The WRDs are to be fenced off to prevent cattle ingress, in turn protecting the native groundcover, and to preventing damage to the WRD surface. There is no direct economic benefit of native ecosystem on the WRD.

6.2.3.7 Social Benefit

The social benefit of re-establishing native ecosystem is the visually amenity and cohesion to the surrounding environment.

6.2.4 RA4 - Mine Infrastructure Areas

6.2.4.1 Outcome

The proposed post mine land use for RA4 is low intensity grazing. The exception to this is Landholder tracks, which will be retained for future use.

6.2.4.2 Landform Design

The preferred PMLU for the rehabilitation areas is to be reflective of the current pre-mining landform characterised by undulating hills, and relatively flat land draining towards Agate Creek.

To achieve the final landform:

- Infrastructure will be decommissioned and removed from the Project;
- Sediment dams and the water storage dam will be desilted, with material removed to the WRDs;
- Domains will be shaped by plant to drain similarly to the pre-mining landform;
- Subsoil will be spread where required to assist in achieving a free draining, low gradient landform;
- Topsoil will be spread to a thickness of 0.20cm for vegetation establishment.
- Native grasses and groundcover species will self-establish. Where self-establishment is not achieved, seeding of the access tracks will occur.

6.2.4.3 Environmental Benefit

The establishment of low intensity grazing will provide a good coverage of vegetation, which will minimise the chance of erosion due to runoff. The establishment of pasture on the domains will also limit the amount of fuel load, reducing the impact of potential bushfires.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems.

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

6.2.4.4 Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the Mine Infrastructure Areas to low-intensity grazing will provide an additional grazing area, leading to a direct increase in the economic benefit to the future landholder.

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

6.2.4.5 Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

6.2.5 RA 5 - Water Storage

A Landholder agreement is in place with Howlong Station to retain water management structures for water storage. A copy of the agreement is provided in Appendix D. Water quality monitoring throughout operations will determine if treatment or removal of water and sediment is required. The structures will be made safe and non-polluting for being given to the landholder.

6.2.5.1 Outcome

The proposed PMLU for the RA5 is water storage.

6.2.5.2 Environmental Benefits

Similar to RA2, the PMLU of water storage will support the surrounding PMLU and provide a more consistent water source, throughout the year. It will also reduce the amount of groundwater accessed for grazing activities.

6.2.5.3 Economic Benefits

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Provide an additional water source, will lead to a direct economic benefit to the future landholder.

6.2.5.4 Social Benefit

Future landholders will likely be pastoral holdings. Providing a water source suitable for stock would result in a PMLU that is consistent with surrounding land uses.

6.2.6 RA6 – Exploration

Exploration disturbance is rehabilitated, within 12 months of disturbance activities, in accordance with the Code of Environmental Compliance for Exploration and Mineral Development.

6.2.6.1 Outcome

The proposed post mine land use for RA5 is low intensity grazing.

6.2.6.2 Environmental Benefit

The establishment of low intensity grazing will provide a good coverage of vegetation, which will minimise the chance of erosion as a result of runoff. The establishment of pasture on the domains will also limit the amount of fuel load, reducing the impact of potential bushfires.

The pasture covered PMLU may also provide a food source for native fauna. The pasture cover will produce seed and flowers throughout the seasons, which may be utilised by native fauna, therefore helping support local ecosystems

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

6.2.6.3 Economic Benefit

Establishing grazing pastures will result in a lower cost of direct seeding and a quicker establishment of adequate vegetation cover, potentially leading to an earlier relinquishment of Mine Leases.

Future landowners of the Project area will likely be pastoralists as per the surrounding land uses. Rehabilitating the exploration areas to low-intensity grazing will provide an additional grazing area, leading to a direct increase in the economic benefit to the future landholder.

Additionally, other than occasional watering during closure, no further activities would be required to form a stable landform consistent with grazing.

6.2.6.4 Social Benefit

Future landholders will likely be pastoral holdings. Returning the land to grazing pastures will be preferential as this would result in a PMLU that is consistent with surrounding land uses.

6.3 PMLU Completion criteria

Completion criteria is used to determine if the PMLU has been achieved and shows if the mining domain has been rehabilitated to a point that the Final Landform PMLU has been achieved at surrender.

The Rehabilitation Milestones (RM) are outlined below.

Table 23. PMLU completion criteria

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
RM1	Infrastructure decommissioning and removal	• All buildings and associated infrastructure dismantled and removed offsite • All hardstand and concrete areas decommissioned removed • Pipelines removed • Waste removed • Drillholes, sediment ponds and sumps decommissioned • Machinery/ equipment not required for rehabilitation removed from site	Infrastructure is required to be removed from site to enable surface treatment of areas.	Documented inspection following infrastructure decommissioning and removal.
RM2	Remediation of contaminated land/sediment	• Contaminated land assessment is completed by a suitably qualified person • Identified contaminated material removed • Validation sampling determine that contaminant removal has been successful	• Contaminated material is required to be removed to minimise potential for environmental harm. • A validation report will provide verification that contaminants have been removed and landform shaping can commence.	Validation sampling report accepted by a suitably qualified Contaminated Land Auditor.
RM3	Landform development and reshaping / re-profiling (RA1)	• Pits backfilled with waste rock and suitably compacted • RA1 determined to be geotechnically stable by a suitably qualified geotechnical engineer	Landform is made safe to wildlife and humans	Inspection and report by a suitably qualified geotechnical engineer. QAQC report detailing that works were completed in accordance with design plans.

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
RM4	Landform development and reshaping / re-profiling (RA2)	• RA2 determined to be geotechnically stable by a suitably qualified geotechnical engineer • Safety bunding in constructed • Fencing and signage is erected	The final landform must be made stable and safe to humans and wildlife.	Inspection and report by a suitably qualified geotechnical engineer.
RM5	Landform development and reshaping / re-profiling (RA3)	• Landform is shaped as per design • RA3 determined to be geotechnically stable by a suitably qualified geotechnical engineer	The final landform must be consistent with the surrounding land and profiled to limit erosion.	Inspection and report by a suitably qualified geotechnical engineer. QAQC report detailing that works were completed in accordance with design plans.
RM6	Landform development and reshaping / re-profiling (RA4)	• Landform is shaped to be gently sloping, characteristic of the natural landform • Landform ripped parallel to landform • RA4 determined to be geotechnically stable by a suitably qualified geotechnical engineer	The final landform must be consistent with the surrounding land and profiled to limit erosion.	QAQC report detailing that works were completed in accordance with design plans.
RM7	Landform development and reshaping / re-profiling (RA5)	• HPDE Liner removed • RA5 determined to be geotechnically stable by a suitably qualified geotechnical engineer.	The final landform must be made stable and safe to humans and wildlife.	QAQC report detailing that works were completed in accordance with design plans.
RM8	Surface preparation	• Compacted soil ripped to at least 300mm • Topsoil placement of a minimum 20cm, where required	• Ripping and application of growth media will encourage	QAQC report detailing that works were completed in accordance with design plans.

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
			establishment of vegetation.	
RM9	Revegetation (native ecosystem)	• Natural revegetation strikes creates a groundcover >30% of analogue sites • Seeding rate of 4 – 10 kg/ha achieved where native species does not achieve >30% of analogue sites. • Where natural vegetation strike is not achieved to >30% of analogue sites, direct seeding of native species achieves >30% of analogue sites.	• Monitoring will assess success of natural revegetation and determine if intervention measures are required eg. further application of seed is required. • Vegetation species have been selected based on PMLU of grazing.	Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.
RM10	Revegetation (grazing)	• Natural revegetation strikes creates a groundcover >30% of analogue sites • Seeding rate of 4 – 10 kg/ha achieved (if natural revegetation unsuccessful) • Pasture vegetation seeding creates cover >30% of analogue sites of analogue sites.	• Monitoring will assess success of natural revegetation and determine if intervention measures are required eg. further application of seed is required. • Vegetation species have been selected	Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality.

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
			based on pre mine Regional Ecosystems.	
RM11	Achievement of surface requirements (native ecosystem)	• Weed species in densities less than 10% total coverage • Vegetation is comparable to established reference sites. • Average erosion rate of <5 t/ha/y with the maximum erosion rate at any point on the landform of <10 t/ha/y. • Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality • Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low • Groundwater monitoring complies with ANZECC/ARMCANZ (2000) Table 4.3.2 for livestock drinking water	• Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y. • Livestock drinking water values have been selected based on surrounding land use of grazing • Monitoring sites have been selected to capture all areas of disturbance • RA will be compared to reference sites to account for seasonal fluctuations.	• Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. • Report summarising water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality.
RM12	Achievement of surface requirements (grazing)	• Weed species in densities less than 10% total coverage • Vegetation is comparable to established reference sites. • Average erosion rate of <5 t/ha/y with the maximum erosion rate at any point on the landform of <10 t/ha/y.	• Site specific vegetation completion criteria will be determined based on reference site monitoring.	• Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
		• Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality • Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low • Groundwater monitoring complies with ANZECC/ARMCANZ (2000) Table 4.3.2 for livestock drinking water	• Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y. • Livestock drinking water values have been selected based on surrounding land use of grazing • Monitoring sites have been selected to capture all areas of disturbance • RA will be compared to reference sites to account for seasonal	will include data over a suitable period, considering seasonality. • Report summarises water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality.
RM13	Achievement of post-mining land use to a stable condition (native ecosystem)	• Vegetation is comparable to established reference sites. • Native fauna observed or indicators of these species have been recorded. • Certification from an REPQ that the domain has achieved stable condition • Certification from an AQP that the landform achieved a factor of safety 1.5.	• Site specific vegetation completion criteria will be determined based on reference site monitoring. • Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y.	• Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. • Report summarises water and sediment quality monitoring. The report will include data over a

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
		• Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality • Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low • Groundwater monitoring complies with ANZECC/ARMCANZ (2000) Table 4.3.2 for livestock drinking water	• Livestock drinking water values have been selected based on surrounding land use of grazing • Monitoring sites have been selected to capture all areas of disturbance • RA will be compared to reference sites to account for seasonal	suitable period, considering seasonality. • Inspection and report by a suitably qualified geotechnical engineer.
RM14	Achievement of PMLU to a stable condition (grazing)	• RA has maintained a stable, safe condition. • Vegetation is comparable to established reference sites. • Surface water quality measured at REMP sites complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality • Stream sediment at REMP sites complies with ANZECC/ARMCANZ (2000) Interim Sediment Quality Guidelines – low • Groundwater monitoring complies with ANZECC/ARMCANZ (2000) Table 4.3.2 for livestock drinking water	• Site specific vegetation completion criteria will be determined based on reference site monitoring. • Excessive rilling is unlikely to occur at erosion rates of <5t/ha/y. • Certification from a AQP is required for relinquishment. • Livestock drinking water values have	• Report summarising regular rehabilitation monitoring, utilising techniques such as the BioCondition Assessment Manual (or similar). The report will include data over a suitable period, considering seasonality. • Report summarises water and sediment quality monitoring. The report will include data over a suitable period, considering seasonality. • Inspection and report by a suitably qualified person to verify

Rehabilitation milestone		Milestone criteria	Justification of completion criteria	Verification of milestone achievement
			been selected based on surrounding land use of grazing • Monitoring sites have been selected to capture all areas of disturbance • RA will be compared to reference sites to account for seasonal	that the area has maintained a stable condition.
RM15	Achievement of PMLU to a stable condition (water storage)	• RA has maintained a stable, safe condition. • Pit water quality sampling complies with ANZECC/ARMCANZ (2000) for Livestock Drinking Water Quality	• Certification from a AQP is required for relinquishment. • Livestock drinking water values have been selected based on surrounding land use of grazing	• Report summarising water quality monitoring. The report will include data over a suitable period, considering seasonality. • Inspection and report by a suitably qualified person to verify that the area has maintained a stable condition.

7. Non-use management areas

There are no proposed non-use management areas.

8. Voids in Floodplains

The six Agate Creek Pits are situated on undulating terrain in the centre areas of ML 10003. To assess whether the voids will be impacted by flooding, ATC Williams (2022) conducted a hydraulic assessment using TUFLOW, a two-dimensional finite difference program. The results of the assessment are summarised below and provided in Appendix E.

8.1 Hydraulic Assessment

8.1.1 Model Domains

The TUFLOW model was set up to quantify the impacts of the 1:100 AEP and 1:1,000 AEP and includes the following areas:

- Open cut Pits 1 – 6;
- Four waste rock dumps;
- Seven sediment basins; and
- Water storage dam.

8.1.2 Base Topography

The topographical base for the TUFLOW model was developed from the Shuttle Radar Topography Mission (SRTM)-derived 1 Second data.

8.1.3 Direct Rainfall and Inflow Hydrographs

Direct rainfall was adopted over the mine site area, whist an inflow hydrograph was used at the upstream end of the model extents to represent flow within Agate Creek. The rainfall and hydrograph adopted represented the critical duration based on the RORB outputs for the median peak flow of the 0.1% AEP event with no losses (ATC Williams, 2022).

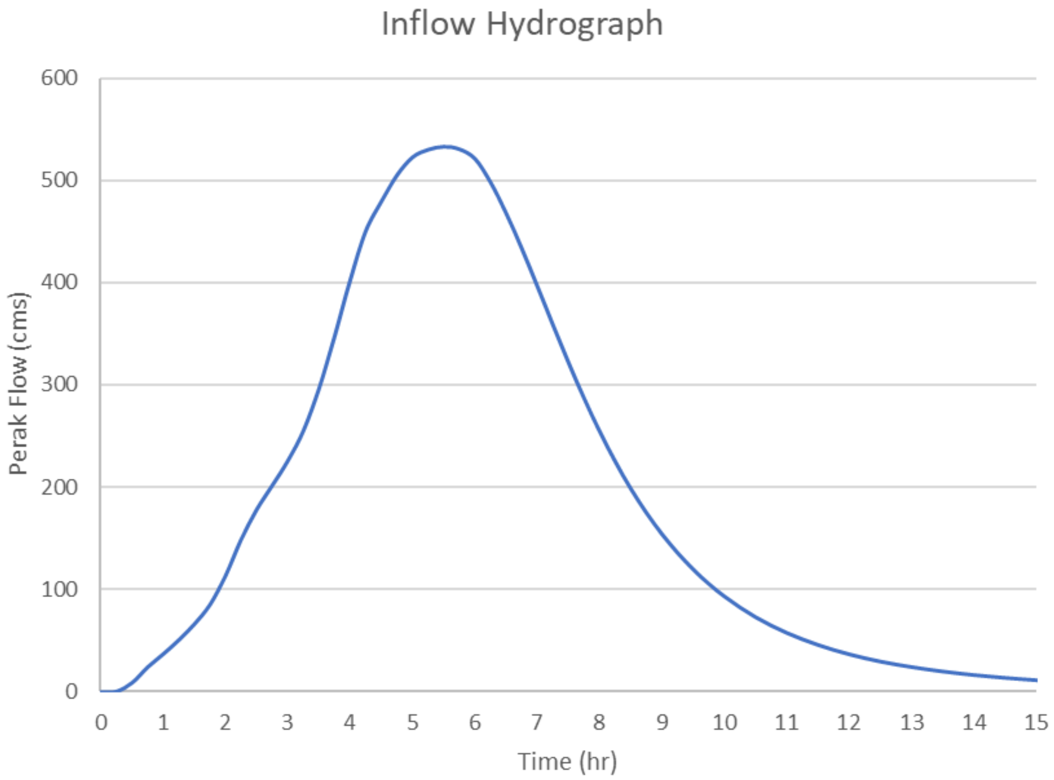


Figure 17. 0.1% AEP Agate Creek Inflow Hydrograph (ATC Williams, 2022)

8.1.4 Structures

8.1.4.1 Water Storage Dam

The MAW Dam is to be located to the south of the Pit developments and will receive inputs from the open cut pits and sediment basins (when discharge is not possible due to quality) via pumped transfer. The geometric parameters of the concept design for the proposed MAW dam are detailed in Table 19.

Table 19. MAW Dam Details (ATC Williams, 2022)

Parameter	Value
Indicative Depth (m)	4.4 m
Total Storage to Emergency Spillway	250 ML
Internal Batter Slopes	1 (V) : 3 (H)
External batter Slopes	1 (V) : 3 (H)

8.1.4.2 Sediment Pond Sizing

Proposed sediment ponds sizes were set with a spill risk of <20% (to achieve 80% hydraulic efficiency) as per the State Planning Policy (SPP) requirements. The required volume for the sediment storage was also determined based on the estimated soil loss of approximately 270 t/ha/yr and an assumed clean out frequency of every six (6) months.

Table 20. Sediment Ponds Details (ATC Williams, 2022)

Pond	Catchment Area (ha)	Settling Zone Volume (ML)	Sediment Storage Volume (ML)	Total Storage Volume (ML)	Depth from Spillway (FSL) (m)	Length at FSL (m)	Width at FSL (m)
A	1.72	2.7	0.2	3.9	2.5	75	23
B	2.73	4.1	0.3	4.4	2.7	85	27
C	5.84	6.5	0.7	7.2	2.7	103	33
D	7.92	8.8	0.9	9.7	2.9	113	37
E	5.84	6.5	0.7	7.2	2.7	103	33
F	3.24	4.2	0.4	4.6	2.6	88	28
Rom Pad	2.5 ha	4.1	0.3	4.4	2.7	85	27

8.1.5 Boundary Conditions

The outflow boundary conditions were modelled as free-draining outlets with slopes approximated from the elevation data (0.5% was adopted to Agate Creek). It was assumed that Agate Creek is not impacted by backwater or tailwater levels at this location (ATC Williams, 2022).

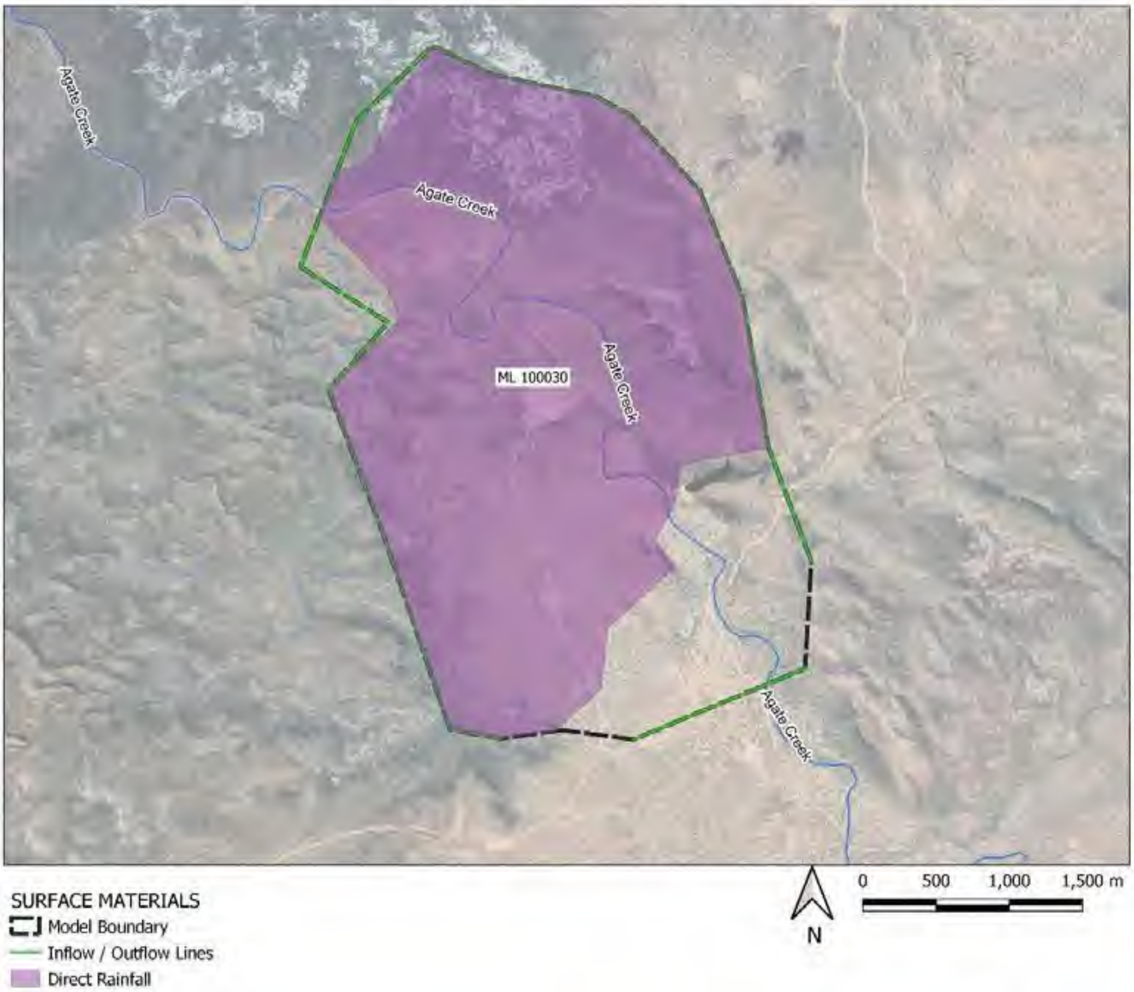


Figure 18. Tuflow Model Extents (ATC Williams, 2022)

8.1.6 Surface Roughness

Default surface roughness was modelled as a depth-varying Manning's 'n' value. Aerial imagery indicates similar vegetation conditions over the undisturbed site areas and the external catchments. A depth-varying Manning's 'n' value was adopted for the natural grasses due to the relatively high natural grassland over the catchment surfaces and sheet flow conditions being dominant within the flatter areas of the catchment (ATC Williams, 2022).

Table 21. Manning's Surface Roughness Parameters (ATC Williams, 2022)

Description	Manning's 'n'	Infiltration (IL, CL) (mm)	Losses Direct Rainfall Depth (IL, CL) (mm)
Floodplain (default where not overlayed by a material below)	Depth varying: Depth = 0 m to < 0.3 m, n = 0.2 Depth ≥ 0.3 m, n = 0.050	0, 0	0, 6.3
Medium Density Trees	0.075	0, 0	0, 6.3
Channel Flow	**0.030**	**0, 0**	

8.1.7 Flood Depths and Elevations

Flooding of Agate Creek overtops the creek's banks and generally follows the watercourse alignment. The 0.1% event maximum flood depths vary from shallow depths on the outer banks to approximately 6-8 m in deeper areas of the creek. Flow predominately runs along the eastern extents of the proposed mine development area and flows to the northwest. Pit 5 within the southern portion of the mine development area was found to have the least freeboard to the estimated flood levels at approximately 6 m. All remaining pit voids were well clear of the of the floodplain (ATC Williams, 2022).

8.1.8 Elevations

Agate Creek stream is modelled to experience high magnitude event velocities due to the relatively narrow channel and high peak flows. For the 0.1 % AEP event, velocity over the inundated Agate Creek floodplain varies between 0.5 - 5 m/s. Flow velocities from gullies were of less magnitude at only 0.5 m/s to 1.5 m/s (ATC Williams, 2022).

8.2 Flooding of Voids

Tuflow software has been utilised by ATC Williams to predict flood levels, velocity and depths of Agate Creek for a 0.1% AEP event. Modelling indicates that floodwaters from Agate Creek during events will not intrude on voids, with the majority of floodwaters being confined to the Agate Creek floodplain. Model results are displayed in Figure 19 to Figure 21.

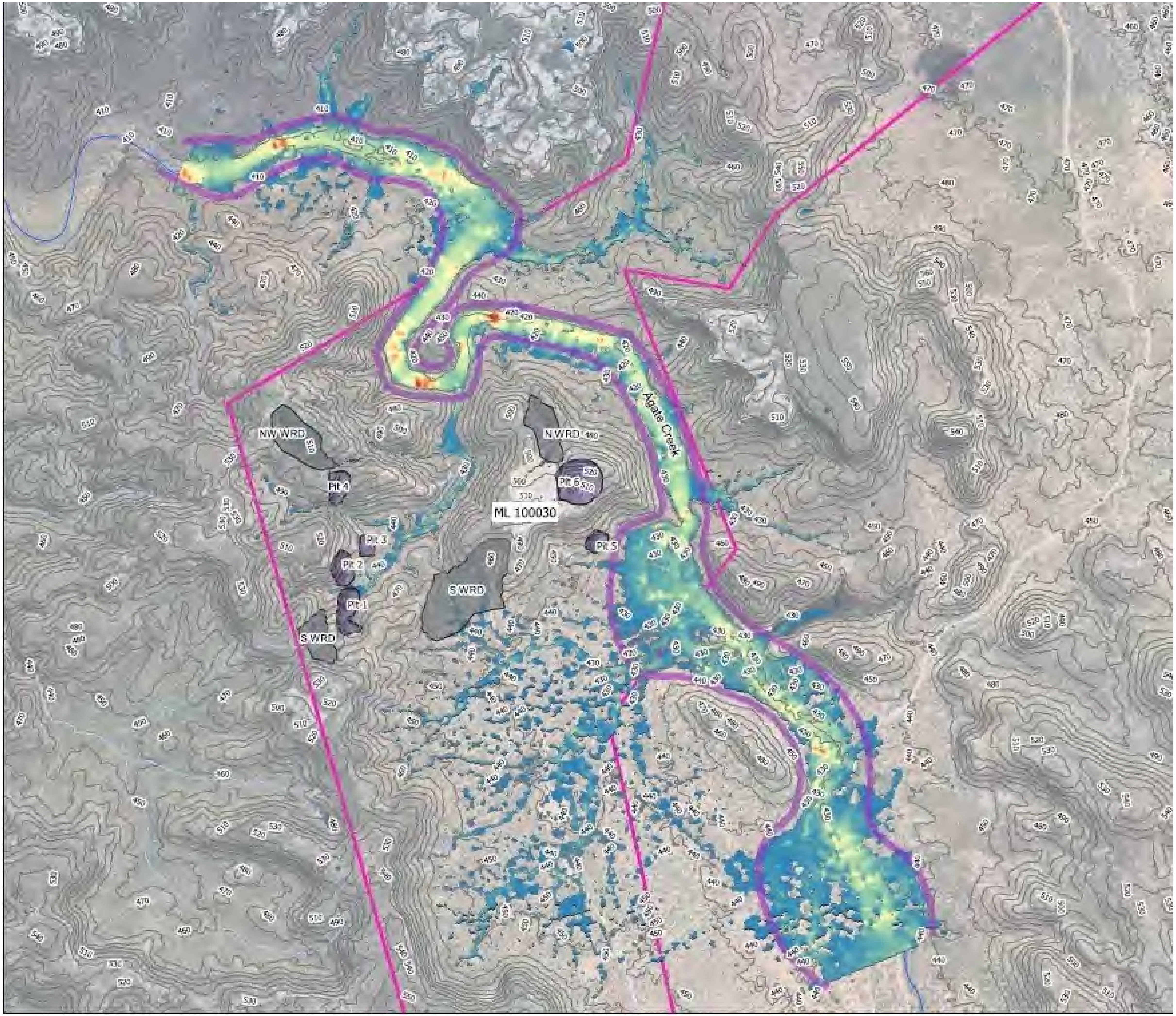
Figure 19. 0.1% AEP Maximum Velocity

LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM VELOCITY (m/s)

- 0.0
- 1.0
- 2.0
- 3.0
- 4.0
- 5.0
- 6.0



Client: Laneway Reources Ltd
Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

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Source: ATC Williams
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WULGURU TECHNICAL SERVICES

Figure 20. 0.1% AEP Maximum Water Depth

LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER DEPTH (m)

- <= 0.1
- 0.1 - 1
- 1 - 2
- 2 - 3
- 3 - 4
- 4 - 5
- 5 - 6
- 6 - 7
- 7 - 8

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Project number: 2021.08003
Coordinate Reference System: GDA 2020 Z54
Date: 1 June 2022

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Source: ATC Williams
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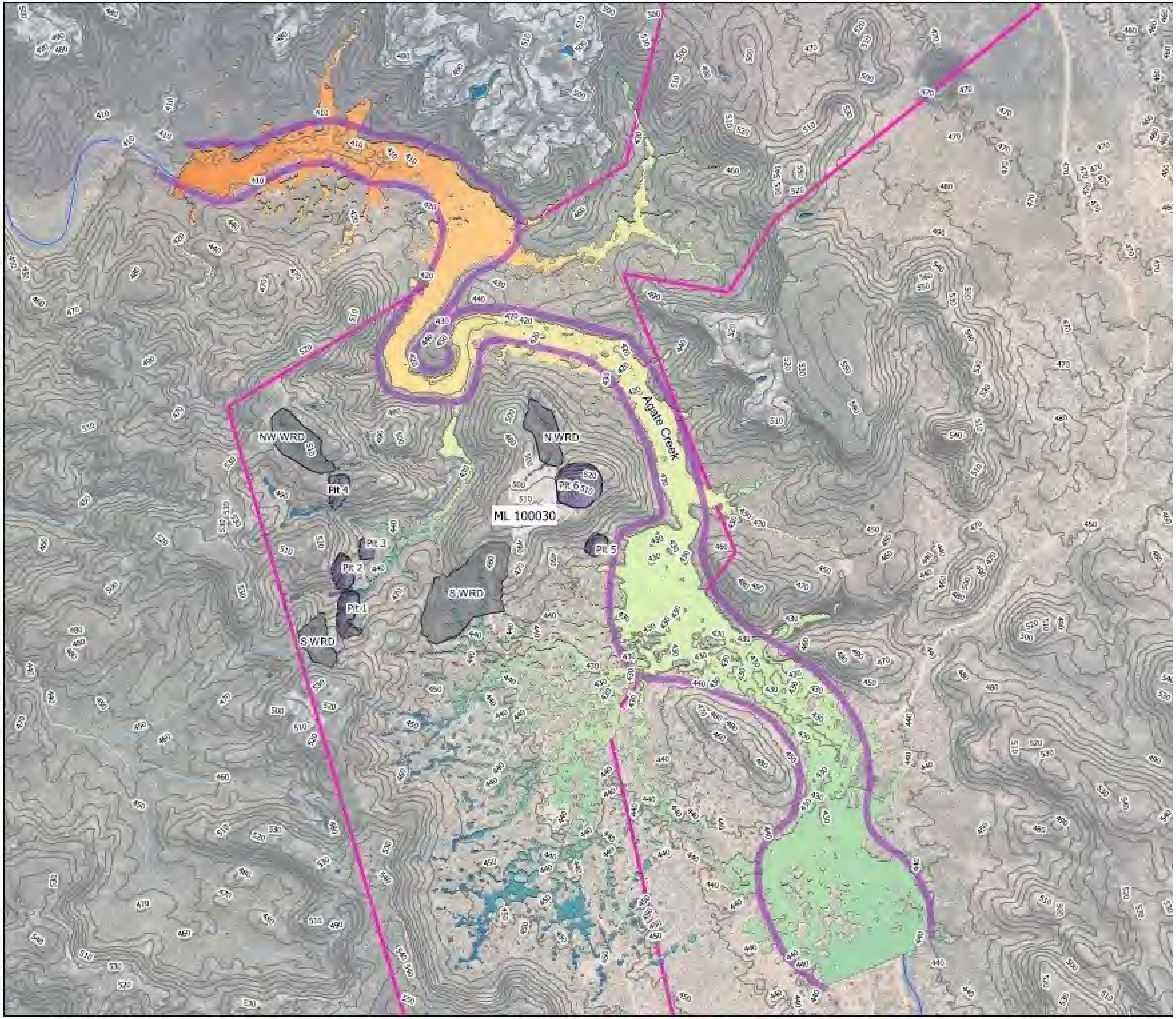
Figure 21. 0.1% AEP Maximum Water Elevation

LEGEND

- MINE LEASE
- EXISTING SITE CONTOURS 10m
- ASSUMED FLOODPLAIN EXTENTS

MAXIMUM WATER ELEVATION (RL m)

- 400
- 410
- 420
- 430
- 440
- 450



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9. Rehabilitation and Management Methodologies

9.1 General rehabilitation principles

9.1.1 Site Services

To ensure site safety, all services will be terminated, disconnected and isolated. Generators will be decommissioned and removed from site. Licenced contractors will remove sewage to a licensed offsite facility. Telecommunication services will be disconnected and removed. The infrastructure at the Project site will be decommissioned, removed, dismantled, or salvaged. Landholder roads as agreed will be left in a serviceable condition.

9.1.2 Contaminated Land Assessment

A contaminated land assessment is to be completed by a suitably qualified person, at all rehabilitation areas. Any contaminated material will be disposed of within the WRDs. Validation sampling will be completed to determine if the contaminant removal has been completed appropriately.

9.1.3 Site Preparation

Once all infrastructure and any contaminated material has been removed from site, the surface will be prepared to promote establishment of vegetation. Compacted surfaces will be deeply ripped to at least 300mm.

9.1.4 Soil Capping and Material Assessment

Topsoil will be required to supplement the growth of vegetation, reducing erosion, and helping to sustain the PMLU. Waste rock will be utilised to backfill Pits 1-4.

. A preliminary materials balance is provided in Table *22*.

Table 22. Project Soil Types

RA	Area (ha)	Volume of topsoil required (m^3)	Volume of NAF required (m^3)
RA1	3.83	1,660	87,000
RA2	3.44	0	0
RA3	25.88	51,760	0
RA4	13.93	27,860	0
RA5	6.49	0	0
RA6	3.34	6,680	0
Total	60.11	87,960	87,000
Available		1,076,210*	2,729,000

*Includes available topsoil across whole of ML100030 which may be utilised via borrow pits for use in rehabilitation

9.1.5 Topsoil Striping

Where available, topsoil was stripped during the construction phase of the project. Prior to new ground disturbance, topsoil is stripped and stockpiled within the RA3 domain. Stockpiles are to be surveyed annually, and the total volume recorded in the Topsoil Stockpile Register.

Table 23.Stockpiles Topsoil Volumes

Soil Type	Description	Estimated Volume(m^3)*
Brown Mellic Kandosol	Brown loamy A1 horizon with coarse sand. Light brown loamy B1 horizon with coarse sand	15,213
Red Massive Gypsic Vertosol	Redish brown clay loam A1 horizon. Light redish brown clay B horizon with gypseous nodules	975
Brown Bleached Kandosol	Brown loamy sand A1 horizon. Light brown sandy loam B horizon with no segregations	351
Brown Lithsolic Rudosol	Unsuitable topsoil due to shallow A1 horizon and rock content	0
Total		**16,539**

*Only includes volumes of topsoil to be stripped during construction. Additional topsoil is available outside current mining domains and may be accessed in future via borrow pits

9.1.6 Topsoil Stockpiling

Once stripped, topsoil is stored at a maximum height of 2m, and only in locations that have been previously designated by site plans. A register of topsoil stockpiles is kept and maintained on-site, recording stockpile number, placement date, source location, soil type, and any relevant comments. Stockpiles are designed and located to minimise topsoil loss through runoff and erosion and are marked and identifiable with signage. Active stockpiles are inspected as part of ongoing environmental inspections.

9.1.7 Topsoil Application

Topsoil will be spread at depths of approximately 0.2m. There is a limited volume of high-quality topsoil at Agate Creek within mining domain areas. Additional topsoil may be accessed via borrow pits within ML 100030. Topsoil application will be prioritised to areas which pose more of a risk of erosion (bare and/or compacted areas) such as the WRDs and infrastructure areas.

Where land is adequately prepared for rehabilitation, the application of topsoil will occur in essentially the reverse sequence to topsoil stripping. The process for the application of topsoil to surfaces is as follows:

- Laneway will ensure that the mining domain/area has been decommissioned (infrastructure removed).
- The landform is shaped to final landform design either using insitu material or burden (non-acid forming).
- Landform will then be ripped. Ripping will occur via dozer with ripper attachment parallel to surface contours.
- Topsoil will be applied and ripped to promote vegetation strike.
- After application, the topsoil will be stabilised with a sterile cover crop, pasture grasses and/or native species to establish revegetation cover as early as possible.
- Install appropriate ESCs.

9.1.8 Erosion and Sediment Control

Erosion and sediment control measures will be implemented and documented using environmental inspection forms. Permanent erosion and sediment controls have been incorporated into the designs and are based on catchment characterisation.

Revegetation will minimise erosion and act as a sediment control, and ensure landforms are both geochemically and geophysically stable.

Effective erosion and sediment control structures are installed surrounding the site. An allowance has been made to retain four additional sediment controls post mine closure, with some minor earthworks required to ensure these controls are safe and effective. The site runoff dam is the primary sediment control on the Project. Site affected water will continue to be directed to this structure.

Erosion and sediment control plans should be considered when conducting rehabilitation activities, and should include the following:

- Contours and drainage lines;
- Disturbance limits;
- Earthwork extents;
- Control measure locations;
- Order of work schedule;
- Construction details and notes; and
- Specific operating procedures.

9.1.9 Revegetation

Surfaces will be ripped to a depth of 300mm, where practical, and allowed to revegetate naturally. If annual monitoring identifies that natural revegetation has not been successful (natural vegetation strike <30% surface coverage compared to reference site), areas will be seeded with appropriate plant species. Plant species have been selected considering the pre clearance regional ecosystem and well as the integrity of WRD. The proposed target species are provided in Table 24.

Table 24. Vegetation seed mix

RA2		RA1	RA3, RA4, RA5
Target Regional Ecosystem		9.12.11 2.11.1a	9.5.10a/9.12.11
Dominant species	N/A	Eucalyptus crebra	Eucalyptus microneura
		Eucalyptus whitei	Eucalyptus crebra
		Corymbia erythrophloia	Eucalyptus leptophleba
		Corymbia dallachiana	Eucalyptus whitei
		Denhamia cunninghamii	Corymbia pocillum
		Gardenia vilhelmii	Corymbia erythrophloia
		Grevillea glauca	Corymbia dallachiana
		Heteropogon contortus	Denhamia cunninghamii
		Aristida spp	Petalostigma banksii
			Gardenia vilhelmii
			Grevillea glauca
			Heteropogon contortus
			Aristida spp
			Themeda triandra

9.1.10 Weed Management

Weed hygiene practices will be implemented at all stages of closure. All mobile plant, machinery, heavy vehicles and earthmoving equipment will be inspected upon entry to site. If weeds or seeds are identified, vehicles and equipment will be cleaned in the site wash bay. Weed density will be monitored as part of rehabilitation monitoring, and appropriate treatment controls will be implemented as required.

9.1.11 Water Management

The water management strategy for the Project aims to separate clean stormwater from potentially affected site water. Structures such as runoff dams and sediment dams will be retained onsite whilst rehabilitation works are occurring. Controlled releases of water will occur when required and when water quality meets the release criteria stipulated in the EA.

Closure objectives for Agate Creek stipulate final landforms are to be geochemically stable and will not generate seepage or leach to surface water or groundwater. Contaminated land validation sampling will verify that contaminated material has been removed or if additional work is required to prevent the release of contaminants to waters.

9.1.12 Flooding

The result of flood modelling is included in Section 8. Flood modelling indicates that the mining operations and infrastructure are located above Agate Creek 0.1% AEP event levels. The risk of flooding is not expected to impact upon the success of rehabilitation activities.

9.1.13 Subsidence Management

There are no underground workings proposed at Agate Creek. Subsidence management is not required.

9.1.14 Waste characterisation

C&R Consulting (2022) conducted a geochemical waste rock characterisation (WRC) study. The initial results suggest that waste rock is predominantly benign lithology of mostly felsic volcanics, as such, most waste rock samples are in the slightly acidic range. This is in line with the underlying lithologies present. A summary of the study is provided below.

9.1.14.1 Methodology

The waste rock sampling programme for the six proposed open-cut pits was guided by the Australian technical guidelines for the geochemical assessment of mining wastes (Department of Mines and Energy [DME], 1995; Department of Environment and Heritage Protection [DEHP], 2013; Commonwealth of Australia [COA], 2016). The DME (1995) guideline recommends that the tonnage of mined material determine the sampling interval, whereas the more recent guidelines favour a risk-based approach.

The waste characterisation sampling strategy for the Agate Creek stage 2 expansion open-cut pits incorporated the collection of samples from regular intervals (every 3 m) in selected RC drill holes. These selected drillholes were chosen to represent a cross-section of the rock profile in each proposed open-cut pit.

The interval spacing was selected to cover all areas anticipated to have acid rock drainage (ARD) potential – including around the ore bodies, alteration zones, transitional material and fresh rock. This sampling methodology was adopted with the aim to provide a good statistical and spatial representation of the waste rock profile in each pit.

A total of 260 rock samples were collected from 27 drill holes across the six proposed pits (Table 25).

Table 25. Summary of Samples Taken Across Proposed Pits (C&R Consulting, 2022).

Proposed Pit	Waste tonnes	Number of holes	Hole ID	Number of samples	Number of samples/pit
Pit 1	750,195	4	CCGC338	7	22
			CCGC339	1	
			CCGC340	7	
			CCGC341	7	
Pit 2	348,570	3	CCGC321	9	22
			CCGC343	7	
			CCGC344	6	
Pit 3	51,627	2	CCGC323	5	14
			CCGC324	9	
Pit 4	229,591	5	CCGC316	9	34
			CCGC319	11	
			CCGC345	7	
			CCGC346	1	
			CCGC347	6	
Pit 5	157,318	2	CCGC326	7	18
			CCGC329	11	
Pit 6	2,236,780	11	CCGC302	3	150
			CCGC303	9	
			CCGC306	11	
			CCGC308	11	
			CCGC309	1	
			CCGC311	21	
			CCGC334	6	
			CCGC336	1	
			CCGC349	14	
			CCGC354	25	
			CCGC356	48	
Total	**3,774,081**	**27**	**-**	**260**	**260**

9.1.14.2 Static Tests

All 260 samples dispatched to the ALS laboratory underwent static geochemical testing to evaluate the risk associated with the potential oxidation of sulphides, acid generation, and the presence of metals/metalloids and salts.

Each sample underwent static geochemical testing for:

- pH;

- Electrical conductivity (EC);
- Total sulphur;
- Acid neutralising capacity (ANC);
- Net acid generation (NAG);
- Net acid production potential (NAPP);
- Major dissolved anions for Cl, F and SO4; and
- Total metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V and Zn.

Further information is provided in Appendix B.

9.1.14.3 Kinetic Leach Column Tests

Kinetic leach column (KLC) tests accelerate the weathering of samples and provide information on the magnitude and/or effects of dynamic processes that result from weathering. Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period of time.

Four samples were dispatched to a NATA-accredited laboratory for KLC tests: one from Pit 1, one from Pit 4 and two from Pit 6. These large KLC samples (>25 kg) represent a considerable proportion of the waste rock profile of each pit

Each kinetic leachate column underwent kinetic geochemical testing for:

- pH;
- EC;
- Total dissolved solids (calculated);
- Hardness;
- Acidity;
- Alkalinity;
- Major cations for Ca, Mg, Na and K;
- Major anions for Cl, F and SO4; and
- Dissolved metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Sb, Se, Te, Th, U, V and Zn.

Further information is provided in Appendix B.

9.1.14.4 Geochemical Analysis Results

9.1.14.4.1 Acid Base Account

pH Value

Of the 260 waste rock samples, the median pH value was neutral (6.7) with values ranging from slightly acidic (4.5) to slightly basic (8.8). As demonstrated in Figure 22, the majority of the samples were in the neutral range, however, slightly acidic samples were prevalent, indicative of the waste rock lithology.

Due to the method of testwork (fluid extract from crushed samples with a very high surface area to solution ratio) it is noted that both low and high pH results in the waste rock are expected to be a worst case scenario. Further, for significant runoff to occur at Agate Creek, the expected rainfall dilution factor would be greater than 1:5 (sample:water) ratio utilised in analysis thus counteracting the resulting acidity or alkalinity (C&R Consulting, 2022).

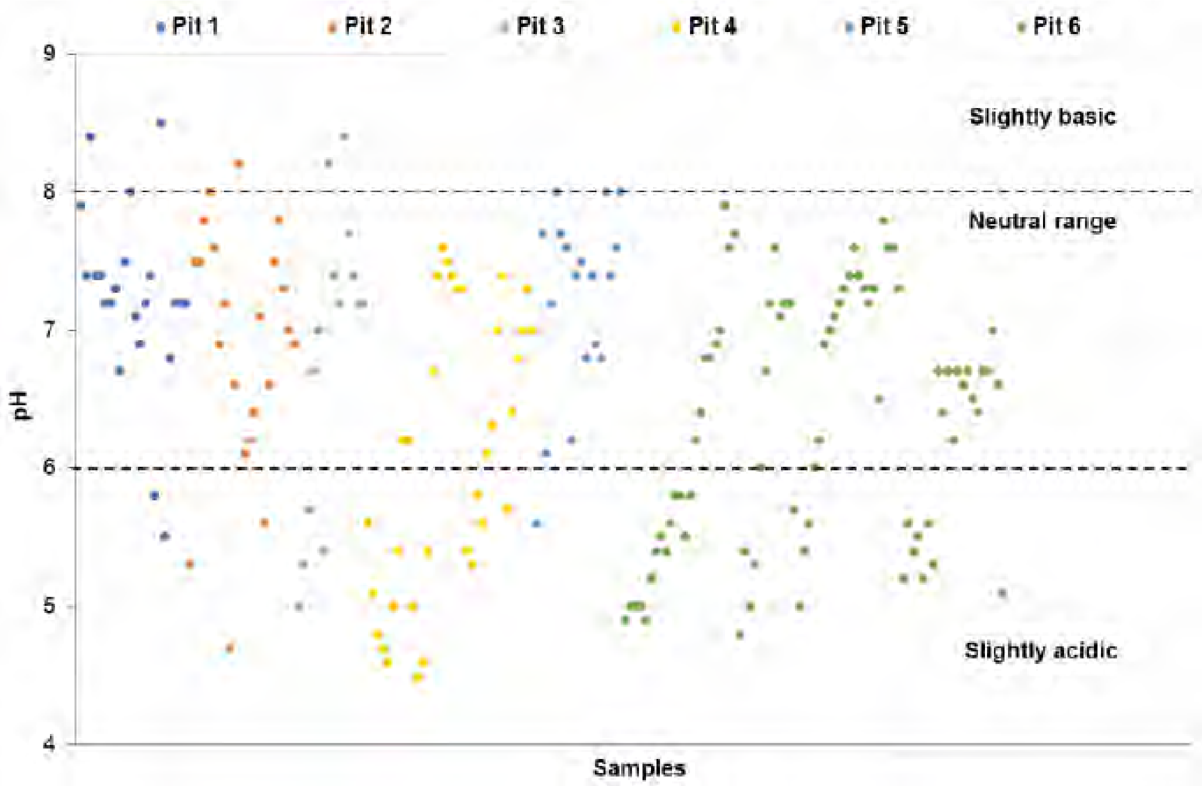


Figure 22. pH Values for Agate Creek Waste Rock Samples (C&R Consulting, 2022).

Electrical Conductivity

Majority of the waste rock samples have low electrical conductivity (EC) values (<300 µS/cm). The results ranges from 7 µS/cm to 1,680 µS/cm with a low median of 46 µS/cm. With the exception of an outlier from Pit 2 (1,680 µS/cm), all EC results were below 500 µS/cm.

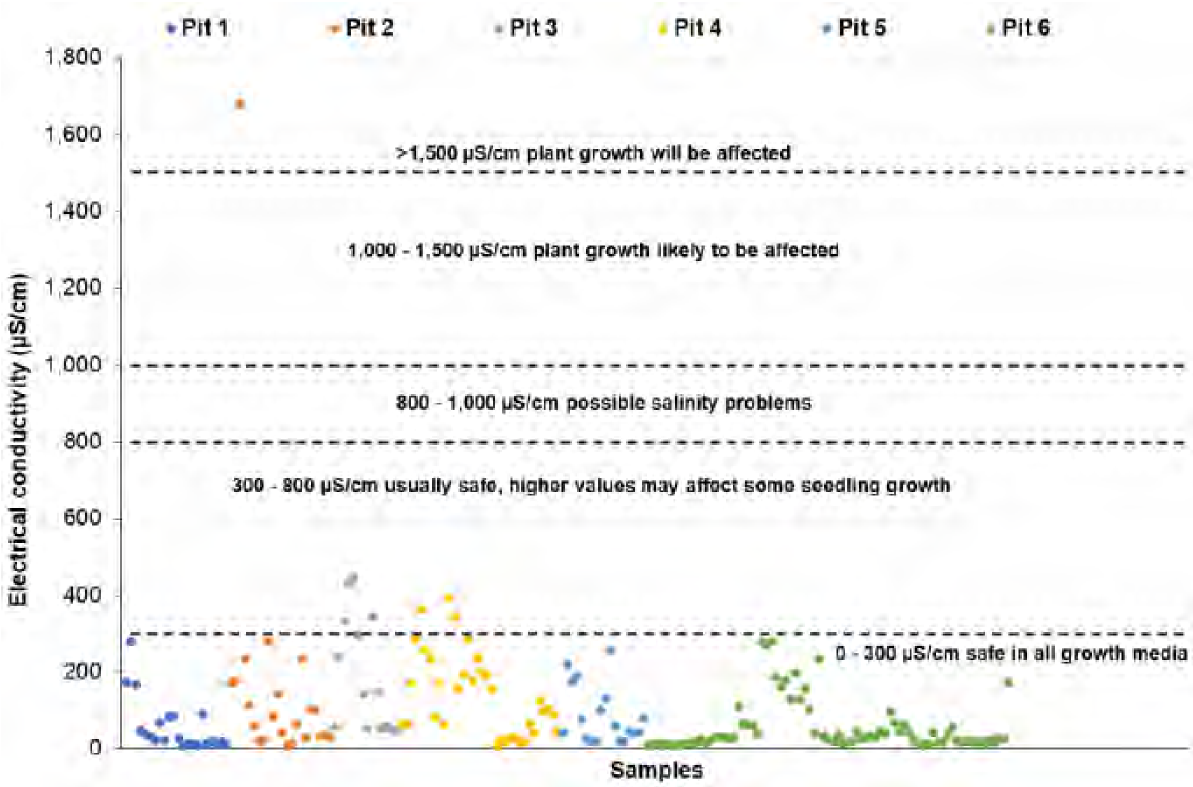


Figure 23. Electrical Conductivity for Agate Creek Waste Rock Samples (C&R Consulting, 2022).

Total Sulphur

Sulphur levels measured in the waste rock samples were extremely low with majority of the samples being below the limit of reporting (<0.01%) with the highest result being 3.05%. Resultingly, majority of the waste rock is considered barren with respect to total sulphur (Figure 24).

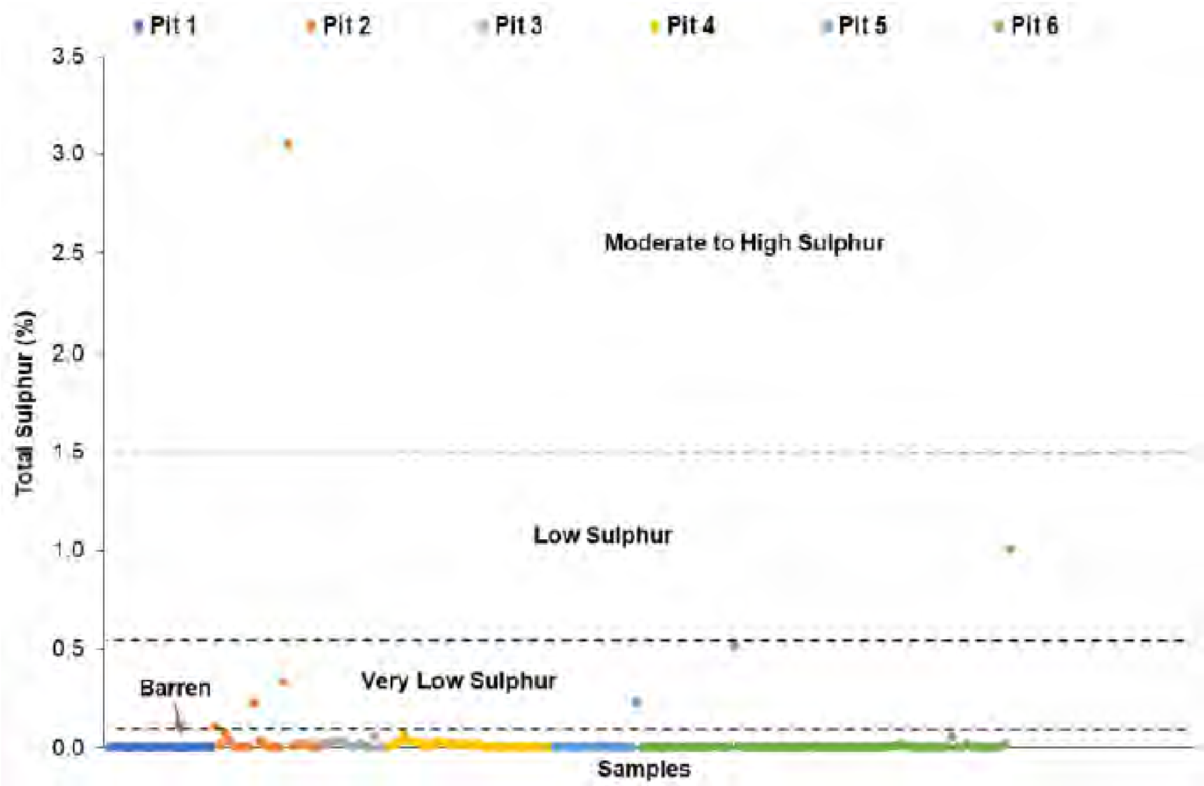


Figure 24. Total Sulphur Concentration for Agate Creek Waste Rock Samples (C&R Consulting, 2022).

Maximum Potential Acidity (MPA)

MPA is the maximum amount of acid that can be produced by the oxidation of sulphur-bearing minerals in the waste rock material. MPA is calculated from the total sulphur content. The MPA – that could be generated by the 260 Agate Creek waste rock samples – ranges from 0.15 to 93.3 kg H_2SO_4/t and has a low median value of 0.2 kg H_2SO_4/t. (C&R Consulting, 2022).

Acid Neutralising Capacity (ANC)

ANC is related to the amount of acid neutraliser (usually carbonate minerals) in the waste rock sample. ANC is determined experimentally by reacting a standardised acid mixture with a known amount of waste rock sample – and is reported as kg H_2SO_4/t eq. (equivalent). The ANC of the 260 Agate Creek waste rock samples ranges from 0.25 to 28.0 kg H_2SO_4/t eq., with a low median of 3.0 kg H_2SO_4/t eq. (C&R Consulting, 2022).

ANC:MPA Ratio

The ANC:MPA ratio can assist in classifying the potential for waste rock samples to generate acid. The low and negligible risk samples contain more acid-neutralising than acid-generating minerals, whereas the potential and increased risk samples contain more acid-generating than acid-neutralising minerals. To summarise the Agate Creek waste rock sample ANC:MPA ratio results:

- 204 samples are considered to be of negligible to low risk;
- 41 samples are deemed to be a potential risk; and
- 15 samples are regarded as an increased risk.

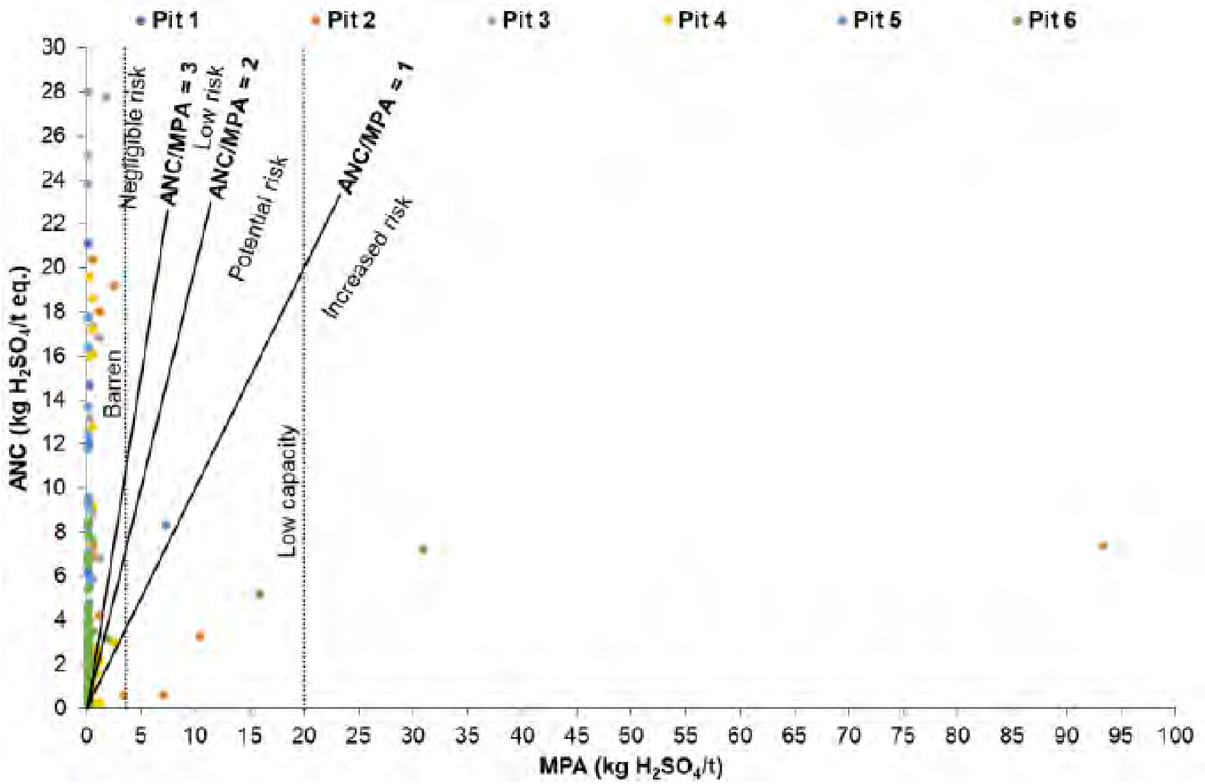


Figure 25. ANC:MPA Results for Agate Creek Waste Rock Samples.

Net Acid Production Potential (NAPP)

NAPP is a theoretical calculation of the net acid producing (or consuming) value of a rock sample. The NAPP values provide classify the acid forming potential of a material (C&R Consulting, 2022).

Table 26. NAPP Classification Categories (C&R Consulting, 2022; Miller, 1997).

ARD Classification	NAPP Value ($kg\ H_2SO_4/t$)
Potentially Acid Forming (PAF)	>10
Uncertain	0 to 10
Non-Acid Forming (NAF)	-50 to 0
Acid Consuming Material	< -50

Of the 260 waste rock samples, 45 have positive NAPP values. However, most of these positive samples are in the uncertain range, with only three samples having values greater than 10. These are associated with either Pit 2 or Pit 6 (C&R Consulting, 2022).

Net Acid Generation (NAG) Test

The NAG test is used to directly measure the net amount of acid produced by a waste rock sample.

Generally speaking, samples with a $NAG_{(pH)}$ (oxidised pH) below 4.5 may be acid generating and samples with a $NAG_{(pH)}$ equal or greater than 4.5 (≥4.5) are unlikely to be acid producing. However, the NAG test does not estimate acid neutralisation potential, therefore the combined use of the NAPP values and the NAG results were utilised for a more detailed classification of acid generation.

Figure 26 demonstrates that most Agate Creek waste rock samples have a $NAG_{(pH)}$ greater than 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast, one sample has a negative NAPP value and $NAG_{(pH)}$ below 4.5. In addition, several samples have NAPP values slightly above 0 that coincide with $NAG_{(pH)}$ in excess of 4.5. Both groups are classified as uncertain PAF. Five samples are certainly PAF, having a $NAG_{(pH)}$ less than 4.5 and a positive NAPP value. (C&R Consulting, 2022).

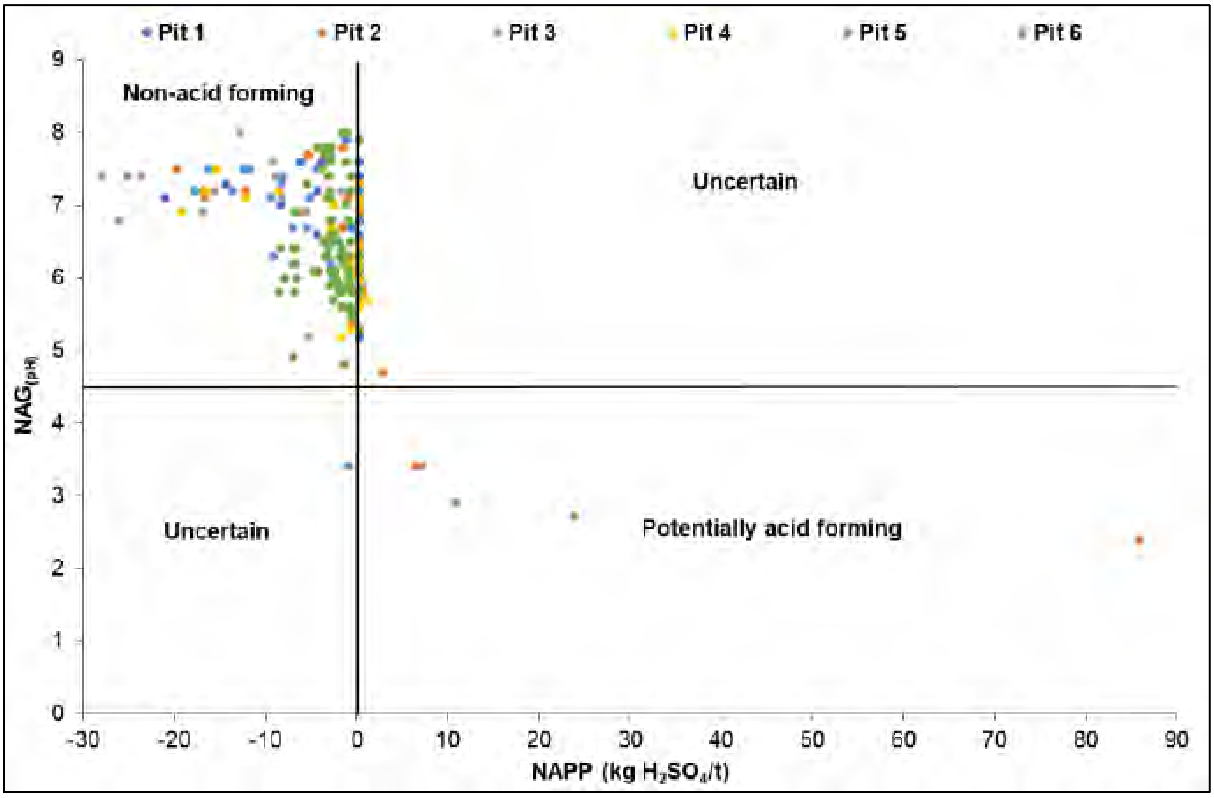


Figure 26. NAG(pH) versus NAPP for Agate Creek Waste Rock Samples (C&R Consulting, 2022).

Applying the NAG(pH) and total sulphur geochemical classification criteria (Table 27), it can be shown that most waste characterisation samples are NAF.

Of the 260 Agate Creek waste rock samples, there are only six samples that could be categorised as PAF when the NAG(pH):

- Three samples in Pit 2;
- One sample in Pit 5; and
- Seven samples in Pit 6.

However, these samples make up less than 14% of total samples and sulphur values are still very low to low (with the exception of Pit 2). It is therefore expected that only one of these six samples presents an acid drainage issue because:

- The amount of produced acid would be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

Table 27. Geochemical Classification Criteria for Agate Creek Waste Rock Samples (C&R Consulting, 2022).

Geochemical Classification	Total Sulphur (%)	$NAG_{(pH)}$	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6
NAF (barren)	≤0.1	-	22	18	14	34	17	142
NAF (very low sulphur)	>0.1 to ≤0.55	≥4.5	0	1	0	0	0	1
NAF (low sulphur)	0.55 to 1.5	≥4.5	0	0	0	0	0	0
PAF (very low sulphur)	0.1 to ≤0.55	<4.5	0	2	0	0	1	6
PAF (low sulphur)	0.55 to 1.5	<4.5	0	0	0	0	0	1
PAF (moderate to high sulphur)	>1.5	<4.5	0	1	0	0	0	0
Percentage of NAF samples			100%	86.4%	100%	100%	94.4%	95.3%
Percentage of very low sulphur PAF samples			0%	9.1%	0%	0%	6%	4.0%
Percentage of low sulphur PAF samples			0%	0%	0%	0%	0%	0.7%
Percentage of moderate to high sulphur PAF samples – actionable levels			0%	4.5%	0%	0%	0%	0%

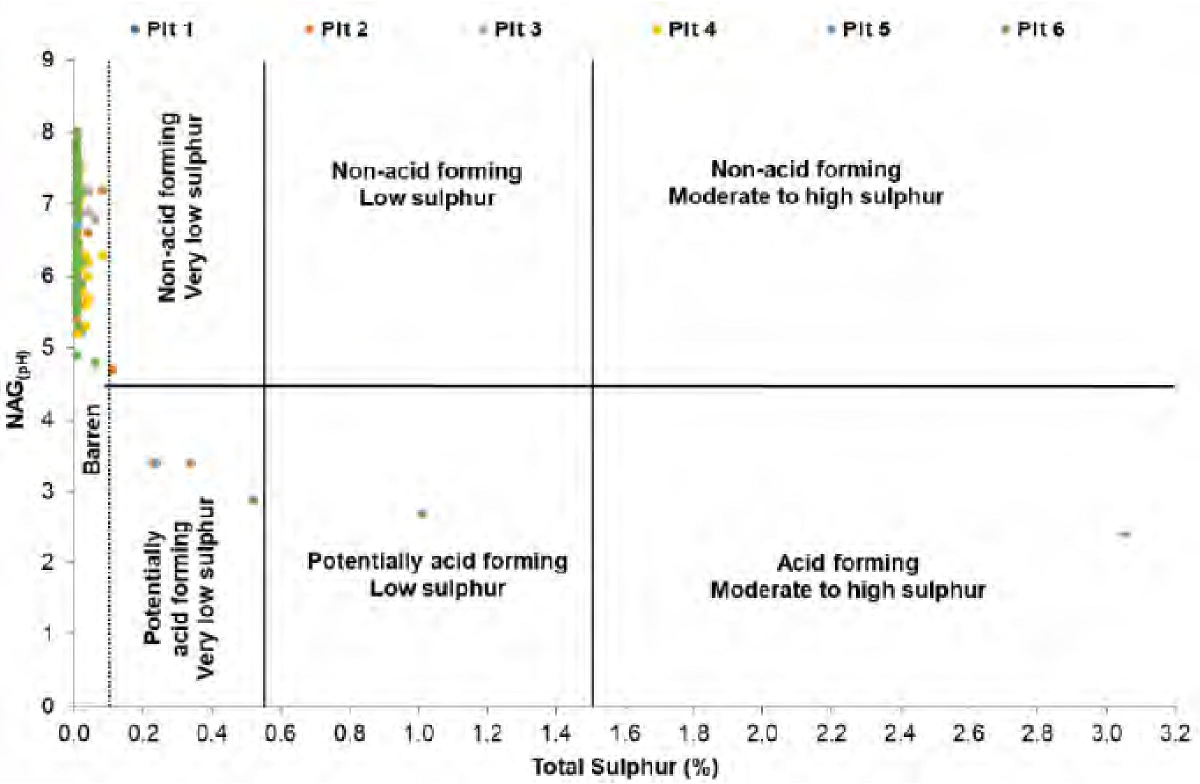


Figure 27. $NAG_{(pH)}$ versus Sulphur for Agate Creek Waste Rock Samples (C&R Consulting, 2022).

9.1.14.5 Metal / Metalloid Analyses

Metal and Metalloid analyses indicate that levels of fluoride were above the guideline level of 2 mg/L in many of the waste rock samples (static tests). Results ranged from >0.5 mg/L to 63 mg/L. Fluoride values are not uncommon for the Agate Creek area which is a volcanic province where fluorine enrichment is not unexpected. The possibility of a high ambient level implies that the overall risk associated with fluoride is low. In the KLC results, fluoride trended down to the compliance level of 2 mg/L by the 4th leach, supporting the overall proposition that the overall environmental risk from fluoride is low (C&R Consulting, 2022).

Dissolved sulphate levels in the static test results from waste rock samples range from 5 mg/L to 1760 mg/L with a low median value of 20 mg/L. Only one sample from Pit 2 is above the ANZECC and ARMCANZ (2000) Livestock Drinking Water Guideline of 1000 mg/L. Sulphate values in the Kinetic Leach Tests were all within compliance levels. Based on these results the environmental risk from sulphate is considered low (C&R Consulting, 2022).

KLC tests indicate concentrations of aluminium, boron, copper and zinc above guideline values. These exceedances were relatively low and were probably associated with adsorbed species on colloids being included in the “dissolved” analyses. As such, these exceedances are considered to impact only a very low to low environmental risk to the Agate Creek waste rock dumps (C&R Consulting, 2022).

Results of Metal and Metalloid analyses are detailed in Appendix B.

9.1.14.6 Risk of Waste Rock Impacts

The WRC of waste rock across the 6 proposed pits at Agate Creek are considered to be of low risk to the receiving environment given the results of Static and Kinetic analyses (Appendix B).

9.1.14.7 Identification of Waste Rock

Waste rock material is initially classified by the Laneway geologist using both the geological model. Following firing and stockpiling of waste, the geologists inspects the material and confirms the initial classification as either NAF or PAF. Classified waste rock is then transported to the surface for placement in the appropriate WRD. Once in the dump, the waste rock is again sampled to verify the classification. This ensures that the material has been placed in the correct location.

9.1.15 Final landform design

The proposed PMLU's are a mixture of native ecosystem and low intensity grazing. Reshaping will be required at certain domains, to ensure the landform is stable and not susceptible to erosion. Waste rock will be backfilled to Pits 1 – 4 and any residual material will be disposed of in the WRD. Water management structures and Pits 5-6 are to be retained as water storages.

9.1.15.1 Landform Structures

Final Landform structures for the Project are detailed in Table 28.

Table 28. Landform structures for the Project

RA	Landform Design and Rehabilitation
RA1	• Pits are to be backfilled with waste rock. • The surface will be shaped to ensure a safe, stable landform. • Landform will be topsoiled and ripped to promote vegetation growth. • Landforms will be seeded with species relevant to the regional ecosystem. • Domain to be monitored for rehabilitation success.
RA2	• Pits are to be stabilised by securing the highwalls to ensure a safe, stable landform. • Once deemed stable, a bund and fencing will be erected around the open cut to prevent ingress.
RA3	• Landforms to be shaped to a stable landform. • Topsoil will be applied to bring the domain to final landform elevation. • Topsoil will be ripped parallel to the contour to promote vegetation strike. • Landforms will be seeded with pasture species • Domain to be monitored for rehabilitation success.
RA4	Areas to be progressively rehabilitated during time domains are no longer required. • Infrastructure is to be decommissioned and removed from site. Access tracks, fence lines and hardstands required for the PMLU to be retained. • Landform to be shaped with subsoil to become free draining. • Topsoil will be applied to bring the domain to final landform elevation. • Topsoil will be ripped parallel to the contour to promote vegetation strike. • Landform will be seeded with pasture and native species. • Domain to be monitored for rehabilitation success.
RA5	• All associated infrastructure is to be removed from the domain. • Mine affected material is to be disposed of the in WRDs. • HPDE Liner removed • If required, landforms will be shaped to ensure a safe, stable landform.
RA6	• Infrastructure (if any) is to be removed from exploration tracks and pads. • Exploration tracks and pads are to be ripped parallel to the contours (where possible). • Personnel are to be excluded from rehabilitation exploration areas to allow for self-establishment of native vegetation.

9.1.15.2 Quality Assurance

Some of the key risks associated with final landform construction are failing to follow the design, non-conformance of construction materials to specifications, inadequate quality of construction, failure to correctly implement a Quality Assurance / Quality Control (QA/QC) procedure to identify construction inadequacies. Construction management, technical supervision, and QA/QC of final landforms will be done by an AQP, to ensure that construction aligns with the design plan. An AQP will prepare a QA/QC document to verify landform design is stable and has been constructed in accordance with the design plan.

9.1.15.3 Determining Landform Establishment Success

Final landforms should be both geochemically and geotechnically stable, and have self-sustaining vegetation cover, in alignment with designated PLMUs. Rehabilitation milestones and monitoring programs will be developed to provide objective measurement of these requirements.

Criteria for determining the success of rehabilitation works will be developed, and will include the following:

- Water leaving rehabilitated landforms will meet acceptable standards and will not pose adverse impacts to surrounding water sources. Water quality will be demonstrated to be stable or improving over several wet/dry seasons cycles.
- Achievement of agree PLMUs
- Rehabilitation final landforms show trends towards long-term stability.

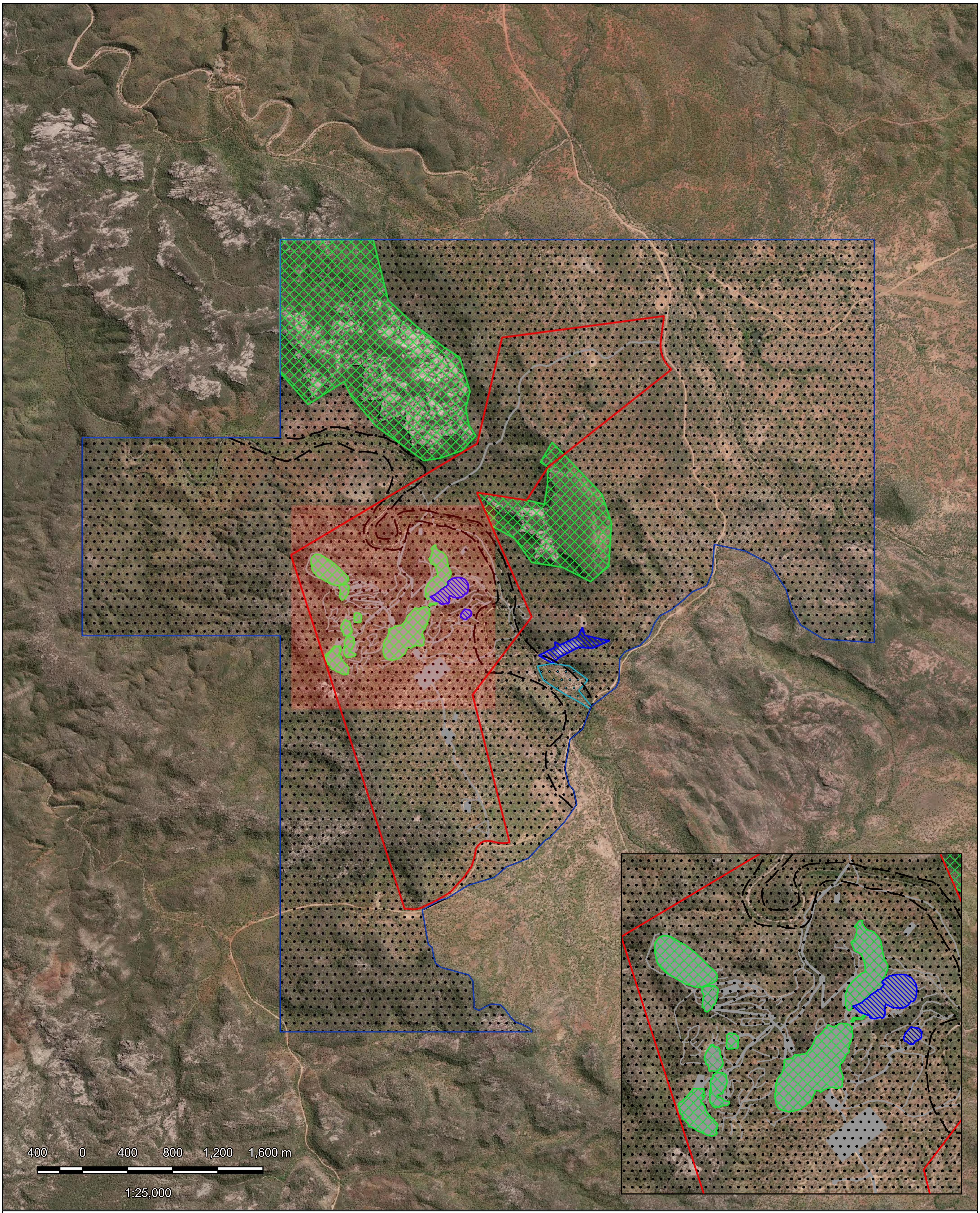
9.1.15.4 Limitations

Limitations of final landform design are as follows:

- Accuracy of soil quality and availability at closure;
- Future impacts of climate change on rainfall event intensity, duration, and frequency; and
- The nature of final waste material

The following assumptions have been made for the final landform design:

- sufficient cover material is available;
- cover and waste material nature are conformant to current assessments; and
- progressive rehabilitation will commence as soon as land becomes available.



Client: Laneway Resources Ltd
Project number: 2021.08003
CRS: GDA2020 EPSG: 7844
Date: 11 October 2022

Print as A3

Figure 28. Final Landform and Post Mine Land Use

Legend
- Mineral Development Licence
- Mining Lease
- Maximum Disturbance Footprint
- Flood Plain Extent - 2022 ATC Williams

ESRI Satellite

Post Mine Land Used
- Low intensity Grazing
- Native Ecosystem
- Recreation
- Water Storage

WULGURU TECHNICAL SERVICES

9.2 Void Closure Plan

9.2.1 Minimising Final Voids

There are six proposed open pits at a total of 8.93 ha. Pits 1-4 will be backfilled with waste rock to minimise the final voids for the project. Pits 5-6 will be retained as voids for use as water storage. The proposed dimensions for residual voids are detailed in Table 29.

Table 29 Proposed void dimensions

	Length (m)	Width (m)	Depth (m)	Area (ha)	Storage capacity (ML)
Pit 5	110	80	418	0.64	28.7
Pit 6	180	180	42	4.46	751.3

9.2.2 Voids in floodplains

As discussed in 9.1.12, the results from the flood impact assessment (ATC Williams, 2022) indicate that the Agate Creek floodplain traverses through the mine lease, however the major mine features are outside of the floodplain extents. Specifically, it was found that the proposed open cut pits are not impacted by the 0.1% Annual Exceedance Probability (AEP) flood event.

9.2.3 Geotechnical stability

Geotechnical studies will be completed, on closure, based on the final landform after mining ceases. These studies will determine if additional earthworks are required to ensure the long-term stability and safety of the final voids. The studies will consider long term erosion, weathering, and the effects of significant hydrological events.

9.2.4 Geochemical stability

A waste rock characterisation study was completed for the project, with a detailed summary discussed above (See 9.1.14). A total of 18 (Pit 5) and 150 (Pit 6) samples were collected from the proposed voids. Approximately 95% of all samples from Pit 5 and Pit 6 were NAF. A summary of the NAG (pH) versus total sulphur geochemical classification criteria for the waste rock samples is provided in Table 30. Overall, the waste rock associated with the project is relatively benign and considered of very low to low risk of environmental harm (C&R, 2022). Pit water quality will be assessed throughout the life of the operations to quantify any potential emerging risks to achieving the PMLU.

Table 30 Waste rock characterisation for proposed voids

Geochemical classification	Total Sulphur (%)	NAG (H)	Pit 5	Pit 6

NAF (barren)	≤0.1	-	17	142
NAF (very low sulphur)	>0.1 to ≤0.55	≥ 4.5	0	1
NAF (low sulphur)	0.55 to 1.5	≥ 4.5	0	0
PAF (very low sulphur)	0.1 to ≤0.55	< 4.5	1	6
PAF (low sulphur)	0.55 to 1.5	< 4.5	0	1
PAF (moderate to high sulphur)	>1.5	< 4.5	0	0
Percentage of NAF samples			94.4%	95.3%
Percentage of very low sulphur PAF samples			6%	4.0%
Percentage of low sulphur PAF samples			0%	0.7%
Percentage of moderate to high sulphur PAF samples – actionable levels			0%	0%

9.2.5 Water balance

A water balance assessment was completed for a post closure scenario, with the results presented in Appendix F.

The maximum spill probability was modelled as ~20% for Pit 5 and <1% for Pit 6, respectively. Pit 5 has the potential to spill in a rare event, due to the shallow wall level. As the site is in a rural region, there is limited local infrastructure in proximity to the pit. The nearest residential area is Old Robin Hood Station, approximately 8km to the northeast of Pit 5. The impacts to people from a spill from Pit 5 are considered low risk.

Pit 6 gradually increases in storage before fluctuating around a relatively consistent water level. Pit 6 achieves a less than 1% spill risk as the pit has a large volume available as well as a small contributing catchment, combined with high evaporation rates for the region.

Water quality in the pits will be monitoring throughout operations to determine the potential risk to the environment in the event of a spill from either void.

9.2.6 Groundwater resource

The groundwater census completed within the 10 km buffer from Agate Creek found no registered groundwater bores. Accordingly, the impact to other groundwater users within close proximity to Agate Creek is considered to be negligible (C&R, 2022).

9.2.7 Groundwater modelling

The relationship between groundwater flows and Pit 6 were calculated, assuming that all flow is directed to Pit 6. Hydraulic conductivities of all rocks within the Agate Creek site are very low to low (10-8 to 10-7 m/sec) which implies that inflows into the Pit 6 will also be low – 11.329 L/min to 16.201 L/min on a worst-case scenario or 4.828 to 7.686 L/min on a more likely scenario. As discussed in

Section 4.3, elevation differences between the bed of Agate Creek and CCWB521 supports the understanding that the groundwater system does not impact or interact with flow in Agate Creek. Groundwater and pit water quality will be assessed throughout the life of the operations to determine if there are any outflows from either pit to the groundwater resource.

9.2.8 Predicted water quality

In general, the Agate Creek groundwater monitoring network currently expresses good quality water, with most bores meeting drinking water quality guidelines for both human and livestock consumption, excluding fluoride. The potential risk to groundwater from the mining operations at Agate Creek relate to the storage and interaction with waste rock, particularly within the residual voids. The findings of the waste rock assessment are presented in detail in Section 9.1.14. Overall, the waste rock associated with the project is relatively benign and considered of very low to low risk of environmental harm (C&R, 2022).

Groundwater and pit water quality will be assessed throughout the life of the operations to quantify any potential emerging risk to achieving the PMLU. Water quality monitoring will consider stratification and any resulting impacts to water quality within the pits.

9.2.9 Rehabilitation and management strategies

The final voids for the pits will be left in safe condition with stock exclusion fences, and 2m high abandonment bunds constructed around the perimeter of each pit. Geotechnical assessments will determine if any additional works are required to achieve certification as safe and stable.

9.3 Rehabilitation Maintenance

Monitoring of rehabilitation must take place and demonstrate:

- Landform stability;
- Effective erosion control;
- No negative effects on EV of any waters from stormwater runoff and seepage; and
- Healthy growth and recruitment rates of vegetation, and management of declared plants.

Maintenance activities on rehabilitated areas post-closure will be guided by general site inspections and rehabilitation monitoring. Maintenance may include:

- Management of newly recruited vegetation (re-planting of failed vegetation recruitment) prior to its establishment within the ecosystem;
- Repair eroded areas and damage drainage systems;
- Improved management of surface water runoff through modifying landforms or structures;
- Upkeep of water management structures;
- Removing drainage that is not needed for long-term stability; and
- Replacing and repairing fences and signage (where probable).

It is expected that maintenance will be more intensive in the first years following closure and will gradually decrease as PLMUs begin to establish.

9.4 Summary of Key Rehabilitation and Management Practices

Table 31 details the key rehabilitation activities for each relevant activity. The rehabilitation activities drive achievement of the rehabilitation and management milestones and inform the associated PRCP schedule.

Table 31. Key Rehabilitation Activities to Drive Achieve Rehabilitation Milestones

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
RA1	Open cut pits 1-4	• Pits will be backfilled with waste rock and suitably compacted • The surface will be shaped to ensure a safe, stable landform. • Landform will be topsoiled and ripped to promote vegetation growth. • Landforms will be seeded with species relevant to the regional ecosystem. • Domain to be monitored for rehabilitation success.	• The timing of rehabilitation will depend on any probable or proved ore reserve remaining within the pit on closure. • Approximately 2035	RM3 RM9 RM11 RM13
RA2	Open cut pits 5-6	• Pits are to be stabilised by securing the highwalls to ensure a safe, stable landform. • Once deemed stable, a bund and fencing will be erected around the open cut to prevent ingress. • Monitor water quality to assess whether the PMLU has been achieved.	• The timing of rehabilitation will depend on any probable or proved ore reserve remaining within the pit on closure. • Approximately 2035	RM4 RM15
RA3	Waste Rock Dumps Topsoil dump	• Undertake assessment for contaminated land and remediate if required. • Remove contaminated material and dispose of in WRD. • Spread remaining over the WRD areas. • Shape landform to be free draining and of similar shape to the surrounding topography. • Spread topsoil on landform to a minimum thickness of 20cm. • Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. • Where required, apply ameliorants/ fertiliser. • Rip landform parallel to landform contours.	• Waste rock will be removed from dumps to backfill the pit. The timing of rehabilitation will depend on any probable or proved ore reserve remaining within the pit on closure. • Topsoil stockpiles will be utilised in rehabilitation of other RAs. The footprint will be available all topsoil resources have been exhausted. • Approximately 2035	RM5 RM8 RM9 RM11 RM13

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
		• Apply selected pasture seed mix to landform. • Monitor to assess rehabilitation success and whether the PMLU has been achieved.		
RA4	ROM ROM Stockpiles	• Undertake assessment for contaminated land and remediate if required. • Remove contaminated material and dispose of offsite (if required). • Shape landform as per Figure 16. • Spread topsoil on landform to a minimum thickness of 20cm. • Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. • Where required, apply ameliorants/ fertiliser. • Rip landform parallel to landform contours. • Apply selected pasture seed mix to landform. • Monitor to assess rehabilitation success and whether the PMLU has been achieved	• Area will be available for rehabilitation with the completion of mining in 2025 • Landform establishment by 2027 • Seeding to be completed by end 2032	RM1 RM2 RM6 RM8 RM10 RM12 RM14
	Access roads and tracks Mine haul road Laydown yards Camps/administration	• Undertake assessment for contaminated land and remediate if required. • Remove contaminated material and dispose of offsite (if required). • Decommission any remnant infrastructure and remove/dispose of. • Shape landform to be free draining and of similar shape to the surrounding topography. • Spread topsoil on landform to a minimum thickness of 20cm.	• Ore may be processed after mining has been completed. Area will be available for rehabilitation once processing has been complete. • Landform establishment by 2027. • Seeding to be completed by end 2032. • Access tracks account for 0.2 Ha of RA3. Access tracks are required for the PMLU and therefore, not included in this PRCP schedule.	RM1 RM2 RM6 RM8 RM10 RM12 RM14

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
		• Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. • Where required, apply ameliorants/ fertiliser. • Rip landform parallel to landform contours. • Apply selected pasture seed mix to landform. • Monitor to assess rehabilitation success and whether the PMLU has been achieved.	• 7.28 ha of tracks will be retained under a landholder agreement. Remaining tracks and haul roads will commence rehabilitation in 2026.	
RA5	Water storage dam Sediment Ponds	• Decommission any remnant infrastructure from mining. • Undertake assessment for contaminated land and remediate if required. • Remove contaminated material and dispose of offsite (if required). • . • Monitor water quality to assess whether the PMLU has been achieved.	• Required as a water supply for rehabilitation of other mining domains.	RM1 RM2 RM7 RM15

RA6	Exploration Drill Pads and Tracks	• Decommission drill holes (if required):
		  ○ Seal drill holes by an appropriately qualified person
		  ○ Cut collar below ground level
		• Decommission drill pads, removing infrastructure and rubbish.
		• Undertake assessment for contaminated land and remediate if required. Contaminated material to be disposed of offsite (if required).
		• Shape landform to be free draining and of similar shape to the surrounding topography.
		• Spread topsoil on landform to a minimum thickness of 200mm.
			• Exploration pads and tracks available for remediation with the completion of exploration.
			• Landform establishment to occur in 2026.
			• Seeding to be completed by end 2026.
				RM1
				RM2
				RM8
				RM10
				RM12
				RM14

Rehabilitation Area	Relevant Activities	Rehabilitation Activities	Rehabilitation Timing	Rehabilitation Milestones
		• Conduct analysis on spread topsoil to determine whether topsoil is suitable to achieve the PMLU, or whether ameliorants/ fertiliser is required. • Where required, apply ameliorants/ fertiliser. • Rip landform parallel to landform contours. • Apply selected pasture seed mix to landform. • Monitor to assess rehabilitation success and whether the PMLU has been achieved.		

10. Risk Assessment

A closure and rehabilitation risk assessment has been prepared in accordance with Section 126C(1)(f) of the EP Act. The risk methodology utilised has been developed based on the *Australia and New Zealand Standard AS/NZS for Risk Management – Principles and Guidelines* (ISO 31000:2018).

The risk management process involves the systematic application of policies, procedures, and practices to the activities of communicating and consulting, establishing the context and assessing, treating, monitoring, reviewing, recording, and reporting risk.

Closure and rehabilitation risk assessments have the objective to identify and define specific risks from closure and rehabilitation and associated activities toward environmental, economic, and social values.

10.1 Risk Identification

The purpose of risk identification is to find, recognise and describe risks that might help or prevent an organisation achieving its objectives. Relevant, appropriate, and up-to-date information is important in identifying risks (Standards Australia, 2018).

The following factors have been considered by this risk assessment:

- Tangible and intangible sources of risk;
- Causes and events;
- Threats and opportunities;
- Vulnerabilities and capabilities;
- Changes in the external and internal context;
- Indicators or emerging risks;
- The nature and value of assets and resources;
- Consequences and their impacts on objectives;
- Limitations of knowledge and reliability of information;
- Time-related factors; and
- Biases, assumptions, and beliefs of those involved.

10.2 Risk Analysis and Evaluation

The purpose of risk analysis is to comprehend the nature of risk and its characteristics, including, where appropriate, the level of risk. Risk analysis can be undertaken with varying degrees of detail and complexity, depending on the purpose of the analysis, the availability and reliability of information and the resources available. Risk analysis techniques can be qualitative, quantitative or a combination of these and should include:

- the likelihood of events and consequences
- the nature and magnitude of consequences
- complexity and connectivity
- time-related factors and volatility
- the effectiveness of existing controls
- sensitivity and confidence levels.

A likelihood of occurrence and severity of consequence rating has been assigned to each identified risk in accordance with the risk matrix detailed in Table 32. Control measures have been developed following the identification of risks to achieve a level of risk that is considered to be an acceptable level, as described in Table 33.

Table 32. Risk Matrix

Likelihood of Occurrence	Severity of Consequence Catastrophic (5)	Major (4)	Moderate (3)	Minor (2)	Insignificant (1)
Almost certain (5)	**10**	**9**	**8**	**7**	**6**
Likely (4)	**9**	**8**	**7**	**6**	**5**
Possible (3)	**8**	**7**	**6**	**5**	**4**
Unlikely (2)	**7**	**6**	**5**	**4**	**3**
Rare (1)	**6**	**5**	**4**	**3**	**2**
Risk Score	**Risk Rating**	**Actions Required**			
9 – 10	Extreme	Requires immediate action to reduce risk score.			
7 – 8	High	Requires an action plan approved by senior management.			
5 – 6	Moderate	Specific monitoring and procedures required.			
2 - 4	Low	Management through routine procedures and protocols.			

Table 33. Risk Evaluation

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
RM1 Infrastructure decommissioning and removal	Infrastructure is not adequately identified during planning process	Failure to remove all infrastructure in accordance with schedule. Achievement of RM1 is delayed.	2	3	5	A register of infrastructure is to be developed to track which structures exist in each rehabilitation area. Demolition works to be scoped with area managers to identify all infrastructure.	The proposed actions will ensure the demolition works are correctly scoped and scheduled.	1	3	4	Contractors will return to site to remove all infrastructure.
RM2 Remediation of contaminated land	Previously unidentified contamination source discovered.	Financial cost of remediation Achievement of RM2 is delayed.	3	3	6	Records are to be kept of all spills and other incidents occurring at the Project that might result in contamination. Employees and contractors are to be made aware of their reporting obligations through a Site Induction. Initial consultation with an approved	Disturbance is restricted to approved areas as defined on the EA. Initial contaminant land assessments will identify areas for further investigation and remediation.	2	3	5	Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants. Any contamination will be investigated and further contaminated land

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
						contaminant land assessor to identify contamination targets for remediation or removal.					sampling/ removal will be conducted as required.
	Contaminated sediment is not removed to appropriate depth.	Contamination of land and water resources Ongoing cost of remediation Financial cost of remobilising earthworks crew	3	3	6	Conduct validation sampling to determine that contaminant removal has been successful.	To be suitable for a PMLU of low-intensity grazing, contaminated land must be removed from the Contaminated Land Register or the Environmental Management Register. These works must be approved by a suitably qualified person and an approved auditor (under the	2	3	5	Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants. Any contamination will be investigated and further contaminated land sampling/ removal will be conducted as required

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
							Environmental Protection Act 1999 Act).				
RM3 Landform development and reshaping (RA1)	Final landform not adequately shaped per design.	Reduced safety or instability of landform. Erosion leading to contamination of water ways. Unsuccessful revegetation	4	3	7	Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer	Proposed landform is to be gently sloping, limiting potential for erosion	2	3	5	Landform will be reshaped until stability is achieved.
RM4 Landform development and reshaping (RA2)	Final landform not adequately shaped per design.	Reduced safety or instability of landform. Erosion leading to contamination of water ways. Unsuccessful revegetation	4	3	7	Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer	Proposed landform is to be gently sloping, limiting potential for erosion. Little earthworks will be required to achieve profile.	2	3	5	Landform will be reshaped until stability is achieved.
	Unstable landform	Uncontrolled movement of landform Fauna injury/death	3	4	7	Assessment of void by suitably qualified person Landform will be stabilised mechanical if required	Assessment will identify any high risk areas for treatment	2	4	6	Ongoing monitoring will guide corrective action as required

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
						Bunding, perimeter fencing and signage					
	Wildlife accessing pit	Fauna injury/death Erosion	4	4	8	Bunding, perimeter fencing and signage	Bunding and fencing will prevent wildlife access	2	4	6	Ongoing monitoring will guide corrective action as required
RM5 Landform development and reshaping (RA3)	Final landform not adequately shaped per design.	Reduced safety or instability of landform. Erosion leading to contamination of water ways. Unsuccessful revegetation	4	3	7	Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer	Proposed landform is to be gently sloping, limiting potential for erosion. Little earthworks will be required to achieve profile.	2	3	5	Landform will be reshaped until stability is achieved.
	Contaminated material not fully encapsulated in the WRD	Contamination of land and water resources	3	4	7	Contaminated land assessment will be undertaken prior to shaping.	Assessment will identify if any contaminated materials is exposed on the WRD.	3	3	6	Ongoing rehabilitation monitoring will identify presence of previously unidentified contaminants.

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
											Any contamination will be investigated and further contaminated land sampling/ removal will be conducted as required.
RM6 Landform development and reshaping (RA4)	Final landform not adequately shaped per design.	Reduced safety or instability of landform. Erosion leading to contamination of water ways. Unsuccessful revegetation.	4	3	7	Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer	Proposed landform is to be gently sloping, limiting potential for erosion. Little earthworks will be required to achieve profile.	2	3	5	Landform will be reshaped until stability is achieved.
RM7 Landform development and reshaping (RA5)	Final landform not adequately shaped per design.	Reduced safety or instability of landform. Erosion leading to contamination of water ways.	4	3	7	Landform is assessed as geotechnically stable by a suitably qualified geotechnical engineer	Landform will be assessed as stable prior to achievement of PMLU	2	3	5	Landform will be reshaped until stability is achieved.

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
RM8 Surface preparation	Insufficient topsoil	Erosion Unsuccessfully revegetation Cost of repeating landform reshaping and surface preparation.	4	3	7	Topsoil will be selectively placed at high risk areas in 5m wide sections. Additional topsoil will obtained from an external source if required.	High risk areas will received more intense treatment.	3	3	6	Ongoing erosion and vegetation monitoring will guide management interventions. Additional topsoil or ameliorants will be applied as required.
	Inappropriate topsoil management whilst stockpiled	Reduced viability of topsoil, limiting plant establishment at rehabilitated sites. Topsoil infested with weed propagules, which will invade rehabilitated sites.	3	2	5	Topsoil is managed as per existing site procedures. Topsoil is recorded in the Topsoils Register and is inspected regularly.	Site has established processes to minimise risk.	2	2	4	Topsoil will be inspected prior to application. Any contaminated topsoil will not be used for rehabilitation.
	Vehicles contaminated with weed seeds used for earthworks.	Weeds invading rehabilitated sites, inhibiting the	3	2	5	Vehicles will be inspected prior to entering site.	Site has established	2	2	4	A weed treatment program will

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
		establishment of desirable species and preventing achievement of RM11 and RM12.				Vehicles will be cleaned in the site washdown bay if weeds or seeds are identified.	processes to minimise risk.				be implemented, if required.
	Heavy rainfall occurring prior to establishment of vegetative cover.	Loss of topsoil Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil to eroded surfaces	3	2	5	Earthworks will be completed during the dry season. Earthworks will be scheduled progressively so that areas are exposed for the least amount of time possible.	The area has established wet/dry seasons and works can be scheduled.	2	2	4	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
RM9 Revegetation (native ecosystem)	Natural revegetation unsuccessfully	Inability to meet RM11 and RM13	3	2	5	Areas will be monitored annually, for 5 years, and seeded if natural vegetation is unsuccessful	Annual monitoring will allow early detection if seeded is required.	2	2	4	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
RM10 Revegetation (grazing)	Natural revegetation unsuccessful	Inability to meet RM12 and RM14	3	2	5	Areas will be monitored annually, for 5 years, and	Annual monitoring will allow early	2	2	4	Apply seed as required.

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
						seeded if natural vegetation is unsuccessful	detection if seeded is required.				
	Heavy rain immediately after seeding.	Loss of topsoil. Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil and seed to eroded surfaces.	3	2	5	Low slope gradient in landform design to limit capacity for sediment loss. Surface preparation and sowing is not to take place if heavy rain (>40 mm) is forecast over any one day within the next fortnight.	The area has established wet/dry seasons and works can be scheduled taking this into account.	2	2	4	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
	Drought over the first months after planting.	Poor seedling survival and establishment. Increased exposure of bare soil leading to erosion	3	2	5	Planting is to take place in the early wet season, when probability of further rain during seedling establishment is high.	The area has established wet/dry seasons and works can be scheduled taking this into account.	2	2	4	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
	Vehicles and/or footwear contaminated with weed seeds	Weeds invading rehabilitated sites, inhibiting the	3	2	5	Vehicles will be inspected prior to entering site.	The site has established controls.	2	2	4	A weed treatment program will

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
		establishment of desirable species and preventing achievement of RM9 and RM11.				Vehicles will be cleaned in the site washdown bay if weeds or seeds are identified.					be implemented, if required.
	Intruding livestock.	Grazing could lead to poor seedling establishment.	2	2	4	Areas will be fenced to allow vegetation to establish.	PMLU is for native habitat so cattle will be excluded.	1	2	3	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
RM11 Achievement of surface requirements (native ecosystem)	Weed species dominating native species	Weeds spreading to other rehabilitation areas. Outcompeting native species Cost of treatment Delay in achieving RM	3	2	5	Annual monitoring to identify high risk areas. Weed treatment completed early to minimise outbreak	The site has established controls.	2	2	4	A weed treatment program will be implemented, if required.
	Revegetation unsuccessful	Erosion Potential weed recruitment Delay in achieving RM	3	3	6	Annual monitoring to high risk areas. Seeding to occur if revegetation is not successful	Annual monitoring will allow early detection if	2	3	5	Rehabilitation monitoring will guide corrective action

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
		Cost of additional seeding					seeded is required.				(reseeding, etc) as required.
	Significant erosion	Loss of topsoil. Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil and seed to eroded surfaces.	3	2	5	Low slope gradient in landform design to limit capacity for sediment loss. Annual monitoring to identify high risk areas	Monitoring will allow early identification and intervention.	2	2	4	Rehabilitation monitoring will guide corrective action (topsoilling etc) as required.
RM12 Achievement of surface requirements (grazing)	Weed species dominating native species	Weeds spreading to other rehabilitation areas. Outcompeting native species Cost of treatment Delay in achieving RM	3	2	5	Annual monitoring to identify high risk areas. Weed treatment completed early to minimise outbreak	Monitoring will allow early identification and intervention	2	2	4	A weed treatment program will be implemented, if required.
	Revegetation unsuccessful	Erosion Potential weed recruitment Delay in achieving RM Cost of additional seeding	3	3	6	Annual monitoring to high risk areas. Seeding to occur if revegetation is not successful	Annual monitoring will allow early detection if seeded is required.	2	3	5	Rehabilitation monitoring will guide corrective action (reseeding,

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
											etc) as required.
	Significant erosion	Loss of topsoil. Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil and seed to eroded surfaces.	3	2	5	Low slope gradient in landform design to limit capacity for sediment loss. Annual monitoring to identify high risk areas	Monitoring will allow early identification and intervention.	2	2	4	Rehabilitation monitoring will guide corrective action (topsoilling etc) as required.
	Intruding livestock.	Grazing could lead to poor seedling establishment.	3	2	5	Areas will be fenced until RM12 is achieved.	Fencing will limit cattle access.	2	2	4	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
RM13 Achievement of post mining land use to a stable condition (native ecosystem)	Weed species dominating native species	Weeds spreading to other rehabilitation areas. Outcompeting native species Cost of treatment	3	2	5	Annual monitoring to identify high risk areas. Weed treatment completed early to minimise outbreak	Monitoring will allow early identification and intervention	2	2	4	A weed treatment program will be implemented, if required.

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
		Delay in achieving RM									
	Revegetation unsuccessful	Erosion Potential weed recruitment Delay in achieving RM Cost of additional seeding	3	3	6	Annual monitoring to high risk areas. Seeding to occur if revegetation is not successful	Annual monitoring will allow early detection if seeded is required.	2	3	5	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
	Significant erosion	Loss of topsoil. Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil and seed to eroded surfaces.	3	2	5	Low slope gradient in landform design to limit capacity for sediment loss. Annual monitoring to identify high risk areas	Monitoring will allow early identification and intervention.	2	2	4	Rehabilitation monitoring will guide corrective action (topsoilling etc) as required.
RM14 Achievement of post mining land use to a stable condition (grazing)	Weed species dominating native species	Weeds spreading to other rehabilitation areas. Outcompeting native species Cost of treatment Delay in achieving RM	3	2	5	Annual monitoring to identify high risk areas. Weed treatment completed early to minimise outbreak	Monitoring will allow early identification and intervention	2	2	4	A weed treatment program will be implemented, if required.

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
	Revegetation unsuccessful	Erosion Potential weed recruitment Delay in achieving RM Cost of additional seeding	3	3	6	Annual monitoring to high risk areas. Seeding to occur if revegetation is not successful	Annual monitoring will allow early detection if seeded is required.	2	3	5	Rehabilitation monitoring will guide corrective action (reseeding, etc) as required.
	Significant erosion	Loss of topsoil. Siltation of downstream waterways. Failure of vegetation to establish on eroded surfaces. Cost of reapplying topsoil and seed to eroded surfaces.	3	2	5	Low slope gradient in landform design to limit capacity for sediment loss. Annual monitoring to identify high risk areas	Monitoring will allow early identification and intervention.	2	2	4	Rehabilitation monitoring will guide corrective action (topsoilling etc) as required.
	Landform doesn't support grazing	Delay in achieving PMLU.	3	4	7	Annual monitoring to determine trajectory of vegetation establishment. Re-seeding as required.	PMLU is consistent with surrounding land use. Monitoring will allow early identification and intervention.	2	4	6	Rehabilitation monitoring will guide corrective action (seeding, etc) as required

Rehabilitation Milestone	Hazard	Potential Impact	Risk Rating L	C	R	Risk Controls	Justification of controls	Residual Risk Rating L	C	R	Remedial Measures
RM15 Achievement of post mining land use to a stable condition (water storage)	Water quality exceeds guideline values for stock watering	Costly water removal or treatment Failure to meet PMLU	3	3	6	Ongoing monitoring during operations to maintain pit water quality.	Monitoring will identify emerging risks well before rehabilitation activities commence.	2	3	5	Treat water as required.

11. Monitoring and Maintenance

11.1 Rehabilitation Milestone Monitoring

The achievement of early rehabilitation milestones (RM1 – RM8) will be demonstrated by the monitoring described in Table 16. A detailed monitoring program has been developed to assess achievement of RM9 – RM15. This program is described below.

11.2 Monitoring Program

A Monitoring and Maintenance Program has been developed for the Project in accordance with Section 3.8 of the PRC Plan Guideline. The objective of the monitoring program is to evaluate the progress of rehabilitation towards fulfilling the rehabilitation criteria as well as to implement adaptive management techniques and interventions as required. The program will:

- Compare monitoring results against rehabilitation milestone criteria
- Determine the trajectory of rehabilitation success
- Identify areas for improvement
- Compare rehabilitation areas to analogue sites
- Assess effectiveness of environmental controls
- Assess vegetation health
- Identify areas where seeding or the application of fertilizers/ameliorants may be required
- Assess existing and potential erosion
- Assess native fauna species diversity and the effectiveness of habitat creation for target fauna species.

The success of rehabilitated areas will be determined by continued progression, stability, and self-sustainability, with analogue sites providing a comparative basis. Rehabilitated areas are expected to reach the same landscape functionality as a given analogue sites.

11.2.1 Establishment of Reference sites

Analogue sites will be used to compare rehabilitation success with regard to groundcover, carrying capacity, weed proportion and species mix. Analogue sites will be established for each PMLU. Analogue sites will be recorded using GIS and signposted to prevent disturbance during operational activities.

Monitoring of analogue sites will be completed using the same monitoring methods employed at rehabilitation areas, as described below. Monitoring will be completed biannually, in the wet and dry seasons, for the first five years of sites being established. Following this, this monitoring program will be reviewed, and the frequency may be adjusted as required.

11.2.2 Monitoring Schedule

Initial monitoring will occur approximately 12 months after revegetation has commenced has been completed to observe the success, identify risks, and develop baseline data. Monitoring will be ongoing, and the timing of the programs will take into consideration potential seasonal and long-term weather influences.

The creeks and drainage lines at Agate Creek are ephemeral therefore inhibiting the ability to collect and assess surface water samples within fixed timings. Resultingly, surface water monitoring will be undertaken at nominated points when available and accessible.

11.2.3 Desktop Monitoring

Desktop monitoring will be completed prior to on-site monitoring work. Using LiDAR and aerial imagery, an understanding of the following can be gained:

- Assessing landform design through a Digital Elevation Slope Model;
- Potential erosion areas to be confirmed during field surveys;
- Representative locations to establish permanent monitoring plots in respect to the rehabilitation slope, PMLUs, and accessibility.

An erosion monitoring program will be developed, focusing on areas with high erosion potential, such as final landforms with steep slopes.

11.2.4 Landform and Erosion

Desktop monitoring will determine high risk areas to focus landform and erosion monitoring. Assessments completed for early milestones will also be considered when developing the land and erosion monitoring plan.

11.2.5 Soil

Soil monitoring will be conducted for all mining domains except for residual voids. A soil monitoring program will be developed for Agate Creek, and will aim to:

- Optimise rehabilitation processes;
- Accurately measure utilisation of stockpile storage and soil reuse; and
- Optimise stockpile management and reuse.

Samples will be acquired, and soil profiles logged by an appropriately qualified person, and analysed at an accredited laboratory. Analytes proposed to be tested are detailed in Table 34.

Table 34. Analysis Parameters for the Soil Monitoring Program

Parameter	Purpose			Monitoring phase	
		Topsoil	Subsoil	Initial	Major
pH	Identify variations that may inhibit plant growth and sustainability.	x	x	x	x

EC and Chloride	Identify areas that may inhibit germination and establishment.	x	x	x	x
Exchangeable cations	Links to soil stability, fertility, nutrient availability, and structure.	x	x	x	x
Organic carbon	Indicates soil nutrient stores and soil structure. Variations can indicate successfulness.	x		x	x
Major elements including N, P, K, S, Ca, and Mg.	Indicator of nutrients and potential for runoff or acid Metalliferous drainage.	x		x	x
Trace elements including Mn, Fe, Zn, and Cu	All are important to the vegetation success.	x		x	x
Metals	Metals that have been identified as occurring at elevated levels during material characterisation should be tested for during monitoring.	x	x	x	x
Physical parameters	Soil texture and other characteristics will affect water entry and storage as well as impact on erosion, dispersion, and success.	x	x	x	
Field analysis	Gain an understanding of soil profile characteristics for interpretation purposes.	x	x	x	

11.2.6 Vegetation

Vegetation monitoring methods will be based on the BioCondition Assessment Framework for Terrestrial Biodiversity in Queensland Assessment Manual (Queensland Herbarium, 2015).

Acceptance criteria are rehabilitation performance goals presented as criterion completion scores for relevant attributes of vegetation. They provide measures: to which rehabilitation progress can be compared to determine success of the rehabilitation; to identify the need for intervention and management actions; and by which rehabilitated land is deemed to be complete.

Preliminary completion criteria are presented in Table 35. Completion criteria will be finalised based on results from monitoring at reference sites over the course of operations.

Table 35 Completion Criteria Summary

Criterion	Completion Score
T1 Height	70% of reference site
Total Native Tree Species	70% of reference site
Shrub Species Richness	70% of reference site
Grass Species Richness	70% of reference site
Forbes and Other Species Richness	70% of reference site
Non-native Plant Cover (%)	<10%
Native Perennial Grass Cover (%)	70% of reference site
Native Forbes and Other Species Cover (%)	70% of reference site
Native Shrubs Cover (%)	25% of reference site
Non-native Grass Cover (%)	<10%

Non-native Forbes and Other Species Cover (%)	<10%
Litter (%)	80% of reference site
Canopy	50% of reference site
Subcanopy	25% of reference site
Total Canopy	70% of reference site
Shrub	70% of reference site
Stems/hectare (tree)	70% of reference site
Stems/hectare (shrub	70% of reference site
Stems/hectare (eucalypt)	<10%

11.2.7 Surface Waters

Surface waters will continue to be monitored at locations nominated in the EA. The ANZECC Livestock Guideline values will continue to be utilised to provide parameters and trigger limits for surface waters at Agate Creek as detailed in Table 36. Pit water quality will be monitoring throughout rehabilitation.

Table 36.Surface Water Trigger Limits

Parameter	Trigger Value (Low Risk) (mg/L)
Aluminium	5
Arsenic	0.5 up to 5
Boron	5
Cadmium	0.01
Chromium	1
Cobalt	1
Copper	1
Fluoride	2
Lead	0.1
Mercury	0.002
Molybdenum	0.15
Nickel	1
Selenium	0.02
Uranium	0.2
Zinc	20
Calcium	1000
Nitrate and Nitrite	400
Sulfate	1000
Total Dissolved Solids (TDS)	5000

11.2.8 Groundwater

Groundwater will continue to be monitored on a quarterly basis. Water quality results will be compared to ANZECC/ARMCANZ Table 4.3.2 for livestock drinking water.

11.3 Maintenance

The results of the monitoring program will inform any necessary maintenance activities. Examples of potential maintenance activities includes:

- Reapplication of topsoil, ameliorants and/or fertiliser
- Adjusting vegetation seed mixes
- Erosion repair
- Reestablishment of drainage lines
- Water treatment

Where required, maintenance activities will be planned and conducted to ensure the long-term success of rehabilitation.

11.4 Analysis, Recording, and Reporting

All actions will occur in accordance with relevant Queensland Guidelines including the Queensland Monitoring and Sampling Manual. This includes appropriately qualified personnel collecting and analysing the samples and data. The data will be analysed to identify trends, changes, anomalies, and to track progress. Throughout the process, the data and achievements will be assessed against the milestone criteria; remedial actions will occur where necessary.

The relevant data will be stored and processes within internal geospatial and document management systems.

11.5 Quality Assurance

All staff undertaking monitoring and reporting activities will be suitably qualified for that task. QA/QC methodologies will be followed and acted upon should breaches in QA/QC procedures occur.

Samples collected will be sent to NATA accredited laboratory ALS Environmental Townsville for analysis. For surface water and groundwater samples, at a minimum, for every 10 sites sampled, one field blank, travel blank, and duplicate sample will be taken.

Results from this monitoring program will provide information for future and post-mine closure monitoring requirements.

The monitoring and maintenance allows for a repetitive execution-verification-monitoring QA/QC approach to ensure rehabilitation areas progress and achieve the milestone criteria.

11.6 Review

This Plan will be reviewed by an SQP should an amendment to the PRCP be made or under timed renewal of the PRCP. In the context of monitoring, a review of the plan must consider:

- Environmental performance;
- Rehabilitation objectives and indictors;
- Environmental inspection outcomes;

- Changes in relevant legislation, policy and guidelines;
- Changes in the mine plan; and
- Rehabilitation completion criteria.

11.7 EA Relinquishment

Prior to certification of progressive rehabilitation for part of Agate Creek, or acceptance of EA surrender for part or the whole of the Agate Creek tenure, DES must be satisfied with the rehabilitation. The decision is based on either a final rehabilitation report (section 264 of the EP Act) for the whole tenure or a part being surrendered, or a progressive rehabilitation report for part of Agate Creek (section 318Z of the EP Act).

The Proponent is required to prepare either of the above, including a compliance statement, and submit to DES for assessment. Relevant rehabilitation requirements (section 318Z or section 268 of the Ep Act) will be considered by DES when deciding whether to certify progressive rehabilitation or to approve surrender application. A post-relinquishment plan will also need to be developed by the proponent to assist with ongoing land management beyond the surrender of the Agate Creek tenure

12. References

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Appendix A: PRCP Schedule

Post-mining land uses (PMLU)										
Rehabilitation area				RA1						
Relevant activities				Open cut pits 1-4						
Total rehabilitation area size (ha)				3.83						
Commencement of first milestone: <insert milestone reference>				10/12/2035						
PMLU				Native ecosystem						
Date area is available	10/12/35	1/01/37	1/01/42	1/01/47						
Cumulative area available (ha)										
Milestone completed by	10/12/36	10/12/41	10/12/46	10/12/51						
Milestone Reference	**Cumulative area achieved (ha)**									
RM3	3.83									
RM9		3.83								
RM11			3.83							
RM13				3.83						

Post-mining land uses (PMLU)										
Rehabilitation area	RA2									
Relevant activities	Open cut pits 5-6									
Total rehabilitation area size (ha)	5.1									
Commencement of first milestone: <insert milestone reference>	10/12/2035									
PMLU	Water storage									
Date area is available	10/12/35	1/01/37								
Cumulative area available (ha)										
Milestone completed by	10/12/36	10/12/41								
Milestone Reference	**Cumulative area achieved (ha)**									
RM4	5.1									
RM15		5.1								

Post-mining land uses (PMLU)										
Rehabilitation area				RA3						
Relevant activities				Waste rock dumps						
Total rehabilitation area size (ha)				25.88						
Commencement of first milestone: <insert milestone reference>				10/12/2035						
PMLU				Native ecosystem						
Date area is available	10/12/35	1/01/37	1/01/42	1/01/47						
Cumulative area available (ha)										
Milestone completed by	10/12/36	10/12/41	10/12/46	10/12/51						
Milestone Reference	**Cumulative area achieved (ha)**									
RM5	25.88									
RM8	25.88									
RM9		25.88								
RM11			25.88							
RM13				25.88						

Post-mining land uses (PMLU)										
Rehabilitation area	RA4									
Relevant activities	Mine Infrastructure Area									
Total rehabilitation area size (ha)	13.93									
Commencement of first milestone: <insert milestone reference>	10/12/2025									
PMLU	Low intensity grazing									
Date area is available	10/12/25	1/01/27	1/01/28	1/01/33	1/01/38					
Cumulative area available (ha)	13.93	13.93	13.93	13.93	13.93					
Milestone completed by	10/12/26	10/12/27	10/12/32	10/12/37	10/12/42					
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	13.93									
RM2	13.93									
RM6		13.93								
RM8		13.93								
RM10			13.93							
RM12				13.93						
RM14					13.93					

Post-mining land uses (PMLU)										
Rehabilitation area	RA5									
Relevant activities	Water Storages									
Total rehabilitation area size (ha)	6.49									
Commencement of first milestone: <insert milestone reference>	10/12/2025									
PMLU	Low intensity grazing									
Date area is available	10/12/25	1/01/27	1/01/32							
Cumulative area available (ha)	6.49	6.49	6.49							
Milestone completed by	10/12/26	10/12/31	10/12/36							
Milestone Reference	Cumulative area achieved (ha)									
RM1	6.49									
RM2	6.49									
RM7		6.49								
RM15			6.49							

Post-mining land uses (PMLU)										
Rehabilitation area	RA6									
Relevant activities	Exploration									
Total rehabilitation area size (ha)	3.34									
Commencement of first milestone: <insert milestone reference>	10/12/2025									
PMLU	Low intensity grazing									
Date area is available	10/12/25	1/01/27	1/01/32	1/01/37						
Cumulative area available (ha)	3.34	3.34	3.34	3.34						
Milestone completed by	10/12/26	10/12/31	10/12/36	10/12/41						
Milestone Reference	**Cumulative area achieved (ha)**									
RM1	3.34									
RM2	3.34									
RM8	3.34									
RM10		3.34								
RM12			3.34							
RM14				3.34						

Appendix B: Waste Rock Characterisation (C&R Consulting, 2022)

C&R CONSULTING

Geochemical & Hydrobiological Solutions Pty Ltd

ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
Contaminated Site and Mine Water Analysis
Environmental Compliance and Monitoring
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AGATE CREEK GOLD MINE

Waste Rock Characterisation

Report Prepared for:

Date:
August 2022

IMPORTANT NOTE

Christopher Cuff	Cecily Rasmussen
Dr Chris Cuff Director	Dr Cecily Rasmussen Director
18 August 2022	18 August 2022
Date	Date

IMPORTANT INFORMATION

1. This report is prepared and written in the context of the proposals stated in the introduction to this report and its contents should not be used out of context. Furthermore, new information, developing practices and changes in legislation may necessitate revised interpretation of the report after its original submission.
2. The copyright in the written materials shall remain the property of C&R Consulting but with a royalty-free perpetual licence to the client deemed to be granted on payment in full to C&R Consulting by the client of the outstanding amounts.
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4. Where data have been supplied by the client or other sources, including data from previous site audits or investigations, it has been assumed that the information is correct, but no warranty is given to that effect. Although reasonable care and skill has been applied in review of these data, no responsibility can be accepted by C&R Consulting for inaccuracies in the data supplied.
5. This report contains only available factual data obtained for the site/s from the sources described in the text. These data were related to the site/s on the basis of the location information made available to C&R Consulting by the client.
6. The assessment of the site/s is based on information supplied by the client, and on-site inspections by C&R Consulting.
7. The report reflects both the information provided to C&R Consulting in documents made available for review and the results of observations and consultations by C&R Consulting staff.

SUMMARY OF RELEVANT INFORMATION

Project Title	Agate Creek Gold Mine – Waste Rock Characterisation
Property Location	Agate Creek Gold Mine
Property Description	Open-cut gold mine
Project Purpose	Conduct a geochemical waste rock characterisation study to support the major environmental authority amendment for the Agate Creek Gold Mine
Project Number	21108
Client's Details	
Nominated Representative	Scott Hayes-Stanley
Title/Position	Director
Company	Wulguru Technical Services
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Author's Details	
Primary Author	Alexander Barnes
Qualifications	Bachelor of Science, Hons (Economic Geology) Master of Mining Engineering (Geomechanics)
Experience	20+ years of mining experience
Affiliations	Member of Australasian Institute of Mining and Metallurgy

DOCUMENT CONTROL

Version	Compiled by	Date issued	Reviewer(s)	Date returned
Draft 1	A. Barnes M. Knott	26/05/2022	Dr C. Cuff Dr J. Jaffrés	26/05/2022
Draft 2	M. Knott	26/05/2022	M. Ayre (WTS)	14/06/2022
Draft 3	M. Knott Dr. C. Cuff	20/07/2022	M. Ayre (WTS)	22/07/2022
FINAL	M. Knott	18/08/2022	-	-

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EXECUTIVE SUMMARY

C&R Consulting Pty Ltd (C&R) were commissioned by Wulguru Technical Services (WTS) to undertake a geochemical waste rock characterisation (WRC) study of the Agate Creek Gold Mine (Agate Creek). This study will form part of the major environmental authority (EA) amendment and progressive rehabilitation and closure plan that WTS are currently preparing on behalf of Agate Creek's current owners, Laneway Resources.

In accordance with the Queensland Department of Environment and Science (DES, 2021) *Guideline – Progressive rehabilitation and closure plans (PRC plans)*, this WRC study has been undertaken to:

"Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility."

To achieve this, 260 rock samples were collected from 27 drill holes across the six proposed open-cut pits. These samples were tested in a National Association of Testing Authorities accredited laboratory for a range of static and kinetic geochemical properties, including acid generation, salinity, major ions and metal/metalloid concentrations.

The undertaken geochemical testing identified that all of the waste rock samples have similar physical and geochemical characteristics. This is to be expected given that most waste rock areas are constructed of the same lithology (volcaniclastic sediment).

The static geochemical results indicate that all waste rock areas:

- Are overwhelmingly non-acid forming, with 90% of the waste rock considered NAF with the potential to buffer any acid that is produced;
- Display low salinity values (mean of 43.5 µS/cm);
- Have some degree of fluoride enrichment; and
- Are not particularly enriched with respect to any of the other elements analysed.

The kinetic geochemical results compared well with the static results, indicating a level chemical stability.

Overall, the waste rock associated with the project is relatively benign and considered of very low to low risk of environmental harm.

1. INTRODUCTION

1.1 Background Information

C&R Consulting Pty Ltd (C&R) have been asked to undertake a geochemical waste rock characterisation (WRC) study of the Agate Creek Gold Mine (Agate Creek) stage 2 expansion, on behalf of Wulguru Technical Services (WTS). This study will form part of a major environmental authority (EA) amendment and progressive rehabilitation and closure plan (PRCP) that WTS are currently preparing on behalf of Agate Creek's current owners, Laneway Resources (Laneway).

Agate Creek is located in north Queensland, approximately 340 km (520 km by road) west of Townsville and 45 km (70 km by road) south of the township of Forsayth (Figure 1). Alluvial gold was reported at Agate Creek in the early 20th century, and was followed by various prospecting activities – including panning, shallow digs and regional exploration.

In February 2015, Laneway lodged a mining lease application for the Agate Creek prospect following a successful 5,000 tonne bulk trial pit. Mining lease (ML) 100030 was granted to Laneway on 7 February 2019, allowing Laneway to mine up to 250,000 tonnes of ore at Agate Creek under EA EPSL03068015 (dated 6 September 2021).

Laneway intends to progress Agate Creek into the stage 2 expansion phase, requiring approval to mine up to 250,000 tonnes of ore and a major EA amendment. In accordance with the Queensland Department of Environment and Science (DES, 2021) *Guideline – Progressive rehabilitation and closure plans (PRC plans)*, a WRC assessment should be undertaken to accompany the major EA amendment submission.

1.2 Scope of Work

The PRCP guideline (DES, 2021) outlines the WRC reporting requirement:

"Characterise mine wastes in a report that describes the likely physical behaviour and chemical reactivity of the waste materials under the conditions in which they would be stored. The report must address the constituent elements present, and their likely future speciation and mobility."

In order to characterise the mine wastes as per the PRCP guideline, this investigation employed the following scope of works:

- Review existing geological and geochemical data;
- Design a sampling programme to be undertaken as part of the Agate Creek open-cut exploration, reverse-circulation (RC) drilling programme;
- Collate, validate and statistically analyse geochemical test results from a National Association of Testing Authorities (NATA) accredited laboratory;
- Compile a WRC dataset to consider waste rock drainage characteristics and the potential environmental risks these may pose; and
- Conduct a WRC study to provide supporting evidence for the rehabilitation requirements to support the submission of the Agate Creek major EA amendment.

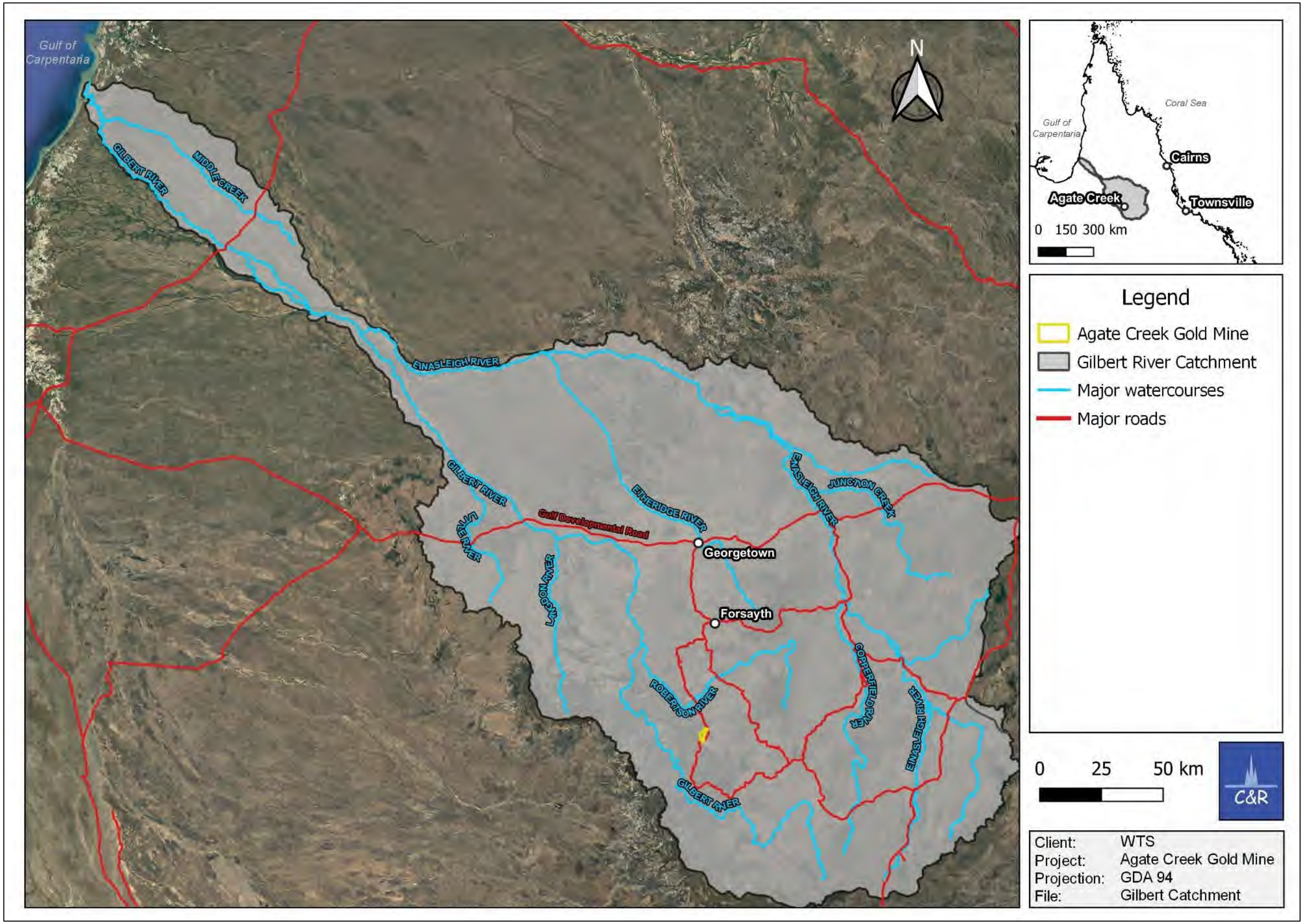

Figure 1: Project site location.

2. SITE DESCRIPTION

Agate Creek is an open-cut gold mining operation located within the Etheridge Shire in north Queensland, within the Gilbert River Basin that flows into the Gulf of Carpentaria (Figure 1). Trial mining commenced at Agate Creek in 2013, with a transition to full-scale production occurring in 2019. All mining activities undertaken at Agate Creek are permitted under the current EA EPSL03068015 (dated 6 September 2021).

2.1 CLIMATE

Agate Creek is located within the seasonally arid tropics, with the area dominated by intense rainfall events throughout the summer months. These rainfall events are often highly variable in their spatial and temporal distribution, with the majority of the rain falling in distinct, spatially separated cells across the landscape. Rainfall throughout the remainder of the year is generally limited to an occasional shower in June or July and evaporation tends to exceed rainfall for almost all days of the year, with the exception of periods with intense rainfall events. The Agate Creek operations are exposed to this seasonal rainfall, whereby it is expected that more than 90% of the rainfall will eventuate as either surface runoff or waste dump seepage.

2.2 GEOLOGY

The Agate Creek deposit is located in the central portion of the Proterozoic Etheridge Province. These Proterozoic Etheridge metamorphic rocks were extensively intruded by Silurian to Early Devonian granitoid batholiths, and dominantly felsic Carboniferous to Early Permian magmatic complexes (Morrison *et al.*, 2019). The mineralisation at Agate Creek is related to the emplacement of Permo-Carboniferous porphyritic rhyolite and andesite extrusives and intrusives, commonly referred to as the Agate Creek Volcanic Group.

Gold mineralisation at Agate Creek is hosted by a low sulphidation, epithermal system consisting of quartz-chalcedony veining, stockwork and breccia. Host rock lithology is predominantly porphyritic rhyolite or andesite that occupy shallow, south-east dipping thrust faults in Silurian granodiorite (Morrison *et al.*, 2019). This host rock is principally volcanic in origin. Therefore, for the purpose of this WRC study, the waste rock is inferred to be entirely composed of the same unit: felsic volcanics with silicified veins and/or breccia.

A series of complex hydrothermal alteration assemblages surround the Agate Creek ore body. These assemblages range from a distal, ubiquitous propylitic zone (chlorite +/- carbonate-epidote-pyrite-haematite) grading inwards to a more proximal, variably argillic to sericitic zone (clay +/- quartz-sericite-pyrite) and locally phyllic zone (silica +/- pyrite or iron oxide) (Morrison *et al.*, 2019). Most of the hydrothermal alteration in the Agate Creek expansion area is predominantly clay +/- silica, sericite and/or pyrite (now weathered to iron oxide). Therefore, alteration was not considered a significant factor in this WRC study.

2.3 PROPOSED OPEN-CUT PITS

2.3.1 STAGE 2 EXPANSION

The stage 2 expansion of the Agate Creek mine involves mining six different open-cut pits (Figure 2). The mine is currently working Pit 6 under the current EA that allows up to 200,000 tonnes of material to be extracted. However, further approval is required to mine Pit 6 deeper – exceeding the 200,000 tonnes limit – as well mining an additional five satellite pits. This proposed Agate Creek stage 2 expansion comprises 3,774,081 tonnes of waste rock material.

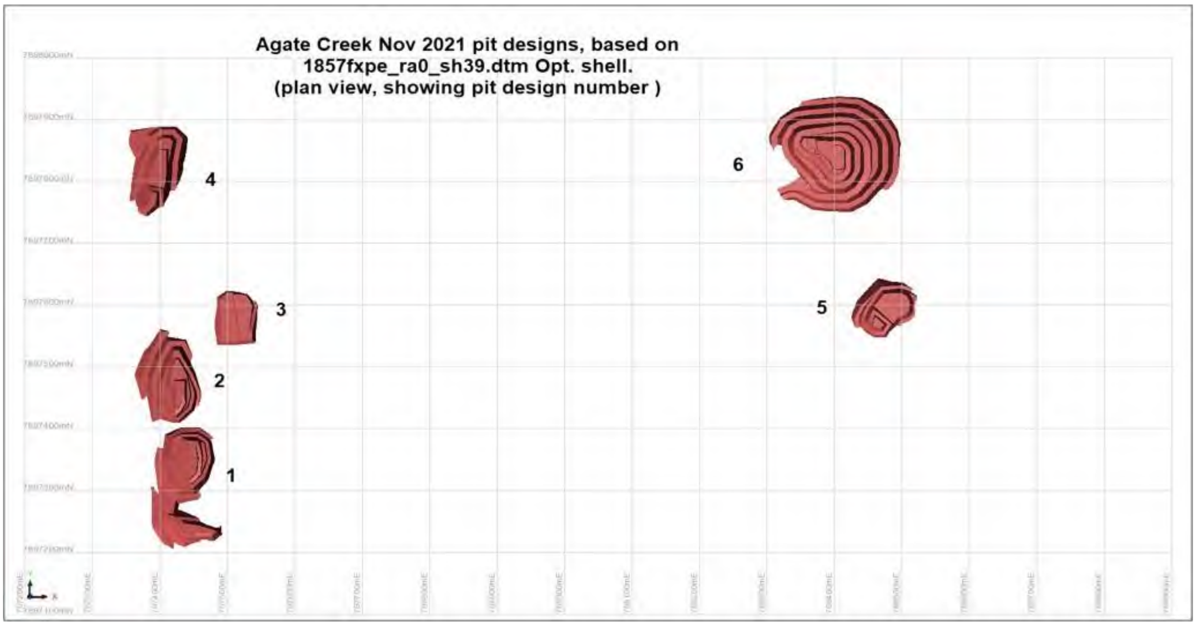

Figure 2: Pit designs for the proposed Agate Creek stage 2 expansion. Figure sourced from WTS.

2.4 WASTE CHARACTERISATION SAMPLING STRATEGY

The waste rock sampling programme for the six proposed open-cut pits was guided by the Australian technical guidelines for the geochemical assessment of mining wastes (Department of Mines and Energy [DME], 1995; Department of Environment and Heritage Protection [DEHP], 2013; Commonwealth of Australia [COA], 2016). The DME (1995) guideline recommends that the tonnage of mined material determine the sampling interval, whereas the more recent guidelines favour a risk-based approach.

The waste characterisation sampling strategy for the Agate Creek stage 2 expansion open-cut pits incorporated the collection of samples from regular intervals (every 3 m) in selected RC drill holes. These selected drillholes were chosen to represent a cross-section of the rock profile in each proposed open-cut pit (Figure 3 to Figure 8).

Figure 9 demonstrates that sampling was undertaken at regular intervals in the selected RC drill holes. The interval spacing was selected to cover all areas anticipated to have acid rock drainage (ARD) potential – including around the ore bodies, alteration zones, transitional material and fresh rock. This sampling methodology was adopted with the aim to provide a good statistical and spatial representation of the waste rock profile in each pit.

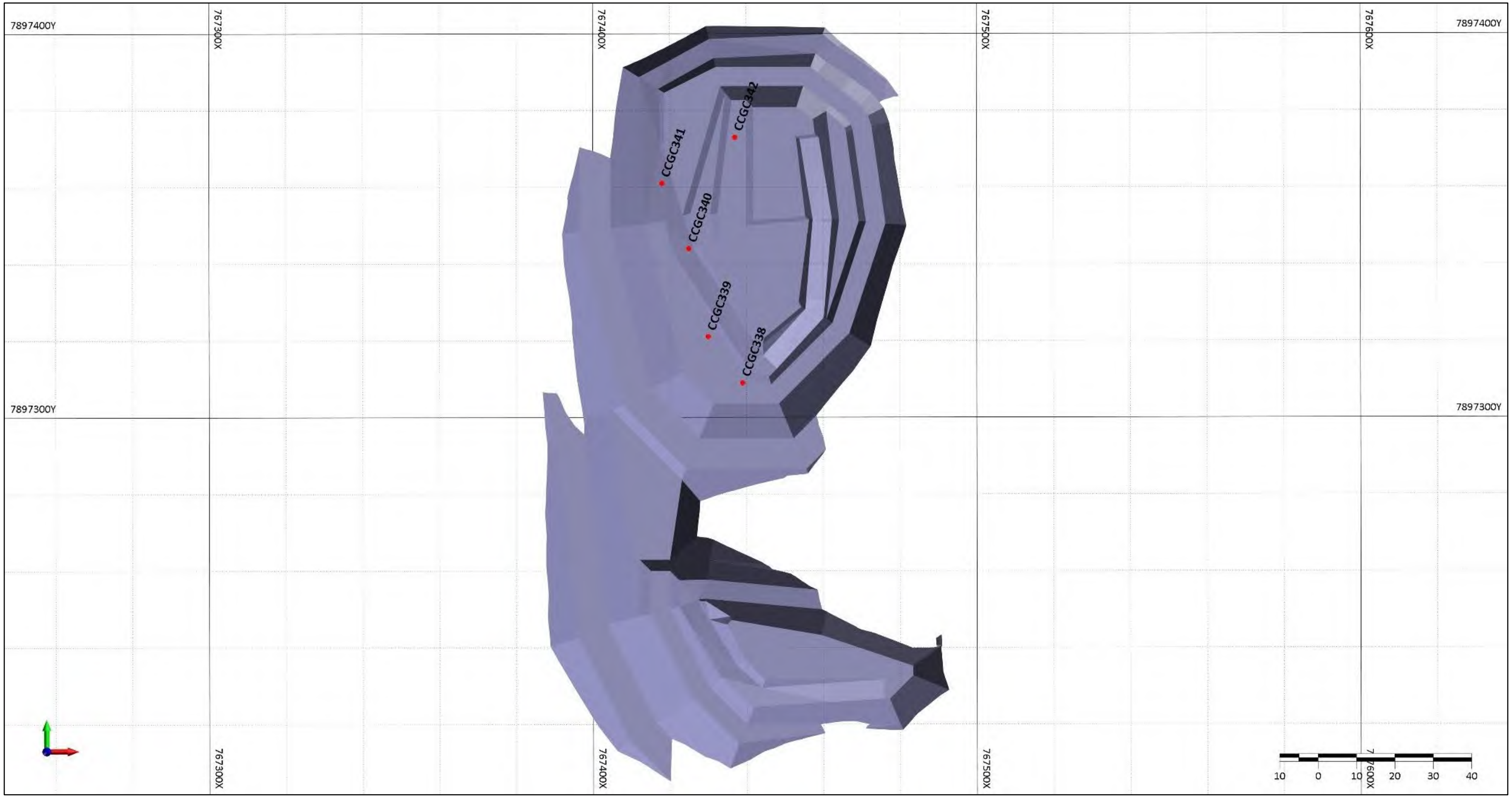

Figure 3: **Location of exploration drill holes sampled in Pit 1.**

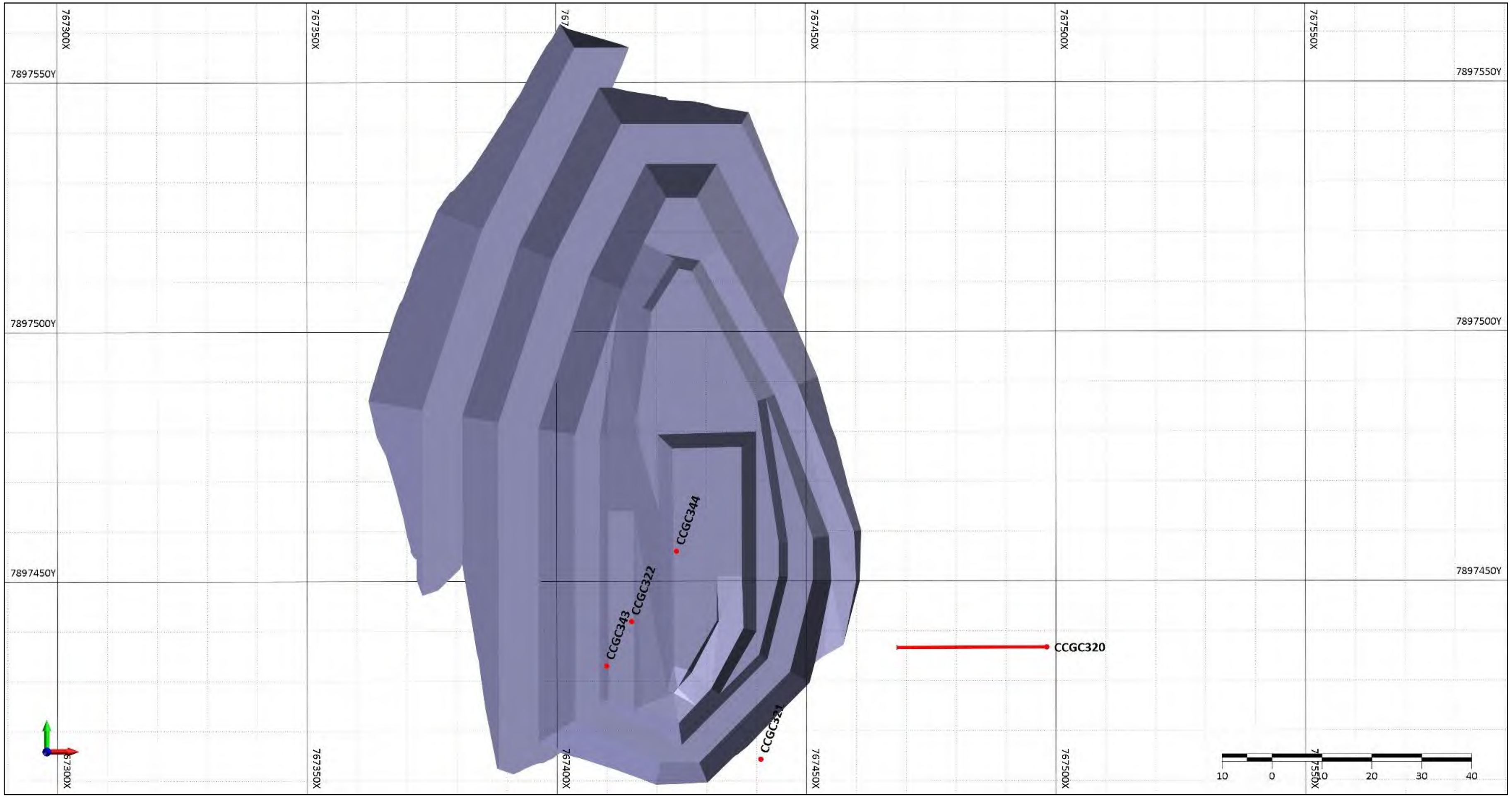

Figure 4: Location of exploration drill holes sampled in Pit 2.

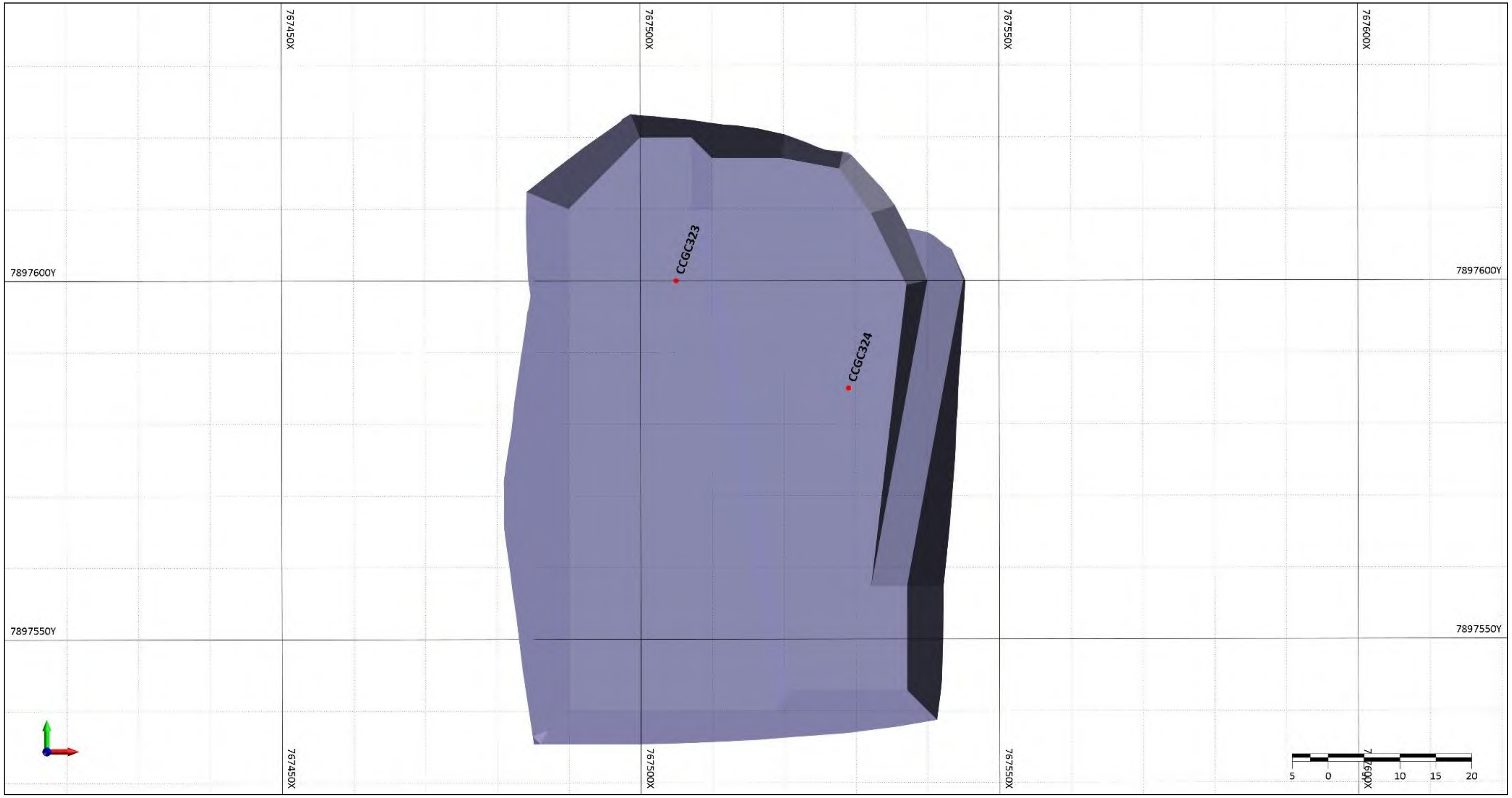

Figure 5: **Location of exploration drill holes sampled in Pit 3.**

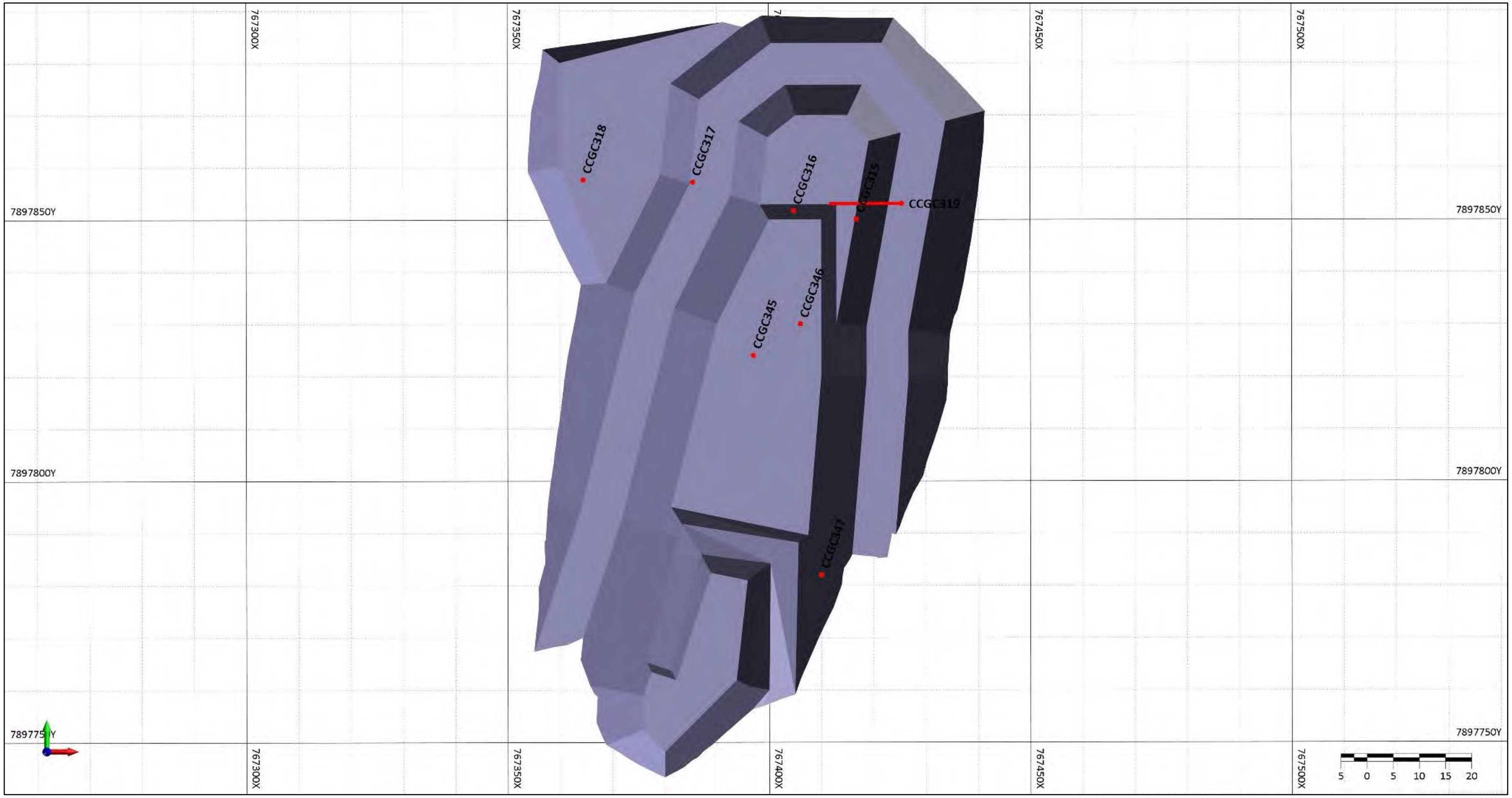

Figure 6: Location of exploration drill holes sampled in Pit 4.

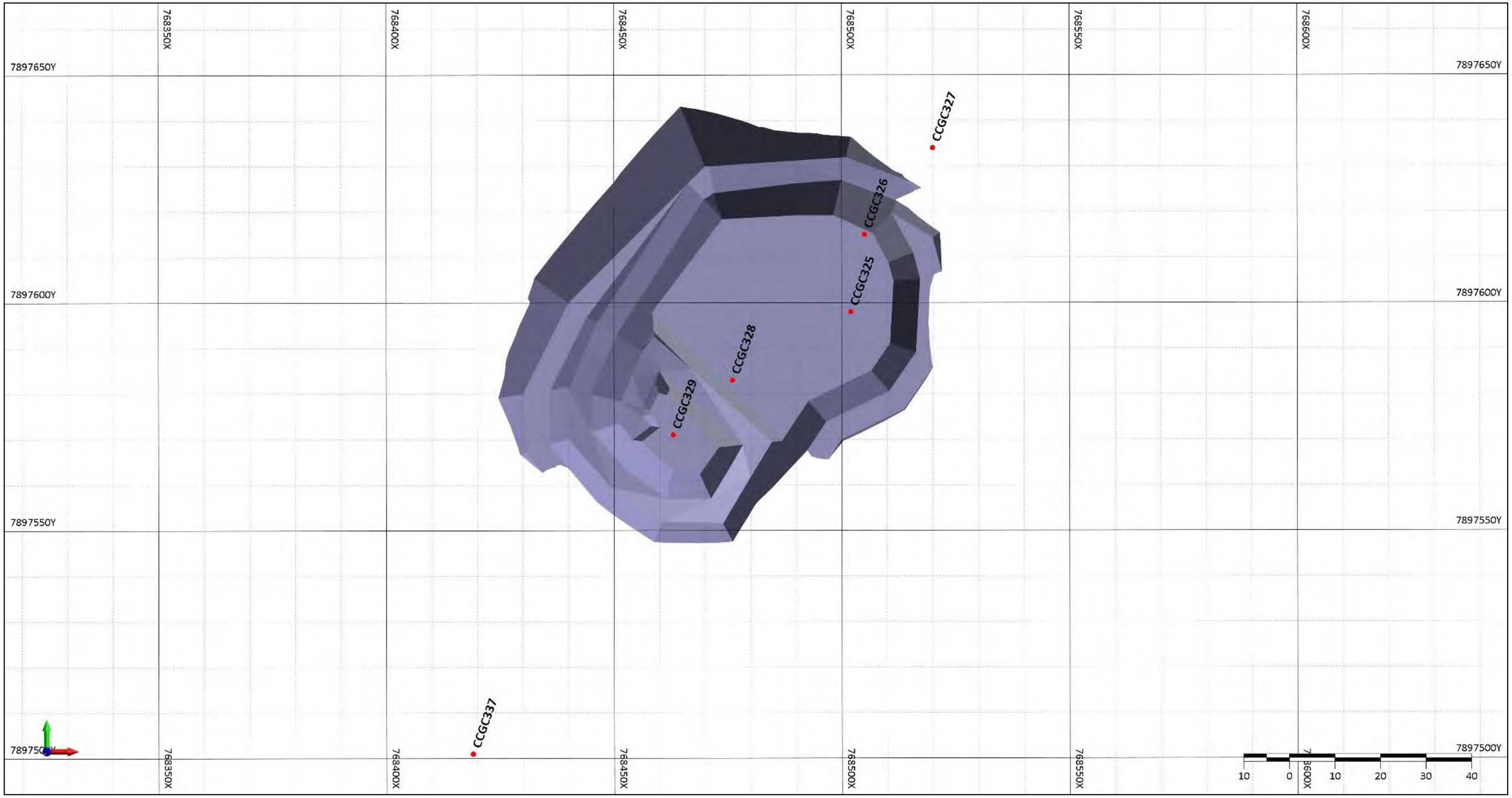

Figure 7: Location of exploration drill holes sampled in Pit 5.

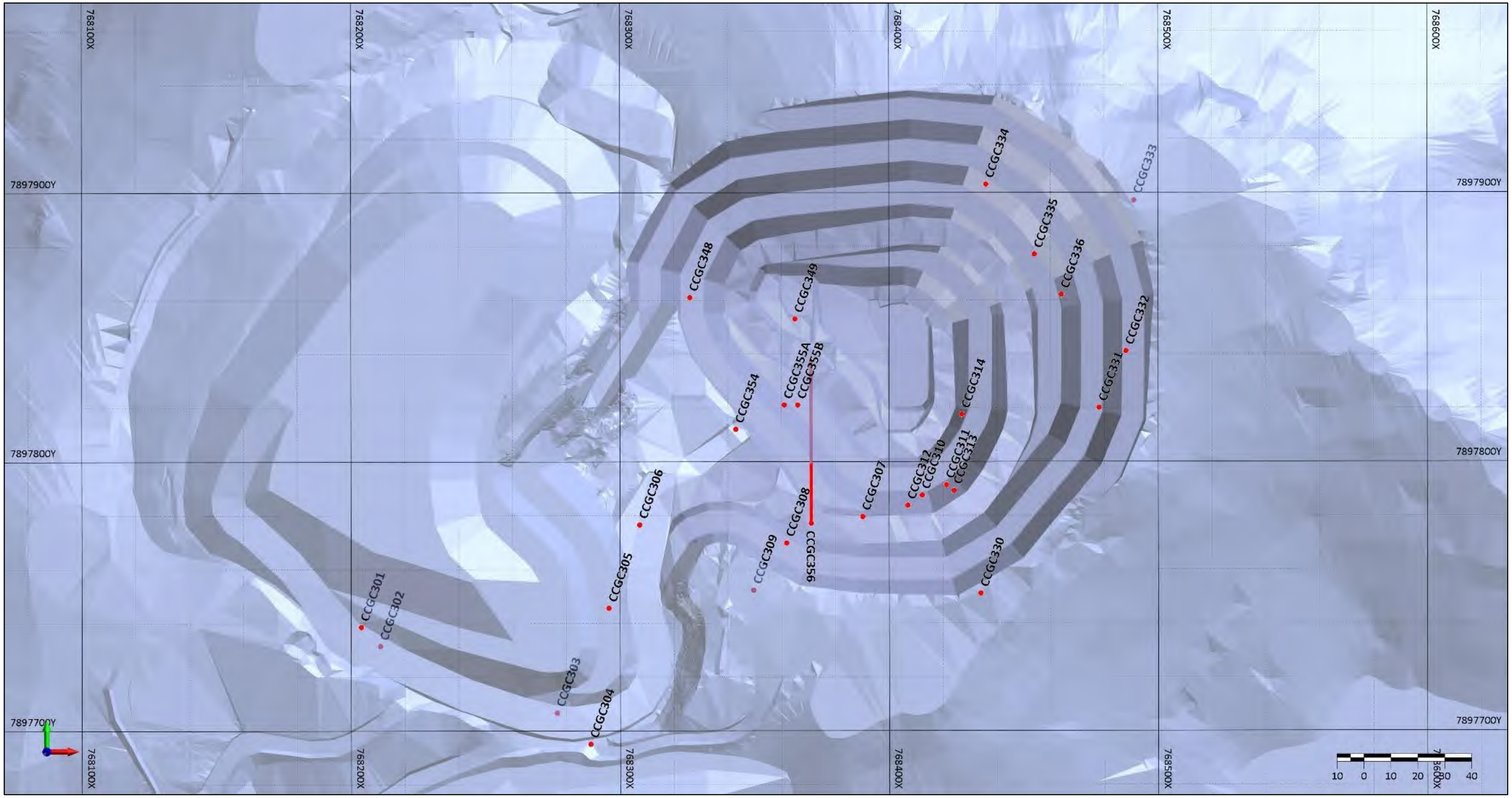

Figure 8: Location of exploration drill holes sampled in Pit 6.

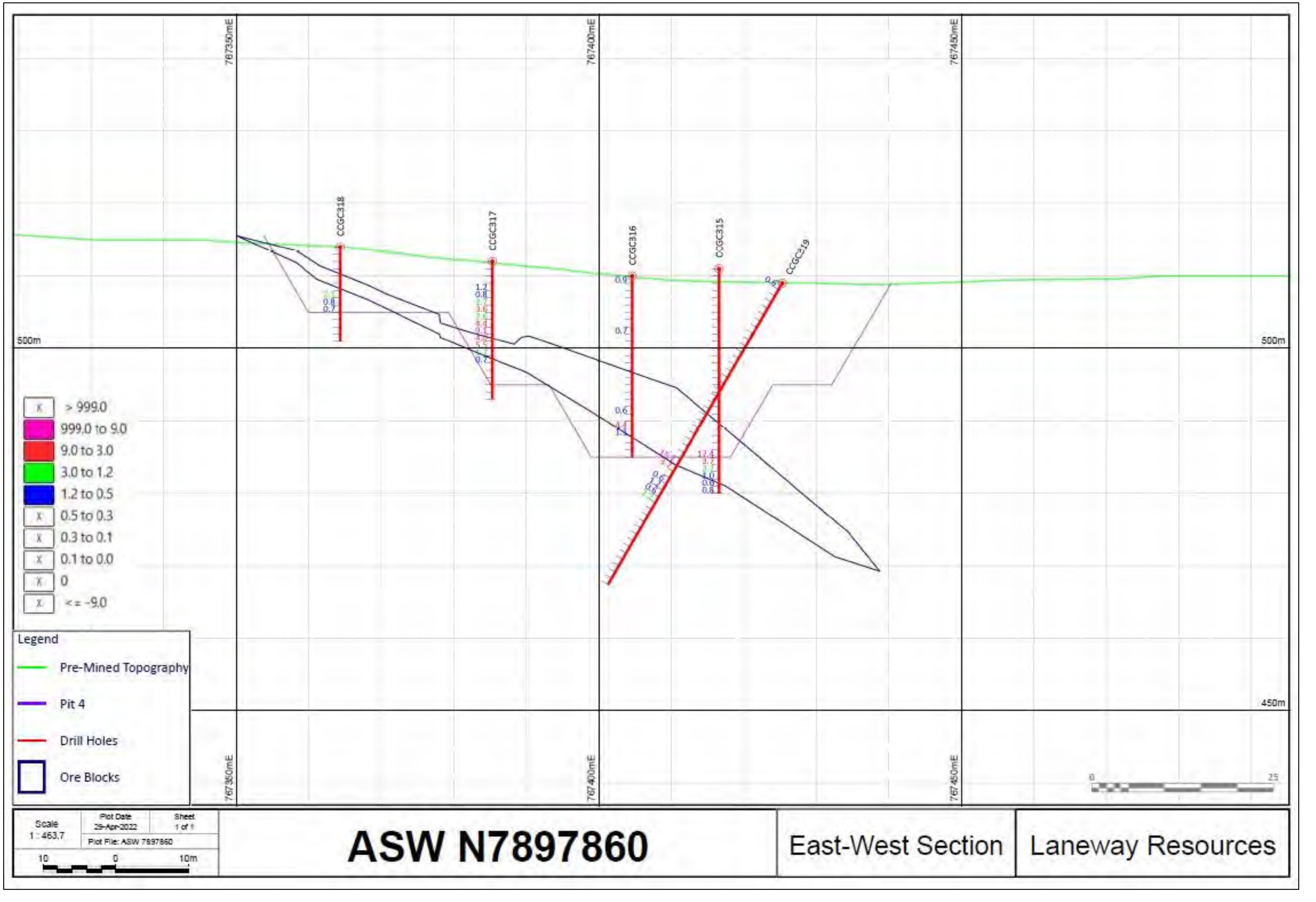

Figure 9: Sample selection example.

3. METHODS

3.1 SAMPLING PROGRAMME

A total of 260 rock samples were collected from 27 drill holes across the six proposed pits. The samples represent the rock type (felsic volcanics) and provide a reasonable distribution of alteration zones and weathering types (oxide, transitional and fresh). The 260 rock samples were taken at regular intervals (generally every 3 m) from select exploration holes (Table 1). Discussions with on-site geologists revealed that it was difficult to accurately determine where the targeted ore occurred within each exploration hole due to the varying ore grades – encountered throughout each hole – that have the potential to be utilised in the future. Therefore, all analysed samples were included in the assessment/investigation to provide a worst-case scenario (because it contains the highly mineralised ore body) characterisation of potential waste rock (Table 1).

Each sample consists of RC chip material collected by Laneway geological personnel at the exploration drilling rig, utilising a cyclone splitter attachment. Laneway provided bulk sample bags for each metre of each exploration hole to a NATA-accredited laboratory. The NATA-accredited laboratory then split the required samples for geochemical analysis. The minimum amount of sample collected (during the split) was 250 g for static tests, with more than 25 kg gathered for kinetic test work.

Table 1: Summary of samples taken across the proposed pits.

Proposed pit	Waste tonnes	Number of holes	Hole ID	Number of samples	Number of samples/pit
Pit 1	750,195	4	CCGC338	7	22
			CCGC339	1	
			CCGC340	7	
			CCGC341	7	
Pit 2	348,570	3	CCGC321	9	22
			CCGC343	7	
			CCGC344	6	
Pit 3	51,627	2	CCGC323	5	14
			CCGC324	9	
Pit 4	229,591	5	CCGC316	9	34
			CCGC319	11	
			CCGC345	7	
			CCGC346	1	
			CCGC347	6	
Pit 5	157,318	2	CCGC326	7	18
			CCGC329	11	
Pit 6	2,236,780	11	CCGC302	3	150
			CCGC303	9	

Proposed pit	Waste tonnes	Number of holes	Hole ID	Number of samples	Number of samples/pit
			CCGC306	11	
			CCGC308	11	
			CCGC309	1	
			CCGC311	21	
			CCGC334	6	
			CCGC336	1	
			CCGC349	14	
			CCGC354	25	
			CCGC356	48	
Total	**3,774,081**	**27**	**-**	**260**	**260**

3.2 Geochemical Characterisation

The geochemical test work was based on industry-recognised procedures for the geochemical characterisation and assessment of mine waste (AMIRA, 2002; The International Network for Acid Prevention [INAP], 2014; COA, 2016).

3.2.1 Static Tests

Static geochemical tests provide information on the bulk geochemical characteristics of samples at a single point in time. They do not provide information on rates of chemical processes – or the release rates due to weathering processes.

All 260 samples dispatched to the ALS laboratory underwent static geochemical testing to evaluate the risk associated with the potential oxidation of sulphides, acid generation, and the presence of metals/metalloids and salts.

Each sample underwent static geochemical testing for:

- pH;
- Electrical conductivity (EC);
- Total sulphur;
- Acid neutralising capacity (ANC);
- Net acid generation (NAG);
- Net acid production potential (NAPP);
- Major dissolved anions for Cl, F and SO_4; and
- Total metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mn, Ni, Pb, Se, V and Zn.

Furthermore, four selected kinetic leach column samples (refer to Section 3.2.2) underwent additional static geochemical testing for:

- Moisture content;
- Major dissolved cations for Ca, Mg, Na and K; and
- Total metals/metalloids for Mo, Sb, Te, Th, Tl and U.

All static geochemical results are provided in Appendix A.

3.2.2 KINETIC LEACH COLUMN TESTS

Kinetic leach column (KLC) tests accelerate the weathering of samples and provide information on the magnitude and/or effects of dynamic processes that result from weathering. Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period of time.

Four samples were dispatched to a NATA-accredited laboratory for KLC tests: one from Pit 1, one from Pit 4 and two from Pit 6. These large KLC samples (>25 kg) represent a considerable proportion of the waste rock profile of each pit (Table 2).

Table 2: Summary of the KLC samples taken across the proposed pits.

Proposed Pit	Borehole	Composite samples	Interval
Pit 1	CCGC339	V34619 – V34636	0 – 21.6 metres
Pit 4	CCGC346	V34745 – V34762	0 – 21.6 metres
Pit 6	CCGC309	V32228 – V32258	0 – 31.0 metres
	CCGC336	V34048 – V34117	0 – 70.0 metres

Individual leach columns were set up for each of the four samples, with a leachate-analysis cycle undertaken on a fortnightly basis.

Each kinetic leachate column underwent kinetic geochemical testing for:

- pH;
- EC;
- Total dissolved solids (calculated);
- Hardness;
- Acidity;
- Alkalinity;
- Major cations for Ca, Mg, Na and K;
- Major anions for Cl, F and SO_4; and
- Dissolved metals/metalloids for Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Sb, Se, Te, Th, U, V and Zn.

All kinetic geochemical results are provided in Appendix B.

4. GEOCHEMICAL RESULTS

4.1 ACID BASE ACCOUNT

4.1.1 pH VALUE

The pH value of the 260 waste rock samples ranged from slightly acidic (4.5) to slightly basic (8.8), with a neutral median pH value of 6.7. The standard deviation (SD) of the dataset is 1.0. In general, most waste rock samples are in the neutral range (Figure 10). However, slightly acidic samples are also prevalent, indicative of the waste rock lithology (largely felsic volcanics).

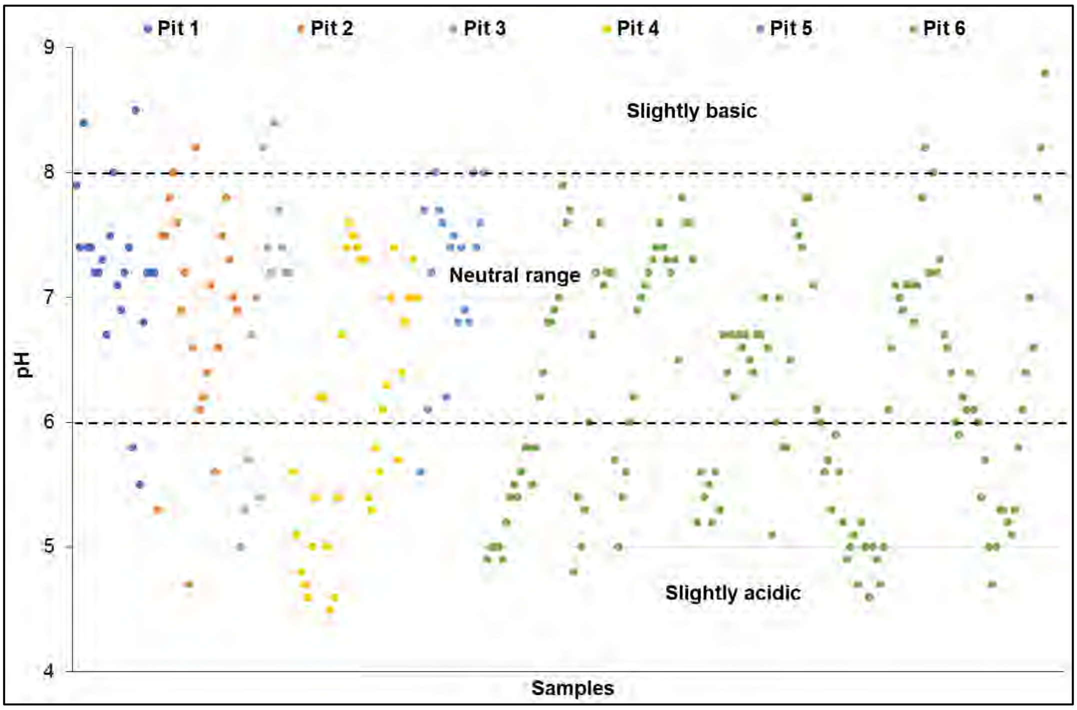

Figure 10: pH values for Agate Creek waste rock samples.

Because of the method of testwork (i.e. fluid extract from crushed samples, with a very high surface area to solution ratio), it is expected that both the low and high pH results in the waste rock are a worst-case scenario. Therefore, it is envisaged that the pH of runoff from the proposed open-cut pits waste rock will not be as low or high as that reflected in the waste rock sample test results. Also, in order for significant runoff to occur at Agate Creek, the rainfall dilution factor would be expected to be greater than the 1:5 (sample:water) ratio used in the extract solutions for analysis. This, in turn, would counteract the resulting acidity or alkalinity.

4.1.2 ELECTRICAL CONDUCTIVITY (EC)

The EC of the 260 Agate Creek waste rock samples ranges from 7 µS/cm to 1,680 µS/cm and has a very low median value of 43.5 µS/cm. Most Agate Creek waste rock samples have low EC values (<300 µS/cm). Apart from an outlier in Pit 2 (1,680 µS/cm), EC values in all waste rock samples are below 500 µS/cm (Figure 11).

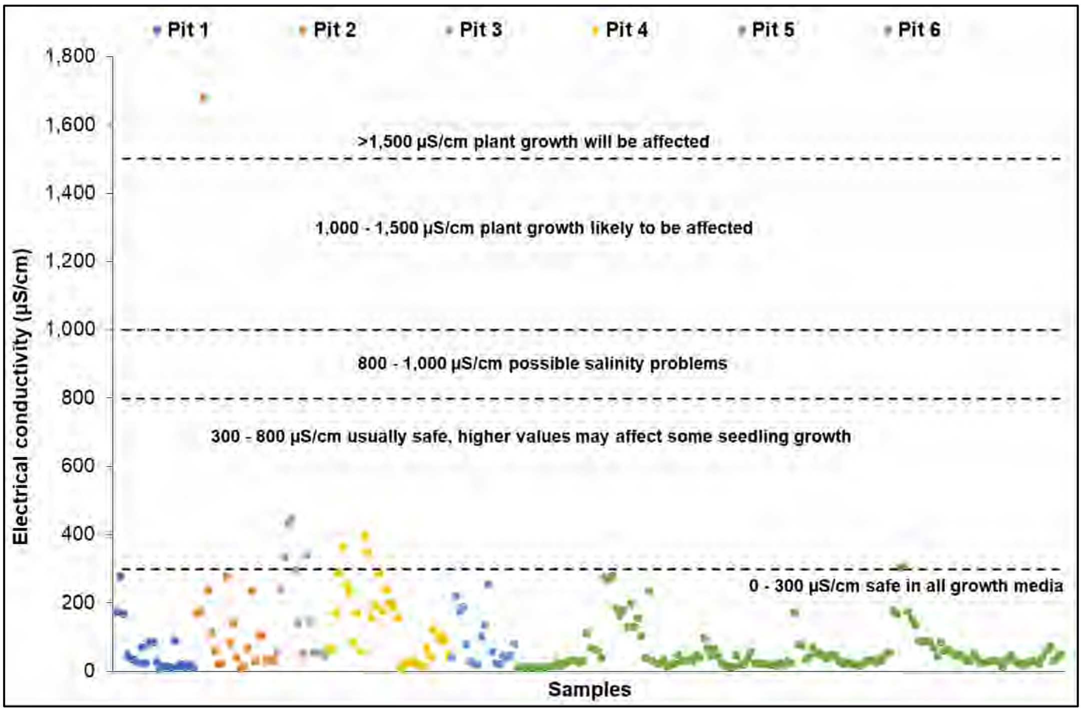

Figure 11: Electrical conductivity for Agate Creek waste rock samples.

4.1.3 TOTAL SULPHUR

The total sulphur (measured by LECO method) of the 260 Agate Creek waste rock samples ranged from <0.01% (i.e. below the limit of reporting [BLOR]) to 3.05%. The median is extremely low, with most samples BLOR. Most of the Agate Creek waste rock is therefore barren (<0.1%) with respect to total sulphur (Figure 12). Except for one value each in Pit 2 (3.05%) and Pit 6 (1.01%), all values above the barren level (i.e. >0.1%) are still classified as very low (<0.55%).

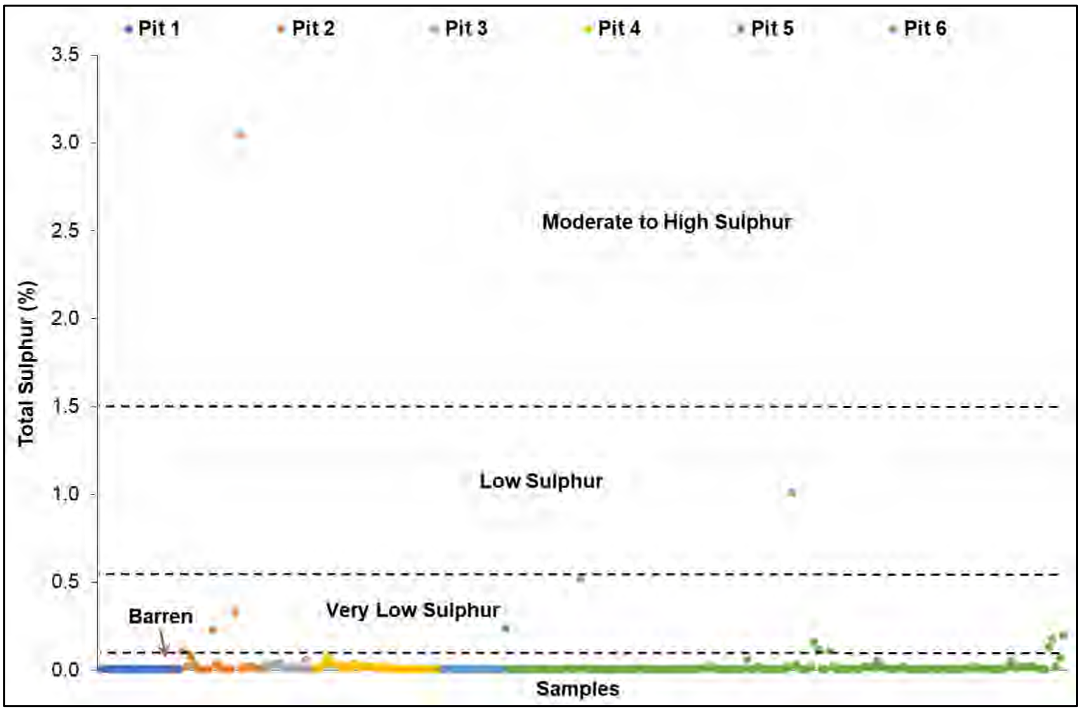

Figure 12: Total sulphur concentration for Agate Creek waste rock samples.

4.1.4 Maximum Potential Acidity

Maximum potential acidity (MPA) is the maximum amount of acid that can be produced by the oxidation of sulphur-bearing minerals in the waste rock material. MPA is calculated from the total sulphur content. The MPA – that could be generated by the 260 Agate Creek waste rock samples – ranges from 0.15 to 93.3 kg H_2SO_4/t and has a low median value of 0.15 kg H_2SO_4/t.

4.1.5 Acid Neutralising Capacity (ANC)

ANC is related to the amount of acid neutraliser (usually carbonate minerals) in the waste rock sample. ANC is determined experimentally by reacting a standardised acid mixture with a known amount of waste rock sample – and is reported as kg H_2SO_4/t eq. (equivalent). The ANC of the 260 Agate Creek waste rock samples ranges from 0.25 to 28.0 kg H_2SO_4/t eq., with a low median of 3.0 kg H_2SO_4/t eq.

4.1.6 ANC:MPA Ratio

The ANC:MPA ratio can assist in classifying the potential for waste rock samples to generate acid.

Generally speaking – and depending on the mineralogy – a sample with an ANC:MPA ratio below 1 is likely to be acid forming because it contains more acid-generating than acid-neutralising minerals. Samples with an ANC:MPA ratio of ≥1 but ≤2 have a degree of uncertainty and represent a potential risk, whereas samples with an ANC:MPA ratio of >2 are generally low risk. However, there are exceptions because samples with an MPA of <3.1 kg H_2SO_4/t are considered to contain insufficient acid-forming potential (i.e. they are barren). Conversely, samples with an MPA of >3.1 but <10 kg H_2SO_4/t would, at worst, be classified as low capacity, potentially acid-forming (PAF) material (Figure 13).

The 260 Agate Creek waste rock samples have an ANC:MPA ratio ranging from 0.08 to 183.01, with a median value of 11.93. According to these ANC:MPA ratios, with respect to acid-generation:

- 204 samples are considered to be of negligible to low risk;
- 41 samples are deemed to be a potential risk; and
- 15 samples are regarded as an increased risk.

This is because the low and negligible risk samples contain more acid-neutralising than acid-generating minerals, whereas the potential and increased risk samples contain more acid-generating than acid-neutralising minerals.

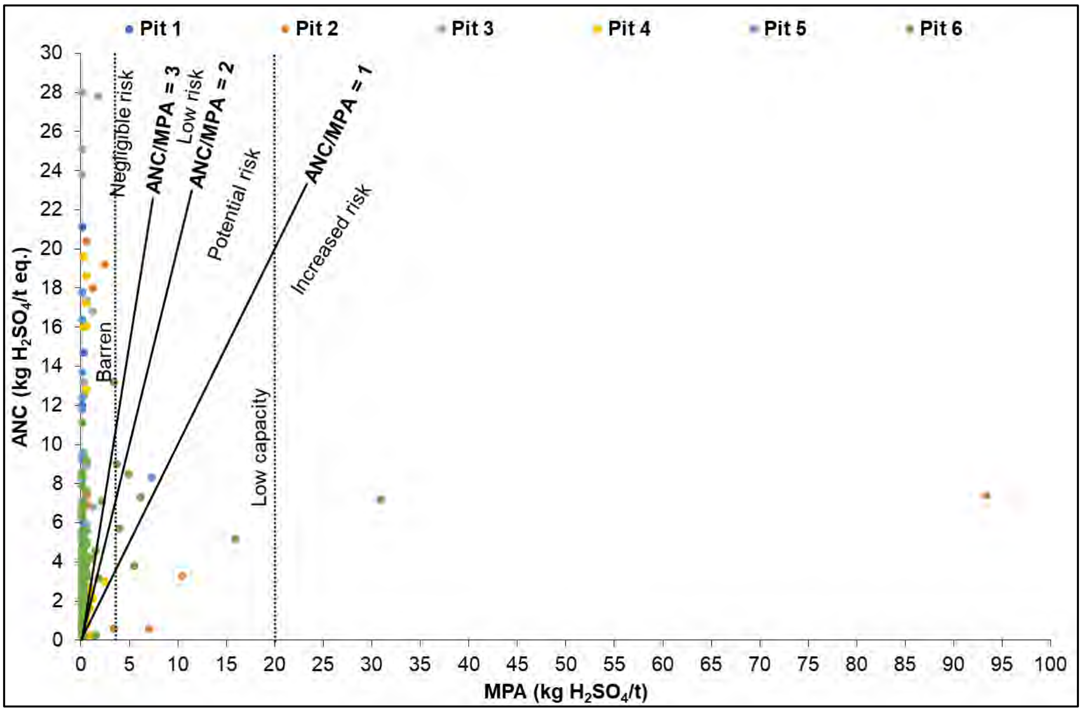

Figure 13: MPA versus ANC for Agate Creek waste rock samples.

4.1.7 NET ACID PRODUCTION POTENTIAL (NAPP)

NAPP is a theoretical calculation of the net acid producing (or consuming) value of a rock sample.

Generally speaking, samples with a negative NAPP value are non-acid forming (NAF), and those with a positive NAPP value are PAF. Miller (1997) provides further categorisation of waste rock material based on the magnitude of the NAPP value (Table 3).

Table 3: NAPP classification categories.

ARD Classification	NAPP Value (kg H_2SO_4/t)
Potentially acid forming (PAF)	> 10
Uncertain	0 to 10
Non-acid forming (NAF)	-50 to 0
Acid consuming material	< -50

Of the 260 waste rock samples, 45 have positive NAPP values. However, most of these positive samples are in the uncertain range, with only three samples having values greater than 10. These are associated with either Pit 2 or Pit 6.

4.2 NET ACID GENERATION (NAG) TEST

The NAG test is used to directly measure the net amount of acid produced by a waste rock sample.

Generally speaking, samples with a $NAG_{(pH)}$ (oxidised pH) below 4.5 may be acid generating and samples with a $NAG_{(pH)}$ equal or greater than 4.5 (≥4.5) are unlikely to be acid producing. However, the NAG test does not estimate acid neutralisation potential. Therefore, AMIRA (2002) recommends the combined use of the NAPP values and the NAG results for a more detailed classification of acid generation.

Figure 14 demonstrates that most Agate Creek waste rock samples have a $NAG_{(pH)}$ of at least 4.5 and a NAPP value below 0. Therefore, they are not acid generating. In contrast, five samples has a negative NAPP value and $NAG_{(pH)}$ below 4.5. In addition, several samples have NAPP values slightly above 0 that coincide with $NAG_{(pH)}$ in excess of 4.5. Both groups are classified as uncertain PAF. Six samples are certainly PAF, having a $NAG_{(pH)}$ less than 4.5 and a positive NAPP value (Figure 14).

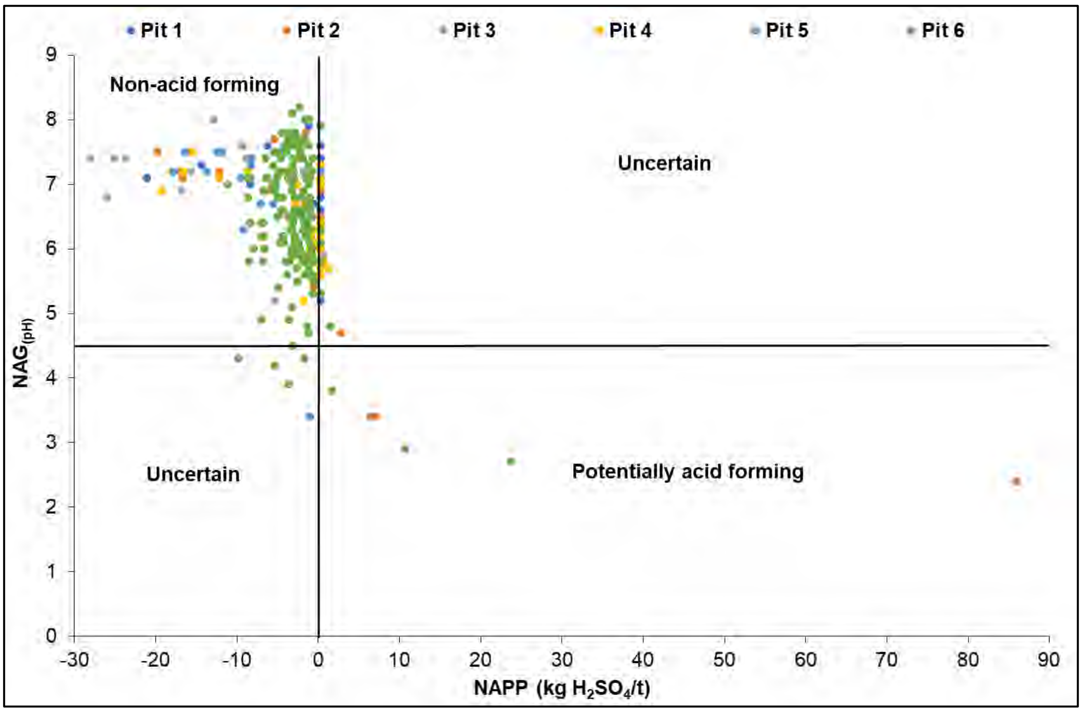

Figure 14: $NAG_{(pH)}$ versus NAPP for Agate Creek waste rock samples.

A summary of the $NAG_{(pH)}$ versus total sulphur geochemical classification criteria for the waste rock samples is presented in Table 4.

Table 4: Geochemical classification criteria for Agate Creek waste rock samples.

Geochemical Classification	Total Sulphur (%)	$NAG_{(pH)}$	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6
NAF (barren)	≤0.1	-	22	18	14	34	17	142
NAF (very low sulphur)	>0.1 to ≤0.55	≥ 4.5	0	1	0	0	0	1
NAF (low sulphur)	0.55 to 1.5	≥ 4.5	0	0	0	0	0	0
PAF (very low sulphur)	0.1 to ≤0.55	< 4.5	0	2	0	0	1	6
PAF (low sulphur)	0.55 to 1.5	< 4.5	0	0	0	0	0	1
PAF (moderate to high sulphur)	>1.5	< 4.5	0	1	0	0	0	0
Percentage of NAF samples			100%	86.4%	100%	100%	94.4%	95.3%
Percentage of very low sulphur PAF samples			0%	9.1%	0%	0%	6%	4.0%
Percentage of low sulphur PAF samples			0%	0%	0%	0%	0%	0.7%
Percentage of moderate to high sulphur PAF samples – actionable levels			0%	4.5%	0%	0%	0%	0%

Applying the $NAG_{(pH)}$ and total sulphur geochemical classification criteria (Table 4), it can be shown that most waste characterisation samples are NAF (Figure 15).

Of the 260 Agate Creek waste rock samples, there are only 11 samples that could be categorised as PAF when the $NAG_{(pH)}$ and total sulphur values are considered:

- Three samples in Pit 2;
- One sample in Pit 5; and
- Seven samples in Pit 6.

These samples make up less than 14% of the total sample size for their respective areas – and their sulphur values are still very low to low except for one sample in Pit 2. It is therefore expected that only one of these eleven samples presents an acid drainage issue because:

- The amount of produced acid would be negligible; and
- Any acid produced by the samples will be buffered by the surrounding NAF rock that makes up more than 90% of the waste rock.

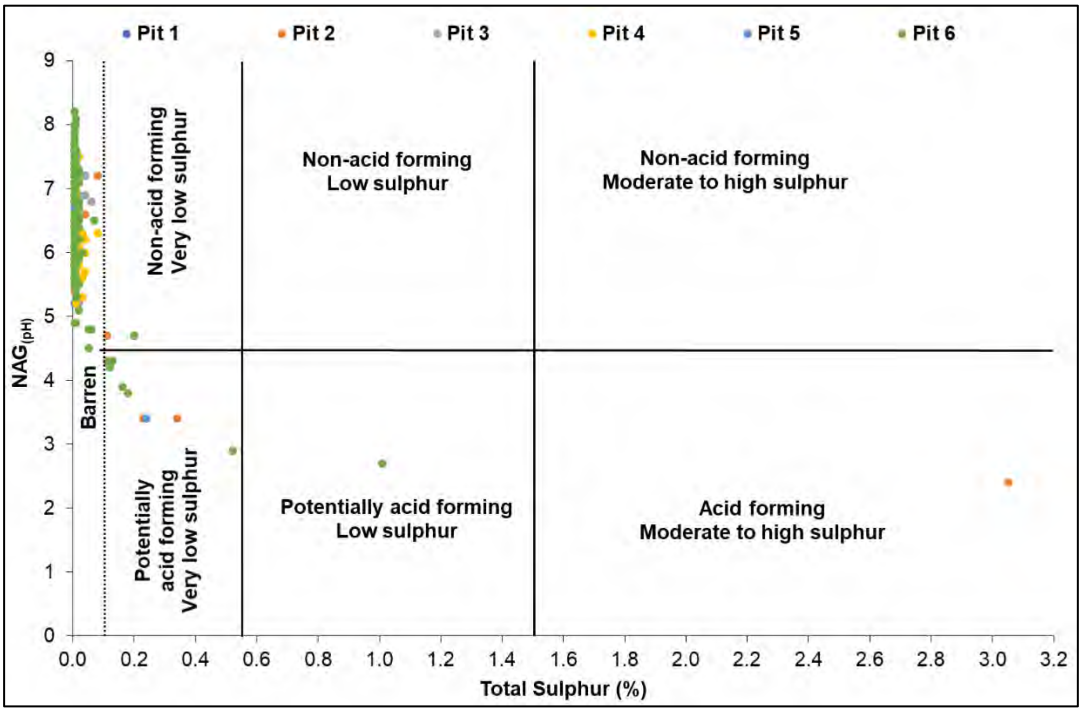

Figure 15: NAG$_{(pH)}$ versus sulphur for Agate Creek waste rock samples.

4.3 METAL/METALLOID ANALYSES

Static multi-element scans were undertaken on the 260 Agate Creek waste rock samples. This test work was carried out to assess natural background elemental levels, and to identify if any elements (particularly metals and metalloids) are present in the waste rock at concentrations that may be of environmental concern with respect to revegetation and water quality.

4.3.1 GEOCHEMICAL ABUNDANCE INDEX

The total metal and metalloid concentrations in the waste rock can be compared to the average crustal abundance of unmineralised soils (INAP, 2014). In this process, the geochemical abundance index (GAI) is used to report on the extent of elemental enrichment, by relating the actual concentration in a sample with the average crustal abundance on a $\log_2$ scale (Table 5).

Table 5: Geochemical abundance index classification categories.

GAI	Enrichment Factor	Classification
<1	Less than 3-fold enrichment	Not enriched
1	3- to 6-fold enrichment	Not enriched
2	6- to 12-fold enrichment	Slightly enriched
3	12- to 24-fold enrichment	Significantly enriched
4	24- to 48-fold enrichment	Significantly enriched
5	48- to 96-fold enrichment	Highly enriched
6	Greater than 96-fold enrichment	Highly enriched

As a general guide, samples with a GAI of 3 or greater indicate enrichment that may warrant further investigation. However, elements identified as enriched may not necessarily be a reason for concern regarding revegetation and/or water quality because:

- The average crustal abundance varies between different literature sources;
- Some elements are more environmentally important than others (i.e. As, Al, Cr, Cd, Cu, Pb, Se and Zn are more important than Ca, Fe, Mg and Na);
- If a sample is shown to be enriched in a particular element, there is no direct correlation that the sample will leach the element at elevated concentrations; and
- The nature of an ore deposit means that the background levels for some elements are expected to be elevated.

Similarly, because an element is not enriched does not mean that it will never be a concern because – under certain conditions (e.g. low pH) – the solubility of some common, environmentally important elements (such as Al, Cu, Cd, Fe and Zn) will increase significantly.

Summaries of the multi-element scans and GAIs for the Agate Creek waste rock samples are presented in Table 6. Boron was intentionally left out of these tables because all of the test results (n = 260) were BLOR (<50 mg/kg). Similarly, all tellurium values were BLOR (<0.5 mg/kg), although the number of measurements (four) is limited. The limit of reporting is well above the normal crustal abundance of tellurium, which is approximately a hundred times lower.

Any laboratory analyses that were reported as BLOR were not included in the GAI-related statistical analysis. The BLOR data were purposely omitted to minimise bias in the GAI calculation and resulting statistics.

Table 6: Summary of multi-element analyses, results and geochemical abundance indices for Agate Creek waste rock samples.

Element	Unit	Limit of Reporting	ACA*	n	n#	Concentration Statistics			NEPM Guideline HIL~ 'Recreational C'	GAI Statistics			
						Min.	Median	Max.		Min. GAI	Median GAI	Max. GAI	Number of GAIs ≥3
Aluminium	mg/kg	50	82,000	260	260	380	1,300	41,000	-	0	0	0	0
Antimony	mg/kg	0.1	0.2	4	4	0.2	0.4	1.8	-	0	0	2	0
Arsenic	mg/kg	5	1.5	260	154	BLOR^	6.5	206	300	1	2	6	42
Barium	mg/kg	10	500	260	206	BLOR	20	530	-	0	0	0	0
Beryllium	mg/kg	1	2.6	260	33	BLOR	BLOR	6	90	0	0	0	0
Cadmium	mg/kg	1	0.11	260	6	BLOR	BLOR	2	90	2	2.5	3	3
Chromium	mg/kg	2	100	260	245	BLOR	8	90	300	0	0	0	0
Cobalt	mg/kg	2	20	260	196	BLOR	5	190	300	0	0	2	0
Copper	mg/kg	5	50	260	206	BLOR	11	364	17,000	0	0	2	0
Iron	mg/kg	50	41,000	260	260	380	15,650	107,000	-	0	0	0	0
Lead	mg/kg	5	14	260	195	BLOR	9	111	600	0	0	2	0
Manganese	mg/kg	5	950	260	243	BLOR	192.5	4,260	19,000	0	0	1	0
Mercury	mg/kg	0.1	0.05	260	2	BLOR	BLOR	0.3	80	2	2	2	0
Molybdenum	mg/kg	0.1	1.5	4	4	0.2	1.85	3.7	-	0	0	0	0
Nickel	mg/kg	2	80	260	232	BLOR	8	291	1,200	0	0	1	0
Selenium	mg/kg	5	0.05	260	1	BLOR	2.5	8	700	6	6	6	1
Thallium	mg/kg	0.1	0.6	4	1	BLOR	BLOR	0.1	-	0	0	0	0
Thorium	mg/kg	0.1	12	4	4	0.6	0.85	1.7	-	0	0	0	0
Uranium	mg/kg	0.1	2.4	4	4	0.3	0.45	0.6	-	0	0	0	0
Vanadium	mg/kg	5	160	260	191	BLOR	9	406	-	0	0	0	0
Zinc	mg/kg	5	75	260	238	BLOR	35	395	30,000	0	0	1	0

* Average crustal abundance (Bowen, 1979).

Number of reported measurements that were not below the limit of reporting.

~ *National Environment Protection (Assessment of Site Contamination) Measure 1999 – Health-based investigation levels* (NEPC, 2013).

^ Below limit of reporting.

Red shaded cells are above the NEPM HIL Guidelines for 'Recreational C' areas.

Orange shaded cells indicate significant enrichment (i.e. ≥ 12 – 24 fold enrichment with respect to the average crustal abundance).

Based on the GAI assessment of the Agate Creek waste rock samples, approximately 27% of the waste rock samples are significantly enriched with respect to arsenic (Table 6). Most (n = 30) of the enriched arsenic samples (n = 42) have a GAI of 3, with a further nine samples attributed a GAI of 4. Two arsenic samples are associated with a GAI of 5, whereas only one sample reaches a GAI of 6.

The sole sample with selenium above the limit of reporting suggests that the waste rock is significantly enriched with respect to that trace element. However, a GAI of 5 would be obtained even if half of the LOR value (2.5 mg/kg) were to be applied to the GAI assessment. Thus, because of analytical limitations in measurement precision, any sample that included selenium testing would automatically be associated with a high GAI.

Of the six cadmium samples at or above the LOR, only three results reached a GAI of 3.

4.3.2 CONTAMINANT LIMITS

The metals/metalloid concentrations of the 260 Agate Creek waste rock samples have been compared against the National Environment Protection Measure (NEPM) health-based investigation level (HIL) guidelines for ‘Recreational C’ – public open space scenario (National Environment Protection Council [NEPC], 2013). Table 6 demonstrates that all analysed metals/metalloids would meet the ‘Recreational C’ limits.

4.4 STATIC WATER QUALITY ANALYSES

Static water quality multi-element scans were undertaken on water extracts from the 260 Agate Creek waste rock samples. This testwork was carried out in order to assess water quality characteristics (particularly salinity and soluble anion levels) that could potentially be sourced from the waste rock in leachate.

Before data analysis was undertaken, results below the laboratory limit of reporting (LOR) were entered into the database as half the LOR value, in line with the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZECC and ARMCANZ, 2000). Also based on the dilution ratio (1:5) and EC values of the water extracts, all values reported as mg/kg are assumed to be the equivalent in mg/L.

There are no specific regulatory criteria for salinity or anion concentrations from waste rock material on mine sites in Queensland. Furthermore, the current EA for Agate Creek does not specify contaminant release limits for salinity or soluble anions. Consequently, the results for the waste rock water extracts have been compared with the ANZECC and ARMCANZ (2000) guidelines for livestock drinking water.

Note: It is inappropriate to use the ANZECC and ARMCANZ (2000) freshwater ecosystems guidelines to compare the anion and EC levels of the water extracts with environmental trigger levels. This is because the freshwater ecosystems guidelines do not contain anion trigger values. Further, the guidelines only apply tropical criteria for salinity triggers in the Agate Creek area – and do not consider the local geological and climatic conditions (i.e. Agate Creek is in a volcanic province that receives relatively low and highly seasonal rainfall).

4.4.1 SALINITY

The EC of the water extracts from the 260 Agate Creek waste rock samples ranges from 7 µS/cm to 1,680 µS/cm and has a very low median value of 43.5 µS/cm. These EC values generally represent fresh water and are well below the ANZECC and ARMCANZ (2000) livestock drinking water trigger limit of 5,970 µS/cm (Figure 16). Further, the Queensland Government document *Science Notes – Land series – L137* (provided in Appendix C), states that 1,500 to 2,000 µS/cm soil (using a 1 in 5 static test method) is considered slightly saline.

The study only recorded one sample in this range with all other static samples recording values well below 500 µS/cm (Figure 16). This suggests that salinity is not an issue associated with the Agate Creek Mine waste rock.

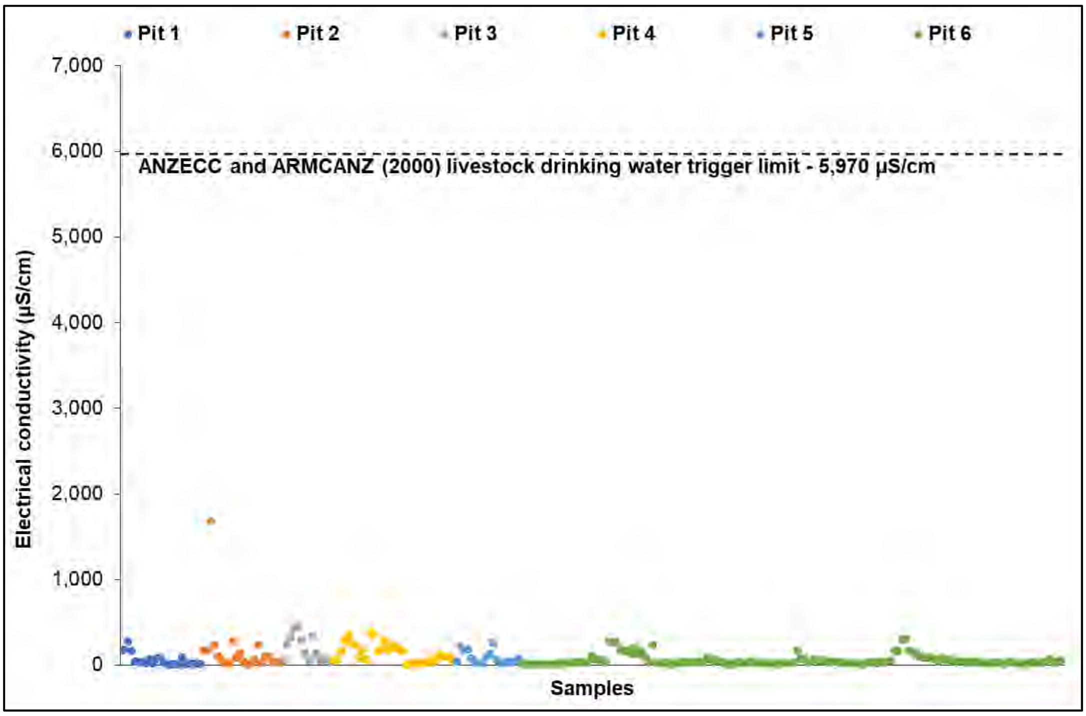

Figure 16: Electrical conductivity for water extracts from Agate Creek waste rock samples.

It should be noted that the ECs of the water extracts are higher than that expected of the surface runoff and seepage from the proposed waste rock material. This is because dissolution rates will be lower in the waste rock dumps than observed in the static laboratory samples. The KLC tests demonstrate this, with lower electrical conductivity values recorded compared to the static results (refer to Section 4.5.2).

4.4.2 FLUORIDE

The fluoride values of the water extracts from the 260 Agate Creek waste rock samples ranges from BLOR (<1 mg/kg) to 63 mg/kg and has a median value of 4 mg/kg. In the 260 water extracts, fluoride exceeded the low-risk trigger level for livestock drinking water (2 mg/L; ANZECC & AMRCANZ, 2000) on multiple occasions (Figure 17). While this guideline value is not directly comparable to the results (as the guideline is for surface waters [mg/L] and not sediment extracts [mg/kg]), exceedances may be of a concern as elevated fluoride is prevalent in most of the waste rock (Table 7). However, these fluoride levels are not unusual for the Agate Creek area. As a volcanic province, much of the rock, surface water and groundwater are enriched with respect to fluoride. Therefore, the risk of fluoride – sourced from the Agate Creek waste rock – further enriching fluoride levels in the receiving environment is low.

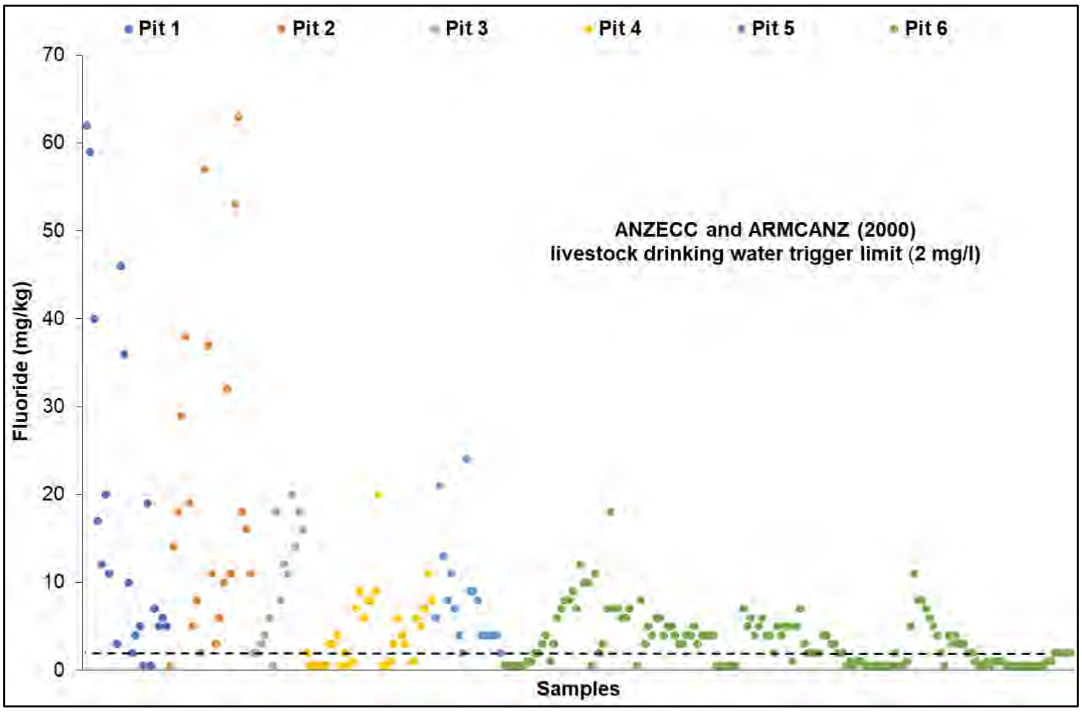

Figure 17: Fluoride values for water extracts from Agate Creek waste rock samples.

Table 7: Fluoride statistics for waste rock sample water extracts.

Fluoride Statistic	Unit	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6
Minimum	mg/L	0.5	0.5	0.5	0.5	2	0.5
Median	mg/L	10	15	9.5	3	6.5	3
Maximum	mg/L	62	63	20	20	24	18
SD	mg/L	19	18	7	4	6	3
cv	%	1.1	0.9	0.7	1.0	0.8	1.0
n	-	21	22	14	33	18	148
Percentage of samples exceeding 2 mg/L		85.7%	90.9%	78.6%	57.6%	88.9%	49.3%

^ BLOR – Below the limit of reporting.

4.4.3 SULPHATE

The dissolved sulphate levels of the water extracts from the 260 Agate Creek waste rock samples range from 5 mg/kg to 1,780 mg/kg and have a low median value of 20 mg/kg. Except for one value (a sample in Pit 2), all results were below the ANZECC and ARMCANZ (2000) beef cattle livestock drinking water trigger limit of 1,000 mg/L (if applied as 1,000 mg/kg; Figure 18). However, the guideline is only used to provide an indication of elevated levels and an exceedance displayed in Figure 18 does not necessarily imply the sample is toxic to cattle. This is because the guideline is developed for surface waters [mg/L] and not sediment extracts [mg/kg]. Instead, these results suggest that sulphate levels within waste rock are not of concern to the environmental values associated with the site.

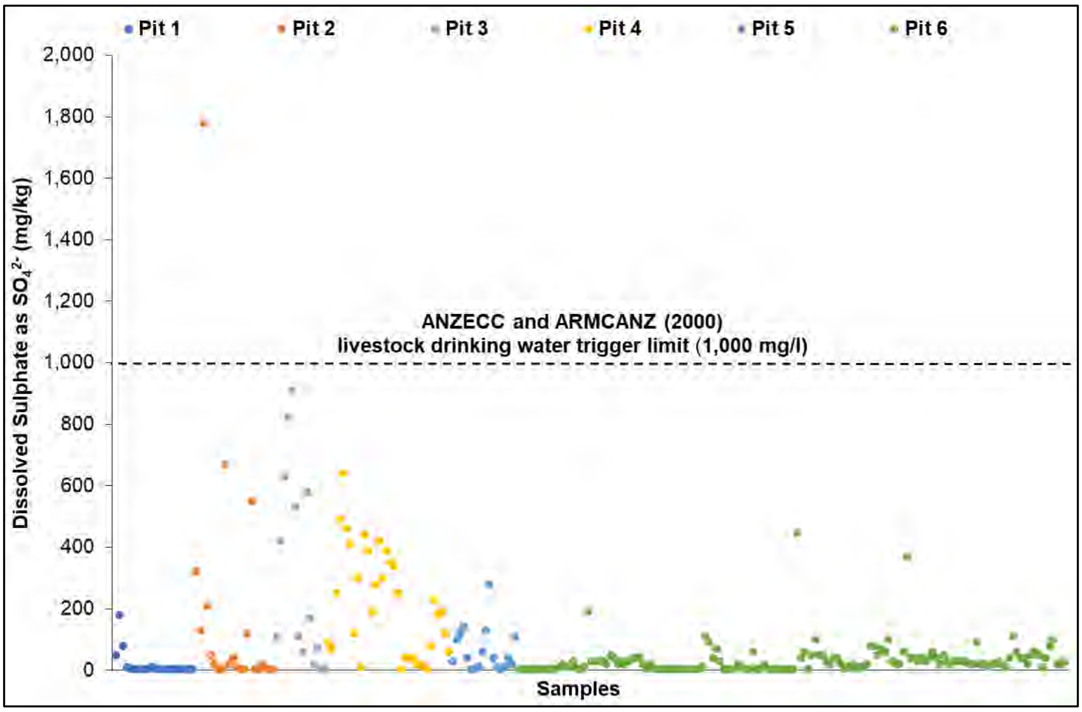

Figure 18: Sulphate values for water extracts from Agate Creek waste rock samples.

4.5 KINETIC LEACH COLUMN WATER QUALITY ANALYSES

In order to understand the potential for the Agate Creek waste rock to leach environmental contaminants into the surrounding environment, KLC tests were undertaken on four composite samples (refer to Section 3.2.2). Unlike static tests, KLC tests measure the varying geochemical characteristics of sample effluent over a prolonged period, consequently providing a better indication of chemical reactivity of waste materials under potential storage conditions.

The results of the waste rock KCL tests have to be considered against the mineralogy, and thus the chemical composition of the host rock and its associated complex hydrothermal alteration assemblages. The waste rock will be dominated by the host rock assemblage of rhyolite and andesite. Mineralogically, the composition of the rhyolite is dominated by alkali feldspars > plagioclase feldspars and quartz with minor biotite, muscovite, pyroxenes, amphiboles, oxides, and glass. Comparably, the mineralogical composition of andesites is dominated by plagioclase feldspars and amphiboles, with minor amounts of quartz, pyroxene, biotite and muscovite.

The composition of the primary mineralogy will be supplemented by material from the complex alteration assemblages (refer Section 2.2). The majority of the rocks will, to some degree, have been subjected to recent weathering cycles which will have changed the primary and alteration mineralogy to a series of minerals of very fine to colloidal particle size, including clay minerals (illite, smectites, kaolinite and mixed layer variants), and hydrated oxyhydroxides of Al, Fe and Mn (e.g. gibbsite, goethite and “birnessite”).

It is the reaction of the above mineral phases that determine the composition of the leach fluid.

Before data analysis was undertaken of the leach data, results below the laboratory LOR were entered into the database as half the LOR value, in line with the *Australian and New Zealand guidelines for fresh and marine water quality* (ANZG, 2018).

There are no specific regulatory criteria for contaminant releases from waste rock material on mine sites in Queensland. Furthermore, the current EA for Agate Creek does not specify contaminant release limits. Consequently, the results for the KLC tests are compared with the ANZG (2018) guidelines for freshwater ecosystems (95% species protection level) and livestock drinking water (Table 8).

Table 8: Summary of kinetic leach multi-element analyses and results.

Quality Characteristic	Limit of Reporting	Livestock Guideline[1]	Freshwater Ecosystems Guideline[2]	Bore ID	Leach 0	Leach 1		Leach 2		Leach 3		Leach 4		Leach 5	
					V	V	C	V	C	V	C	V	C	V	C
pH[3]	0.01	5 – 9	NA[4]	CCGC339	6.49	6.50	-	6.24	-	6.48	-	6.15	-	6.30	-
				CCGC346	5.82	6.30	-	5.88	-	5.98	-	5.59	-	5.45	-
				CCGC309	6.38	5.51	-	6.53	-	6.87	-	5.48	-	6.00	-
				CCGC336	5.84	5.88	-	5.57	-	5.66	-	5.40	-	5.55	-
EC[3] (µS/cm)	1	5,970[5]	NA[4]	CCGC339	553	68	-	49	-	44	-	41	-	36	-
				CCGC346	231	223	-	43	-	38	-	36	-	36	-
				CCGC309	20	14	-	15	-	14	-	10	-	17	-
				CCGC336	38	13	-	21	-	21	-	25	-	18	-
Sulphate (mg/L)	1	1,000	NA	CCGC339	3	BLOR	3.5	BLOR	4	BLOR	4.5	BLOR	5	BLOR	5.5
				CCGC346	49	63	112	12	124	11	135	10	145	10	155
				CCGC309	BLOR	BLOR	1	BLOR	1.5	BLOR	2.0	BLOR	2.5	BLOR	3
				CCGC336	1	BLOR	1.5	BLOR	2	BLOR	2.5	BLOR	3	1	4
Fluoride (mg/L)	0.1	2	NA	CCGC339	6.6	4.0	10.6	2.4	13.0	2.1	15.1	2.0	17.1	2.1	19.2
				CCGC346	0.6	0.8	1.4	0.5	1.9	0.4	2.3	0.5	2.8	0.5	3.3
				CCGC309	0.4	BLOR	0.45	BLOR	0.5	BLOR	0.55	BLOR	0.6	BLOR	0.65
				CCGC336	0.2	BLOR	0.25	BLOR	0.3	BLOR	0.35	0.1	0.45	0.1	0.55
Aluminium (mg/L)	0.01	5	0.055	CCGC339	BLOR	0.07	0.075	0.16	0.235	0.02	0.255	0.01	0.265	0.02	0.285
				CCGC346	BLOR	0.01	0.015	0.04	0.055	0.02	0.075	BLOR	0.08	0.01	0.09
				CCGC309	0.06	0.01	0.07	0.01	0.08	0.01	0.09	BLOR	0.095	BLOR	0.10
				CCGC336	0.03	BLOR	0.035	BLOR	0.04	BLOR	0.045	BLOR	0.05	BLOR	0.055
Arsenic (mg/L)	0.001	0.5	0.013	CCGC339	BLOR	0.001	0.0015	BLOR	0.002	0.002	0.004	BLOR	0.0045	BLOR	0.005
				CCGC346	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
				CCGC309	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
				CCGC336	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
Boron (mg/L)	0.05	5	0.37	CCGC339	0.19	0.13	0.32	0.07	0.39	0.08	0.47	0.12	0.59	0.11	0.70
				CCGC346	0.17	1.15	1.32	0.18	1.5	0.19	1.69	0.25	1.94	0.30	2.24
				CCGC309	BLOR	BLOR	0.05	BLOR	0.075	BLOR	0.1	0.07	0.17	BLOR	0.195

Quality Characteristic	Limit of Reporting	Livestock Guideline[1]	Freshwater Ecosystems Guideline[2]	Bore ID	Leach 0	Leach 1		Leach 2		Leach 3		Leach 4		Leach 5	
					V	V	C	V	C	V	C	V	C	V	C
				CCGC336	0.13	0.26	0.39	0.42	0.81	0.69	1.5	0.96	2.46	0.80	3.26
Cadmium (mg/L)	0.0001	0.01	0.0002	CCGC339	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
				CCGC346	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
				CCGC309	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
				CCGC336	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
Copper (mg/L)	0.001	1.0[6]	0.0014	CCGC339	BLOR	BLOR	0.001	0.001	0.002	BLOR	0.0025	BLOR	0.003	BLOR	0.0035
				CCGC346	BLOR	0.002	0.0025	BLOR	0.003	BLOR	0.0035	BLOR	0.004	BLOR	0.0045
				CCGC309	BLOR	BLOR	0.001	0.001	0.002	BLOR	0.0025	BLOR	0.003	BLOR	0.0035
				CCGC336	0.002	BLOR	0.0025	BLOR	0.003	BLOR	0.0035	BLOR	0.004	BLOR	0.0045
Lead (mg/L)	0.001	0.1	0.0034	CCGC339	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
				CCGC346	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
				CCGC309	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
				CCGC336	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
Manganese (mg/L)	0.001	NA	1.900	CCGC339	0.031	0.004	0.035	0.003	0.038	0.003	0.041	0.002	0.043	0.002	0.045
				CCGC346	0.018	0.035	0.053	0.003	0.056	0.004	0.06	0.003	0.063	0.004	0.067
				CCGC309	BLOR	BLOR	0.001	0.006	0.007	0.009	0.016	0.004	0.02	0.016	0.036
				CCGC336	0.015	0.006	0.021	0.017	0.038	0.015	0.053	0.013	0.066	0.007	0.073
Mercury (mg/L)	0.0001	0.002	0.0006	CCGC339	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
				CCGC346	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
				CCGC309	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
				CCGC336	BLOR	BLOR	0.0001	BLOR	0.00015	BLOR	0.0002	BLOR	0.00025	BLOR	0.0003
Nickel (mg/L)	0.001	1.0	0.011	CCGC339	BLOR	BLOR	0.001	BLOR	0.0015	0.001	0.0025	BLOR	0.003	BLOR	0.0035
				CCGC346	BLOR	0.003	0.0035	BLOR	0.004	BLOR	0.0045	BLOR	0.005	BLOR	0.0055
				CCGC309	BLOR	BLOR	0.001	BLOR	0.0015	BLOR	0.002	BLOR	0.0025	BLOR	0.003
				CCGC336	BLOR	BLOR	0.001	BLOR	0.0015	0.001	0.0025	BLOR	0.003	BLOR	0.0035
Zinc (mg/L)	0.005	20	0.008	CCGC339	BLOR	BLOR	0.005	BLOR	0.0075	0.024	0.0315	BLOR	0.034	BLOR	0.0365
				CCGC346	BLOR	0.131	0.1335	BLOR	0.136	BLOR	0.1385	BLOR	0.141	BLOR	0.1435
				CCGC309	BLOR	BLOR	0.005	BLOR	0.0075	BLOR	0.010	BLOR	0.0125	BLOR	0.015

Quality Characteristic	Limit of Reporting	Livestock Guideline[1]	Freshwater Ecosystems Guideline[2]	Bore ID	Leach 0	Leach 1		Leach 2		Leach 3		Leach 4		Leach 5	
					V	V	C	V	C	V	C	V	C	V	C
				CCGC336	BLOR	0.007	0.0095	0.011	0.0205	0.010	0.0305	0.006	0.033	0.007	0.040
Acidity[3] as $CaCO_3$ (mg/L)	1	NA	NA	CCGC339	3	2	-	BLOR	-	3	-	1	-	3	-
				CCGC346	2	3	-	BLOR	-	3	-	1	-	3	-
				CCGC309	2	1	-	BLOR	-	2	-	2	-	3	-
				CCGC336	2	1	-	BLOR	-	3	-	2	-	3	-

[1] Australian guidelines for livestock drinking water - trigger values (low risk) (ANZG, 2018). Note: Metal guideline values are based on the total fraction, whereas results are provided as dissolved. Care must be taken when undertaking comparisons.

[2] Australian guidelines for aquatic freshwater ecosystems - 95% species protection level (ANZG, 2018). Note: Metal guideline values are based on the dissolved fraction.

[3] Cumulative results are not provided for pH, EC or acidity as these values are deemed inappropriate for assessing these quality characteristics.

[4] pH and EC guidelines for freshwater ecosystems for tropical regions are not representative of the climatic and/or geological conditions at Agate Creek.

[5] EC has been calculated from the tolerances of livestock (beef cattle) to total dissolved solids in livestock drinking water using a 1.4925 multiplier (ANZG, 2018).

[6] Cattle trigger value (low risk) for copper is cited.

Indicates an exceedance of the relevant livestock drinking water guideline value.

Indicates an exceedance of the relevant freshwater ecosystems guideline value.

V – Raw value.

C – Running cumulative total.

NA – Not available.

BLOR – Below the limit of reporting.

4.5.1 PH VALUE

The KLC results show that pH remains relatively stable over the course of the tests (Table 8 and Figure 19). Three of the samples show a marginal decreasing trend while CCGC309 recorded a drop in pH after the first leach before increasing over leaches 2 and 3 (Table 8 and Figure 19). While a marginal decrease over time is noted at most sites, no samples show a significant increase in acidity over time (Table 8; Figure 19 and Figure 20).

It should be noted that both pH and acidity are inherent properties of the mineralogical composition. Significant changes would only be expected if there were large changes in the overall mineralogy (e.g. total dissolution of phases) during the leaching process.

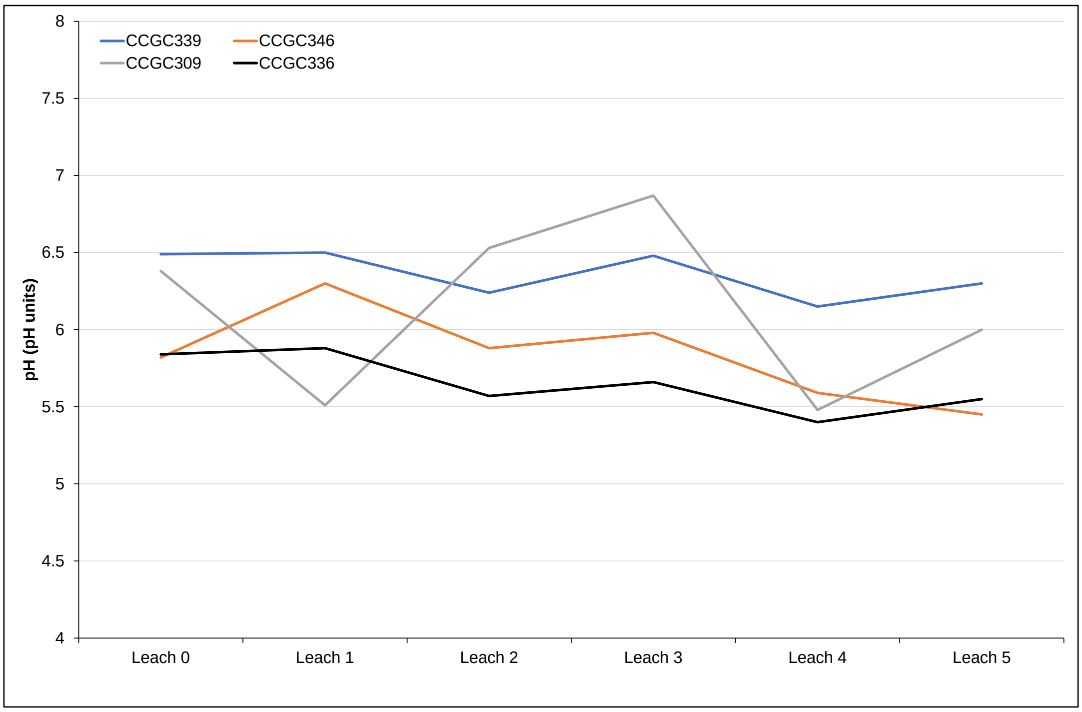

Figure 19: Trend in pH of each KLC tested sample over time.

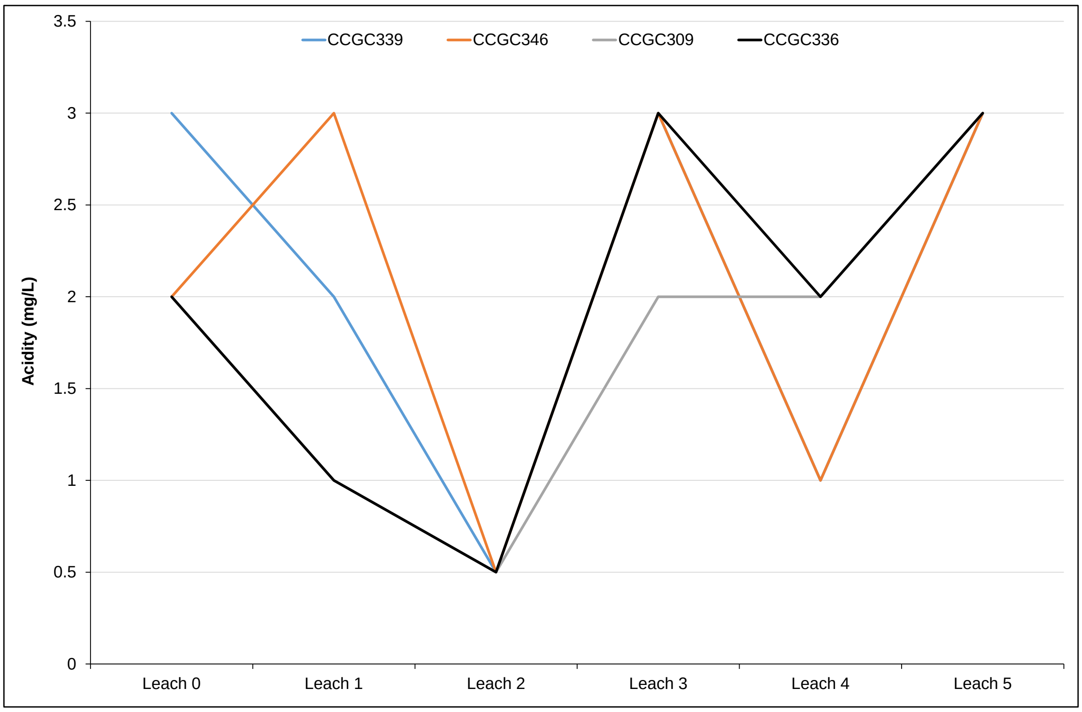

Figure 20: Trends in acidity observed in each KLC tested sample over time.

4.5.2 ELECTRICAL CONDUCTIVITY

Electrical conductivity is a property that will not accumulate over time with each value representing an individual snapshot in time. Thus, between successive leaches, conductivity in all samples generally falls, ranging from 553 to 20 µS/cm in leach 0 to 41, to 10 µS/cm in leach 4 (Table 8 and Figure 21). This is consistent with the general dilution of the leachate over time. These results indicate that each sample would still be considered freshwater under both the US Geological Survey guidelines (i.e. <1,560 µS/cm; refer to https://www.usgs.gov/special-topics/water-science-school/science/saline-water-and-salinity) and the Queensland Government (i.e. <1,500 µS/cm; refer to the Science Note provided in Appendix C). Therefore, salinity is not an issue associated with the Agate Creek Mine waste rock.

While electrical conductivity is not accumulative, the end products, upon evaporation (i.e. salts), are accumulative. This is true of any water evaporating in the bed sands of a stream where halite saturation (i.e. EC > 300,000 µS/cm) are achieved in the dry season.

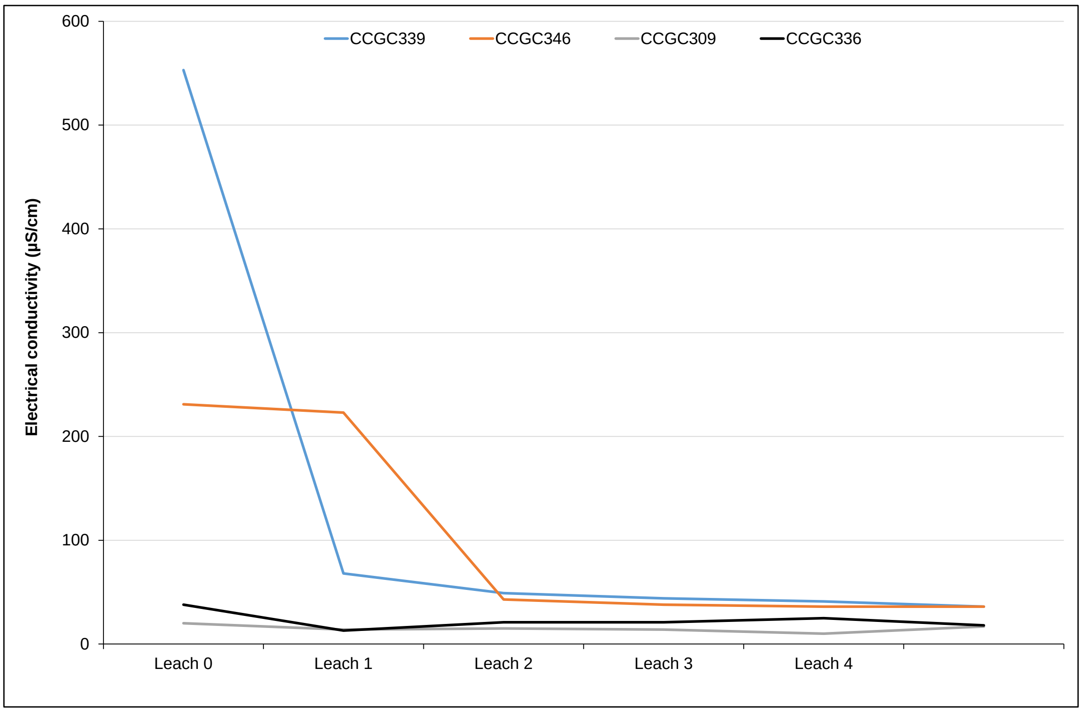

Figure 21: Trends in electrical conductivity observed in each KLC tested sample over time.

4.5.3 METALS / METALLOIDS

Most metal concentrations were found to be either compliant with relevant guideline values, or only exceeded these values in the cumulative results at the end of testing (Table 8). For instance, cadmium was recorded below the LOR in every sample tested. However, the cumulative results were found to exceed the 95% species protection level for aquatic ecosystems after leach 4 (Table 8). This is a result of the conservative method used to calculate the cumulative value in the event of below the LOR values (i.e. adopt a value equal to 50% of the limit of reporting), combined with the number of leaches performed, and the relatively low guideline value. Therefore, although the cumulative value for cadmium appears to have exceeded the aquatic ecosystem guideline value in leach 4, it is suggested that cadmium levels within Agate Creek Mine's waste rock are not of environmental concern.

With respect to metals and metalloids, cumulative values may be of use in assessing the total load that may build up by evaporation in any downstream sediments and may be available for later mobilisation in flow events.

Only four metals or metalloids were regularly recorded above their respective aquatic ecosystem guideline values (Table 8):

- Dissolved aluminium;
- Dissolved boron;
- Dissolved copper; and
- Dissolved zinc.

Values for aluminium (refer Figure 22 and Table 8) were opportunistic up to Leach 3 after which a consistent overall drop for all samples was observed. Erratic behaviour in Leaches 0 to 2 was shown by all samples, except for CCGC336. Non-compliance values (above 0.055 mg/L) were shown by CCGC309 in Leach 0 and CCGC339 in Leaches 1 and 2, with the value in Leach 2 exceeding 0.150 mg/L (Figure 22 and Table 8). After Leach 2, levels in all samples decrease systematically. Accumulated values in all samples (except for CCGC336) exceed the 0.055 mg/L threshold (Figure 22 and Table 8).

As indicated above, individual levels are largely opportunistic, representing mineral availability to reaction at any particular time. Further, much of the “dissolved” aluminium will be in colloidal form.

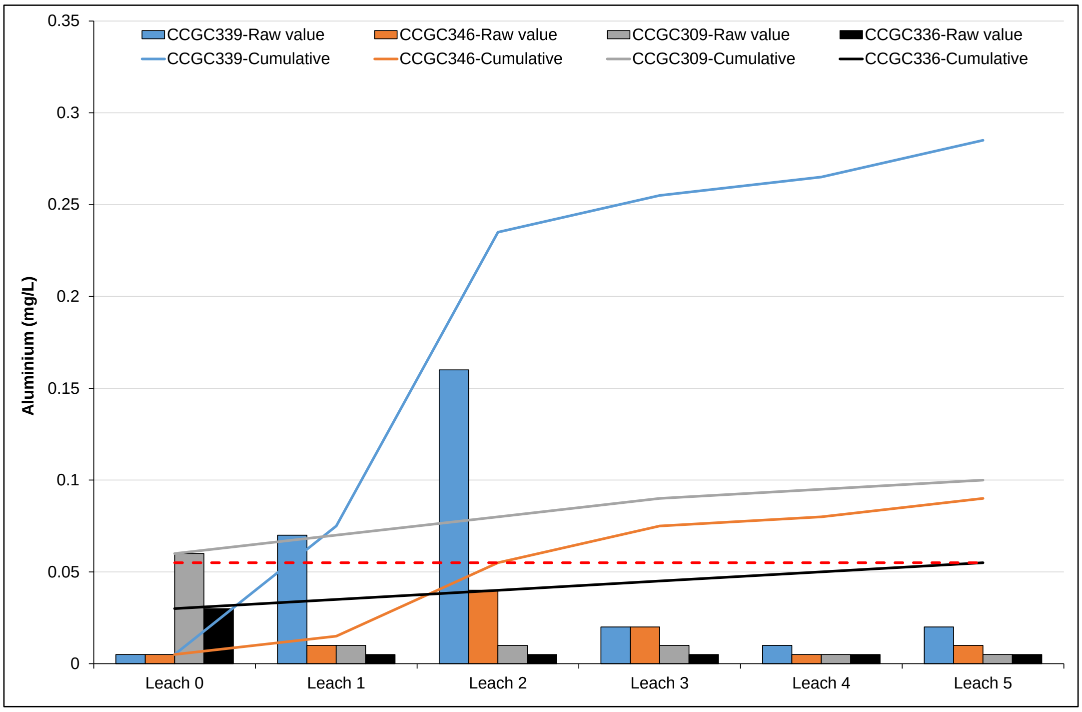

Figure 22: Cumulative trends and individual leach values of dissolved aluminium observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).

Dissolved Boron levels reacted as expected in all samples (i.e. initially elevated and then relatively compliant levels in later leaches), except CCGC336 (Figure 23). CCGC336 (located in Pit 6) increased in dissolved boron concentrations with each subsequent leach, displaying an almost exponential cumulative rise in values up to leach 4. However, the results of leach 5 show the values of dissolved boron began to decrease (Figure 23). The relatively higher boron values from CCGC336 may be a response of the clay minerals present, in the sample, to the slight decrease in pH (increase in acidity) shown by the same sample over the 5 leaches.

Dissolved copper marginally exceeded the guideline value on two occasions in two separate samples (Figure 24). Both CCGC346 (from Pit 4) and CCGC336 (from Pit 6) recorded one result each above the guideline value with all other results from these two samples recorded below the LOR (Figure 24). Figure 24 shows the levels of copper within the waste rock quickly leach from the system at marginal levels prior to reducing to compliant concentrations. While the accumulation of copper within aquatic environments can be of environmental concern, it is predicted that the relatively low levels of copper leaching from the Agate Creek Mine waste rock are of negligible concern to its downstream receiving environment.

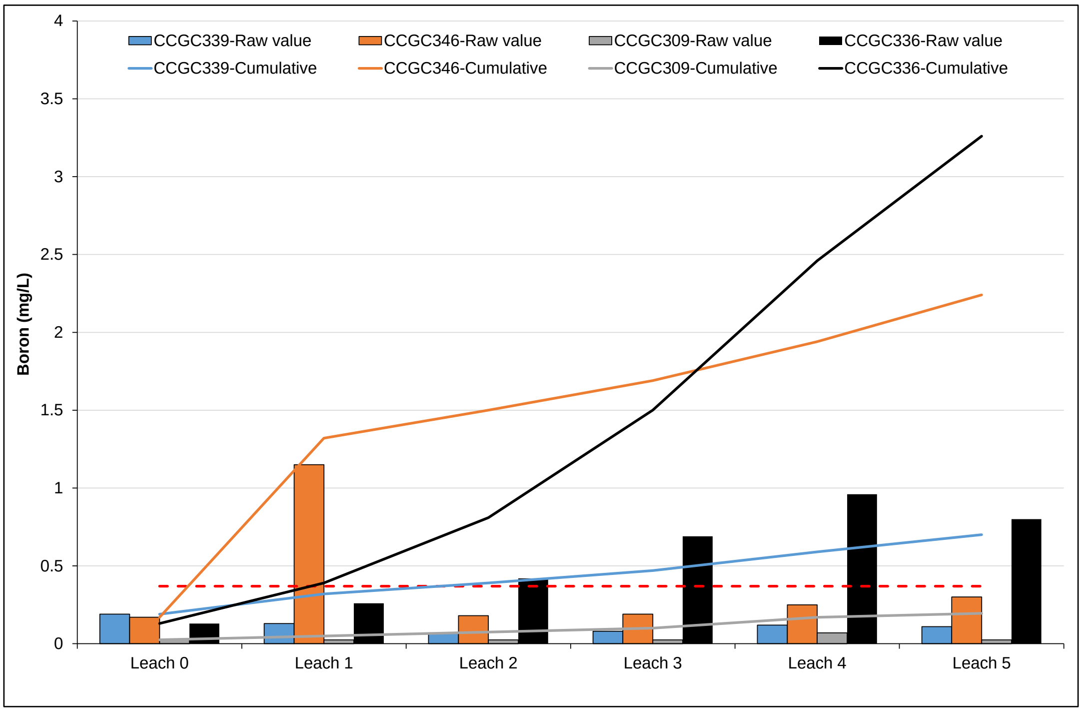

Figure 23: Cumulative trends and individual leach values of dissolved boron observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).

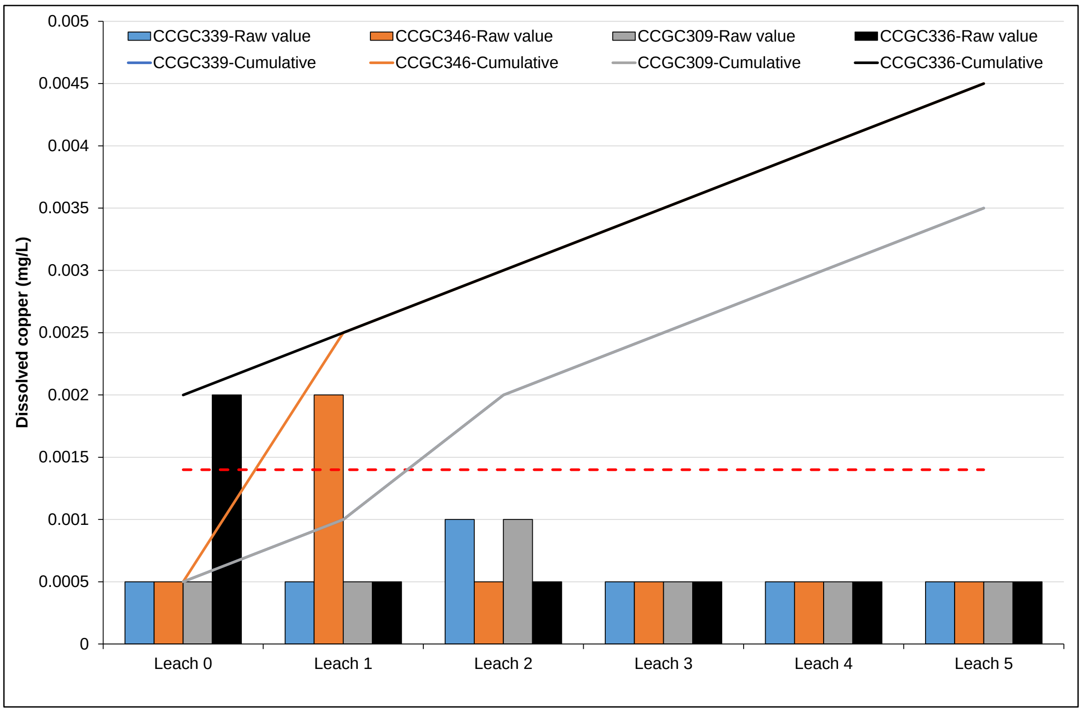

Figure 24: Cumulative trends and individual leach values of dissolved copper observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).

During leach 1, CCGC346 (Pit 4) recorded one large spike of dissolved zinc (well above the aquatic ecosystem guideline level), but recorded levels below the LOR on every other occasion (Figure 25). CCGC309 (in Pit 6) is the only sample to record all values below the LOR, with no other site following any particular trend in results (Table 8 and Figure 25). In the absence of appreciable sulphate (i.e. evidence of sulphide oxidation) the behaviour of both copper and zinc are problematical. The most likely source of these metals into solution in the geological context (i.e. waste rock) is desorption from negatively charged manganese oxy-hydroxide colloids, and or, possibly negatively charged aluminium oxy-hydroxide colloids. Attempts to investigate these possibilities using correlation analyses have not been entirely successful. Possibly, by including adsorption on to smectite as an additional parameter may lead to success. Modelling at this level is beyond the scope of this current study.

Overall, it is considered likely that the probable sources of both copper and zinc are desorption from oxy-hydroxides and clays. This desorption would be opportunistic in the leaching solution as mineral species, and consequent value, may be elevated, but would be expected to show an overall decrease between successive leaches. This trend is generally consistent with the data up to Leach 5.

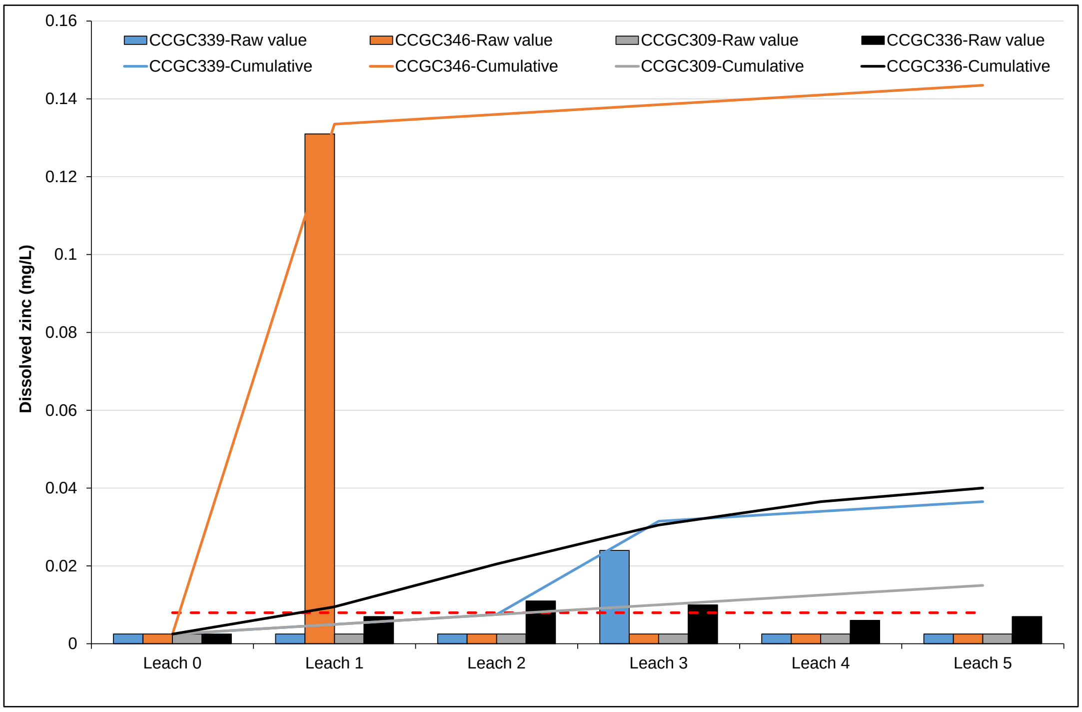

Figure 25: Cumulative trends and individual leach values of dissolved zinc observed in each KLC tested sample over time compared against the ANZG (2018) 95% species protection level for freshwater systems (red dashed line).

4.5.4 FLUORIDE

The KLC test results demonstrate that there is an expected overall accumulation of fluoride with successive leaching in sample CCGC339 (Table 8 and Figure 26). In all other samples (and particularly levels of fluoride), particulates are approximately constant with successive leaches.

For CCGC309, levels of fluoride fell from 6.6 mg/L in Leach 0, to 4 mg/L in Leach 1, to 2.0 mg/L in Leach 4 (Table 8 and Figure 26). The compliance level is 2.0 mg/L. The initial high level is probably due to the presence of the alteration mineral fluorite (CaF2) and its dissolution. Successive leaches reduce the influence of this mineral by dissolution.

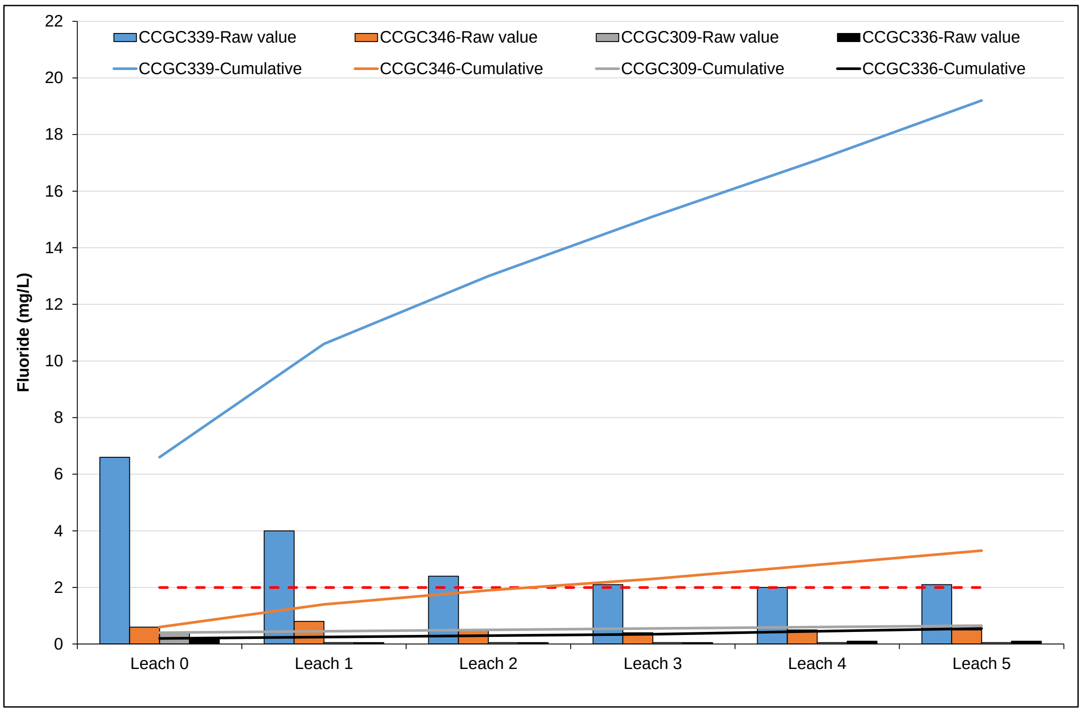

Figure 26: Cumulative trends and individual leach values of fluoride observed in each KLC tested sample over time compared against the ANZG (2018) livestock drinking water value (red dashed line).

5. CONCLUSION AND RECOMMENDATIONS

5.1 ACID MINE DRAINAGE

Static testing of 260 samples from Pits 1 to 6 from Agate Creek Mine were analysed for a broad range of analytes in manners consistent with the relevant protocols. Of the 260 samples analysed only 11 samples could be categorised as PAF. These samples are all found in Pits 2, 5 and 6 with 7 of the 11 being found in Pit 6. All of these, except for one sample in Pit 2, still only have very low to low sulphur values. Therefore, only one sample presents any possibility of acid mine drainage. Thus, it is expected that:

- The amount of any acid potentially produced will be small, and
- Any acid produced by the waste rock will be buffered by the surrounding NAF rock which makes up >90% of the waste rock.

Therefore, it is considered that the acid mine drainage risk posed by the waste rock associated with the project is very low.

5.2 SALINITY

The EC of water from the Agate Creek waste rock samples ranged from 7 to 1680 µS/cm with a very low median value of 43.5 µS/cm. These values are all within (or similar to in the case of the maximum value) appropriate guideline values for freshwater systems. Therefore, it is considered that salinity is not an issued in the management of the Agate Creek waste rock piles.

5.3 ELEMENTS

A broad range of analytes were assessed in both the static leach tests and KLC tests, with the following results of note:

- Fluoride: Levels were above the target level of 2 mg/L in many of the 260 waste rock samples analysed using static tests. The range in values overall was >0.5 mg/L to 63 mg/L. These exceedances may be of concern as fluorine is present in most of the waste rock, principally in the alteration zone minerals (fluorite) and in the micas. However, these fluoride values are not universal for the Agate Creek area which is a volcanic province where fluorine enrichment is not unexpected. The possibility of a high ambient level implies that the overall risk associated with fluoride is low.

  In the kinetic leach results, fluoride trended down to the compliance level of 2 mg/L by the 4th leach, supporting the overall proposition that the overall environmental risk from fluoride is low.
- Sulphate: The dissolved sulphate levels in the static test results from the Agate Creek waste rock samples range from 5 mg/L to 1760 mg/L with a low median value of 20 mg/L. Only one sample from Pit 2 is above the ANZECC and ARMCANZ (2000) Livestock Drinking Water Guideline of 1000 mg/L.

  Sulphate values in the KLC tests were all within compliance levels. Based on these results the environmental risk from sulphate is considered low.
- Metals and Metalloids: In KLC tests, levels above compliance values were detected for aluminium, boron, copper and zinc. These exceedances were relatively low and were probably associated with adsorbed species on colloids being included in the "dissolved" analyses. As such, these exceedances are considered to display a very low to low environmental risk associated with the Agate Creek waste rock piles.

5.4 RECOMMENDATIONS

The overall risk associated with the Agate Creek waste rock material is most likely very low to possibly low. In the light of this level of risk, capping is not recommended or appropriate. Any waste rock piles developed by the mining activities should be covered with layers of sub-soil and top-soil and revegetated with a range of native plant and grass species appropriate to the soils and climate of the area.

Additionally, it is recommended that the site determine site-specific water quality objectives for the receiving environment of Agate Creek and the groundwaters of relevance to the site, with particular focus on fluoride, sulphate, aluminium, boron, copper and zinc. This will allow for appropriate monitoring of potential impacts from operations/activities associated with the proposed project.

6. REFERENCES

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Appendix A – Static Results

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2203022**	Page	: 1 of 26
Client	: **C & R CONSULTING PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: ALEXANDER BARNES	Contact	: Princess Marcelo
Address	: 188 ROSS RIVER ROAD AITKENVALE QUEENSLAND 4812	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Agate Creek Geochemistry	Date Samples Received	: 01-Feb-2022 09:00
Order number	: ----	Date Analysis Commenced	: 10-Feb-2022
C-O-C number	: ----	Issue Date	: 08-Mar-2022 16:57
Sampler	: PETER NEVILLE		
Site	: ----		
Quote number	: TV/178/21		
No. of samples received	: 56		
No. of samples analysed	: 56		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG005T (Total Metals by ICP-AES): V33205 (EB2203022-039) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V32485 (EB2203022-010) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V32512 (EB2203022-019) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32482	V32485	V32488	V32491	V32494
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-009	EB2203022-010	EB2203022-011	EB2203022-012	EB2203022-013
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.0	5.4	5.6	6.0	6.2
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	-0.5	-7.0	-6.8	-1.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	40	234	32	23	22
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.3	5.5	4.9	5.8	5.9
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	1.9	3.8	13.6	3.5	3.4
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	0.5	7.0	6.8	1.1
ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	0.7	0.7	0.1
Fizz Rating	----	0	Fizz Unit	0	0	1	1	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	1.7	<1.0	1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	20	<10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	330	40	100	110
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2420	1950	1470	1740	1680
Arsenic	7440-38-2	5	mg/kg	11	33	6	26	9
Barium	7440-39-3	10	mg/kg	20	240	40	40	70
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	8	6	16	9	8
Cobalt	7440-48-4	2	mg/kg	2	<2	<2	5	5
Copper	7440-50-8	5	mg/kg	7	7	9	17	14
Iron	7439-89-6	50	mg/kg	17800	5860	6030	12000	15700
Lead	7439-92-1	5	mg/kg	7	13	10	10	14

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32482	V32485	V32488	V32491	V32494
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-009	EB2203022-010	EB2203022-011	EB2203022-012	EB2203022-013
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	33	<5	5	481	120
Nickel	7440-02-0	2	mg/kg	4	5	9	5	6
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	17	13	9	21	16
Zinc	7440-66-6	5	mg/kg	32	24	6	21	34
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	8	3	5	4

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	V32497	V32500	V32503	V32506	V32509
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203022-014	EB2203022-015	EB2203022-016	EB2203022-017	EB2203022-018
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.9	7.0	7.1	7.2	7.3
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-0.6	-0.8	-0.8	-0.9	-1.2
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	36	13	20	22	47
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.8	6.0	5.9	6.3	7.0
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	3.6	2.5	3.2	1.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	0.6	0.8	0.8	0.9	1.2
ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	<0.1	<0.1	0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	1.1	<1.0	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	10	<10	10	30
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1700	1860	1420	2150	1390
Arsenic	7440-38-2	5	mg/kg	8	17	<5	<5	<5
Barium	7440-39-3	10	mg/kg	70	80	30	20	20
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	12	11	9	12	14
Cobalt	7440-48-4	2	mg/kg	6	14	3	30	4
Copper	7440-50-8	5	mg/kg	10	23	14	19	9
Iron	7439-89-6	50	mg/kg	22400	18100	6650	32200	9560
Lead	7439-92-1	5	mg/kg	17	16	14	13	10

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

			Sample ID	V32497	V32500	V32503	V32506	V32509
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-014	EB2203022-015	EB2203022-016	EB2203022-017	EB2203022-018
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	62	312	84	376	191
Nickel	7440-02-0	2	mg/kg	11	14	8	25	10
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	11	9	<5	8	5
Zinc	7440-66-6	5	mg/kg	36	38	37	120	38
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	6	6	4	5	5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32512	V32515	V32518	V32521	V32524
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-019	EB2203022-020	EB2203022-021	EB2203022-022	EB2203022-023
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**7.4**	**7.6**	**7.4**	**7.3**	**7.2**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	**-0.8**	**-6.7**	**-6.7**	**-1.1**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**28**	**30**	**35**	**30**	**47**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**7.9**	**6.5**	**6.4**	**6.9**	**8.0**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	**1.6**	**1.2**	**0.2**	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	**0.8**	**6.7**	**6.7**	**1.1**
ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	**0.7**	**0.7**	**0.1**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**1**	**1**	**0**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	**1.0**	**1.0**	**1.0**	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	**20**	**20**	**20**	**40**
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**1920**	**1240**	**1370**	**1450**	**1450**
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	**70**	**20**	**40**	**10**	**100**
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**11**	**14**	**12**	**18**	**8**
Cobalt	7440-48-4	2	mg/kg	**10**	**4**	**3**	**2**	<2
Copper	7440-50-8	5	mg/kg	**9**	**11**	<5	**9**	**12**
Iron	7439-89-6	50	mg/kg	**27100**	**10900**	**9370**	**7860**	**8500**
Lead	7439-92-1	5	mg/kg	**6**	**8**	**20**	**11**	**10**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32512	V32515	V32518	V32521	V32524
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-019	EB2203022-020	EB2203022-021	EB2203022-022	EB2203022-023
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**456**	**161**	**104**	**219**	**128**
Nickel	7440-02-0	2	mg/kg	**19**	**13**	**10**	**10**	**10**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**6**	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	**72**	**38**	**34**	**35**	**39**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**4**	**3**	**3**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32527	V32530	V32533	V32536	V32539
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-024	EB2203022-025	EB2203022-026	EB2203022-027	EB2203022-028
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.3	6.5	7.8	7.6	7.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-1.6	-1.0	-1.2	-0.7	-0.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	41	96	69	46	65
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.0	6.8	7.6	7.4	7.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	1.0	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1.6	1.3	1.5	1.0	1.4
ANC as CaCO3	----	0.1	% CaCO3	0.2	0.1	0.2	0.1	0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	110	90	40	70
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	0.01	0.01	0.01	0.02
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	120	10	10	20
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1240	1780	1190	3330	3170
Arsenic	7440-38-2	5	mg/kg	<5	21	5	<5	7
Barium	7440-39-3	10	mg/kg	130	290	50	50	80
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	9	8	10	14	13
Cobalt	7440-48-4	2	mg/kg	6	45	18	7	7
Copper	7440-50-8	5	mg/kg	15	22	6	12	8
Iron	7439-89-6	50	mg/kg	8470	16400	9940	25600	26200
Lead	7439-92-1	5	mg/kg	11	18	19	9	17

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32527	V32530	V32533	V32536	V32539
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-024	EB2203022-025	EB2203022-026	EB2203022-027	EB2203022-028
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	325	52	562	515	738
Nickel	7440-02-0	2	mg/kg	10	43	18	14	12
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	<5	5	6	14	11
Zinc	7440-66-6	5	mg/kg	42	185	83	94	63
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	0.3	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	5	3	4	4	4

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32542	V33151	V33154	V33157	V33189
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-029	EB2203022-030	EB2203022-031	EB2203022-032	EB2203022-033
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.3	6.9	7.2	4.7	5.0
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-3.0	-0.6	<0.5	6.4	0.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	44	21	23	278	57
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.2	5.4	6.9	3.4	5.9
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	2.4	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	2.8	1.0	5.2	1.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	3.3	0.6	<0.5	0.6	<0.5
ANC as CaCO3	----	0.1	% CaCO3	0.3	<0.1	<0.1	<0.1	<0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	1.5	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	<10	<10	670	110
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	<0.01	0.23	0.02
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	<10	<10	100	30
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	5820	750	610	8800	2410
Arsenic	7440-38-2	5	mg/kg	<5	19	6	37	18
Barium	7440-39-3	10	mg/kg	40	<10	<10	<10	10
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	13	13	5	33	12
Cobalt	7440-48-4	2	mg/kg	7	2	<2	48	20
Copper	7440-50-8	5	mg/kg	10	25	25	155	48
Iron	7439-89-6	50	mg/kg	48100	6850	1010	46100	28500
Lead	7439-92-1	5	mg/kg	10	<5	<5	<5	9

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32542	V33151	V33154	V33157	V33189
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-029	EB2203022-030	EB2203022-031	EB2203022-032	EB2203022-033
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**903**	**36**	**6**	**589**	**187**
Nickel	7440-02-0	2	mg/kg	**18**	**10**	**3**	**118**	**6**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**10**	**10**	**8**	**64**	**57**
Zinc	7440-66-6	5	mg/kg	**120**	**15**	<5	**215**	**16**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**4**	**5**	**8**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	V33192	V33195	V33198	V33201	V33202
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203022-034	EB2203022-035	EB2203022-036	EB2203022-037	EB2203022-038
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.3	5.7	6.7	7.0	5.4
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.3	-1.8	-5.6	-15.6	-8.3
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	242	334	429	446	296
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.2	7.2	6.9	7.2	7.1
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	5.3	<0.1	0.2	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	5.9	2.7	6.8	16.8	8.9
ANC as CaCO3	----	0.1	% CaCO3	0.6	0.3	0.7	1.7	0.9
Fizz Rating	----	0	Fizz Unit	1	0	0	1	1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	1.0	1.7	2.9	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	420	630	820	910	530
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.03	0.04	0.04	0.02
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	90	130	180	160	120
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1190	1460	6370	14500	3050
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	13	18
Barium	7440-39-3	10	mg/kg	60	20	20	<10	20
Beryllium	7440-41-7	1	mg/kg	<1	1	<1	1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	6	7	16	32	20
Cobalt	7440-48-4	2	mg/kg	4	37	39	53	31
Copper	7440-50-8	5	mg/kg	38	68	142	125	44
Iron	7439-89-6	50	mg/kg	14400	38500	40900	71800	40900
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	10

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33192	V33195	V33198	V33201	V33202
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-034	EB2203022-035	EB2203022-036	EB2203022-037	EB2203022-038
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**29**	**1580**	**1070**	**4260**	**453**
Nickel	7440-02-0	2	mg/kg	**4**	**17**	**47**	**62**	**14**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**28**	**32**	**66**	**126**	**70**
Zinc	7440-66-6	5	mg/kg	**15**	**68**	**68**	**108**	**33**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**2**	**3**	**4**	**6**	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33205	V33208	V33211	V33214	V33217
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-039	EB2203022-040	EB2203022-041	EB2203022-042	EB2203022-043
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	8.2	7.4	7.2	8.4	7.7
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-12.9	-8.9	-16.8	-9.3	-23.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	143	52	342	147	55
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	8.0	7.4	6.9	7.6	7.4
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.2	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	13.2	9.2	17.4	9.6	23.8
ANC as CaCO3	----	0.1	% CaCO3	1.3	0.9	1.8	1.0	2.4
Fizz Rating	----	0	Fizz Unit	1	1	1	1	1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.0	<1.0	2.0	<1.0	2.6
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	110	60	580	170	20
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	0.01	0.02	0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	90	20	140	60	20
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2780	1140	27000	2470	22300
Arsenic	7440-38-2	5	mg/kg	<5	<5	9	11	<5
Barium	7440-39-3	10	mg/kg	80	20	<10	<10	20
Beryllium	7440-41-7	1	mg/kg	2	<1	<1	<1	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	12	28	31	13	26
Cobalt	7440-48-4	2	mg/kg	23	49	58	9	53
Copper	7440-50-8	5	mg/kg	73	56	60	9	80
Iron	7439-89-6	50	mg/kg	49000	9310	56000	6440	55400
Lead	7439-92-1	5	mg/kg	<5	<5	<5	21	9

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33205	V33208	V33211	V33214	V33217
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-039	EB2203022-040	EB2203022-041	EB2203022-042	EB2203022-043
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**2090**	**852**	**973**	**212**	**1560**
Nickel	7440-02-0	2	mg/kg	**12**	**31**	**162**	**20**	**135**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**50**	**14**	**111**	**9**	**106**
Zinc	7440-66-6	5	mg/kg	**59**	**24**	**114**	**17**	**121**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**18**	**8**	**12**	**11**	**20**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33220	V33223	V33226	V33246	V33249
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-044	EB2203022-045	EB2203022-046	EB2203022-047	EB2203022-048
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.4	7.2	7.2	5.6	7.7
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-26.0	-25.1	-28.0	-9.2	-4.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	58	51	46	42	221
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.8	7.4	7.4	6.3	7.5
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.8	<0.1	<0.1	0.9	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	27.8	25.1	28.0	9.2	4.8
ANC as CaCO3	----	0.1	% CaCO3	2.8	2.6	2.8	0.9	0.5
Fizz Rating	----	0	Fizz Unit	1	1	1	1	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.1	5.4	5.0	1.7	1.4
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	70	<10	<10	30	100
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.06	<0.01	<0.01	<0.01	0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	20	20	30	200
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	21800	27200	25400	5320	2570
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	6	<5
Barium	7440-39-3	10	mg/kg	10	60	30	80	510
Beryllium	7440-41-7	1	mg/kg	1	2	2	<1	1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	26	27	30	9	8
Cobalt	7440-48-4	2	mg/kg	40	62	50	3	6
Copper	7440-50-8	5	mg/kg	51	109	120	5	6
Iron	7439-89-6	50	mg/kg	46500	57400	51100	14600	8610
Lead	7439-92-1	5	mg/kg	<5	<5	<5	7	7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33220	V33223	V33226	V33246	V33249
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-044	EB2203022-045	EB2203022-046	EB2203022-047	EB2203022-048
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**2040**	**3200**	**1400**	**28**	**416**
Nickel	7440-02-0	2	mg/kg	**102**	**136**	**132**	**4**	**9**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**86**	**137**	**130**	**17**	**6**
Zinc	7440-66-6	5	mg/kg	**57**	**78**	**75**	**19**	**38**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**14**	**18**	**16**	**6**	**21**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33252	V33255	V33258	V33261	V33264
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-049	EB2203022-050	EB2203022-051	EB2203022-052	EB2203022-053
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.1	7.2	8.0	7.7	7.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.6	-2.9	-12.4	-8.2	-17.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	175	189	78	28	21
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.0	6.2	7.5	7.4	7.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	3.0	1.4	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.6	2.9	12.4	8.2	17.8
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.3	1.2	0.8	1.8
Fizz Rating	----	0	Fizz Unit	0	0	1	0	1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.1	<1.0	1.1	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	120	140	40	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	140	150	60	20	10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1290	760	3840	6740	7000
Arsenic	7440-38-2	5	mg/kg	7	5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	190	30	90	60	40
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	7	17	11	21	21
Cobalt	7440-48-4	2	mg/kg	<2	<2	7	12	11
Copper	7440-50-8	5	mg/kg	8	8	19	12	8
Iron	7439-89-6	50	mg/kg	4170	2930	16700	19000	18200
Lead	7439-92-1	5	mg/kg	7	6	11	8	6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33252	V33255	V33258	V33261	V33264
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-049	EB2203022-050	EB2203022-051	EB2203022-052	EB2203022-053
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**16**	**13**	**199**	**359**	**407**
Nickel	7440-02-0	2	mg/kg	**6**	**12**	**17**	**18**	**18**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	<5	<5	**9**	**19**	**19**
Zinc	7440-66-6	5	mg/kg	**15**	**12**	**72**	**64**	**59**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**13**	**8**	**11**	**7**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33327	V33330	V33333	V33336	V33339
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-054	EB2203022-055	EB2203022-056	EB2203022-057	EB2203022-058
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.2	7.4	7.5	6.8	7.4
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-5.5	-16.4	-9.5	-5.2	-3.0
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	19	100	133	256	58
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.7	7.5	7.1	7.1	7.8
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.8	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	5.8	16.4	9.5	5.5	3.0
ANC as CaCO3	----	0.1	% CaCO3	0.6	1.7	1.0	0.6	0.3
Fizz Rating	----	0	Fizz Unit	0	1	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	1.0	<1.0	1.1	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	60	130	280	40
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	<0.01	0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	60	100	170	40
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	6940	6440	7330	6200	1580
Arsenic	7440-38-2	5	mg/kg	6	7	6	<5	8
Barium	7440-39-3	10	mg/kg	90	90	40	160	90
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	13	10	20	10	11
Cobalt	7440-48-4	2	mg/kg	10	10	12	14	5
Copper	7440-50-8	5	mg/kg	<5	6	10	14	10
Iron	7439-89-6	50	mg/kg	20200	16000	22300	18800	5040
Lead	7439-92-1	5	mg/kg	10	11	10	7	12

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33327	V33330	V33333	V33336	V33339
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-054	EB2203022-055	EB2203022-056	EB2203022-057	EB2203022-058
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**158**	**857**	**287**	**111**	**219**
Nickel	7440-02-0	2	mg/kg	**13**	**12**	**19**	**23**	**10**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**24**	**15**	**28**	**16**	**7**
Zinc	7440-66-6	5	mg/kg	**48**	**36**	**64**	**129**	**38**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**2**	**24**	**9**	**9**	**8**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33342	V33345	V33348	V33351	V33354
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203022-059	EB2203022-060	EB2203022-061	EB2203022-062	EB2203022-063
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.9	6.8	8.0	7.4	7.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	-11.8	-8.3	-13.7	-7.1
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	22	20	46	40	45
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.2	7.5	7.3	7.2	6.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	0.9
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	11.8	8.3	13.7	7.1
ANC as CaCO3	----	0.1	% CaCO3	<0.1	1.2	0.8	1.4	0.7
Fizz Rating	----	0	Fizz Unit	0	1	0	1	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	<10	10	40	20
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	10	<10	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2360	2530	8260	5420	9800
Arsenic	7440-38-2	5	mg/kg	10	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	80	60	60	20	50
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	7	6	11	10	14
Cobalt	7440-48-4	2	mg/kg	6	7	22	6	8
Copper	7440-50-8	5	mg/kg	11	9	14	12	17
Iron	7439-89-6	50	mg/kg	7770	7810	27400	18500	26500
Lead	7439-92-1	5	mg/kg	8	9	10	10	13

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	V33342	V33345	V33348	V33351	V33354
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203022-059	EB2203022-060	EB2203022-061	EB2203022-062	EB2203022-063
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**180**	**138**	**278**	**240**	**63**
Nickel	7440-02-0	2	mg/kg	**11**	**8**	**45**	**10**	**12**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**6**	**7**	**14**	**12**	**15**
Zinc	7440-66-6	5	mg/kg	**52**	**39**	**122**	**51**	**73**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**4**	**4**	**4**	**4**	**4**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33357	----	----	----	----
			Sampling date / time	01-Feb-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2203022-064	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**8.0**	----	----	----	----
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-1.0**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**80**	----	----	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**3.4**	----	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	**4.0**	----	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**6.3**	----	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**8.3**	----	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	**0.8**	----	----	----	----
Fizz Rating	----	0	Fizz Unit	**0**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**110**	----	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	**0.24**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**8370**	----	----	----	----
Arsenic	7440-38-2	5	mg/kg	**7**	----	----	----	----
Barium	7440-39-3	10	mg/kg	**160**	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg	**20**	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	**13**	----	----	----	----
Copper	7440-50-8	5	mg/kg	**9**	----	----	----	----
Iron	7439-89-6	50	mg/kg	**29600**	----	----	----	----
Lead	7439-92-1	5	mg/kg	**11**	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33357	----	----	----	----
			Sampling date / time	01-Feb-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2203022-064	--------	--------	--------	--------
				Result	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**401**	----	----	----	----
Nickel	7440-02-0	2	mg/kg	**17**	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Vanadium	7440-62-2	5	mg/kg	**25**	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**55**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	----	----	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**2**	----	----	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2203026**	Page	: 1 of 4
Amendment	: **1**		
Client	: **C & R CONSULTING PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: ALEXANDER BARNES	Contact	: Princess Marcelo
Address	: 188 ROSS RIVER ROAD AITKENVALE QUEENSLAND 4812	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Agate Creek Geochemistry	Date Samples Received	: 01-Feb-2022 09:00
Order number	: ----	Date Analysis Commenced	: 15-Feb-2022
C-O-C number	: ----	Issue Date	: 10-Mar-2022 15:27
Sampler	: PETER NEVILLE		
Site	: ----		
Quote number	: TV/178/21		
No. of samples received	: 1		
No. of samples analysed	: 1		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Amendment (10/3/22): This report has been amended and re-released to allow the reporting of additional analytical data, specifically Thorium that was missed at the log-in stage.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34048 to V34117 Composite	----	----	----	----
			Sampling date / time	01-Feb-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2203026-001	--------	--------	--------	--------
				Result	----	----	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.3**	----	----	----	----
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-3.3**	----	----	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**19**	----	----	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**7.1**	----	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	----	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	----	----	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**3.3**	----	----	----	----
ANC as CaCO3	----	0.1	% CaCO3	**0.3**	----	----	----	----
Fizz Rating	----	0	Fizz Unit	**0**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	----	----	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**20**	----	----	----	----
ED093S: Soluble Major Cations								
Calcium	7440-70-2	10	mg/kg	<10	----	----	----	----
Magnesium	7439-95-4	10	mg/kg	<10	----	----	----	----
Sodium	7440-23-5	10	mg/kg	<10	----	----	----	----
Potassium	7440-09-7	10	mg/kg	**20**	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**710**	----	----	----	----
Arsenic	7440-38-2	5	mg/kg	<5	----	----	----	----
Barium	7440-39-3	10	mg/kg	<10	----	----	----	----
Beryllium	7440-41-7	1	mg/kg	<1	----	----	----	----
Boron	7440-42-8	50	mg/kg	<50	----	----	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34048 to V34117 Composite	----	----	----	----
			Sampling date / time	01-Feb-2022 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB2203026-001	--------	--------	--------	--------
				Result	----	----	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Cadmium	7440-43-9	1	mg/kg	<1	----	----	----	----
Chromium	7440-47-3	2	mg/kg	**5**	----	----	----	----
Cobalt	7440-48-4	2	mg/kg	<2	----	----	----	----
Copper	7440-50-8	5	mg/kg	<5	----	----	----	----
Iron	7439-89-6	50	mg/kg	**5180**	----	----	----	----
Lead	7439-92-1	5	mg/kg	<5	----	----	----	----
Manganese	7439-96-5	5	mg/kg	**78**	----	----	----	----
Nickel	7440-02-0	2	mg/kg	<2	----	----	----	----
Selenium	7782-49-2	5	mg/kg	<5	----	----	----	----
Vanadium	7440-62-2	5	mg/kg	**6**	----	----	----	----
Zinc	7440-66-6	5	mg/kg	**14**	----	----	----	----
EG020T: Total Metals by ICP-MS								
Thorium	7440-29-1	0.1	mg/kg	**0.8**	----	----	----	----
Molybdenum	7439-98-7	0.1	mg/kg	**2.4**	----	----	----	----
Antimony	7440-36-0	0.1	mg/kg	**0.5**	----	----	----	----
Uranium	7440-61-1	0.1	mg/kg	**0.4**	----	----	----	----
Tellurium	22541-49-7	0.5	mg/kg	<0.5	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	----	----	----	----

CERTIFICATE OF ANALYSIS

Work Order	: **EB2203029**	Laboratory	: Environmental Division Brisbane
Client	: **C & R CONSULTING PTY LTD**	Contact	: Princess Marcelo
Contact	: ALEXANDER BARNES	Address	: 2 Byth Street Stafford QLD Australia 4053
Address	: 188 ROSS RIVER ROAD AITKENVALE QUEENSLAND 4812		
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Agate Creek Geochemistry	Date Samples Received	: 01-Feb-2022 09:00
Order number	: ----	Date Analysis Commenced	: 10-Feb-2022
C-O-C number	: ----	Issue Date	: 10-Mar-2022 15:31
Sampler	: PETER NEVILLE		
Site	: ----		
Quote number	: TV/178/21		
No. of samples received	: 73		
No. of samples analysed	: 73		

NATA
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Accredited for compliance with
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Ben Felgendrejeris	Senior Acid Sulfate Soil Chemist	Brisbane Inorganics, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

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^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **SPLIT WORK ORDER: It should be noted that ALS has split this work order over the following work orders (EB2203032, EB2203029) due to the size of the sample numbers. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com**
- EG005T (Total Metals by ICP-AES): V33031 (EB2203029-046) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V31908 (EB2203029-005) and V320030 (EB2203029-015) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V31900	V31903	V31905	V31906	V31908
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-001	EB2203029-002	EB2203029-003	EB2203029-004	EB2203029-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**4.9**	**5.0**	**5.0**	**5.0**	**4.9**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-0.7**	**-1.1**	**-0.7**	**-2.0**	**-1.6**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**10**	**10**	**13**	**10**	**13**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**5.6**	**5.6**	**5.5**	**5.8**	**5.8**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**4.4**	**6.1**	**4.2**	**3.3**	**4.4**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**0.7**	**1.1**	**0.7**	**2.0**	**1.6**
ANC as CaCO3	----	0.1	% CaCO3	<0.1	**0.1**	<0.1	**0.2**	**0.2**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**1000**	**980**	**1300**	**740**	**920**
Arsenic	7440-38-2	5	mg/kg	<5	**6**	**13**	<5	<5
Barium	7440-39-3	10	mg/kg	**10**	**10**	**10**	<10	<10
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**5**	**2**	**3**	<2	<2
Cobalt	7440-48-4	2	mg/kg	<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg	<5	<5	**8**	<5	<5
Iron	7439-89-6	50	mg/kg	**2240**	**4760**	**10700**	**2000**	**810**
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	V31900	V31903	V31905	V31906	V31908
Sampling date / time				01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203029-001	EB2203029-002	EB2203029-003	EB2203029-004	EB2203029-005
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	<5	<5	**6**	**5**	<5
Nickel	7440-02-0	2	mg/kg	**3**	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**10**	**6**	**6**	<5	<5
Zinc	7440-66-6	5	mg/kg	<5	<5	**8**	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V31910	V31912	V31914	V31916	V31918
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-006	EB2203029-007	EB2203029-008	EB2203029-009	EB2203029-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.2**	**5.4**	**5.5**	**5.4**	**5.6**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	**-1.6**	**-1.9**	**-2.4**	**-2.5**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**10**	**10**	**11**	**13**	**15**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**5.8**	**5.6**	**5.9**	**6.6**	**6.1**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**3.6**	**4.2**	**2.7**	**0.8**	**2.1**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	**1.6**	**1.9**	**2.4**	**2.5**
ANC as CaCO3	----	0.1	% CaCO3	<0.1	**0.2**	**0.2**	**0.2**	**0.2**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	**1.0**	**1.0**	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	**10**	**10**	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**1000**	**790**	**1080**	**1010**	**760**
Arsenic	7440-38-2	5	mg/kg	<5	<5	**5**	**8**	**9**
Barium	7440-39-3	10	mg/kg	**10**	**20**	**40**	**60**	**10**
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	<2	**2**	**3**	**2**	<2
Cobalt	7440-48-4	2	mg/kg	<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg	<5	<5	**6**	**7**	**13**
Iron	7439-89-6	50	mg/kg	**380**	**4920**	**5820**	**5600**	**3400**
Lead	7439-92-1	5	mg/kg	<5	<5	**7**	**10**	**6**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V31910	V31912	V31914	V31916	V31918
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-006	EB2203029-007	EB2203029-008	EB2203029-009	EB2203029-010
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	<5	<5	**20**	**93**	**39**
Nickel	7440-02-0	2	mg/kg	<2	<2	**2**	**3**	**2**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	<5	**6**	**7**	**8**	<5
Zinc	7440-66-6	5	mg/kg	<5	<5	**10**	**11**	**14**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	**1**	**1**	**2**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V31920	V31922	V31997	V32000	V32003
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-011	EB2203029-012	EB2203029-013	EB2203029-014	EB2203029-015
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.8	5.8	5.5	5.8	6.2
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	-3.0	-1.0	-1.7	-2.9
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	15	26	16	23	29
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.1	7.1	6.1	6.4	7.6
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	3.4	<0.1	1.5	1.3	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	3.0	1.0	1.7	2.9
ANC as CaCO3	----	0.1	% CaCO3	<0.1	0.3	<0.1	0.2	0.3
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.2	1.4	<1.0	<1.0	1.1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	10	20	10	10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	230	<10	<10	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	980	990	410	620	990
Arsenic	7440-38-2	5	mg/kg	14	11	19	<5	11
Barium	7440-39-3	10	mg/kg	40	10	40	20	80
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	2	<2	5	8	5
Cobalt	7440-48-4	2	mg/kg	3	6	<2	<2	8
Copper	7440-50-8	5	mg/kg	11	9	12	<5	9
Iron	7439-89-6	50	mg/kg	9380	14700	4630	2510	13800
Lead	7439-92-1	5	mg/kg	8	5	<5	<5	7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V31920	V31922	V31997	V32000	V32003
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-011	EB2203029-012	EB2203029-013	EB2203029-014	EB2203029-015
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	188	66	23	22	307
Nickel	7440-02-0	2	mg/kg	4	5	4	4	8
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	5	6	8	<5	<5
Zinc	7440-66-6	5	mg/kg	18	25	10	<5	29
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	3	4	1	3	6

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32006	V32009	V32012	V32015	V32018
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-016	EB2203029-017	EB2203029-018	EB2203029-019	EB2203029-020
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.4	6.8	6.8	6.9	7.0
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-1.5	-3.4	-3.7	-2.0	10.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	33	29	25	30	112
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.2	6.5	7.8	6.5	2.9
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	9.9
NAG (pH 7.0)	----	0.1	kg H2SO4/t	3.3	1.6	<0.1	1.2	12.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1.8	3.4	3.7	2.0	5.2
ANC as CaCO3	----	0.1	% CaCO3	0.2	0.4	0.4	0.2	0.5
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.3	1.1	1.1	1.4	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	<10	<10	10	190
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	<0.01	<0.01	0.52
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	<10	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1200	900	1320	1020	4250
Arsenic	7440-38-2	5	mg/kg	14	7	27	15	59
Barium	7440-39-3	10	mg/kg	210	40	70	20	10
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	4	5	6	4	7
Cobalt	7440-48-4	2	mg/kg	3	<2	7	4	15
Copper	7440-50-8	5	mg/kg	7	<5	12	6	12
Iron	7439-89-6	50	mg/kg	4940	7590	17700	11700	22900
Lead	7439-92-1	5	mg/kg	9	8	14	6	8

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	V32006	V32009	V32012	V32015	V32018
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203029-016	EB2203029-017	EB2203029-018	EB2203029-019	EB2203029-020
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**54**	**77**	**462**	**103**	**506**
Nickel	7440-02-0	2	mg/kg	**7**	**6**	**7**	**8**	**29**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	<5	<5	**5**	<5	**11**
Zinc	7440-66-6	5	mg/kg	**34**	**22**	**26**	**27**	**126**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**7**	**8**	**8**	**9**	**7**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32021	V32024	V32027	V32137	V32140
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-021	EB2203029-022	EB2203029-023	EB2203029-024	EB2203029-025
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.9	7.6	7.7	4.8	5.4
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-3.1	-5.5	-2.2	-1.7	-2.7
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	67	63	59	39	276
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.4	7.3	6.0	5.8	5.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	1.2	1.3	1.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	3.4	5.5	2.2	1.7	2.7
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.6	0.2	0.2	0.3
Fizz Rating	----	0	Fizz Unit	0	1	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	1.6
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	30	30	30	20
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	<10	20	310
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1560	1000	1060	2360	1800
Arsenic	7440-38-2	5	mg/kg	<5	<5	9	10	11
Barium	7440-39-3	10	mg/kg	40	20	40	30	120
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	4	3	2	6	11
Cobalt	7440-48-4	2	mg/kg	7	6	4	<2	3
Copper	7440-50-8	5	mg/kg	6	<5	12	<5	9
Iron	7439-89-6	50	mg/kg	22000	26400	18100	13200	11000
Lead	7439-92-1	5	mg/kg	8	5	8	<5	5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32021	V32024	V32027	V32137	V32140
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-021	EB2203029-022	EB2203029-023	EB2203029-024	EB2203029-025
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**365**	**428**	**382**	**19**	**25**
Nickel	7440-02-0	2	mg/kg	**11**	**6**	**7**	**3**	**8**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**7**	**7**	**6**	**17**	**12**
Zinc	7440-66-6	5	mg/kg	**78**	**61**	**46**	**14**	**21**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**12**	**10**	**10**	<1	**11**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32143	V32146	V32149	V32152	V32155
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-026	EB2203029-027	EB2203029-028	EB2203029-029	EB2203029-030
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.0	5.3	6.0	6.7	7.2
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.2	-2.3	-2.9	-3.4	-3.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	270	279	186	162	180
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.9	6.0	6.8	6.3	7.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	2.0	1.9	0.9	2.3	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.2	2.3	2.9	3.4	3.6
ANC as CaCO3	----	0.1	% CaCO3	0.2	0.2	0.3	0.4	0.4
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.6	1.5	<1.0	1.1	1.1
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	50	40	20	30	20
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	370	350	210	140	200
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1830	1410	1220	1460	1200
Arsenic	7440-38-2	5	mg/kg	29	14	8	12	7
Barium	7440-39-3	10	mg/kg	70	30	20	130	20
Beryllium	7440-41-7	1	mg/kg	1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	9	21	17	17	19
Cobalt	7440-48-4	2	mg/kg	4	3	4	8	4
Copper	7440-50-8	5	mg/kg	9	8	8	11	8
Iron	7439-89-6	50	mg/kg	20500	5580	6080	10200	8550
Lead	7439-92-1	5	mg/kg	8	6	10	13	12

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32143	V32146	V32149	V32152	V32155
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-026	EB2203029-027	EB2203029-028	EB2203029-029	EB2203029-030
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	14	9	85	63	162
Nickel	7440-02-0	2	mg/kg	11	14	12	21	15
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	9	10	7	7	6
Zinc	7440-66-6	5	mg/kg	35	21	16	64	17
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	2	3	7	18	7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32158	V32161	V32164	V32167	V32967
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-031	EB2203029-032	EB2203029-033	EB2203029-034	EB2203029-035
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.6	7.1	7.2	7.2	5.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.8	-3.9	-2.9	-4.5	-2.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	130	198	129	157	64
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.8	7.5	7.7	7.8	7.0
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.8	3.9	2.9	4.5	2.9
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.4	0.3	0.4	0.3
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	1.4	1.3	<1.0	1.1	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	30	40	40	40	90
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	110	210	110	160	20
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1110	1230	1300	3060	3170
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	6
Barium	7440-39-3	10	mg/kg	20	20	100	20	30
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	15	14	11	12	20
Cobalt	7440-48-4	2	mg/kg	4	5	10	18	29
Copper	7440-50-8	5	mg/kg	7	7	12	12	70
Iron	7439-89-6	50	mg/kg	17400	45200	33500	47900	31900
Lead	7439-92-1	5	mg/kg	13	15	15	11	28

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	V32158	V32161	V32164	V32167	V32967
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203029-031	EB2203029-032	EB2203029-033	EB2203029-034	EB2203029-035
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	217	814	1100	451	405
Nickel	7440-02-0	2	mg/kg	13	11	11	24	17
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	6	9	11	8	53
Zinc	7440-66-6	5	mg/kg	28	46	40	140	47
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	7	6	6	7	2

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32970	V32973	V32976	V32979	V32982
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-036	EB2203029-037	EB2203029-038	EB2203029-039	EB2203029-040
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.1	4.8	4.7	4.6	5.0
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-0.2	-1.0	-0.6	-0.9	-1.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	64	170	287	362	256
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.1	6.0	6.3	6.2	6.3
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	5.3	3.2	2.4	1.0	1.0
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	0.8	2.2	3.0	2.1	2.3
ANC as CaCO3	----	0.1	% CaCO3	<0.1	0.2	0.3	0.2	0.2
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	70	250	490	640	460
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.04	0.08	0.04	0.03
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	40	60	60	70	40
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1070	1000	1210	1510	1130
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	13
Barium	7440-39-3	10	mg/kg	30	<10	<10	<10	10
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	1	1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	10	10	9	13	10
Cobalt	7440-48-4	2	mg/kg	<2	<2	<2	4	<2
Copper	7440-50-8	5	mg/kg	8	11	19	66	62
Iron	7439-89-6	50	mg/kg	29100	15700	16600	44500	31100
Lead	7439-92-1	5	mg/kg	<5	<5	<5	34	24

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32970	V32973	V32976	V32979	V32982
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-036	EB2203029-037	EB2203029-038	EB2203029-039	EB2203029-040
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	<5	<5	<5	**27**	**6**
Nickel	7440-02-0	2	mg/kg	**3**	**5**	**3**	**6**	**4**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**11**	**13**	**21**	**83**	**34**
Zinc	7440-66-6	5	mg/kg	<5	**7**	**5**	**24**	**12**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32985	V32988	V32991	V33025	V33028
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-041	EB2203029-042	EB2203029-043	EB2203029-044	EB2203029-045
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.4	6.2	6.2	5.0	4.5
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-1.7	-0.7	-0.4	-1.8	1.2
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	233	82	168	60	394
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.6	6.1	5.8	5.2	5.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	4.4	3.3	5.7	2.6	1.4
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.6	1.0	1.0	2.1	<0.5
ANC as CaCO3	----	0.1	% CaCO3	0.3	0.1	<0.1	0.2	<0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	1.6
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	410	120	300	10	440
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.01	0.02	0.01	0.04
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	30	20	20	60	230
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1380	880	840	1400	1470
Arsenic	7440-38-2	5	mg/kg	22	18	26	<5	<5
Barium	7440-39-3	10	mg/kg	10	<10	<10	10	30
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	14	12	9	7	9
Cobalt	7440-48-4	2	mg/kg	<2	<2	2	2	8
Copper	7440-50-8	5	mg/kg	38	29	123	13	23
Iron	7439-89-6	50	mg/kg	31500	31600	23500	15600	33100
Lead	7439-92-1	5	mg/kg	14	10	31	<5	<5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V32985	V32988	V32991	V33025	V33028
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-041	EB2203029-042	EB2203029-043	EB2203029-044	EB2203029-045
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**12**	**25**	**77**	**25**	**230**
Nickel	7440-02-0	2	mg/kg	**6**	**6**	**7**	**2**	**7**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**104**	**10**	**10**	**15**	**32**
Zinc	7440-66-6	5	mg/kg	**16**	**10**	**24**	**7**	**27**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**3**	**3**	**4**	<1	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33031	V33034	V33037	V33040	V33043
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-046	EB2203029-047	EB2203029-048	EB2203029-049	EB2203029-050
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	4.6	5.4	6.7	7.4	7.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-0.7	0.6	-12.2	-16.6	-8.6
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	347	158	194	286	177
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	5.3	5.8	7.1	7.2	7.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	2.2	4.2	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	1.6	<0.5	12.8	17.2	9.2
ANC as CaCO3	----	0.1	% CaCO3	0.2	<0.1	1.3	1.8	0.9
Fizz Rating	----	0	Fizz Unit	0	0	1	1	1
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.0	<1.0	1.4	2.7	2.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	390	190	280	420	300
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.03	0.02	0.02	0.02	0.02
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	200	90	70	90	40
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	2180	3170	11600	41000	32400
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	<5
Barium	7440-39-3	10	mg/kg	60	<10	10	10	<10
Beryllium	7440-41-7	1	mg/kg	<1	<1	1	2	2
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	16	13	17	71	90
Cobalt	7440-48-4	2	mg/kg	10	17	67	182	85
Copper	7440-50-8	5	mg/kg	35	26	27	74	75
Iron	7439-89-6	50	mg/kg	28900	27700	36700	94500	68200
Lead	7439-92-1	5	mg/kg	7	<5	<5	15	8

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33031	V33034	V33037	V33040	V33043
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-046	EB2203029-047	EB2203029-048	EB2203029-049	EB2203029-050
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**186**	**97**	**218**	**871**	**741**
Nickel	7440-02-0	2	mg/kg	**8**	**25**	**55**	**101**	**68**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**32**	**17**	**29**	**176**	**151**
Zinc	7440-66-6	5	mg/kg	**37**	**63**	**129**	**216**	**165**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	**1**	**7**	**9**	**6**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33046	V33049	V33052	V33055	V33133
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-051	EB2203029-052	EB2203029-053	EB2203029-054	EB2203029-055
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.5	7.4	7.3	7.3	5.3
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-18.0	-15.7	-15.5	-19.3	2.8
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	238	200	190	157	169
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.2	7.5	7.5	6.9	4.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	0.2	2.2
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	18.6	16.0	16.1	19.6	0.6
ANC as CaCO3	----	0.1	% CaCO3	1.9	1.6	1.6	2.0	<0.1
Fizz Rating	----	0	Fizz Unit	1	1	1	1	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	2.3	1.8	2.2	3.0	1.6
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	390	350	340	250	320
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.01	0.02	0.01	0.11
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	40	30	20	20	30
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	34900	28700	29500	38000	5080
Arsenic	7440-38-2	5	mg/kg	<5	<5	<5	<5	60
Barium	7440-39-3	10	mg/kg	<10	10	20	10	40
Beryllium	7440-41-7	1	mg/kg	2	2	2	2	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	2	<1
Chromium	7440-47-3	2	mg/kg	27	38	28	60	26
Cobalt	7440-48-4	2	mg/kg	107	118	100	82	33
Copper	7440-50-8	5	mg/kg	96	100	99	134	71
Iron	7439-89-6	50	mg/kg	95800	91500	94100	107000	44400
Lead	7439-92-1	5	mg/kg	11	12	26	94	16

Analytical Results

Sub-Matrix: SOIL
(Matrix: SOIL)

Compound	CAS Number	LOR	Unit	V33046	V33049	V33052	V33055	V33133
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203029-051	EB2203029-052	EB2203029-053	EB2203029-054	EB2203029-055
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	785	1490	1150	1170	632
Nickel	7440-02-0	2	mg/kg	75	92	70	102	31
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	198	165	181	240	91
Zinc	7440-66-6	5	mg/kg	187	234	317	395	55
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	8	8	9	20	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33136	V33139	V33142	V33145	V33148
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-056	EB2203029-057	EB2203029-058	EB2203029-059	EB2203029-060
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.5	7.5	7.8	8.0	7.6
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-19.8	-16.8	-16.8	-12.2	-5.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	177	1680	236	114	59
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.5	7.2	7.2	7.2	7.7
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	20.4	19.2	18.0	12.5	5.4
ANC as CaCO3	----	0.1	% CaCO3	2.1	2.0	1.8	1.3	0.5
Fizz Rating	----	0	Fizz Unit	1	1	1	1	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	8.4	6.6	3.2	2.5	1.5
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	130	1780	210	50	20
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	0.02	0.08	0.04	0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	120	750	120	30	10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	24200	25300	24800	18700	2320
Arsenic	7440-38-2	5	mg/kg	7	8	50	8	44
Barium	7440-39-3	10	mg/kg	290	280	270	270	90
Beryllium	7440-41-7	1	mg/kg	3	6	6	6	3
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	37	33	28	23	11
Cobalt	7440-48-4	2	mg/kg	63	89	91	190	24
Copper	7440-50-8	5	mg/kg	99	129	74	89	246
Iron	7439-89-6	50	mg/kg	60700	72400	65400	69500	50600
Lead	7439-92-1	5	mg/kg	6	5	7	<5	<5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33136	V33139	V33142	V33145	V33148
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-056	EB2203029-057	EB2203029-058	EB2203029-059	EB2203029-060
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	2710	2360	2830	3300	638
Nickel	7440-02-0	2	mg/kg	145	164	169	291	25
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	148	139	118	78	50
Zinc	7440-66-6	5	mg/kg	80	138	158	369	100
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	14	18	29	38	19

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33833	V33836	V33839	V33842	V33845
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-062	EB2203029-063	EB2203029-064	EB2203029-065	EB2203029-066
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**5.2**	**5.6**	**5.4**	**5.5**	**5.2**
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-2.7**	**-2.8**	**-3.1**	<0.5	**-1.9**
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**23**	**16**	**12**	**12**	**45**
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**6.1**	**6.5**	**6.4**	**6.3**	**6.3**
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**1.7**	**1.1**	**1.0**	**1.2**	**2.7**
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**2.7**	**2.8**	**3.1**	<0.5	**1.9**
ANC as CaCO3	----	0.1	% CaCO3	**0.3**	**0.3**	**0.3**	<0.1	**0.2**
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	**0**	**0**
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	**20**
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**30**	**20**	**10**	<10	**40**
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**950**	**860**	**380**	**1270**	**810**
Arsenic	7440-38-2	5	mg/kg	<5	**8**	<5	<5	<5
Barium	7440-39-3	10	mg/kg	<10	<10	<10	<10	<10
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	**4**	**10**	**10**	**5**	**10**
Cobalt	7440-48-4	2	mg/kg	<2	<2	<2	<2	<2
Copper	7440-50-8	5	mg/kg	<5	<5	<5	<5	<5
Iron	7439-89-6	50	mg/kg	**800**	**2130**	**1660**	**1150**	**1710**
Lead	7439-92-1	5	mg/kg	<5	<5	<5	<5	<5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33833	V33836	V33839	V33842	V33845
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-062	EB2203029-063	EB2203029-064	EB2203029-065	EB2203029-066
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	<5	**6**	**5**	<5	**5**
Nickel	7440-02-0	2	mg/kg	<2	<2	<2	<2	<2
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	<5	<5	<5	<5	<5
Zinc	7440-66-6	5	mg/kg	<5	<5	<5	<5	<5
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	<1	<1	<1	<1

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33848	V34601	V34604	V34607	V34610
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-067	EB2203029-068	EB2203029-069	EB2203029-070	EB2203029-071
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	5.6	7.9	7.4	8.4	7.4
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.4	-12.0	-14.4	-6.2	-4.4
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	18	174	278	166	48
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.1	7.5	7.3	7.6	7.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	1.2	<0.1	<0.1	<0.1	<0.1
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.4	12.0	14.7	6.2	4.4
ANC as CaCO3	----	0.1	% CaCO3	0.2	1.2	1.5	0.6	0.4
Fizz Rating	----	0	Fizz Unit	0	1	1	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	3.0	3.7	1.8	1.3
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	10	50	180	80	10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	20	130	210	160	20
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	1060	19400	26300	2560	1480
Arsenic	7440-38-2	5	mg/kg	<5	31	16	<5	9
Barium	7440-39-3	10	mg/kg	<10	70	20	150	40
Beryllium	7440-41-7	1	mg/kg	<1	1	<1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	7	41	50	16	17
Cobalt	7440-48-4	2	mg/kg	<2	88	73	32	15
Copper	7440-50-8	5	mg/kg	<5	108	84	140	102
Iron	7439-89-6	50	mg/kg	1370	53500	68500	29900	30700
Lead	7439-92-1	5	mg/kg	<5	11	9	6	7

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V33848	V34601	V34604	V34607	V34610
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203029-067	EB2203029-068	EB2203029-069	EB2203029-070	EB2203029-071
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	<5	**2010**	**1250**	**2130**	**873**
Nickel	7440-02-0	2	mg/kg	<2	**184**	**189**	**47**	**23**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**6**	**129**	**170**	**62**	**74**
Zinc	7440-66-6	5	mg/kg	<5	**90**	**165**	**119**	**54**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	<1	**62**	**59**	**40**	**17**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34613	V34616	V34618	----	----
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2203029-072	EB2203029-073	EB2203029-074	--------	--------
				Result	Result	Result	----	----
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	**7.4**	**7.2**	**7.2**	----	----
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	**-0.5**	**-4.5**	**-3.9**	----	----
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	**36**	**34**	**24**	----	----
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	**6.7**	**6.6**	**7.6**	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t	**1.3**	**1.0**	<0.1	----	----
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	**0.5**	**4.5**	**3.9**	----	----
ANC as CaCO3	----	0.1	% CaCO3	<0.1	**0.4**	**0.4**	----	----
Fizz Rating	----	0	Fizz Unit	**0**	**0**	**0**	----	----
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	----	----
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**10**	**10**	<10	----	----
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	**870**	**2370**	**920**	----	----
Arsenic	7440-38-2	5	mg/kg	**12**	**9**	**7**	----	----
Barium	7440-39-3	10	mg/kg	**10**	**10**	**150**	----	----
Beryllium	7440-41-7	1	mg/kg	<1	<1	<1	----	----
Boron	7440-42-8	50	mg/kg	<50	<50	<50	----	----
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	----	----
Chromium	7440-47-3	2	mg/kg	**6**	**8**	**15**	----	----
Cobalt	7440-48-4	2	mg/kg	**3**	**7**	**54**	----	----
Copper	7440-50-8	5	mg/kg	**29**	**23**	**68**	----	----
Iron	7439-89-6	50	mg/kg	**2260**	**9050**	**4520**	----	----
Lead	7439-92-1	5	mg/kg	**8**	<5	<5	----	----

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34613	V34616	V34618	----	----
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	----	----
Compound	CAS Number	LOR	Unit	EB2203029-072	EB2203029-073	EB2203029-074	--------	--------
				Result	Result	Result	----	----
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	39	182	1170	----	----
Nickel	7440-02-0	2	mg/kg	4	17	27	----	----
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	----	----
Vanadium	7440-62-2	5	mg/kg	24	23	13	----	----
Zinc	7440-66-6	5	mg/kg	5	19	14	----	----
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	----	----
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	12	20	11	----	----

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB2203032**	Page	: 1 of 18
Client	: **C & R CONSULTING PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: ALEXANDER BARNES	Contact	: Princess Marcelo
Address	: 188 ROSS RIVER ROAD AITKENVALE QUEENSLAND 4812	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: ----	Telephone	: +61-7-3243 7222
Project	: Agate Creek Geochemistry	Date Samples Received	: 01-Feb-2022 09:00
Order number	: ----	Date Analysis Commenced	: 10-Feb-2022
C-O-C number	: ----	Issue Date	: 08-Mar-2022 16:47
Sampler	: PETER NEVILLE		
Site	: ----		
Quote number	: TV/178/21		
No. of samples received	: 40		
No. of samples analysed	: 40		

NATA
Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- **SPLIT WORK ORDER: It should be noted that ALS has split this work order over the following work orders (EB2203032, EB2203029) due to the size of the sample numbers. For any further information regarding this processing of samples please contact ALS client services division on ALSEnviro.Brisbane@alsglobal.com**
- EG005T (Total Metals by ICP-AES): V34637 (EB2203032-001) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34640 (EB2203032-002) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34708 (EB2203032-021) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34712 (EB2203032-023) shows poor matrix spike recovery due to sample heterogeneity. This has been confirmed by visual inspection.
- EG005T (Total Metals by ICP-AES): V34664 (EB2203032-011) shows poor duplicate results due to sample heterogeneity. This has been confirmed by visual inspection.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34637	V34640	V34643	V34646	V34649
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203032-001	EB2203032-002	EB2203032-003	EB2203032-004	EB2203032-005
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	6.7	7.5	8.0	7.1	6.9
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	-2.8	-21.1	<0.5	<0.5	<0.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	23	82	85	27	7
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	6.8	7.1	7.6	6.5	6.1
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	0.7	<0.1	<0.1	1.3	3.7
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	2.8	21.1	<0.5	<0.5	<0.5
ANC as CaCO3	----	0.1	% CaCO3	0.3	2.2	<0.1	<0.1	<0.1
Fizz Rating	----	0	Fizz Unit	0	1	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	3.5	3.4	1.5	<1.0	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	10	30	40	<10	<10
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	18200	22600	1900	1200	410
Arsenic	7440-38-2	5	mg/kg	16	24	<5	23	<5
Barium	7440-39-3	10	mg/kg	200	70	60	20	20
Beryllium	7440-41-7	1	mg/kg	2	1	1	<1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	48	46	16	6	<2
Cobalt	7440-48-4	2	mg/kg	44	44	17	3	3
Copper	7440-50-8	5	mg/kg	100	80	90	49	8
Iron	7439-89-6	50	mg/kg	49000	51800	40600	13600	1490
Lead	7439-92-1	5	mg/kg	9	10	11	<5	<5

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34637	V34640	V34643	V34646	V34649
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203032-001	EB2203032-002	EB2203032-003	EB2203032-004	EB2203032-005
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**951**	**499**	**853**	**105**	**228**
Nickel	7440-02-0	2	mg/kg	**90**	**116**	**24**	**5**	**4**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	**147**	**125**	**52**	**22**	<5
Zinc	7440-66-6	5	mg/kg	**96**	**111**	**92**	**14**	**7**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**3**	**46**	**36**	**10**	**2**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Sample ID	V34652	V34654	V34655	V34658	V34661
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
Compound	CAS Number	LOR	Unit	EB2203032-006	EB2203032-007	EB2203032-008	EB2203032-009	EB2203032-010
				Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)								
pH Value	----	0.1	pH Unit	7.2	7.4	5.8	8.5	5.5
EA009: Net Acid Production Potential								
Net Acid Production Potential	----	0.5	kg H2SO4/t	<0.5	<0.5	<0.5	-1.2	<0.5
EA010: Conductivity (1:5)								
Electrical Conductivity @ 25°C	----	1	µS/cm	14	14	10	91	14
EA011: Net Acid Generation								
pH (OX)	----	0.1	pH Unit	7.4	7.0	6.8	7.9	5.2
NAG (pH 4.5)	----	0.1	kg H2SO4/t	<0.1	<0.1	<0.1	<0.1	<0.1
NAG (pH 7.0)	----	0.1	kg H2SO4/t	<0.1	<0.1	0.6	<0.1	4.0
EA013: Acid Neutralising Capacity								
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t	<0.5	<0.5	<0.5	1.2	<0.5
ANC as CaCO3	----	0.1	% CaCO3	<0.1	<0.1	<0.1	0.1	<0.1
Fizz Rating	----	0	Fizz Unit	0	0	0	0	0
EA055: Moisture Content (Dried @ 105-110°C)								
Moisture Content	----	1.0	%	<1.0	<1.0	<1.0	2.3	<1.0
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	<10	<10	<10	<10
ED042T: Total Sulfur by LECO								
Sulfur - Total as S (LECO)	----	0.01	%	<0.01	<0.01	<0.01	<0.01	<0.01
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	<10	<10	10	70	20
EG005(ED093)T: Total Metals by ICP-AES								
Aluminium	7429-90-5	50	mg/kg	600	840	4050	4460	870
Arsenic	7440-38-2	5	mg/kg	13	10	17	41	11
Barium	7440-39-3	10	mg/kg	20	10	70	70	<10
Beryllium	7440-41-7	1	mg/kg	<1	<1	1	1	<1
Boron	7440-42-8	50	mg/kg	<50	<50	<50	<50	<50
Cadmium	7440-43-9	1	mg/kg	<1	<1	<1	<1	<1
Chromium	7440-47-3	2	mg/kg	<2	<2	37	10	3
Cobalt	7440-48-4	2	mg/kg	6	4	41	28	<2
Copper	7440-50-8	5	mg/kg	10	18	50	145	14
Iron	7439-89-6	50	mg/kg	2160	1800	47600	13800	3340
Lead	7439-92-1	5	mg/kg	6	33	6	5	<5

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	V34652	V34654	V34655	V34658	V34661
			Sampling date / time	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00	01-Feb-2022 00:00
				EB2203032-006	EB2203032-007	EB2203032-008	EB2203032-009	EB2203032-010
				Result	Result	Result	Result	Result
EG005(ED093)T: Total Metals by ICP-AES - Continued								
Manganese	7439-96-5	5	mg/kg	**266**	**202**	**1680**	**435**	**22**
Nickel	7440-02-0	2	mg/kg	**8**	**6**	**46**	**56**	**4**
Selenium	7782-49-2	5	mg/kg	<5	<5	<5	<5	<5
Vanadium	7440-62-2	5	mg/kg	<5	<5	**85**	**46**	**14**
Zinc	7440-66-6	5	mg/kg	**12**	**12**	**21**	**75**	**5**
EG035T: Total Recoverable Mercury by FIMS								
Mercury	7439-97-6	0.1	mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1
EK040S: Fluoride Soluble								
Fluoride	16984-48-8	1	mg/kg	**4**	**5**	<1	**19**	<1