APPENDIX A: BLUE BUSH PROJECT WASTE ACCEPTANCE CRITERIA

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Blue Bush Project Waste Acceptance Criteria

	Operational	
Waste description	**Solid Waste**	**Liquid Waste**
Acidic solutions or acids in solid form	✓	✓
Animal effluent and residues (abattoir effluent, poultry and fish processing waste)	✗	✗
Antimony; antimony compounds	✓	✓
Arsenic; arsenic compounds	✓	✓
Asbestos	✓	✓
Barium compounds (excluding barium sulphate)	✓	✓
Basic solutions or bases in solid form	✓	✓
Beryllium; beryllium compounds	✓	✓
Boron compounds	✓	✓
Cadmium; cadmium compounds	✓	✓
Ceramic-based fibres with physico-chemical characteristics similar to those of asbestos	✓	✓
Chlorates	✓	✓
Chromium compounds (hexavalent and trivalent)	✓	✓
Clinical and related wastes	✗	✗
Cobalt compounds	✓	✓
Containers which are contaminated with residues of substances referred to in this list	✓	✓
Copper compounds	✓	✓
Cyanides (inorganic)	✓	✓
Cyanides (organic)/nitriles	✓	✓
Encapsulated, chemically-fixed, solidified or polymerised wastes referred to in this list	✓	✓
Ethers	✓	✓

Filter cake contaminated with residues of substances referred to in this list	✓	✓
Fire debris and fire washwaters	✓	✓
Fly ash, excluding fly ash generated from Australian coal fired power stations	✓	✓
Grease trap waste	✗	✗
Halogenated organic solvents	✓	✓
Highly odorous organic chemicals (including mercaptans and acrylates)	✓	✓
Inorganic fluorine compounds excluding calcium fluoride	✓	✓
Inorganic sulfides	✓	✓
Isocyanate compounds	✓	✓
Lead; lead compounds	✓	✓
Mercury; mercury compounds	✓	✓
Metal carbonyls	✓	✓
Nickel compounds	✓	✓
Non toxic salts	✓	✓
Organic phosphorus compounds	✓	✓
Organic solvents excluding halogenated solvents	✓	✓
Organohalogen compounds - other than substances referred to in this list	✓	✓
Oxidising agents	✓	✓
Perchlorates	✓	✓
Phenols, phenol compounds including chlorophenols	✓	✓
Phosphorus compounds excluding mineral phosphates	✓	✓
Polychlorinated dibenzo-furan (any congener)	✓	✓
Polychlorinated dibenzo-p-dioxin (any congener)	✓	✓
Reactive chemicals	✓	✓

Reducing agents	✓	✓
Residues from industrial waste treatment/disposal operations.	✓	✓
Selenium; selenium compounds	✓	✓
Soils contaminated with a controlled waste	✓	✓
Surface active agents (surfactants), containing principally organic constituents and which may contain metals and inorganic materials	✓	✓
Tannery wastes (including leather dust, ash, sludges and flours)	✓	✓
Tellurium, tellurium compounds	✓	✓
Thallium; thallium compounds	✓	✓
Triethylamine catalysts for setting foundry sands	✓	✓
Tyres		
Vanadium compounds	✓	✓
Waste chemical substances arising from research and development or teaching activities including those which are not identified and/or are new and whose effects on human health and/or the environment are not known	✓	✓
Waste containing peroxides other than hydrogen peroxide	✓	✓
Waste from heat treatment and tempering operations containing cyanides	✓	✓
Waste from the manufacture, formulation and use of wood-preserving chemicals	✓	✓
Waste from the production, formulation and use of biocides and phytopharmaceuticals	✓	✓
Waste from the production, formulation and use of inks, dyes, pigments, paints, lacquers and varnish	✓	✓
Waste from the production, formulation and use of organic solvents	✓	✓
Waste from the production, formulation and use of photographic chemicals and processing materials	✓	✓

Waste from the production, formulation and use of resins, latex, plasticisers, glues and adhesives	✓	✓
Waste from the production and preparation of pharmaceutical products	✓	✓
Waste mineral oils unfit for their original intended use	✓	✓
Waste oil/water, hydrocarbons/water mixtures or emulsions	✓	✓
Waste pharmaceuticals, drugs and medicines	✓	✓
Waste resulting from surface treatment of metals and plastics	✓	✓
Waste tarry residues arising from refining, distillation, and any pyrolytic treatment	✓	✓
Waste, substances and articles containing or contaminated with polychlorinated biphenyls (PCBs), polychlorinated naphthalenes (PCNs), polychlorinated terphenyls (PCTs) and/or polybrominated biphenyls (PBBs)	✓	✓
Waste of an explosive nature not subject to other legislation	✗	✗
Wool scouring waste	✓	✓
Zinc compounds	✓	✓

APPENDIX B: OPERATIONAL PROCEDURES FOR LIQUID WASTE AND PFAS WASTE

Tellus has options to use different treatment options for waste received at our near surface geological repositories.

Each waste type is rigorously assessed through the internal Tellus WAP and WAC (refer to Appendix A). No waste type would be accepted for storage or permanent isolation at our geological repositories if it is not able to be treated to meet the strict requirements of the WAP and WAC. For example, if a waste is explosive and is unable to be treated to remove the explosive nature of the waste, it would not be accepted for storage/permanent isolation.

Liquid waste would not be accepted directly for permanent isolation at the BBF. This includes wastes that are received as liquids or solids which may change physical state during or following permanent isolation. An appropriate chemical formulation must be created and verified by Tellus to allow liquid wastes to be safely permanently isolated.

The waste treatment option used to chemically treat waste on-site is broadly based on the following parameters:

- Chemical reaction risk and long-term stability interaction between waste and chemical treatment media over geological time (<1000 years).
- The long-term environmental risk posed by permanently placing the treated waste into a waste cell.
- Relevant legislation – i.e. State environmental legislation, Basel Convention, Stockholm Convention, Minamata Convention etc.
- Chemical-specific issues.
- The long-term physical strength and geotechnical stability of treated waste streams.

Proprietary chemical treatment formulations are individually created by Tellus chemists to chemically neutralise or chemically encapsulate the hazardous components within the waste matrix. As each waste type is different, a different chemical formulation is required. Chemical treatment options include a combination of concrete encapsulation, kaolin encapsulation and chemical neutralisation techniques dependant on the environmental and safety risk posed by each waste type.

Tellus have and continue to conduct extensive proprietary formulation work and associated testing at independent commercial laboratories and universities to determine the long-term stability and leachability of each specific waste formulation. For example, Tellus has recently engaged one of Western Australia's leading concrete testing facilities, Curtin University, backed by professors in Civil Engineering to test the formulations developed by Tellus for structural integrity. Tellus also has a

chemical and geotechnical laboratory at the Sandy Ridge Facility, which allows Tellus to research individual chemical treatment formulations for the long-term safe and environmentally sound permanent isolation of all waste types that are presented to Tellus.

Further to chemical treatment, each waste type is placed into the cell to mitigate any reactivity risk through the very low risk of chemical migration through each individual encapsulated waste type. For example, Tellus would not dispose of a waste with a pH of 6 directly above neutralised encapsulated cyanide waste.

Finally, the natural geology and geotechnical stability of Tellus' geological repositories create the safest and most environmentally sound geological permanent isolation option for hazardous waste types in Australia.

TELLUS

Management Standard

08.800 WASTE ACCEPTANCE

OPERATIONAL PROCEDURE

CHEMICAL TREATMENT OF LIQUID WASTE

Tellus Holdings Ltd

July 20

Approval

The signatures below certify that this procedure has been reviewed and accepted and demonstrates that the signatories are aware of all the requirements contained herein and are committed to ensuring their provision.

	Name	Position	Sign off Status	Effective Date
Document Owner	Robert Beauglehole	Industrial Chemist		7/07/2020
Document Approver	Clive Young	Facility Manager		

Amendment Record

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1 APPLICABILITY

The aim of this procedure is to

- Provide a safe method of chemically treating liquid waste, and in such a way as to manage and/or eliminate any possibility of injury to personnel or damage to equipment.

2 PURPOSE AND SCOPE

The scope of this procedure includes

- All Tellus staff members required to chemically treat waste;
- All Tellus employees, subcontractors and any other personnel involved in such an operation, controlled, on a project by Tellus are to read and sign off on this procedure.

3 RESPONSIBILITIES

Operator	• To STOP task if any unsafe work practices or activity may result in any team member or personnel being at risk; • To ensure procedure has been read and understood before signing off; • To comply with the procedure at all times; • Ensure that plant equipment is in good working order; • To report all incidents/accidents/near misses and instrument damage to supervisor immediately; • Use the correct PPE; and • Take your time and think SAFETY.
Production Supervisor	• To comply with the procedure at all times; • Supervise the chemical treatment of liquid waste; • With assistance from the industrial chemist, conduct safety briefs for each individual chemical treatment process; • Provide adequate PPE required for the task; • To report all incidents/accidents/near misses and instrument damage to supervisor immediately; and • Take your time and think SAFETY.
Laboratory Technician and Laboratory Supervisor	• To comply with the procedure at all times; • Supervise the chemical treatment of liquid waste; • Provide chemical advice throughout the waste treatment process; • With assistance from the operations team, create and test waste formulations at the Sandy Ridge laboratory; • Conduct sampling and analysis of virgin material, waste streams, final product and live treatment samples; • Sample, package and submit any required verification samples to NATA accredited commercial laboratories. • Ensure that laboratory equipment is in good working order; • Use the correct PPE; and

	• Report all incidents/accidents/near misses and instrument damage to supervisor immediately; • Use the correct PPE; and • Take your time and think SAFETY.
Industrial Chemist	• Provide chemical advice to Sandy Ridge staff; • Assess waste stream via WAP process and create waste treatment formulations based on the physical and chemical properties of the waste; • Determine correct PPE and operator safety requirements for the task; • Provide a risk assessment for the chemical treatment of each liquid waste; and • Assess analysis of virgin material, waste streams, final product and live treatment samples

4 DEFINITIONS

Cell	An excavated area (pit) of kaolin which is below ground level which will be used for in cell storage or permanent isolation of waste.
Geological Repository (in the context of Sandy Ridge)	The term geological repository is used to mean a landfill facility constructed with the equivalent properties of a Class IV or Class V Landfill as defined in Landfill Waste Classification and Waste Definitions 1996 (As amended 2019) Western Australian Department of Water and Environmental Regulation. In the context of Sandy Ridge this means an arid near-surface facility used to permanently isolate waste. Geological repositories provide the highest level of containment through the use of carefully selected natural geological barriers rather than reliance on ma-made line systems that are increasingly recognised as cost effective and preferred method of permanently isolating difficult to manage wastes. The geological barrier provides permanent isolation of wastes from the environment over the very long term and creates additional opportunities for the future recovery and recycling of valuable materials from the waste which can re-enter the circular economy.
Hazardous Waste	Component of the waste stream which by its characteristics poses a threat or risk to public health, safety or the environment. As defined in Landfill Waste Classification and Waste Definitions 1996 (As Amended 2019) Western Australian Department of Water and Environmental Regulation.
In Cell Storage	Medium to long term below ground storage of wastes inside a cell with ongoing opportunity to recover waste if required
Permanent isolation	Indefinite below ground storage of wastes determined suitable for acceptance.
Storage	The short term above ground storage of materials following delivery and includes the time awaiting sample, analysis and management prior to movement for “in cell storage”.

5 REQUIREMENT

5.1 Liquid Waste Pre-acceptance

5.1.1 Waste Acceptance Procedure

All waste is accessed under the Tellus Waste Acceptance Procedure (WAP) prior to it being accepted at Sandy Ridge. The WAP ensures that all waste received can be treated to ensure that the waste will remain chemically and physically stable within the waste cell over geological time (greater than 10,000 years).

Liquid waste will not be accepted directly for permanent isolation at Sandy Ridge. This includes wastes that received as liquids or solids which may change physical state during or following permanent

isolation. An appropriate chemical formulation must be created and verified by Tellus to allow liquid wastes to be safely permanently isolated.

5.1.2 Waste Treatment Formulation

Sandy Ridge is a natural geologically stable near surface geological repository that is able to prevent the migration of waste over geological time. Tellus chemists formulate chemical treatments options to encapsulate waste. Chemical treatment allows Tellus to store hazardous waste in compliance with international best practices including the Basel, Minamata and Stockholm conventions. As Tellus is a Class IV and V landfill, Tellus does not dilute waste within chemically unstable mediums such as saw dust.

Proprietary chemical treatment formulations are individually created to chemically neutralise or chemically encapsulate the hazardous components within the waste matrix. As each waste type is different, a different chemical formulation is required. Chemical treatment options include a combination of concrete encapsulation, kaolin encapsulation and chemical neutralisation techniques dependant on the environmental and safety risk posed by each waste type.

5.1.2.1 Concrete Encapsulation

Wastes can be physically and chemically encapsulated within proprietary Tellus developed concrete formulations. Concrete/waste formulations are tested in the Tellus laboratory for strength and geological stability. Tellus opts to use a third party NATA approved commercial laboratory to test the chemical stability of the dry concrete formulation. All wastes are tested for chemical compatibility within the Sandy Ridge laboratory to ensure that there are no hazardous or toxic biproducts caused by the concrete fixation process.

5.1.2.2 Kaolin Encapsulation

Kaolin clay has strong chemical absorption and retention properties. This makes it an appropriate medium to absorb and fixate liquid waste. Extensive proprietary testing of the kaolin clay mined at the Sandy Ridge facility allows for Tellus chemists to determine whether it is a viable and effective treatment option. The Sandy Ridge laboratory is also able to test absorption rates and chemical compatibility of kaolin clay with each specific waste type. This allows for Tellus to create proprietary chemical treatment options for chemically fixating liquid waste within kaolin clay.

5.1.2.3 Chemical Specific Absorption Media

Tellus may opt to use proprietary commercially available chemical specific absorption media to fixate and/or chemically neutralise waste. Each waste will be assessed on a case by case basis by a Tellus chemist. All absorption media formulations will be tested for chemical compatibility within the Sandy Ridge laboratory to ensure that there are no hazardous or toxic biproducts created.

5.1.2.4 Chemical Neutralisation

Waste may be chemically neutralised by using other chemicals. Each waste type will be assessed by a Tellus Chemist on a case by case basis and tested at the Sandy Ridge laboratory to ensure chemical stability. Chemical neutralisation may be combined with an absorption or concrete encapsulation process.

5.1.3 Waste Treatment at Sandy Ridge

5.1.3.1 Waste verification Testing

Prior to treatment, all waste received at Sandy Ridge undergoes a waste verification testing process by Tellus onsite staff as outlined in the WAP. The waste verification process allows Tellus to confirm that the waste received is able to be safely and effectively treated using the predetermined formulation.

5.1.3.2 Virgin Material Testing

Quality Assurance and Quality Control (QA/QC) testing will be performed on all non-waste materials used in the waste formulation process.

5.1.3.3 Preparation of Waste Treatment

Once a formulation has been developed and verified, the formulation will be provided to Sandy Ridge team members to complete. The formulation will include:

- A formulation run sheet including required mass and volume for each individual chemical constituent in the formulation
- A risk assessment
- Required PPE and other relevant safety measures
- A Safety Data Sheet and Chemical Safety Report
- Formulation verification testing requirements

5.1.3.4 Waste Treatment at Sandy Ridge

Waste treatment at Sandy Ridge will be conducted as specified in the provided formulation run sheet. A chemist is available onsite at Sandy Ridge to provide support and advice. To reduce risk and increase efficiency, formulations will typically be completed in large batches of 10 or more tonnes. A proprietary Waste Isolation Plant (WIP) is available to be used onsite as per the conditions set out in the DWER Sandy Ridge operation license. The Sandy Ridge laboratory is available to conduct live chemical analysis during the formulation process should it be required.

5.1.3.5 Permanent Isolation on Treated Waste

Depending on chemical risk, formulated waste may be placed into the waste cell using a range of methods. Typically, a section of the cell will be bunded using kaolin clay. Liquid concrete will be poured into the bunded area and allowed to set and cure before being sealed within a compacted kaolin cap. Treated waste may also be placed into containers before being placed into permanent isolation. Upon placing the waste into the cell, a GPS coordinated are taken and recorded with the waste records.

6 COMPETENCY

- Manual handling training
- Completed training matrix
- Verification of competency

7 RECORDS SUMMARY

All operators are required to read and sign off on Procedure prior to operating and equipment.

8 REFERENCES

8.1 Legislation, Code of Practice or Standard

Name	Source	Type
Landfill Waste Classification and Waste Definitions 1996 (as amended 2018)	Department of Water and Environmental Regulation	Legislation
Mines Safety and Inspection Act 1994 (Part 2 General OSH Duties)	Department of Mines, Industry Regulation and Safety	Legislation
Mines Safety and Inspection Regulations 1995	Department of Mines, Industry Regulation and Safety	Legislation

8.2 Other Procedures, Documents

Document Name	Document Level
AS/NZS-4360 Risk Management	Standard
AS/NZS-4801 Occupational Health and Safety Management Systems	Standard
AS/NZS-2161 Occupational Protective Gloves	Standard
AS/NZS-1337 Eye Protectors for Industrial Applications	Standard
AS/NZS-1801 Occupational Protective Helmets	Standard
AS1270 Hearing Protectors	Standard
AS/NZ-2210 Occupational Protective Footware	Standard
AS/NZ-4602 High Visibility Safety Garment	Standard
Standards Australia (1999), Guide to the sampling and Investigation of Potentially Contaminated Soil	Standard

TELLUS

Management Standard

08.800 PROCESS CONTROL AND DELIVERY

OPERATIONAL PROCEDURE

CHEMICAL TREATMENT OF PFAS WASTE

Tellus Holdings Ltd

July 20

CHEMICAL TREATMENT OF PFAS WASTE

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Document Reviewer				
Document Approver	Clive Young	Facility Manager		

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CHEMICAL TREATMENT OF PFAS WASTE

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CHEMICAL TREATMENT OF PFAS WASTE

1 APPLICABILITY

The aim of this procedure is to

- Provide a safe method of chemically treating PFAS waste, and in such a way as to manage and/or eliminate any possibility of injury to personnel or damage to equipment.

2 PURPOSE AND SCOPE

The scope of this procedure includes

- All Tellus staff members required to chemically treat waste;
- All Tellus employees, subcontractors and any other personnel involved in such an operation, controlled, on a project by Tellus are to read and sign off on this procedure.

3 RESPONSIBILITIES

Operator	• To STOP task if any unsafe work practices or activity may result in any team member or personnel being at risk; • To ensure procedure has been read and understood before signing off; • To comply with the procedure at all times; • Ensure that plant equipment is in good working order; • To report all incidents/accidents/near misses and instrument damage to supervisor immediately; • Use the correct PPE; and • Take your time and think SAFETY.
Production Supervisor	• To comply with the procedure at all times; • Supervise the chemical treatment of liquid waste; • With assistance from the industrial chemist, conduct safety briefs for each individual chemical treatment process; • Provide adequate PPE required for the task; • To report all incidents/accidents/near misses and instrument damage to supervisor immediately; and • Take your time and think SAFETY.
Laboratory Technician and Laboratory Supervisor	• To comply with the procedure at all times; • Supervise the chemical treatment of liquid waste; • Provide chemical advice throughout the waste treatment process; • With assistance from the operations team, create and test waste formulations at the Sandy Ridge laboratory; • Conduct sampling and analysis of virgin material, waste streams, final product and live treatment samples; • Sample, package and submit any required verification samples to NATA accredited commercial laboratories. • Ensure that laboratory equipment is in good working order;

	• Use the correct PPE; and • Report all incidents/accidents/near misses and instrument damage to supervisor immediately; • Use the correct PPE; and • Take your time and think SAFETY.
Industrial Chemist	• Provide chemical advice to Sandy Ridge staff; • Assess waste stream via WAP process and create waste treatment formulations based on the physical and chemical properties of the waste; • Determine correct PPE and operator safety requirements for the task; • Provide a risk assessment for the chemical treatment of each liquid waste; and • Assess analysis of virgin material, waste streams, final product and live treatment samples

4 DEFINITIONS

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Hazardous Waste	Component of the waste stream which by its characteristics poses a threat or risk to public health, safety or the environment. As defined in Landfill Waste Classification and Waste Definitions 1996 (As Amended 2019) Western Australian Department of Water and Environmental Regulation.
In Cell Storage	Medium to long term below ground storage of wastes inside a cell with ongoing opportunity to recover waste if required
Permanent isolation	Indefinite below ground storage of wastes determined suitable for acceptance.
PFAS	Per- and poly-fluoroakyl substances that are used in products that resist heat, oil, stains and water.
Storage	The short term above ground storage of materials following delivery and includes the time awaiting sample, analysis and management prior to movement for “in cell storage”.

5 REQUIREMENT

5.1 International PFAS Regulation

5.1.1 Stockholm Convention

Perfluorooctane sulphonic acid (CAS No: 1763-23-1), its salts and perfluorooctane sulphonyl fluoride sulphonyl fluoride (CAS No: 307-35-7) have been classified as a persistent organic pollutant (POP).

Although the Stockholm Convention highly recommends that the production and use of PFAS should where possible be reduced or ceased, there is a significant volume of legacy waste present in Australia that requires safe and environmentally sound disposal.

5.1.2 Basel Convention

Sandy Ridge is a natural geologically stable near surface geological repository that is able to prevent the migration of waste over geological time. The Waste Cells at Sandy Ridge exceed the requirements set out in the Basel Convention for the safe permanent isolation of POP waste.

Alternative waste disposal options including thermal destruction may produce hazardous biproducts such as dioxins furans and. These hazardous biproducts present a significant health and environmental risk, particularly when the process is being conducted at one industrial location, consolidating and concentrating the volume of hazardous biproducts produced. Due to the hazardous biproducts of thermal destruction, permanent isolation of PFAS waste within a geological repository is the safest and most economically viable solution for safely disposing of PFAS waste.

5.2 Australian PFAS Regulation

5.2.1 PFAS National Environmental Management Plan

The PFAS National Environment Management Plan (NEMP) addresses the wide range of issues associated with PFAS contamination, including the management of PFAS contaminated materials. The Sandy Ridge facility surpasses the requirements for landfills as described in the document.

Landfill criteria for total concentration of PFAS have been capped at 50 mg/kg. This is based on the PFAS requirements of the Stockholm Convention and Basel Convention on the Transboundary Movements of Hazardous Waste and Their Disposal.

5.3 PFAS Waste Pre-acceptance

5.3.1 Waste Acceptance Procedure

All waste is accessed under the Tellus Waste Acceptance Procedure (WAP) prior to it being accepted at Sandy Ridge. The WAP ensures that all waste received can be treated to ensure that the waste will remain chemically and physically stable within the waste cell over geological time (greater than 10,000 years).

PFAS contaminated liquid waste will not be accepted directly for permanent isolation at Sandy Ridge. This includes wastes that received as liquids or solids which may change physical state during or following permanent isolation. An appropriate chemical formulation must be created and verified by Tellus to allow liquid wastes to be safely permanently isolated.

5.4 PFAS Waste Treatment

5.4.1 Waste Treatment Formulation

Sandy Ridge is a natural geologically stable near surface geological repository that is able to prevent the migration of waste over geological time. Tellus chemists formulate chemical treatments options to encapsulate waste. Chemical treatment allows Tellus to store PFAS contaminated waste in compliance with international best practices including the Basel and Stockholm conventions. As Tellus is a Class IV and V landfill, Tellus does not dilute waste within chemically unstable mediums such as saw dust.

The physical and chemical properties of waste contaminated with PFAS vary significantly. Proprietary chemical treatment formulations are individually created to chemically neutralise or chemically encapsulate each individual waste matrix. As each waste type is different, a different chemical

formulation is required. Chemical treatment options include a combination of concrete encapsulation, kaolin encapsulation and chemical neutralisation techniques dependant on the environmental and safety risk posed by each waste type.

5.4.1.1 Concrete Encapsulation

Wastes can be physically and chemically encapsulated within proprietary Tellus developed concrete formulations. Concrete/waste formulations are tested in the Tellus laboratory for strength and geological stability. Tellus opts to use a third party NATA approved commercial laboratory to test the chemical stability of the dry concrete formulation. All wastes are tested for chemical compatibility within the Sandy Ridge laboratory to ensure that there are no hazardous or toxic biproducts caused by the concrete fixation process.

5.4.1.2 Kaolin Encapsulation

Kaolin clay has strong chemical absorption and retention properties. This makes it an appropriate medium to absorb and fixate liquid waste. Extensive proprietary testing of the kaolin clay mined at the Sandy Ridge facility allows for Tellus chemists to determine whether it is a viable and effective treatment

+ option. The Sandy Ridge laboratory is also able to test absorption rates and chemical compatibility of kaolin clay with each specific waste type. This allows for Tellus to create proprietary chemical treatment options for chemically fixating liquid waste within kaolin clay.

5.4.1.3 Chemical Specific Absorption Media

Tellus may opt to use proprietary commercially available chemical specific absorption media to fixate and/or chemically neutralise waste. Each waste will be assessed on a case by case basis by a Tellus chemist. All absorption media formulations will be tested for chemical compatibility within the Sandy Ridge laboratory to ensure that there are no hazardous or toxic biproducts created.

5.4.2 Waste Treatment at Sandy Ridge

5.4.2.1 Storage of PFAS Waste at Sandy Ridge

PFAS contaminated waste in stored separately from all other waste streams in a dedicated impermeable bunded area.

5.4.2.2 Waste verification Testing

Prior to treatment, all waste received at Sandy Ridge undergoes a waste verification testing process by Tellus onsite staff as outlined in the WAP. The waste verification process allows Tellus to confirm that the waste received is able to be safely and effectively treated using the predetermined formulation.

5.4.2.3 Virgin Material Testing

Quality Assurance and Quality Control (QA/QC) testing will be performed on all non-waste materials used in the waste formulation process.

5.4.2.4 Preparation of Waste Treatment

Once a formulation has been developed and verified, the formulation will be provided to Sandy Ridge team members to complete. The formulation will include:

- A formulation run sheet including required mass and volume for each individual chemical constituent in the formulation
- A risk assessment
- Required PPE and other relevant safety measures

- A Safety Data Sheet and Chemical Safety Report
- Formulation verification testing requirements

5.4.2.5 Waste Treatment at Sandy Ridge

Waste treatment at Sandy Ridge will be conducted as specified in the provided formulation run sheet. A chemist is available onsite at Sandy Ridge to provide support and advice. To reduce risk and increase efficiency, formulations will typically be completed in large batches of 10 or more tonnes. A proprietary Waste Isolation Plant (WIP) is available to be used onsite as per the conditions set out in the DWER Sandy Ridge operation license. The Sandy Ridge laboratory is available to conduct live chemical analysis during the formulation process should it be required.

5.4.2.6 Permanent Isolation of Treated Waste

Depending on chemical risk, formulated waste may be placed into the waste cell using a range of methods. Typically, a section of the cell will be bunded using kaolin clay. Liquid concrete will be poured into the bunded area and allowed to set and cure before being sealed within a compacted kaolin cap. Treated waste may also be placed into containers before being placed into permanent isolation. Upon placing the waste into the cell, a GPS coordinated are taken and recorded with the waste records.

6 COMPETENCY

- Manual handling training
- Completed training matrix
- Verification of competency

7 RECORDS SUMMARY

All operators are required to read and sign off on Procedure prior to operating and equipment.

8 REFERENCES

8.1 Legislation, Code of Practice or Standard

Name	Source	Type
Landfill Waste Classification and Waste Definitions 1996 (as amended 2018)	Department of Water and Environmental Regulation	Legislation
Mines Safety and Inspection Act 1994 (Part 2 General OSH Duties)	Department of Mines, Industry Regulation and Safety	Legislation
Mines Safety and Inspection Regulations 1995	Department of Mines, Industry Regulation and Safety	Legislation

8.2 Other Procedures, Documents

Document Name	Document Level
AS/NZS-4360 Risk Management	Standard
AS/NZS-4801 Occupational Health and Safety Management Systems	Standard
AS/NZS-2161 Occupational Protective Gloves	Standard
AS/NZS-1337 Eye Protectors for Industrial Applications	Standard
AS/NZS-1801 Occupational Protective Helmets	Standard
AS1270 Hearing Protectors	Standard
AS/NZ-2210 Occupational Protective Footware	Standard
AS/NZ-4602 High Visibility Safety Garment	Standard
Standards Australia (1999), Guide to the sampling and Investigation of Potentially Contaminated Soil	Standard

APPENDIX C: SCOPING WORKSHEET

Project :	Blue Bush Facility						
MATTERS		IMPACTS & MITIGATION			ASSESSMENT LEVEL	COMMUNITY ISSUES	SCOPING REPORT
Potential matters that could be affected by the project		Is the project (without mitigation) likely to cause an impact on the matter?	What type of mitigation is needed to manage and mitigate potential impacts (including cumulative impacts)?	Will cumulative assessment be required?	Level of assessment in EIS	If the community raise any concerns about the likely impacts, how will those concerns be addressed?	Where was this addressed in the Scoping Report?
A	B	C	D	E	F	G	H
Group	Specific	Impact?	Mitigation?	Cumulative?		Response?	Section
ACCESS	access to property	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	parking	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	port / airport facilities	N/A			None (include short explanation in Scoping Report)	N/A	N/A
	road / rail network	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
AIR	atmospheric emissions	Yes	Specific	Yes	Detailed Assessment + CIA	Focused Engagement	N/A
	gases	Yes	Specific	Yes	Detailed Assessment + CIA	Focused Engagement	N/A
	particulate matter	Yes	Specific	Yes	Detailed Assessment + CIA	Focused Engagement	N/A
	other - please specify						N/A
AMENITY	noise	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	odour	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	vibration	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	visual	Yes	Standard	Yes	Standard Assessment + CIA	Focused Engagement	N/A
	other - please specify						N/A
BIODIVERSITY	conservation areas	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	native vegetation	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	native fauna	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
BUILT ENVIRONMENT	private property	Yes	Standard	Yes	Standard Assessment + CIA	Focused Engagement	N/A
	public domain	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	public infrastructure	Yes	Standard	Yes	Standard Assessment + CIA	Focused Engagement	N/A
	other - please specify						N/A
ECONOMIC	livelihood	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	natural resource use	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	opportunity cost	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
HAZARDS & RISKS	biosecurity	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	bush fire	Yes	Standard	Yes	Standard Assessment + CIA	Focused Engagement	N/A
	coastal hazards	N/A			None (include short explanation in Scoping Report)	N/A	N/A
	dams	N/A			None (include short explanation in Scoping Report)	N/A	N/A
	dangerous goods	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	environmental hazards	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	floods	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	groundwater contamination	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	hazardous / offensive development	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	land contamination	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	land movement	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	waste	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
HERITAGE	Aboriginal cultural	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	historic	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	natural	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
LAND	land capability	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	soil chemistry	Yes	Standard	Yes	Standard Assessment + CIA	Focused Engagement	N/A
	stability / structure	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	topography	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
SOCIAL	way of life	No			None (include short explanation in Scoping Report)	Focused Engagement	N/A
	community	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	access	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	culture	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	health and wellbeing	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	surroundings	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	rights	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	decision making systems	Unknown	Unknown	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A
WATER	ground water quality	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	hydrological flows (including flooding)	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	surface water quality	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	water availability	Yes	Specific	Yes	Detailed Assessment + CIA	Assessment/Mitigation	N/A
	other - please specify						N/A

APPENDIX D: PRELIMINARY BIODIVERSITY IMPACT ASSESSMENT

Tellus Holdings Ltd

Blue Bush Project

Preliminary Biodiversity Impact Assessment

August 2020

Executive summary

Background

Tellus Holdings Ltd (Tellus) propose to construct and operate a near-surface geological waste repository and associated infrastructure, herein referred to as the 'Blue Bush Facility'. An off-site inter-modal transit station is also proposed to be developed and is herein referred to as the 'Blue Bush Inter-modal'. Collectively, the two proposed facilities are referred to as 'the project' or 'the Blue Bush Project'. The Blue Bush Facility would be located approximately 45 kilometres south of Broken Hill and the Blue Bush Inter-modal would be either located adjacent to the Adelaide-Sydney Railway Line and within or adjacent to the industrial precinct of Broken Hill in the far west of New South Wales.

The project would be assessed as a State Significant Development (SSD) under Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act). This preliminary biodiversity impact assessment has been prepared to present the results of a desktop review of existing information and initial biodiversity field surveys, and to provide an early indication of potential impacts of the project to inform the Referral and Scoping Report for the project. A Biodiversity Development Assessment Report (BDAR) would be prepared at a later date to accompany the SSD application.

Methods

A desktop review was carried out to create a list of threatened flora and fauna species, populations and ecological communities (biota) listed under the NSW *Biodiversity Conservation Act 2016* (BC Act) and *Fisheries Management Act* (FM Act), and matters of national environmental significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that could be expected to occur in the locality based on previous records, known distribution ranges, and habitats present.

Field surveys were completed at the site of the proposed Blue Bush Facility on the 21st, 25th and 26th of May 2020. A brief field inspection was completed from adjacent public roads at the two alternative sites for the proposed Blue Bush Inter-modal as access was not possible at the time of the survey. Field surveys at the Blue Bush Facility site focussed on threatened fauna species, and also included preliminary plant community type mapping and assessment of potential habitat for threatened flora species. Fauna survey methods included habitat assessments, diurnal surveys, remote camera surveys, use of Anabat express units, and spotlighting.

Existing environment

The Blue Bush Facility site is predominantly vegetated with native chenopod shrubland. Pine Creek is located in the west and to the south of the site and Rantyga Creek is located to the east of the site. These creeks are large sandy intermittent watercourses lined with large old *Eucalyptus camaldulensis* (River Red Gum) open woodland, with a heavily disturbed and very weedy understory. Widely spaced small to medium clumps of low *Casuarina pauper* (Black Oak) low sparse woodland and small stands of tall *Hakea tephrosperma* (Hooked Needlewood) occur across the site. High densities of hollow-bearing trees occur along the main water courses. The Blue Bush Facility site is currently grazed.

Blue Bush Inter-modal Site A is predominantly vegetated with native chenopod shrubland and grassland with areas of River Red Gum woodland associated with Stirling Vale Creek in the western portion of the site. High densities of hollow-bearing trees occur along the main water courses. Blue Bush Inter-modal Site B is predominantly cleared.

All creeks at the Blue Bush Facility site and Blue Bush Inter-modal sites are part of the Lowland Darling River aquatic ecological community listed under the FM Act. No key fish habitat is

present. Pine Creek and its floodplain at the Blue Bush Facility site is mapped as a low potential aquatic groundwater dependent ecosystem (GDE). No aquatic GDEs are mapped within Blue Bush Inter-modal Sites A or B.

No threatened ecological communities listed under the EPBC Act are present in the study sites. Small patches of *Acacia loderi* shrublands endangered ecological community (EEC) listed under the BC Act have previously been mapped in and near Blue Bush Inter-modal Site A by GHD in 2017. No threatened ecological communities listed under the BC Act were recorded at the Blue Bush Facility site.

One small sand dune south of the Blue Bush Facility site contains a patch of *Acacia carneorum* (Purple Wood wattle) shrubland. This species is listed as a vulnerable species under the BC Act and the EPBC Act. Seven additional flora species listed under the BC Act (including three additional species listed under the EPBC Act) are considered to have the potential to occur within the Blue Bush Facility site and Blue Bush Inter-modal Site A based on habitat conditions. Further surveys in the appropriate season and conditions would be required to confirm presence or absence of these species. No threatened flora species are likely to occur at Blue Bush Inter-modal Site B.

Four threatened fauna species were identified at the Blue Bush Facility site, and one threatened species has been recorded previously near the Blue Bush Inter-modal Site A, all of which are vulnerable species listed under the BC Act and are ecosystem credit species under the Biodiversity Assessment method (BAM):

- Yellow-bellied Sheath-tail bat (*Saccolaimus flaviventris*).
- Inland Forest Bat (*Vespadelus baverstocki*).
- Little Pied Bat (*Chalinolobus picatus*).
- White-fronted Chat (*Epthianura albifrons*).
- Rufous Fieldwren (*Calamanthus campestris*).

An additional 15 fauna species listed under the BC Act (including five species listed under the EPBC Act) are considered to have the potential to occur within the study sites.

Ecological constraints and opportunities

Much of the proposed Blue Bush Facility site has been mapped as medium ecological constraint. While chenopod shrubland is potential habitat for a number of threatened species listed under the EPBC Act and BC Act, this site is part of an extensive area of similar habitat value and would be unlikely to support the entire population of one of these species. Development should avoid impacts on high constraint areas (drainage lines and riparian vegetation) as far as possible as these provide high quality potential and known habitat for a number of threatened species. Impacts on the very high constraint area (stand of Purple-wood Wattle) would be avoided. This threatened flora species is identified as a species subject to serious and irreversible impacts (SAII) under the BAM and any impact has the potential to result in refusal of the project.

Only a small portion of Blue Bush Inter-modal Site A would potentially be developed. Development should avoid impacts on drainage lines and riparian vegetation in the west of the site, and elsewhere as far as practicable. Impacts on *Acacia loderi* shrublands EEC should be avoided.

Blue Bush Inter-modal Site B is generally of low constraint, except for the presence of mapped first order drainage lines.

Potential impacts

The proposed Blue Bush Facility would comprise infrastructure, including pits and processing plants, waste infrastructure and associated ancillary infrastructure. The site is about

930 hectares in area. For the purposes of this report it is assumed that there would be no construction near Pine Creek, but much of the remaining vegetation at the site is likely to be cleared. There is potential for clearing small patches of *Acacia lode*ri shrublands EEC at the Blue Bush Inter-modal Site A, although this would be avoided where possible. Clearing at both sites would predominantly impact chenopod shrubland.

Direct impacts on Purple-wood Wattle would be purposely avoided, and measures are recommended to protect this stand during construction and operation. Potential habitat is present for a number of other threatened flora species, which would require targeted survey in the appropriate season and conditions to confirm absence, or determine the species polygon for species credits, if present.

Potential habitat is present for a number of threatened birds (such as raptors and cockatoos) and microbats that may roost and breed in River Red Gums along the riparian corridors. Set-backs are proposed to avoid the risk of impacts on water quality, and this would also allow for avoidance of removal of potential breeding habitat for these species. Species credits are unlikely to be required for these species.

Impacts are unlikely for other species credit threatened fauna species/SAII entities such as the Plains-wanderer and Thick-billed Grasswren. These species are restricted in their distribution, and the Blue Bush Facility site and Blue Bush Inter-modal sites are located well away from known records.

There is limited potential for impacts on the Dusky Hopping Mouse, Plains-wanderer and Thick-billed Grasswren (listed under the EPBC Act) given the lack of local records, limited habitat present, and presence of similar habitat types throughout the locality. Impacts on potential habitat for Corben's Long-eared Bat would predominantly be avoided through retention of riparian habitat. There would be negligible impacts on potential habitat for the Australian Painted Snipe. No important habitat for any migratory species would be impacted by the project.

Assessments of significance have been prepared in accordance with the EPBC Act significant impact guidelines for threatened species with the potential to occur and be impacted by the project. These concluded that the project is unlikely to have a significant impact on any threatened biota listed under the EPBC Act.

Further surveys

Further targeted surveys would be conducted as part of preparation of the BDAR to confirm presence or absence of threatened species, and to assist with the design of the Blue Bush Facility and the location of the Blue Bush Inter-modal Site A, and calculate appropriate offsets (where required).

Avoidance and mitigation

The following recommendations are made to avoid impacts on biodiversity values:

- Avoid direct impacts on riparian vegetation associated with Pine Creek at the Blue Bush Facility site and Stirling Vale Creek at the Blue Bush Inter-modal Site A. This would avoid or minimise impacts on potential roosting and breeding habitat for threatened microbats, raptors and cockatoos.
- Avoid any disturbance to the stand of Purple Wood Wattle located to the south of the Blue Bush Facility site.
- Avoid clearing of *Acacia loderi* shrublands where possible at the Blue Bush Inter-modal Site A.
- Locate construction areas to avoid impacts on populations of threatened flora if found to be present, where practicable.

Mitigation measures during construction and operation would include fauna management protocols, erosion and sediment control, and weed management among others. The site would be rehabilitated following decommissioning of the facility.

Offsetting

Ecosystem credits would be calculated for impacts on Plant Community Types as part of the BDAR. Species credits would be calculated for impacts on known habitat for species credit species identified at the sites or considered likely to occur following completion of targeted surveys and detailed habitat assessments.

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Appendix B – Fauna species recorded during field surveys

Appendix C – EPBC Act Assessments of significance

1. Introduction

1.1 Introduction

Tellus Holdings Ltd (Tellus) propose to construct and operate a near-surface geological waste repository and associated infrastructure, herein referred to as the 'Blue Bush Facility'. An off-site inter-modal transit station is also proposed to be developed and is herein referred to as the 'Blue Bush Inter-modal'. Collectively, the two proposed facilities are referred to as 'the project' or 'the Blue Bush Project'. The project would be assessed as a State Significant Development (SSD) under Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

If approved, the Blue Bush Facility would be located approximately 45 kilometres south of Broken Hill and the Blue Bush Inter-modal would be located adjacent to the Adelaide-Sydney Railway Line and within or adjacent to the industrial precinct of Broken Hill in the far west of New South Wales (NSW) (Figure 1-1).

Tellus are currently in the scoping phase of the project, and plan to refer the project to the Commonwealth Minister for the Environment to determine whether the project should be a controlled action or not. A Scoping Report will also be prepared to support a request for the Secretary's Environmental Assessment Requirements (SEARs) for the SDD application.

This preliminary impact assessment report ('the report') has been prepared to provide the results of a desktop review of existing information and initial biodiversity field surveys, and to provide an early indication of potential impacts of the project to inform the Referral and Scoping Report. The report focuses on ecological Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and 'species credit' threatened species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). A Biodiversity Development Assessment Report (BDAR) would need to be prepared in accordance with the Biodiversity Assessment Method (BAM, OEH 2017) to accompany the SSD application, and would include detailed assessment of impacts of the project.

1.2 The project

1.2.1 Blue Bush Facility

Clay would be extracted from open-cut pits at the proposed Blue Bush Facility site. The voids created from this extraction would then be used for the storage and/or permanent isolation of hazardous waste. The Blue Bush Facility would receive up to a maximum of 200,000 tonnes per annum (tpa) of waste for approximately 25 years.

The following infrastructure would be constructed at the proposed Blue Bush Facility site:

- Clay extraction infrastructure – including pits that would eventually become waste cells, and stockpile areas for overburden and kaolin.
- Waste infrastructure – including waste cells (created by the pits), container hardstand, waste inspection area, waste laboratory, waste immobilisation equipment.
- Other ancillary infrastructure – including an administration building, workshop, laydown yard, including repair and maintenance facilities, mobile equipment re-fuelling and washdown, site access and internal haul roads, site fencing and gatehouse, wastewater treatment system and water tanks for raw and potable water, diesel storage tanks, and power generation system.

1.2.2 Blue Bush Inter-modal

The proposed Blue Bush Inter-modal would be used for the temporary storage of clay prior to being transported to market (if it is determined to be of commercial quality) and for the temporary storage of hazardous waste materials prior to their onward transfer to the Blue Bush Facility. Infrastructure, including a road and rail interchange area, a container storage area, office and maintenance and storage sheds would be constructed to support operations at the Blue Bush Inter-modal. Currently two sites (A and B) are being assessed to the west of Broken Hill.

1.3 Purpose of this report

This report has been prepared to support both the Referral to the Australian Government Department of Agriculture, Water and the Environment (DAWE) and the Scoping Report for the Department of Planning, Industry and the Environment.

The aims of the report are to:

- Describe the existing environment at the site, including vegetation types and flora and fauna habitats present.
- Assess the value and conservation significance of native vegetation and habitats in the investigation area.
- Compile a list of threatened biota listed under the BC Act and *Fisheries Management Act 1994* (FM Act) and MNES listed under the EPBC Act previously recorded or predicted to occur in the locality and assess their potential to occur at the site.
- Provide a preliminary assessment of the likely impacts on threatened biota and migratory species from the proposed works.
- Identify potential design options or measures to avoid or minimise the identified impacts.
- Recommend further surveys that would be required to inform a future BDAR, including in particular targeted seasonal surveys for species credit species to satisfy the requirements of the BAM.
- Assess the likely significance of impacts on MNES, in accordance with the EPBC Act significant impact guidelines.
- Provide concluding statements regarding the likely significance of impact of the proposed development on threatened biota listed under the BC Act and FM Act or MNES listed under the EPBC Act.

1.4 Assessment areas

Study sites: refers to the approximately 1,400-hectare area of the development envelope identified on Pine Point Station for development of the Blue Bush Facility site, and two smaller development envelopes for the Inter-modal site (sites A and B) to the west of Broken Hill township.

Study area: refers to a broader area, including private properties and road reserves within a 10 km buffer surrounding the study site locations. The study area covers a much broader area than the expected zone of impact, and the additional information captured has been used to provide context to determine the significance of ecological features identified within the study site (for example, whether they are part of a larger area, or whether there are potential impacts on ecological features outside the study site). The study area was only assessed at a desktop level.

Locality: 20-kilometre radius of the study sites. A broad locality was used as few records of threatened species occur within 10 kilometres of the study sites.

1.5 Scope and limitations

This report has been prepared by GHD for Tellus and may only be used and relied on by Tellus for the purpose agreed between GHD and Tellus Holdings Ltd as set out in section 1.2 of this report.

GHD otherwise disclaims responsibility to any person other than Tellus arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

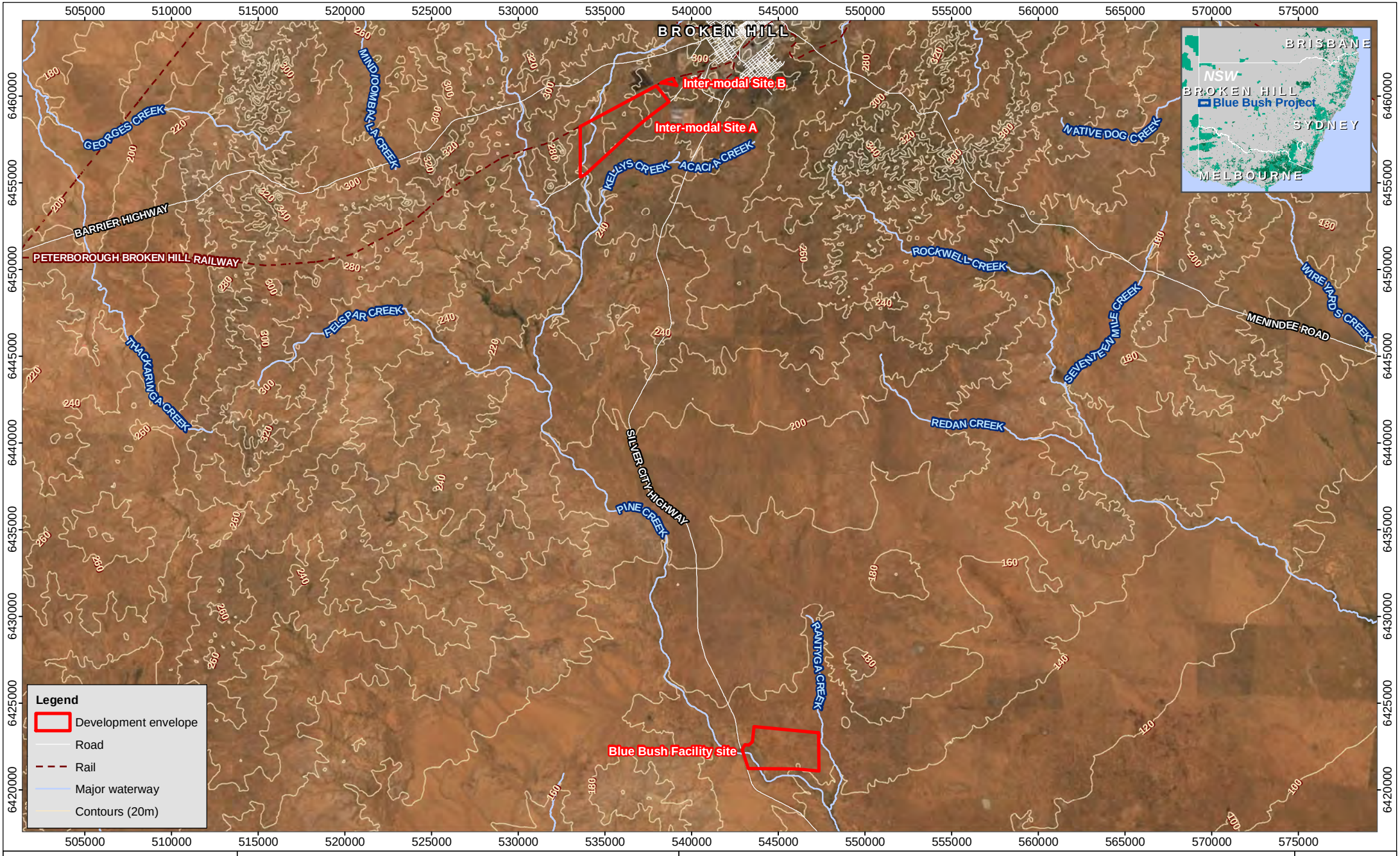
The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer section(s) 3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

The opinions, conclusions and any recommendations in this report are based on information obtained from, and testing undertaken at or in connection with, specific sample points. Site conditions at other parts of the site may be different from the site conditions found at the specific sample points.

Investigations undertaken in respect of this report are constrained by the particular site conditions (for example ongoing drought), and access restrictions (at the Inter-modal sites). As a result, not all relevant site features and conditions may have been identified in this report.

Site conditions may change after the date of this report. GHD does not accept responsibility arising from, or in connection with, any change to the site conditions. GHD is also not responsible for updating this report if the site conditions change.



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Project location

Figure
1-1
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Tellus Holdings Ltd and GHD endeavour to ensure this map is free of errors but does not represent or warrant (either expressly or impliedly) that the map or its features are accurate or fit for a particular use.

Data source: Aerial imagery - esri 2020 (Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community); General topo - NSW LPI DTDB 2019 & 2015; Inset map - Geoscience Australia.

2. Legislative context

2.1 New South Wales State legislation

2.1.1 Environmental Planning and Assessment Act 1979

The Blue Bush Project is classified as State Significant Development (SSD) and will require approval under Part 4, Division 4.7 of the EP&A Act. A Scoping Report is currently being prepared by Tellus to enable the NSW Planning Secretary to set the Secretary's Environmental Assessment Requirements (SEARs) that would scope the content of an Environmental Impact Statement (EIS) for the Blue Bush Project.

2.1.2 Biodiversity Conservation Act 2016

The BC Act provides legal status for biota of conservation significance in NSW. The BC Act aims to, amongst other things, 'maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development'. It provides for the listing of threatened species and communities, establishes a framework to avoid, minimise and offset the impacts of proposed development (the Biodiversity Offsets Scheme [BOS]), and establishes a scientific method for assessing the likely impacts on biodiversity values and calculating measures to offset those impacts (the Biodiversity Assessment Method [BAM]). As noted in section 1.1, a BDAR prepared in accordance with the BAM would be required to accompany the SSD application.

The BAM sets out how biodiversity values will be assessed, prescribes requirements to avoid and minimise impacts, establishes rules for calculating the number and class of biodiversity credits required for unavoidable impacts, and determines the trading rules that will apply. The methodology includes a software package known as the Biodiversity Assessment Method Calculator (the credit calculator) which processes site survey and assessment data. The credit calculator specifies the type and extent of surveys required for a biodiversity assessment and then processes survey data to calculate the number and type of biodiversity credits that are required to offset impacts of the development.

Ecosystem credits are calculated for impacts on vegetation and threatened fauna species that can be predicted to occur at a site. Species credits are required for all flora species and some fauna species that cannot be easily predicted to occur at a site based on vegetation and habitat surrogates. In addition, some fauna species require species credits for impacts on breeding habitat only, or impacts on mapped areas of important habitat.

The BOS recognises that there are some types of serious and irreversible impacts (SAII) that the community expects will not occur except where the consent authority considers that this type of impact is outweighed by the social and economic benefits that the development will deliver to the State (EES 2020). Under the BC Act, a determination of whether an impact is serious and irreversible must be made in accordance with the principles set up in section 6.7 of the BC Regulation. The framework allows for decision-makers to take into account the scale of an impact and the potential for avoidance and mitigation. These factors are weighed against the status and vulnerabilities of the potential SAII entity to ultimately determine if a proposal will indeed have a serious and irreversible impact and should be refused (OEH, 2017c).

Threatened biota, including ecosystem and species credit species, recorded or likely to occur in the study sites are detailed further in section 4. The likelihood of serious and irreversible impacts is discussed in section 6.3. The results of these initial surveys and assessment would feed into the BDAR. Further surveys recommended to meet the requirements of the BAM are detailed in section 8.

2.1.3 Fisheries Management Act 1994

The objectives of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for the listing of threatened species, populations and ecological communities, key threatening processes and requirements or otherwise for the preparation of a SIS. One of the objectives of the FM Act is to 'conserve key fish habitats' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, the Department of Primary Industries (DPI) has produced the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).

Threatened biota and key fish habitat recorded or likely to occur in the study area are discussed in section 4. An assessment of potential impacts on aquatic habitat and biota would need to be included in the BDAR.

2.2 Commonwealth legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on MNES or the environment of Commonwealth land undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will have or is likely to have a significant impact on a matter of national environmental significance' or a significant impact to the environment of Commonwealth land is deemed to be a 'controlled action' and may not be conducted without prior approval from the Australian Minister for the Environment.

Potential ecological MNES of relevance to this assessment include:

- Threatened species and ecological communities.
- Migratory species.

MNES recorded or likely to occur in the study sites are detailed further in section 4. The likelihood of significant impacts is discussed in section 6.3. The results of these initial surveys and assessment would be used to inform the BDAR.

The proposed action is considered a 'nuclear action' based on the proposed acceptance of Naturally Occurring Radioactive Material (NORM) (up to Very Low Level Waste [VLLW]) and Low Level Waste (LLW).

If the proposed action is determined to be a controlled action under the EPBC Act, the bilateral agreement between the NSW Government and the Australian Government would be implemented to streamline the approval process of the Blue Bush Project.

3. Methods

3.1 Database and literature review

A desktop database review was carried out to create a list of threatened flora and fauna species, populations and ecological communities (biota) listed under the BC Act and FM Act, and MNES listed under the EPBC Act that could be expected to occur in the locality based on previous records, known distribution ranges, and habitats present. The database review assisted with focusing field survey techniques and effort. Biodiversity databases and references pertaining to the locality (i.e. within a 20-kilometre radius of the study sites) that were reviewed prior to conducting field investigations included:

- The NSW BioNet Atlas for records of threatened species listed under the BC Act and EPBC Act which have been recorded within the locality (report generated on 20 May 2020) (DPIE, 2020a).
- The Australian Government Department of Agriculture, Water and Environment (DAWE) Protected Matters Search Tool for MNES listed under the EPBC Act which may occur in the locality (report generated on 20 May 2020) (DAWE 2020a).
- Threatened species profiles online database (DPIE 2020b).
- DAWE online species profiles and threats database (DAWE 2019b).
- The NSW Vegetation Information System (VIS) Classification 2.1 - Community Identification (DPIE 2019c) to identify matching plant community types (PCTs) in the site.
- Aerial photography of the site.

Previous vegetation and threatened species mapping and habitat descriptions for a different project GHD assessed at Blue Bush Inter-modal Site A was reviewed.

Following collation of database records and species and community profiles, a 'likelihood of occurrence' assessment was prepared with reference to the broad habitats at the site (see section 3.3).

3.2 Field survey

3.2.1 Overview

Field surveys for terrestrial flora and fauna were completed at the site of the proposed Blue Bush Facility and brief field inspections were completed from adjacent public roads at the two alternative Inter-modal sites for the proposed Blue Bush Inter-modal by two experienced senior ecologists on the 21st, 25th and 26th of May 2020. The approximately 1,400-hectare proposed development envelope of the Blue Bush Facility site was comprehensively traversed by vehicle and on foot, with all habitats inspected.

The two alternative sites for the Blue Bush Inter-modal were only viewed from a nearby roadside as access was not possible at the time of the survey. GHD conducted brief surveys at the larger Blue Bush Inter-modal site (Site A) for another project in 2017.

Conditions at the study sites were very dry (see section 4.1), and the cool to mild conditions with low winds were suitable for fauna detection. Data was collected using ArcGIS Collector on a hand-held device accurate to 10 m.

3.2.2 Terrestrial flora survey

Flora assessments of the study sites focussed on determination of dominant plant community types (PCTs), assessment of broad vegetation condition and identification of State and Commonwealth-listed threatened ecological communities known or predicted to occur in the wider study area.

At the Blue Bush Facility site, areas of potential habitat were searched for State and Commonwealth listed threatened species known or predicted to occur in the study area, including in particular *Acacia carneorum* (Purple-wood Wattle), *Acacia notabilis* (Mallee Golden Wattle), and *Acacia rivalis* (Creek Wattle).

Qualitative descriptions of vegetation condition were completed, including an assessment of tree health, weed invasion and the impact of livestock grazing and potential timber/firewood extraction. Potential vegetation management issues were identified, such as priority weeds or weeds of national environmental significance (WONs).

Inspections at the two alternative Blue Bush Inter-modal sites were conducted from publicly accessible areas along the road adjacent to the sites. Identification of PCTs, threatened ecological communities and potential habitat for threatened flora species was based on this inspection, regional vegetation mapping, and the results of surveys conducted in 2017 by GHD for another project.

3.2.3 Terrestrial fauna survey

Detailed fauna surveys were conducted at the site of the proposed Blue Bush Facility on 21st, 25th and 26th of May 2020. Survey methods are mapped on Figure 3-1 and summarised in Table 3-1. Some surveys were conducted outside the development envelope, in part to gain an understanding of fauna habitats and species in the area, and in part due to changes to the extent of the development envelope during the assessment.

As noted above, detailed surveys were not conducted at the two alternative sites for the proposed Blue Bush Inter-modal. Potential habitat for threatened biota was assessed based on regional vegetation mapping and existing site knowledge.

Fauna surveys across the site of the proposed Blue Bush Facility included identification of fauna habitats, features and condition to assess the potential for threatened fauna species to occur and be impacted by the project. An inventory of native and exotic species encountered during the field assessment was compiled, with a focus on species of conservation significance. Fauna habitat features including waterbodies and farm dams and areas with a high density of hollow-bearing trees were noted.

Twenty timed 20 to 30 minute / 2-hectare targeted fauna surveys were completed across the study site, in a range of representative habitats (Figure 3-1). These surveys used passive observation and recorded all fauna species encountered and targeted cryptic species such as the BC Act-listed Rufous Fieldwren (*Calamanthus campestris*) and Redthroat (*Pyrrholaemus brunneus*) and the EPBC-listed Thick-billed Grasswren (*Amytornis modestus obscurior*) (currently only known from the White Cliffs area in NSW). These surveys included searches for signs of fauna activity, including tracks, nests, scats, and pellets under roost sites.

Open habitats were assessed for suitability for the EPBC Act-listed Plains Wanderer (*Pedionomus torquatus*).

Large trees along Pine Creek were surveyed for signs of nesting by threatened raptors (such as the Black-breasted Buzzard (*Hamirostra melanosternon*), Little Eagle (*Hieraaetus morphnoides*)) and Major Mitchell's Cockatoo (*Lophochroa leadbeateri*), listed as vulnerable species under the BC Act, and for which species credits are required for breeding habitat.

Seven remote fauna cameras were deployed in a range of suitable habitats (Figure 3-1) to detect cryptic and nocturnal species, potentially including the Plains-wanderer and Dusky Hopping Mouse (*Notomys fuscus*), listed under both the BC Act and EPBC Act. Cameras were left *in situ* for six nights, before collection and analysis of photos.

Anabat express units were deployed at six sites in suitable habitat (Figure 3-1) for a total of four survey nights. Sites targeted included large hollow-bearing River Red Gums along Pine Creek, adjacent to two farm dams, and in chenopod shrubland and Black Oak woodland. Call analysis targeted threatened microbats that can be detected using this method, including the Little Pied Bat (*Chalinolobus picatus*), Inland Forest Bat (*Vespadelus baverstocki*) and possibly the Bristle-faced Free-tail Bat (*Setirostris eleryi*), listed under the BC Act.

Harp trapping of bats was not completed at the time due to concerns of COVID19 transmission from humans to bats and seasonal considerations (cold weather). Harp traps are the only method available to detect the EPBC Act-listed Corben's Long-eared Bat (*Nyctophilus corbeni*) as this species cannot be identified by Anabat call analysis. Future surveys would use harp trapping to target this species.

Spotlight surveys were completed on the evening of 25th May in three representative habitats for threatened nocturnal species, including the Plains Wanderer and Dusky Hopping Mouse.

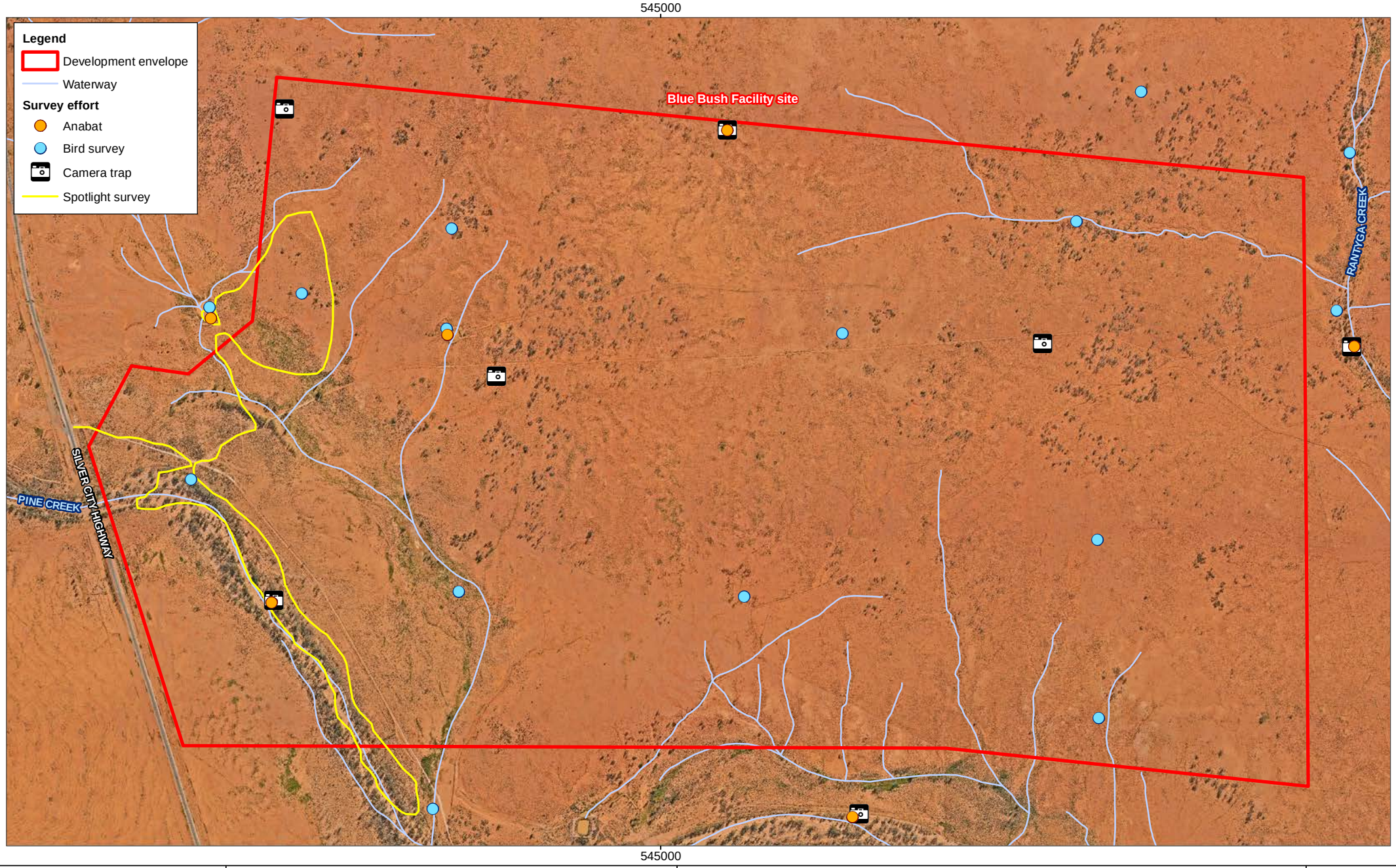
Table 3-1 Summary of fauna survey effort at the Blue Bush Facility site

Survey Method	Target species	Survey effort
Habitat assessments	Threatened species habitats.	Three days across the study site and adjacent areas
20 to 30 minute / 2-hectare targeted fauna surveys	Birds, reptiles and threatened species including Rufous Fieldwren, Redthroat, Thick-billed Grasswren.	Twenty surveys in representative habitats
Remote fauna camera at seven sites	Cryptic and nocturnal species (eg Dusky Hopping Mouse and Plains Wanderer)	42 survey nights (seven cameras for six nights).
Anabat express bat recorder at six sites	Microbats, including threatened Little Pied Bat, Inland Forest Bat and Bristle-faced Free-tail Bat	24 survey nights (four nights at six sites)
Nocturnal spotlighting surveys	Nocturnal species, including Plains Wanderer and Dusky Hopping Mouse	One evening (two ecologists at three sites)

3.3 Likelihood of occurrence

The desktop assessment and results of field surveys were used to assess the likelihood of occurrence of threatened and migratory biota at the study sites. Not all threatened and listed migratory species identified during this assessment are equally likely to occur within the study sites, due to the geographic location, context of the site, or the habitat type and condition.

An assessment of the likelihood of occurrence was completed for the listed threatened and migratory species identified during the desktop review and is provided in Appendix A.



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Survey effort

Figure 3-1

Version: A

Tellus Holdings Ltd and GHD endeavour to ensure this map is free of errors but does not represent or warrant (either expressly or impliedly) that the map or its features are accurate or fit for a particular use.

Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (); General topo - NSW LPI DTDB 2019 & 2015.

4. Existing environment

4.1 Site location and land use

The project is located in the Broken Hill Complex Interim Biogeographic Regionalisation for Australia (IBRA) Bioregion, primarily within the Barrier Range Outwash IBRA subregion, with the north-east and south-west corners of the Blue Bush Facility site crossing marginally into the Barrier Range subregion.

4.1.1 Blue Bush Facility

The Blue Bush Facility site is located 45 kilometres south of Broken Hill, and directly to the east of the Silver City Highway. It would be located on Pine Point Station, which is used for grazing. Surrounding properties are also used for grazing. The site is predominantly vegetated with native shrubland with some areas of woodland.

4.1.2 Blue Bush Inter-modal

The potential Blue Bush Inter-modal sites are located between the rail line and Pinnacles Road, in an industrial area west of Broken Hill. Inter-modal Site A is predominantly vegetated with native shrubland and grassland with some areas of woodland. Inter-modal Site B is predominantly cleared.

4.2 Hydrology

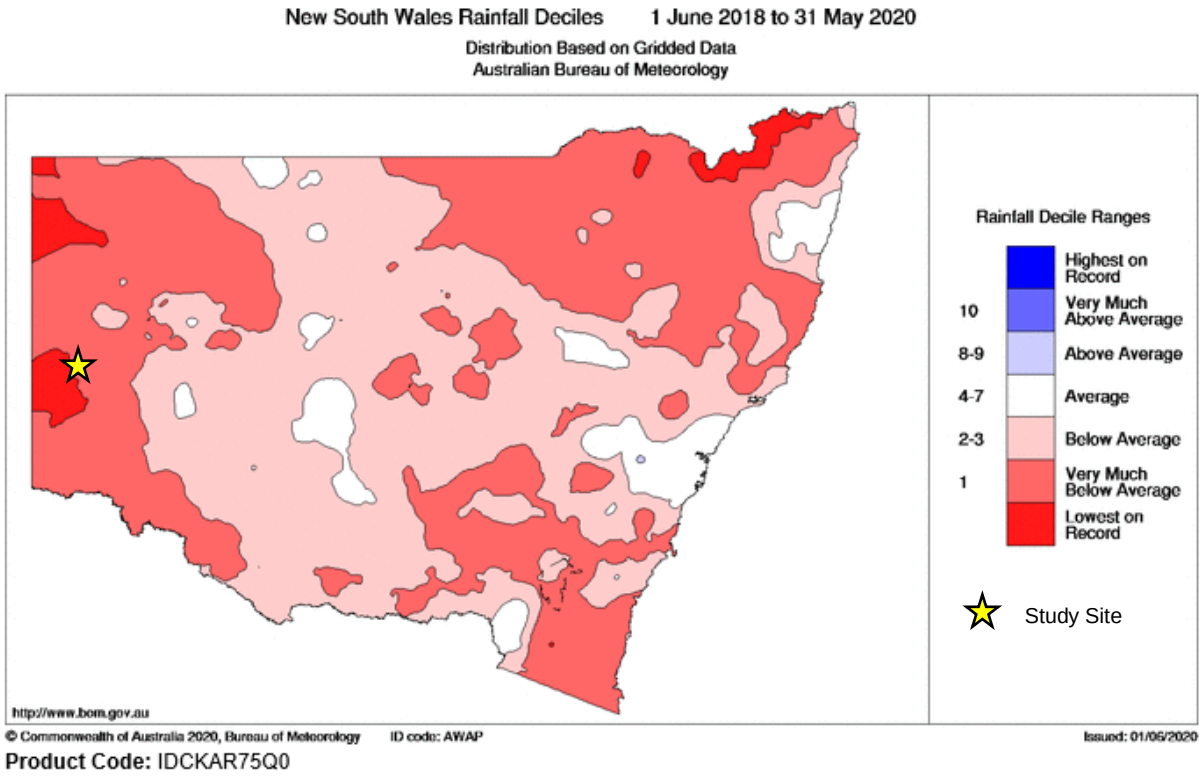
Pine Creek is located in the west and to the south of the Blue Bush Facility site. Rantyga Creek is located to the east of the Blue Bush Facility site. A tributary of Pine Creek (Stirling Vale Creek) is present at Blue Bush Inter-modal Site A. These are large, ephemeral creeks with wide, sandy creek beds, and lined with large River Red Gums. Occasional puddles were present at the time of the survey. Pine Creek is part of the Darling River catchment. The Darling River is located over 100 kilometres to the south-east.

A number of smaller drainage lines and farm dams are also located at the study sites.

4.3 Climate and existing disturbance

The study sites were in severe drought at the time of this assessment, having received the lowest rainfall on record in the previous 24 months according to BOM (2020) (Figure 4-1). The site of the proposed Blue Bush Facility showed signs of moderate degradation from long periods of widespread grazing.

Figure 4-1 24 month rainfall decile, indicating survey site. Source: BOM.



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4.4 Vegetation and flora

4.4.1 Plant community types

A total of 12 PCTs were identified across the study sites and these are summarised below in Table 4-1 and shown on Figure 4-2.

The site of the proposed Blue Bush Facility is characterised by gently undulating gravel plains, intersected in the south-west by the ephemeral but substantial Pine Creek. A number of smaller drainage lines are also present at this site. The gentle slopes are dominated by low to moderately high open chenopod shrublands of *Maireana* (Bluebush), *Atriplex* (Saltbush) and *Scleroleana* (Copperburr) species, with widely spaced small to medium clumps of low *Casuarina pauper* (Black Oak) low sparse woodland and small stands of tall *Hakea tephrosperma* (Hooked Needlewood). Some more productive small drainage lines on the upper slopes contain taller *Maireana sedifolia* (Pearl Bluebush), while lower areas adjoining the creek line contain tall *Atriplex nummularia* (Old Man Saltbush). Pine Creek is a large sandy intermittent watercourse lined with large old *Eucalyptus camaldulensis* (River Red Gum) open woodland, with a heavily disturbed and very weedy understory. One small sand dune south of the Blue Bush Facility site contains a patch of around 60 *Acacia carneorum* (Purple Wood wattle) shrubland (see section 4.8.2).

No detailed site visit was conducted at the two alternative sites for the proposed Blue Bush Inter-modal, however regional vegetation mapping is available for these areas. Seven PCTs are mapped at the larger site (Site A) and are also included in Table 4-1 and shown on Figure 4-2. The smaller Inter-modal site (Site B) does not contain native PCTs.

Table 4-1 Plant community types in the study sites

Vegetation variant	Conservation significance	Blue Bush Facility site	Blue Bush Inter-modal site (larger site – Site A)
PCT 41. River Red Gum open woodland wetland of intermittent watercourses mainly of the arid climate zone.	Not listed	Along the full length of Pine Creek, bisecting the south-west of the study site. Trees in good condition but understory very weedy. 24.6 ha	Mapped along the creek in the west of the site.
PCT 60. Black Oak - Western Rosewood - bluebush/saltbush low sparse woodland on gravel downs in the arid climate zone.	Can be commensurate with *Acacia loderi* shrublands, listed as an endangered ecological community under the BC Act, depending on presence of *Acacia loderi*.	Small to moderate sized clumps of this community are scattered across the study site separated by open areas of chenopod shrubland. Moderate condition with some areas showing signs of livestock grazing. 115.1 ha	Not present
PCt 128. Nelia tall open shrubland of semi-arid sandplains	Can be commensurate with *Acacia loderi* shrublands, listed as an endangered ecological community under the BC Act depending on presence of *Acacia loderi*..	Not present	Small patch mapped in the north-east of the site
PCT 136. Prickly Wattle open shrubland of drainage lines on stony rises and plains of the arid climate zone	Not listed	Not present	Small patches mapped across the site.

Vegetation variant	Conservation significance	Blue Bush Facility site	Blue Bush Inter-modal site (larger site – Site A)
PCT 139. Prickly Wattle tall open shrubland of dunes and sandplains of semi-arid and arid regions	Can be commensurate with *Acacia loderi* shrublands, listed as an endangered ecological community under the BC Act depending on presence of *Acacia loderi*..	Not present	Mapped mainly in the western portion of the site, near the creek
PCt 150. Bottlewasher - Copperburr grassland of the arid zone	Not listed	Not present	Small patches mapped in the north-east and south-west of the site
PCT 154. Pearl Bluebush low open shrubland of the arid and semi-arid plains.	Can be commensurate with *Acacia loderi* shrublands, listed as an endangered ecological community under the BC Act depending on presence of *Acacia loderi*..	Scattered across the run-on areas and shallow gullies of the slopes in the north and north-east of the study site. Moderate to good condition with few weeds. Moderate condition with some areas showing signs of heavy livestock grazing. 7.9 ha	Not present
PCT 155. Bluebush shrubland on stony rises and downs in the arid and semi-arid zones.	Can be commensurate with *Acacia loderi* shrublands, listed as an endangered ecological community under the BC Act depending on presence of *Acacia loderi*..	Across much of the north and central areas on higher, slightly stony open areas. Moderate condition with some areas showing signs of heavy livestock grazing. 665.0 ha	Mapped across large portions of the site.
PCT 156. Bladder Saltbush shrubland on stony plains and downs of the arid zone	Not listed	Not present	Patches mapped on the south-western boundary of the site.

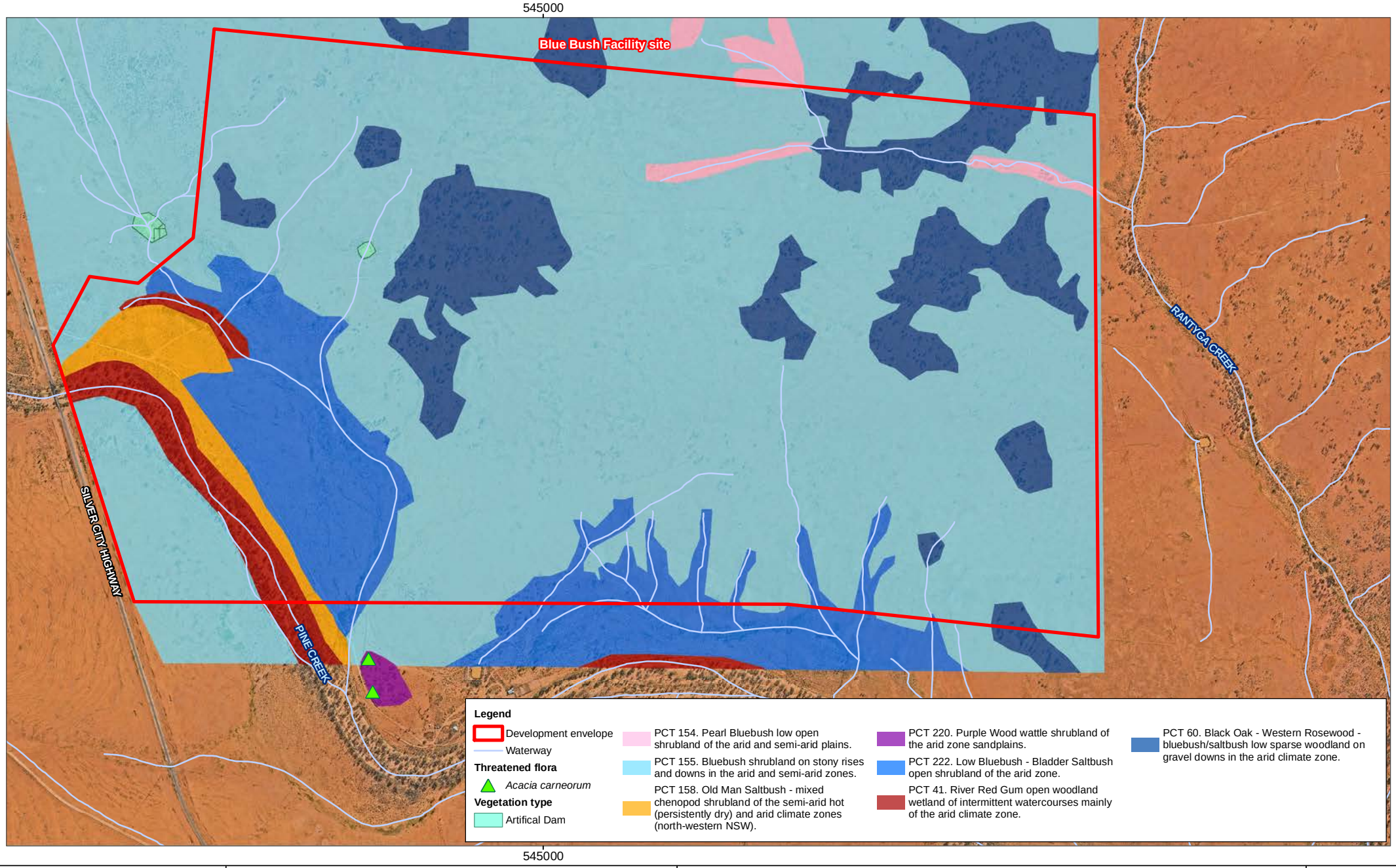
Vegetation variant	Conservation significance	Blue Bush Facility site	Blue Bush Inter-modal site (larger site – Site A)
PCT 158. Old Man Saltbush - mixed chenopod shrubland of the semi-arid hot (persistently dry) and arid climate zones (north-western NSW).	Can be commensurate with Artesian Springs Ecological Community in the Great Artesian Basin, listed as an endangered ecological community under the BC Act. However, this EEC does not occur in the Broken Hill area (DPIE 2020b).	Across the south of the site in lower lying areas above Pine Creek. Moderate condition but likely heavily grazed by livestock at times. 22.0 ha	Not present
PCT 220. Purple Wood wattle shrubland of the arid zone sandplains.	Can be commensurate with *Acacia loderi* shrublands, listed as an endangered ecological community under the BC Act depending on presence of *Acacia loderi*..	One patch on a sand dune south of the study site. Moderate condition with some regeneration. 0 ha within Blue Bush Facility site.	Not present
PCT 222. Low Bluebush - Bladder Saltbush open shrubland of the arid zone	Not listed	Across much of the south and centre of the study site, on lower slopes. Moderate condition with some areas showing signs of heavy livestock grazing. 94.9 ha	Not present

4.4.2 Weeds

In NSW all plants are regulated with a general biosecurity duty under the NSW *Biosecurity Act 2015* to prevent, eliminate or minimise any biosecurity risk they may pose. Some weeds are identified as 'priority weeds' for a particular region, and have additional biosecurity duties. Under the National Weeds Strategy, 32 introduced plants have been identified as Weeds of National Significance (WONS) Two weeds were recorded at the Blue Bush Facility site during the field surveys. These are listed in Table 4-2 along with their type and the relevant management duties.

Table 4-2 Weeds recorded within the Blue Bush Facility site and management duties

Scientific name	Common name	Location	Weed type	Management duty
Datura species	Devils Apple	Along Pine Creek	Environmental/ agricultural weed	General biosecurity duty: Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.
Lycium ferocissimum	African Boxthorn	Across site	Priority weed (western NSW) WONS	General biosecurity duty as above. Regional recommended measure: Land managers should mitigate the risk of the plant spreading from their land. Land managers should reduce impact of plant on priority assets (riparian areas and floodplains).



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Vegetation and threatened flora species

Figure

4-2a

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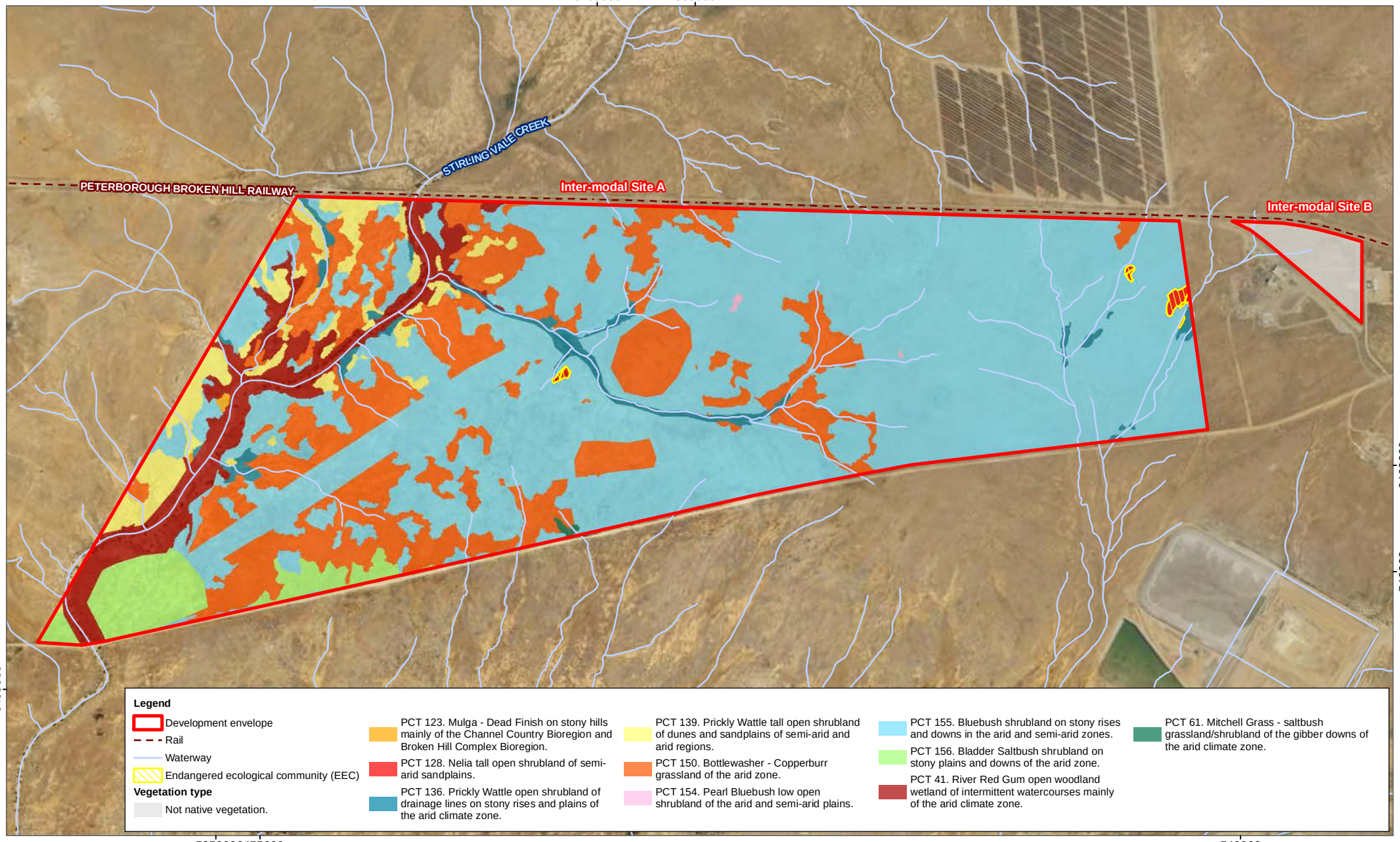
Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2019 & 2015; Vegetation - GHD & OEH.



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Vegetation and threatened flora species

Figure
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Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2019 & 2015; Vegetation - GHD & OEH.

4.5 Fauna and habitat resources

4.5.1 Fauna species

A total of 51 native and four exotic fauna species were recorded during the field survey, including 39 native bird, 12 native mammal (including nine bats) and four exotic mammal species. Results of all fauna surveys are provided in Appendix B.

Four threatened fauna species were recorded at the Blue Bush Facility site and GHD previously recorded one threatened fauna species at the Blue Bush Inter-modal Site A during surveys for another project (see section 4.8). All species are listed as Vulnerable under the NSW BC Act.

4.5.2 Fauna habitats

Blue Bush Facility site

The Blue Bush Facility site contains six broad fauna habitat types (see Table 4-3 and Figure 4-3):

- Low open chenopod shrublands.
- Medium high open chenopod shrublands along drainage depressions.
- Low open Black Oak woodland clumps.
- Tall saltbush (old Man Saltbush) shrublands adjacent to Pine Creek.
- River Red Gum open woodland along Pine Creek.
- Artificial dams containing near-permanent water.

Blue Bush Inter-modal sites

Blue Bush Inter-modal Site A is characterised by undulating plains sloping to the west where the large ephemeral creek is located. The area is dominated by low to moderately high open chenopod shrublands, with areas of prickly wattle and River Red Gums associated with drainage lines. Main fauna habitats present are detailed in Table 4-4 and mapped on Figure 4-3.

Inter-modal Site B is already cleared and provides limited if any habitat for fauna species.

Table 4-3 Fauna habitats at the site of the proposed Blue Bush Facility

Low open chenopod shrublands	
Description	This habitat is the most widespread across the Blue Bush Facility site and corresponds to PCT 155. It comprises open to very open shrublands of small to medium chenopod shrubs with occasional soil cracks and spider burrows. Much of this habitat is in moderate to poor condition following extended dry conditions and likely long-term heavy grazing pressure from livestock and goats. The small shrubs and soil cracks provide shelter for small reptiles, mammals and birds, and foraging opportunities in the form of seeds, fruits and invertebrates.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including small skinks and geckos which inhabit soil cracks, spider burrows and leaf litter surrounding chenopod shrubs. Chenopods provide seeds and invertebrates, important foraging habitat for Thornbill species, the Southern Whiteface (*Aphelocephala leucopsis*) and White-winged Fairy-wren (*Malurus leucopterus*)
Threatened and migratory fauna species recorded or with potential to occur	White-fronted Chat recorded in a number of locations. Potential habitat for the Thick-billed Grasswren, Rufous Fieldwren, Spotted Harrier, Black Falcon, Plains-wanderer, Stripe-faced Dunnart, Ringed Brown Snake and Western Blue-tongued Lizard. Dusky Hopping-mouse can occur in these atypical habitats during eruptive periods after good rainfall.
Photo	

Medium high open chenopod shrublands along drainage depressions	
Description	This habitat occurs in and around the gentle drainage depressions the north of the study site (associated with PCT 154), and in larger areas in the south-east of the site on low lying areas adjacent to Pine Creek (associated with PCT 222). It comprises medium to high, open to relatively dense shrublands on heavy soils with soil cracks and spider burrows. This habitat is mostly in moderate condition with some evidence of extended dry conditions and long-term grazing pressure from livestock and goats. The shrubs and soil cracks provide important shelter for small reptiles, mammals and birds, and foraging opportunities in the form of seeds, fruits and invertebrates.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including dragons, skinks and geckos which inhabit soil cracks, spider burrows, shrub bases and leaf litter surrounding the shrubs. Chenopods provide seeds and invertebrates, important foraging habitat for the White-winged Fairywren, Chestnut-rumped Thornbill and Australian Ringneck.
Threatened and migratory fauna species recorded or with potential to occur	None recorded. Potential habitat for the Thick-billed Grasswren, Rufous Fieldwren, Spotted Harrier, Pied Honeyeater, Stripe-faced Dunnart, Ringed Brown Snake and Western Blue-tongued Lizard. Dusky Hopping-mouse can occur in these atypical habitats during eruptive periods after good rainfall.
Photo	

Low open Black Oak woodland clumps	
Description	This habitat occurs as scattered small to medium sized clumps of low open woodland (PCT 60) surrounded by shrubland. It comprises scattered low Black Oak trees with an understory of small to medium chenopod shrubs. As the only trees away from the creek line these trees provide important refuge for small to medium reptiles, birds and mammals including bats in the form of many small to medium hollows, cracks, loose bark and logs. Mistletoe on trees provide flower resources for birds and bats at some times of year, and the shrub layer provides seeds and invertebrate food resources. This habitat is mostly in moderate to poor condition due to the extended dry conditions and long-term grazing pressure from livestock and goats.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including dragons, skinks and geckos which inhabit tree hollows and cracks, logs on the ground, shrub bases and leaf litter surrounding trees and shrubs. Tree hollows provide breeding habitat for the Greater Bluebonnet (*Northiella haematogaster*) and Mulga Parrot (*Psephotus varius*), and chenopod shrubs provide seeds and invertebrates, important foraging habitat for these parrot species and the Crested Pigeon (*Ocyphaps lophotes*).
Threatened and migratory fauna species recorded or with potential to occur	None recorded. Potential habitat for the Little Eagle, Major Mitchell's Cockatoo, Yellow-bellied Sheathtail-bat, Little Pied Bat and Corben's Long-eared Bat.
Photo	

Tall saltbush (old Man Saltbush) shrublands adjacent to Pine Creek	
Description	This habitat occurs in the south-west of the study site on low lying areas adjacent to Pine Creek. It comprises medium to high, open to relatively dense shrublands (and is associated with PCT 158). This habitat is mostly in moderate condition with some evidence of long-term grazing pressure from livestock and goats. The shrubs and leaf litter provide important shelter for small reptiles, mammals and birds, and foraging opportunities in the form of seeds, fruits and invertebrates.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including dragons, skinks and geckos which inhabit shrub bases and leaf litter surrounding the shrubs. Chenopods provide seeds and invertebrates, important foraging habitat for the Purple-backed Fairy-wren (*Malurus assimilis*), Crested Pigeon, Chestnut-rumped Thornbill and Australian Ringneck.
Threatened and migratory fauna species recorded or with potential to occur	None recorded. Potential habitat for the White-fronted Chat, Major Mitchell's Cockatoo, Pied Honeyeater and Western Blue-tongued Lizard.
Photo	

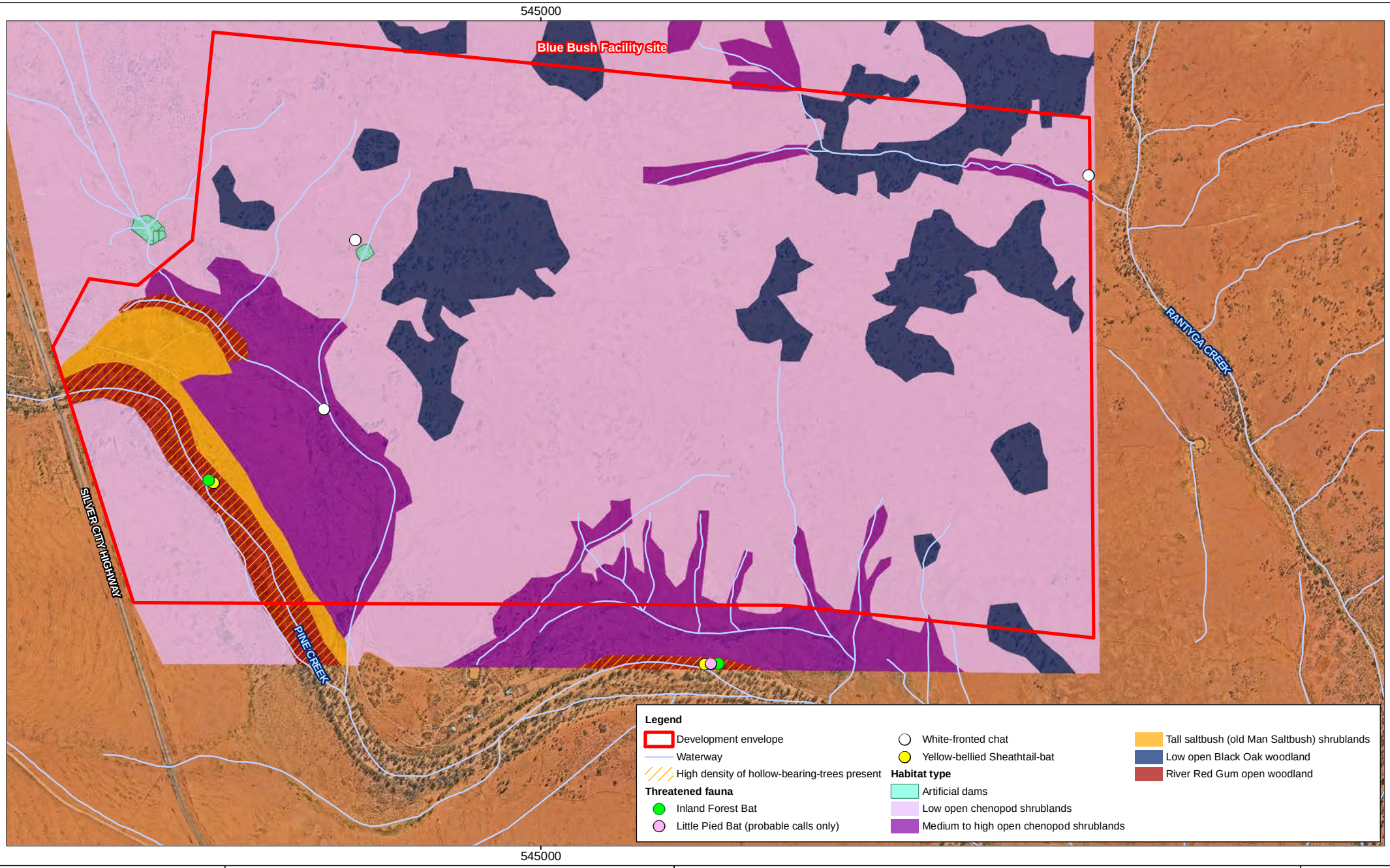
River Red Gum open woodland along Pine Creek	
Description	This habitat occurs in a narrow band of moderately tall open woodland along the banks and within Pine Creek (PCT 41), running near the western boundary of the study site and then turning east south of the site. It comprises an open woodland of large old River Red Gum with an often weedy understory, on a sandy substrate. As the only large trees within the landscape these trees provide important refuge and breeding habitat for a range of reptiles, birds and mammals, including bats, in the form of many hollows of all sizes, cracks, loose bark and logs. Tree canopies provide flower resources for birds and bats at some times of year, and invertebrate food resources. This habitat is mostly in moderate condition, with some evidence of extended dry conditions and long-term grazing pressure from livestock.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including dragons, skinks and geckos which inhabit tree hollows and cracks, logs on the ground and leaf litter. Trees provide nesting habitat for the Nankeen Kestrel (*Falco cenchroides*), tree hollows provide important breeding habitat for the Tree Martin (*Petrochelidon nigricans*), Galah (*Eolophus roseicapilla*), and Australian Ringneck (*Barnardius zonarius*). Large tree canopies provide flower and invertebrate resources important for honeyeaters such as the Yellow-throated Miner (*Manorina flavigula*) and Singing Honeyeater (*Gavicalis virescens*).
Threatened and migratory fauna species recorded or with potential to occur	Yellow-bellied Sheathtail-bat, Inland Forest Bat and Little Pied Bat recorded. Potential roosting and breeding habitat present. Potential breeding habitat for the Little Eagle, Spotted Harrier, Black-breasted Buzzard and Major Mitchell's Cockatoo. Potential roosting and breeding habitat for the Corben’s Long-eared Bat.
Photo	

Artificial dams containing near-permanent water	
Description	This habitat occurs in two locations, one to the west of the Blue Bush Facility site, and one in the western portion of the site. This habitat provides a nearly permanent source of water, which is a critical resource for many species in this arid landscape. The edge of the dam supports a range of medium to tall shrubs providing shelter for wildlife as they move to and from the water, and seeds and flowers at some times of year. This habitat is mostly in moderate to poor condition, with evidence of heavy long-term grazing pressure from domestic livestock and native herbivores.
Typical fauna species recorded or likely to occur	The open water provides a critical drinking resource for many species in this arid landscape, including most bird species (particularly parrots, cockatoos and pigeons), bats, and macropods, including the Western Grey Kangaroo. Dam-side shrubs support the Chirruping Wedgebill (*Psophodes cristatus*), Singing Honeyeater (*Gavicalis virescens*) and Willie Wagtail (*Rhipidura leucophrysand*), whilst wet and open areas favour the Australian Wood Duck (*Chenonetta jubata*) and Magpie-lark (*Grallina cyanoleuca*).
Threatened and migratory fauna species recorded or likely to occur	White-fronted Chats were observed in the damp area around one of the dams. Despite being an artificial habitat, dams potentially provide important habitat for a number of threatened species, including Australian Painted Snipe, Major Mitchell's Cockatoo, and bats, including the Yellow-bellied Sheathtail-bat, Little Pied Bat and Corben’s Long-eared Bat. Low potential for some migratory waders to occur on rare occasions.
Photo	

Table 4-4 Main fauna habitats at Blue Bush Inter-modal Site A

Low open chenopod shrublands	
Description	This habitat is the most widespread across the study site. It is a low open shrubland composed mainly of annual and short-lived woody Saltbushes (*Atriplex* spp.), Bluebushes (*Mairerana* spp.) and Copperburrs (*Sclerolaena* spp.) along with some native grasses and herbs. Fauna habitats include patches of small dense shrubs and grasses, some capable of producing prolific seed in wet seasons, along with some deep, extensively cracking soils and invertebrate burrows. The small shrubs and soil cracks provide shelter for small reptiles, mammals and birds, and foraging opportunities in the form of seeds, fruits and invertebrates.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including small skinks and geckos which inhabit soil cracks, spider burrows and leaf litter surrounding chenopod shrubs. Chenopods provide seeds and invertebrates, important foraging habitat for Thornbill species, the Southern Whiteface (*Aphelocephala leucopsis*) and White-winged Fairy-wren (*Malurus leucopterus*)
Threatened and migratory fauna species recorded or likely to occur	Rufous Fieldwren recorded during GHD's surveys in 2017. Potential habitat for the Thick-billed Grasswren, Spotted Harrier, Black Falcon, Plains-wanderer, Stripe-faced Dunnart, Ringed Brown Snake and Western Blue-tongued Lizard. Dusky Hopping-mouse can occur in these atypical habitats during eruptive periods after good rainfall.
Prickly wattle open shrubland	
Description	This habitat occurs in association with drainage lines and is composed of a tall open shrubland of Prickly Wattle (*Acacia victoriae*) with a dense understorey of tall Bluebush shrubs, tussock grasses, forbs and low herbs. These features provide a range of fauna habitats, including scattered small trees with crevices and loose bark, scattered woody debris and shrubby vegetation, loose stony (gibber) substrates, and sandy substrates.
Typical fauna species recorded or likely to occur	Prickly Wattles fringing intermittent creek-lines offer dense cover which is suitable habitat for a variety of bird species such as fairy-wrens, pipits, chats and field-wrens. This habitat type would support a diversity of native bird, reptile and micro-bat species.
Threatened and migratory fauna species recorded or likely to occur	None recorded. Potential habitat for the Rufous Fieldwren and Redthroat.

Grasslands	
Description	Open grasslands occur as scattered patches within the chenopod shrublands and near the riparian corridor. It is composed mainly of annual and short-lived native grasses and herbs, as well as woody Saltbushes (Atriplex spp.) Bluebushes (Mairerana spp.) and Copperburrs (Sclerolaena spp.).
Typical fauna species recorded or likely to occur	This habitat consists of a relatively homogenous vegetation composition and little variation in regard to other habitat attributes (e.g. lacking in woody debris, larger shrubs, trees or hollows). Small mammals and reptiles would likely reside in deep soil cracks characteristic of this habitat type. Birds would forage on occasion.
Threatened and migratory fauna species recorded or likely to occur	Potential habitat for the Stripe-faced Dunnart (*Sminthopsis macroura*).
River Red Gum open woodland	
Description	This habitat occurs in a narrow band of moderately tall open woodland along the banks and within Stirling Vale Creek, running along the western boundary of the study site. It comprises an open woodland of large old River Red Gum with an often weedy understory, on a sandy substrate. As the only large trees within the landscape these trees provide important refuge and breeding habitat for a range of reptiles, birds and mammals, including bats in the form of many hollows of all sizes, cracks, loose bark and logs. Tree canopies provide flower resources for birds and bats at some times of year, and invertebrate food resources. This habitat is mostly in moderate condition, with some evidence of extended dry conditions and long-term grazing pressure from livestock.
Typical fauna species recorded or likely to occur	A number of common reptile species would be expected to occupy these areas, including dragons, skinks and geckos which inhabit tree hollows and cracks, logs on the ground and leaf litter. Trees provide nesting habitat for the Nankeen Kestrel (*Falco cenchroides*), tree hollows provide important breeding habitat for the Tree Martin (*Petrochelidon nigricans*), Galah (*Eolophus roseicapilla*), and Australian Ringneck (*Barnardius zonarius*). Large tree canopies provide flower and invertebrate resources important for honeyeaters such as the Yellow-throated Miner (*Manorina flavigula*) and Singing Honeyeater (*Gavicalis virescens*).
Threatened and migratory fauna species recorded or likely to occur	None recorded. Potential breeding habitat for the Little Eagle, Spotted Harrier, Black-breasted Buzzard and Major Mitchell's Cockatoo. Stick nests of a kite or similar observed during 2017 surveys. Potential roosting and breeding habitat for the Yellow-bellied Sheathtail-bat, Little Pied Bat and Corben’s Long-eared Bat.



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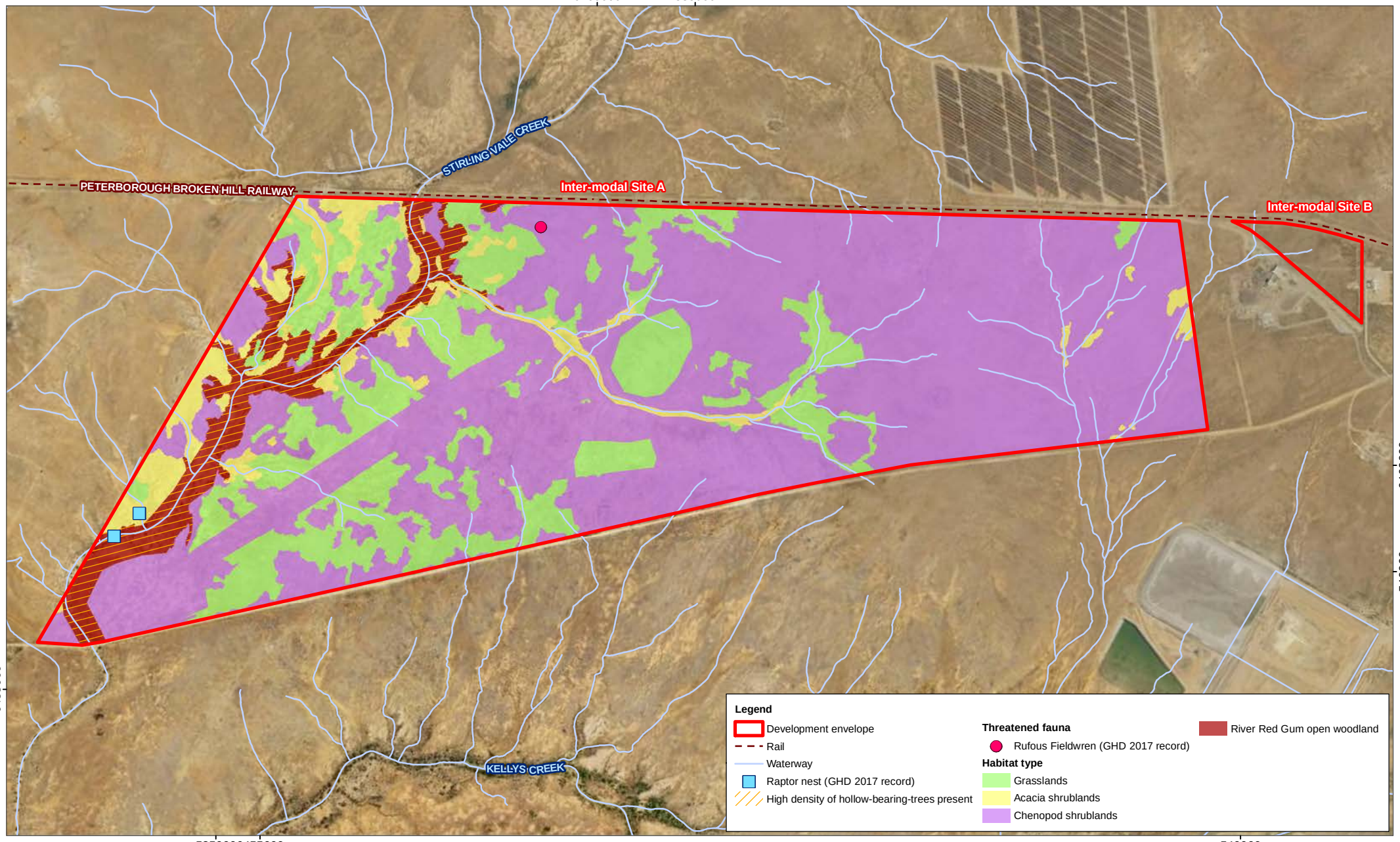
Fauna habitats and threatened fauna species

Figure 4-3a

Version: A

Tellus Holdings Ltd and GHD endeavour to ensure this map is free of errors but does not represent or warrant (either expressly or impliedly) that the map or its features are accurate or fit for a particular use.

Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2019 & 2015; Vegetation - GHD & OEH.



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Fauna habitats and threatened fauna species

Figure 4-3b

Version: A

Tellus Holdings Ltd and GHD endeavour to ensure this map is free of errors but does not represent or warrant (either expressly or impliedly) that the map or its features are accurate or fit for a particular use.

Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2019 & 2015; Vegetation - GHD & OEH.

4.6 Aquatic habitats

Pine Creek flows through the western side of the Blue Bush Facility site and Rantyga Creek is located to the east of the site. A tributary of Pine Creek (Stirling Vale Creek) flows through the south-western side of Blue Bush Inter-modal Site A. These creeks are ephemeral, with no water present at the time of surveys. All creeks are part of the Lowland Darling River aquatic ecological community listed under the FM Act (see section 4.8)

No key fish habitat is mapped in the study sites. The closest mapped key fish habitats are the Great Darling Anabranch and associated lakes, Menindee Lakes, and Stephens Creek to the north-east of Broken Hill (DPI 2007).

No habitat for threatened fish species listed under the FM Act is mapped in the study area. The Great Darling Anabranch has mapped habitat for the Olive Perchlet (*Ambassis agassizii*) and Silver Perch (*Bidyanus bidyanus*) (DPI 2018). This waterway is located over 70 kilometres from the Blue Bush Facility site.

4.7 Groundwater dependent ecosystems

4.7.1 Background

Groundwater dependent ecosystems (GDEs) are ecosystems whose species or ecological processes rely on groundwater. Groundwater dependency can range from total reliance to a proportional, opportunistic use of groundwater (Serov et al 2012). Examples of GDEs include rivers, springs and swamps fed by groundwater, vegetation whose roots can access groundwater, and animals living in aquifers (stygofauna) and cave streams.

GDEs are classified into three broad types (IESC 2019):

- Aquifer and cave ecosystems (subterranean GDEs).
- Ecosystems dependent on the surface expression of groundwater (aquatic GDEs) (rivers and wetlands).
- Ecosystems dependent on the subsurface presence of groundwater (terrestrial GDEs).

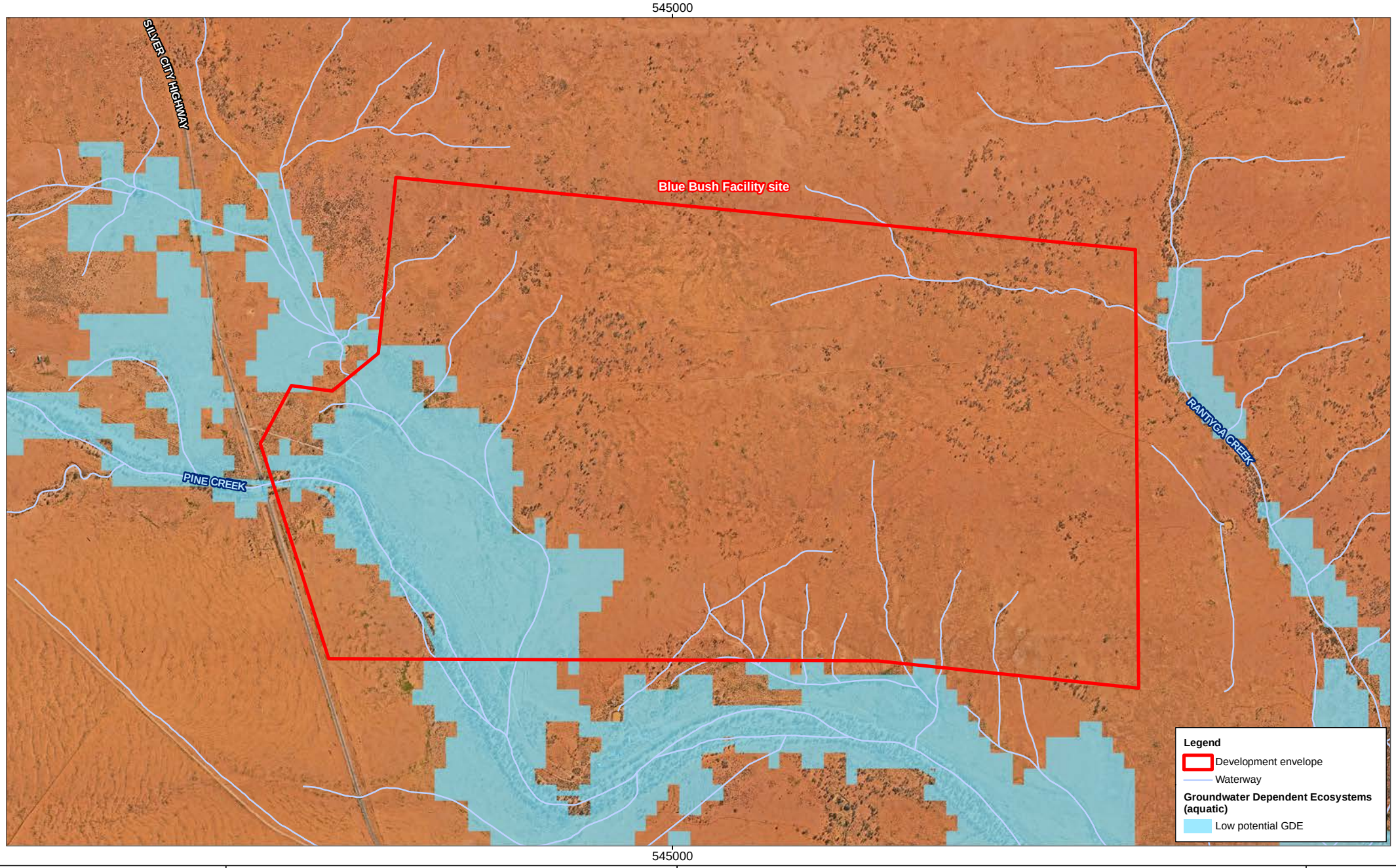
The BOM GDE Atlas maps the potential for groundwater interaction for rivers, springs, and wetland ecosystems across Australia. It shows the aquatic ecosystems that rely on groundwater that has been discharged to the surface, for example, as baseflow or spring flow. The terrestrial GDE layer expresses the potential for groundwater and mapped vegetation communities across Australia to interact. It shows the vegetation communities that interact with groundwater from the water table or in the capillary zone (BOM 2020b).

4.7.2 GDEs in the study sites

Pine Creek and its floodplain at the Blue Bush Facility site is mapped as a low potential aquatic GDE. This area is located in the western portion of the site, and to the south of the site. In addition, the floodplain associated with Rantyga Creek to the east of the site is mapped as a low potential aquatic GDE (see Figure 4-4).

Wetlands associated with Pine Creek and its floodplain south (downstream) of Blue Bush Inter-modal Site A are mapped as a high potential aquatic GDE. No aquatic GDEs are mapped within Blue Bush Inter-modal Site A or B (see Figure 4-4).

Areas of Bluebush shrubland and Prickly Wattle Shrubland near the Blue Bush Inter-modal sites are mapped as having low potential for groundwater interaction (see Figure 4-4). No other vegetation types in these areas are mapped as being potential GDEs. No terrestrial GDEs are mapped at the Blue Bush Facility site.



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Groundwater Dependent Ecosystems

Figure

4-3a

Version: A

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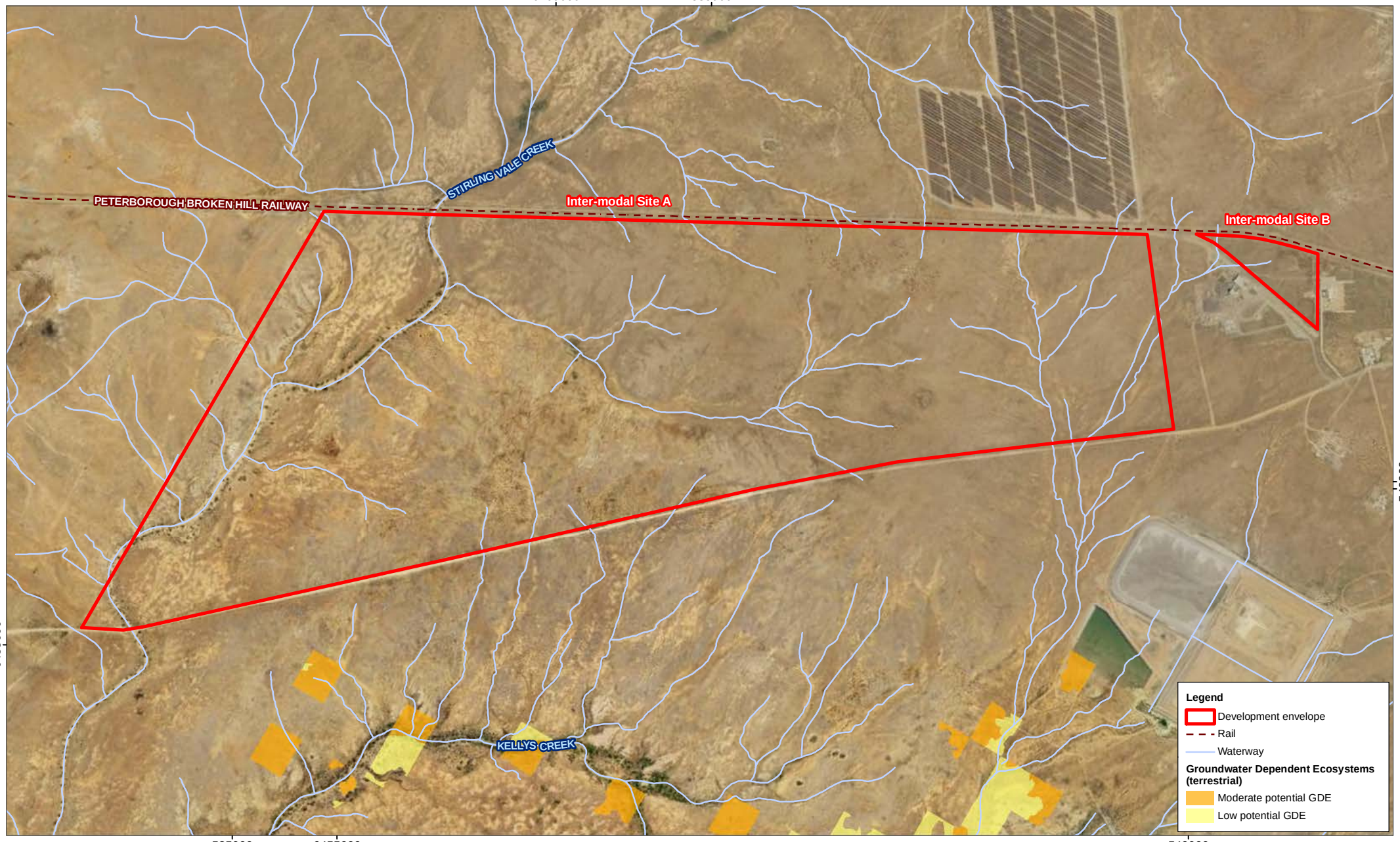
Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2019 & 2015; GDEs - Bioregional Assessment Program 2019.



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Groundwater Dependent Ecosystems

Figure
4-3b
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Data source: Aerial imagery - Tellus (image date - 07/06/2020) & sixmaps 2020 (© Department of Customer Service 2020); General topo - NSW LPI DTDB 2019 & 2015; GDEs - Bioregional Assessment Program 2019.

4.8 Conservation significance

4.8.1 Threatened ecological communities

No threatened ecological communities listed under the EPBC Act are present in the study sites.

One endangered ecological community (EEC) listed under the BC Act was recorded at Blue Bush Inter-modal Site A. Small patches of *Acacia loderi* shrublands EEC have previously been mapped in and near Inter-modal the site by GHD in 2017. This community is dominated by the tall shrub/small tree *Acacia loderi* (commonly known in some parts of its range as Nelia). No *Acacia loderi* was observed at the Blue Bush Facility site during recent surveys, and this EEC is unlikely to be present at this site.

The Lowland Darling River aquatic ecological community listed under the FM Act is present at the Blue Bush Facility site and Blue Bush Inter-modal Sites A and B. This EEC includes all native fish and aquatic invertebrates within all natural creeks, rivers, streams and associated lagoons, billabongs, lakes, anabranches, flow diversions to anabranches and floodplains of the Darling River within NSW. Pine Creek and other drainage lines are streams associated with the Darling River.

4.8.2 Threatened flora species

Fourteen threatened flora species listed under the EPBC Act and/or the NSW BC Act were identified from the desktop assessment of the Wildlife Atlas and PMST search, and knowledge of the GHD botanists, as occurring or predicted to occur in the locality (Appendix A). One threatened flora species listed under the BC Act and EPBC Act was identified near the Blue Bush Facility site (Purple Wood Wattle), and seven additional flora species are considered to have the potential to occur within the study sites based on habitat conditions (see Table 4-5). Surveys would need to be conducted in the appropriate season (spring) or following appropriate rainfall to confirm presence of these species.

No threatened flora species are likely to occur at Blue Bush Inter-modal Site B.

Targeted surveys would be required in spring for threatened flora species for the preparation of the BDAR.

Table 4-5 Threatened flora species known or with the potential to occur

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence (Blue Bush Facility site)	Likelihood of occurrence (Blue Bush Inter-modal Site A)
Acacia carneorum	Purple-wood Wattle	V	V	Species (all year)	Yes. No threshold identified as yet.	**Present.** Recorded on sand dunes to the south of the development envelope at the Blue Bush Facility site, with approximately 60 plants present in PCT 220 (see Figure 4-2). Potential habitat present in woodland areas (PCT 41, 60).	**Possible.** Suitable habitat present in grassland (PCT 61, 150) and woodland areas (PCT 41). Some local records near the Inter-modal site. Not identified on site in GHD 2017 surveys.
Acacia notabilis	Mallee Golden Wattle	E		Species (all year)	No	**Possible.** Suitable habitat present in woodland areas (PCT 41, 60). No records near the Blue Bush Facility site.	**Possible.** Suitable habitat present in woodland areas (PCT 41, 123). Few records in the locality of the Inter-modal site.
Acacia rivalis	Creek Wattle	E		Species (all year)	Yes. No threshold identified as yet.	**Possible.** Suitable habitat present in riparian areas (PCT 41 and adjacent areas). No records near the Blue Bush Facility site.	**Possible.** Suitable habitat present in riparian areas (PCT 41 and 136 and adjacent areas). One record in the locality of the Inter-modal site.
Atriplex infrequens	A saltbush	V	V	Species (Nov-Feb)		**Possible.** Suitable habitat present near drainage lines (PCT 41 and adjacent areas). No local records.	**Possible.** Suitable habitat present near drainage lines (PCT 41 and 136 and adjacent areas). No local records.

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence (Blue Bush Facility site)	Likelihood of occurrence (Blue Bush Inter-modal Site A)
Calotis moorei	A burr-daisy	E	E	Species (Sep-Nov)	Yes. No threshold identified as yet.	**Possible.** Suitable habitat present in areas with sandy soils and chenopod shrublands (PCT 154, 222). No local records.	**Possible.** Suitable habitat present in areas with sandy soils and chenopod shrublands (PCT 154). No local records.
Swainsona flavicarinata	Yellow-keeled Swainsona	E	-	Species (Jun-Oct, survey 4-7 weeks after above average rainfall)	Yes	**Possible.** Suitable habitat present in saltbush areas (PCT 158 and 220 near Pine Creek, and PCT 60 in scattered patches). No local records.	**Possible.** Suitable habitat present in saltbush areas (PCT 61 and 156 in the south of the site). No local records.
Swainsona murrayana	Slender Darling Pea	V	V	Species (Sep)	No	**Possible.** Suitable habitat present in bladder saltbush communities (PCT 222). No local records.	**Possible.** Suitable habitat present bladder saltbush (PCT 156) and grassland communities (PCT 61 and 150). No local records.
Swainsona viridis	Creeping Darling Pea	E	-	Species (Sep - Oct, after average to wet seasonal conditions)	-	**Possible.** Suitable habitat present in riparian areas (PCT 41). No local records.	**Possible.** Suitable habitat present in riparian areas (PCT 41 and 136) No local records.

KEY: E – endangered, V - vulnerable

4.8.3 Threatened fauna species

Thirty-one fauna species listed under the EPBC Act and/or the NSW BC Act were identified from the desktop assessment of the Wildlife Atlas and PMST search as occurring or predicted to occur in the locality (Appendix A).

Four threatened fauna species were identified at the Blue Bush Facility site, and one threatened species has been recorded previously near the Blue Bush Inter-modal Site A (see Figure 4-3), all of which are vulnerable species listed under the BC Act and are ecosystem credit species under the BAM:

- White-fronted Chat (*Epthianura albifrons*).
- Yellow-bellied Sheath-tail bat (*Saccolaimus flaviventris*).
- Inland Forest Bat (*Vespadelus baverstocki*).
- Little Pied Bat (*Chalinolobus picatus*).
- Rufous Fieldwren (*Calamanthus campestris*).

An additional 15 fauna species are considered to have the potential to occur within the study site (Table 4-6).

Species credit fauna species listed under the BC Act that would require further targeted surveys include dual credit species such as the Black-breasted Buzzard, Little Eagle and Major Mitchell's Cockatoo. These species require surveys for nest sites in the breeding season.

The Plains-wanderer is a species credit species and an SAII entity. Important habitat is identified by DPIE as a species credit and impacts on these areas may result in serious and irreversible impacts. Liaison with DPIE confirmed that the study sites are not within draft important areas for the Plains-wanderer (email correspondence received 11 June 2020). Important habitat is likely to be in areas such as the Riverina where known populations occur (Commonwealth of Australia 2016). No species polygon would be required to be mapped for this species, and no serious and irreversible impacts would result from the project.

The Thick-billed Grasswren (central NSW subspecies) is a full species credit species and an SAII entity. An impact on this species may result in serious and irreversible impacts. Areas of potentially suitable bluebush habitat are present at the Blue Bush Facility site and Blue Bush Inter-modal Site A, however no priority Blackbush habitat is present. This species was thought to be extinct in NSW until located recently in the Packsaddle area about 100 km north of Broken Hill. There are no local records of this species, however, targeted surveys are recommended in late winter/early spring.

No threatened fauna species listed under the EPBC Act have been recorded at the study sites. Those with the potential to occur at the Blue Bush Facility site and Blue Bush Inter-modal Site A include the Thick-billed Grasswren (central NSW subspecies), Plains-wanderer, Australian Painted Snipe, and Corben's Long-eared Bat.

Table 4-6 Threatened fauna species known or with the potential to occur

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence at the Blue Bush Facility site	Likelihood of occurrence at Blue Bush Inter-modal Site A
Birds							
Amytornis modestus	Thick-billed Grasswren (central NSW subspecies)	CE	CE	Species (Jul-Sep)	Yes. Any impact on the species from development could be potentially serious and irreversible.	**Possible.** Suitable low saltbush habitat present in some patches at the site. Generally thought to be extinct in NSW until recently located in the Packsaddle area, around 100 km north of Broken Hill. No local records.	**Possible.** Suitable low saltbush habitat present in some patches at the Inter-modal site. Generally thought to be extinct in NSW until recently located in the Packsaddle area, around 100 km north of Broken Hill. No local records.
Calamanthus campestris	Rufous Fieldwren	V		Ecosystem	NA	**Possible.** Suitable habitat of taller bluebush shrubland across the site. Few records near the site.	**Present.** Detected by GHD at Inter-modal site in previous surveys in 2017. Many records in the locality of the Inter-modal site.
Pyrrholaemus brunneus	Redthroat	V		Ecosystem	NA	**Possible.** Suitable habitat of chenopod shrublands present across the study site. Few records near the site.	**Possible.** Suitable habitat of chenopod shrublands present across the site. Preferred habitat for this area of Acacia lined drainage lines on stony/rocky slopes present at Inter-modal site. Many records in the locality of the Inter-modal site.

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence at the Blue Bush Facility site	Likelihood of occurrence at Blue Bush Inter-modal Site A
Circus assimilis	Spotted Harrier	V		Ecosystem	NA	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Pine Creek. Few records in the locality.	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Stirling Vale Creek. Few records in the locality.
Hamirostra melanosternon	Black-breasted Buzzard	V		Dual (Sep-Nov) 500 m buffer around nest tree likely to be required*	No	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Pine Creek. No local records.	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Stirling Vale Creek. Few records in the locality of the Inter-modal site.
Hieraaetus morphnoides	Little Eagle	V		Dual (Aug-Oct) 300 m buffer around nest tree required	No	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Pine Creek. No local records.	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Stirling Vale Creek. Few records in the locality of the Inter-modal site.
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V		Dual (Sep-Dec) 200 m buffer	No	**Possible.** Suitable foraging habitat present across the study site and potential breeding	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence at the Blue Bush Facility site	Likelihood of occurrence at Blue Bush Inter-modal Site A
				around nest tree likely to be required*		habitat in River Red Gums along Pine Creek. No local records.	Red Gums along Stirling Vale Creek. Few records in the locality.
Falco subniger	Black Falcon	V		Ecosystem	NA	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Pine Creek and boundary of Inter-modal site. No local records.	**Possible.** Suitable foraging habitat present across the study site and potential breeding habitat in River Red Gums along Stirling Vale Creek. One record in the locality of the Inter-modal site.
Certhionyx variegatus	Pied Honeyeater	V		Ecosystem	NA	**Possible.** Wide-ranging species, may feed opportunistically in shrubs and Acacias of the study site. No local records.	**Possible.** Wide-ranging species, may feed opportunistically in shrubs and Acacias of the study site. One record in the locality of the Inter-modal site.
Epthianura albifrons	White-fronted Chat	V		Ecosystem	NA	**Present.** Observed on-site during field survey. Potentially suitable open habitat across the site, with smaller areas of suitable damp open habitats around the two dams and parallel to Pine Creek.	**Possible.** Potentially suitable open habitat across the site, with smaller areas of suitable damp open habitats around dams and parallel to the creek. One record in the locality of the Inter-modal site.

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence at the Blue Bush Facility site	Likelihood of occurrence at Blue Bush Inter-modal Site A
Rostratula australis	Australian Painted Snipe	E	E	Ecosystem	NA	**Possible.** Some suitable habitat present at dams and low-lying depressions following local heavy rain. No local records.	**Possible.** Some suitable habitat present at dams and low-lying depressions following local heavy rain. One record in the locality of the Inter-modal site.
Pedionomus torquatus	Plains-wanderer	E	CE	Dual (mapped important areas)	Yes. Any impact on mapped important areas.	**Possible.** Suitable low open habitat present. No local records. No important habitat areas are mapped in the study site.	**Possible.** Suitable low open habitat present. No local records. No important habitat areas are mapped in the study site.
Mammals							
Notomys fuscus	Dusky Hopping-mouse	E	V	Ecosystem	NA	**Possible.** Atypical habitat present in chenopod shrublands at the site. No sand dune (preferred) habitat present. Most records of the species are located in the north-west of the State, with few as far south as Broken Hill. No local records.	**Possible.** Sand-dune habitat present in the western portion of the site. Atypical habitat present in areas dominated by chenopods. Most records of the species are located in the north-west of the State, with few as far south as Broken Hill. One record in the locality.

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence at the Blue Bush Facility site	Likelihood of occurrence at Blue Bush Inter-modal Site A
Sminthopsis macroura	Stripe-faced Dunnart	V		Ecosystem	NA	**Possible.** Suitable habitat present throughout the site. No local records.	**Possible.** Suitable habitat present throughout the site. One record in the locality of the Inter-modal site.
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Ecosystem	NA	**Possible.** Calls of *Nyctophilus* species recorded during Anabat surveys. Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah. No local records.	**Possible.** Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah. No local records.
Vespadelus baverstocki	Inland Forest Bat	V		Ecosystem	NA	**Present.** Probable calls recorded during surveys. Could roost in hollow-bearing trees in River Red Gums and Belah. No local records.	**Possible.** Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah. Few records in the locality of the Inter-modal site.
Chalinolobus picatus	Little Pied Bat	V		Ecosystem	NA	**Present.** Probable calls recorded during surveys. Could roost in hollow-bearing trees in River Red Gums and Belah. No local records.	**Possible.** Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah. Few records in the locality of the Inter-modal site.

Scientific Name	Common Name	BC Act Status	EBPC Act Status	Credit type (survey months)	SAII entity?	Likelihood of occurrence at the Blue Bush Facility site	Likelihood of occurrence at Blue Bush Inter-modal Site A
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V		Ecosystem	NA	**Present.** Could roost in hollow-bearing trees in River Red Gums and Belah. Few records in the locality of the study site.	**Possible.** Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah. Few records in the locality of the study site.
Reptiles							
Pseudonaja modesta	Ringed Brown Snake	E		Ecosystem	NA	**Possible.** Suitable watercourse habitat present. No local records.	**Possible.** Suitable watercourse habitat present. Few records in the locality of the Inter-modal site.
Tiliqua occipitalis	Western Blue-tongued Lizard	V		Ecosystem	NA	**Possible.** Suitable shrubland and grassland habitat present. No local records.	**Possible.** Suitable shrubland and grassland habitat present. Few records in the locality of the Inter-modal site.

KEY: CE – critically endangered, E – endangered, V - vulnerable

* Note that buffer distances are not provided in the Threatened Species Data Collection for the Black-breasted Buzzard or Major Mitchell's Cockatoo. A 500 m buffer is given for the Black-breasted Buzzard, as per the requirement for the White-bellied Sea-eagle, and 200 m is given for Major Mitchell's Cockatoo, as per the requirement for the Glossy Black-cockatoo. These distances would need to be confirmed with the Biodiversity and Conservation Division (BCD) of DPIE if necessary during preparation of the BDAR.

4.8.4 Migratory fauna species

Eight migratory species listed under the EPBC Act were identified from the PMST search as occurring or predicted to occur in the locality (Appendix A).

Migratory wetland species

A critical consideration in assessing the significance of potential impacts on listed migratory shorebird species is whether or not a proposed action is likely to affect 'important habitat' (DoEE 2017). Important habitat is defined separately for 36 of the migratory shorebird species listed under the EPBC Act and Latham's Snipe (*Gallinago hardwickii*).

An area of 'important habitat' for the 36 migratory shorebird species identified in DoEE (2017) is defined as either:

- A site that is identified as internationally important; or
- A site that supports either:
  - at least 0.1 per cent of the flyway population of a single species; or
  - at least 2000 migratory shorebirds; or
  - at least 15 shorebird species (DoE 2017).

No mapped important habitat for migratory waders is located in or near the study sites (DPIE 2020c) (Table 4-7).

Some Australian inland wetlands and grasslands are also important habitat for migratory shorebirds. Many of these inland areas are ephemeral due to variability in Australia's climate and rainfall. For this reason, many inland areas may not be used for several years. However, when these areas receive rain, they can provide extremely productive and important food sources for migratory shorebirds (DoEE 2017).

Important habitat for Latham's Snipe is treated differently due to its cryptic lifestyle. Important habitat for this species occurs at sites that have previously been identified as internationally important for the species, or sites that:

- Support at least 18 individuals of the species; and
- Are naturally occurring open freshwater wetlands with vegetation cover nearby (for example, tussock grasslands, sedges, lignum or reeds within 100 m of the wetland) (DoEE 2017).

No important habitat for Latham's Snipe is likely to be present at the study sites (Table 4-7).

Other migratory birds

A number of other migratory species could occur in the study site on occasion. These include migratory flycatchers that breed in eastern Australian forests and non-breeding migratory birds from Asia. Important habitat for these species generally relates to breeding habitat or habitat that can support an ecologically significant proportion of the population (DoE 2015). No important habitat for other migratory birds is likely to be present at the study sites (Table 4-7).

Table 4-7 Migratory fauna species with the potential to occur at the study sites

Scientific Name	Common Name	EPBC Act	Likelihood of occurrence
Apus pacificus	Fork-tailed Swift	C,J,K	**Possible.** Suitable foraging habitat present. Non-breeding visitor. Important habitat unlikely to be present.
Actitis hypoleucos	Common Sandpiper	C,J,K	**Possible.** May occur at farm dams on occasion. No important habitat mapped in the locality by DPIE (2020c).
Calidris acuminata	Sharp-tailed Sandpiper	Mi, C,J,K	**Possible.** May occur at farm dams on occasion. No important habitat mapped in the locality by DPIE (2020c).
Calidris melanotos	Pectoral Sandpiper	Mi	**Possible.** May occur at farm dams on occasion. No important habitat mapped in the locality by DPIE (2020c).
Gallinago hardwickii	Latham's Snipe	Mi, C,J,K	**Possible.** May occur at farm dams on occasion. Site unlikely to comprise important habitat.

5. Ecological constraints and development opportunities

Ecological constraints and opportunities have been identified at the Blue Bush Facility site and the alternative sites for the Blue Bush Inter-modal based on the presence of native vegetation, threatened ecological communities, and potential habitat for threatened species. These are detailed in Table 5-1 and mapped on Figure 5-1.

Much of the proposed Blue Bush Facility site has the potential for development. While chenopod shrubland is potential habitat for a number of threatened species listed under the EPBC Act and BC Act, this site is likely to be part of a much larger habitat area and would be unlikely to support the entire population of one of these species.

Development should avoid impacts on drainage lines and riparian vegetation as far as possible. There should be no impact on the stand of Purple-wood Wattle. This threatened flora species is an SAII entity under the BAM and any impact has the potential to result in refusal of the project.

Much of the proposed Blue Bush Inter-modal Site A has the potential for development. While chenopod shrubland is potential habitat for a number of threatened species listed under the EPBC Act and BC Act, this site is likely to be part of a much larger habitat area and would be unlikely to support the entire population of one of these species. Only a small portion of this site would be developed. Development should avoid impacts on drainage lines and riparian vegetation in the west of the site, and elsewhere as far as practicable. Impacts on *Acacia loderi* shrublands EEC should be avoided.

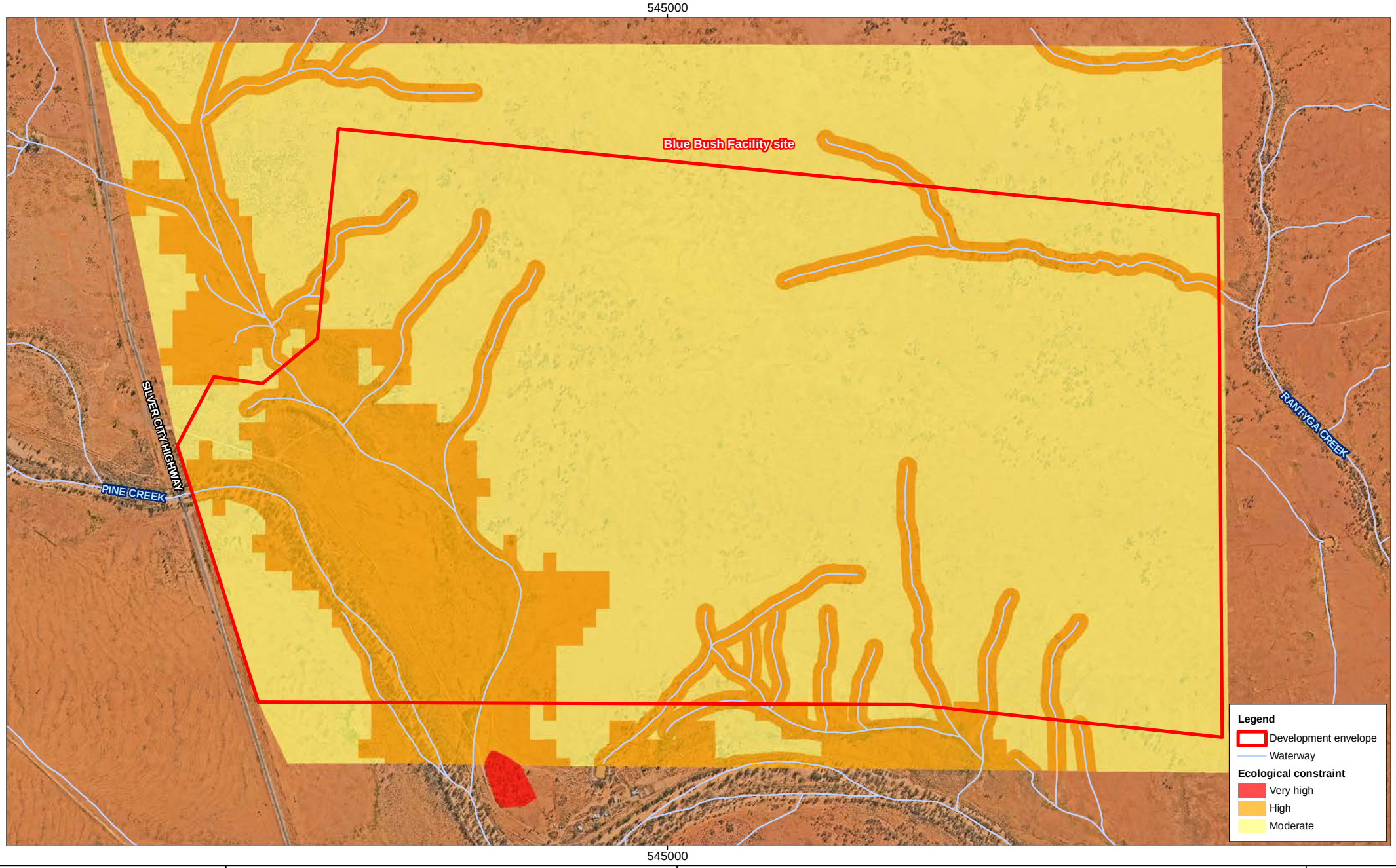
There would be negligible impacts on biodiversity values at Blue Bush Inter-modal Site B.

Table 5-1 Ecological constraints and opportunities

Constraint class	Constraints present	Offset requirements (BC Act)	Blue Bush Facility site	Blue Bush Inter-modal sites	Opportunities
Low	No native vegetation or threatened species habitat present.	No offsets required	Not present	Inter-modal Site B	No ecological hindrance to development
Moderate	Native vegetation present, containing occasional hollow-bearing trees and dams. Potential habitat for a number of threatened species.	Offsets would need to be calculated under the BAM for any impacts on native vegetation and habitat for species credit species (if present)	Majority of the site	Majority of Inter-modal Site A.	Development should be located in these areas rather than areas of high or very high constraint
High	Riparian vegetation and ephemeral drainage lines. High density of hollow-bearing trees and increased likelihood of threatened species occurrence. Known habitat for threatened microbats listed under the BC Act.	Offsets would need to be calculated under the BAM for any impacts on native vegetation and habitat for species credit species (if present)	Pine Creek and other waterways	Stirling Vale Creek and other drainage lines at Inter-modal Site A.	Limited opportunity for development. Impacts in these areas should be avoided as far as possible.
	Presence of *Acacia loderi* shrubland EEC	Offsets would need to be calculated under the BAM for any impacts on native vegetation and habitat for species credit species (if present)	*Acacia loderi* shrubland EEC not present	Small patches of *Acacia loderi* shrubland EEC present at Inter-modal Site A.	Limited opportunity for development. Impacts in these areas should be avoided as far as possible.

Constraint class	Constraints present	Offset requirements (BC Act)	Blue Bush Facility site	Blue Bush Inter-modal sites	Opportunities
	Presence of Lowland Darling River EEC (FM Act) and/or low potential for aguatic GDEs*	-	Pine Creek and other waterways	Stirling Vale Creek and other drainage lines at Inter-modal Site A.	Limited opportunity for development. Impacts in these areas should be avoided as far as possible.
Very high	Stand of Purple-wood Wattle. Potential for impacts on SAII entity and refusal of project.	-	Stand of Purple-wood Wattle in the south of the site.	Potential habitat present at Inter-modal Site A.	No opportunity for development. Impacts in these areas will be avoided.
	High potential aquatic GDEs	-	Not mapped on site	Wetland south of Inter-modal Site A	No opportunity for development. Impacts in these areas will be avoided.

* Note that set-backs for watercourses are mapped on Figure 5-1 as being 40 m. The Officer of Water recommends a vegetated riparian zone (VRZ) width based on watercourse order as classified under the Strahler System of ordering watercourses. A 40 m VRZ is recommended for 4th order creeks and above. Smaller VRZs are recommended for 1st, 2nd and 3rd order streams. Where a watercourse does not exhibit the features of a defined channel with bed and banks, the Office of Water may determine that the watercourse is not waterfront land for the purposes of the WM Act (NOW 2012). Constraints associated with drainage lines are a worst-case scenario.



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Ecological constraints

Figure

5-1a

Version: A

Tellus Holdings Ltd and GHD endeavour to ensure this map is free of errors but does not represent or warrant (either expressly or impliedly) that the map or its features are accurate or fit for a particular use.

Data source: Aerial imagery -Tellus (image date - 07/06/2020) & sixmaps 2020 (); General topo - NSW LPI DTDB 2019 & 2015; Vegetation - GHD & OEH.

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Date: 29/06/2020
12531918_Z004_EcologicalConstraints.mxd

Ecological constraints

Figure

5-1b

Version: A

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Data source: Aerial imagery -Tellus (image date - 07/06/2020) & sixmaps 2020 (); General topo - NSW LPI DTDB 2019 & 2015; Vegetation - GHD & OEH.

6. Preliminary impact assessment

6.1 Direct impacts

6.1.1 Construction phase

The proposed Blue Bush Facility would comprise infrastructure including pits and processing plants, waste infrastructure and associated ancillary infrastructure. The site totals about 930 hectares. For the purposes of this report it is assumed that there would be no construction near Pine Creek, but much of the remaining vegetation at the site is likely to be cleared.

Two options of the Blue Bush Inter-modal site are being investigated. Site A is predominantly vegetated, while Site B is already cleared. For the purposes of this report it is assumed that there would be minimal impacts on riparian habitat at Site A, and clearing would comprise only a small portion of this site.

A summary of direct impacts is provided in Table 6-1.

6.1.2 Operation phase

Clay would be extracted from open-cut pits at the proposed Blue Bush Facility. The voids created from this extraction would then be used for the storage and/or permanent isolation of hazardous waste. The Blue Bush Facility would receive up to a maximum of 200,000 tonnes per annum of waste for approximately 25 years.

Direct impacts on biodiversity values during operation of the project are unlikely.

6.1.3 Decommission and rehabilitation

At completion of the project the Blue Bush Facility would be decommissioned and ancillary infrastructure would be removed. Capping would be placed over the waste to create a final landform suitable for site rehabilitation. The final landforms must be stable and aesthetically consistent with the surrounding landscape, and in a manner that will enable as much of the land as possible to be used once again for grazing purposes. Where possible, rehabilitated landforms should be covered with topsoil and planted with suitable grasses.

This phase of the project is likely to improve biodiversity values at the site compared to the operation phase.

Table 6-1 Direct impacts on biodiversity values during construction

Impact	Blue Bush Facility site	Blue Bush Inter-modal sites
Removal of vegetation	The total development envelope is about 930 ha, however, not all of this would be impacted by the development. The project would predominantly remove Bluebush Shrubland. Areas of Black Oak – Western Rosewood woodland would also be removed. Impacts on riparian River Red Gum habitats would be avoided.	A small portion of the Inter-modal Site A may be impacted. Impacts would likely predominantly clear Bluebush Shrubland and Bottlewasher – Copperburr grassland. Impacts on riparian River Red Gum habitats would be avoided.
Impacts on terrestrial EECs	No EECs are present at the Blue Bush Facility site.	There is potential for impact on small patches of *Acacia loderi* shrubland at Inter-modal Site A. Scattered patches of this EEC occur in the locality.
Impacts on threatened flora	Known habitat for the Purple-wood Wattle south of the Blue Bush Facility site would be avoided. Potential for impacts on other threatened flora is considered unlikely. Further surveys proposed to confirm presence or absence of species and likely impacts.	Potential for impacts on threatened flora is considered unlikely. Further surveys proposed to confirm presence or absence of species and likely impacts.
Removal of habitat resources	Construction of the project would remove up to 930 ha of fauna habitats, predominantly comprising shrublands with smaller areas of woodland. There would be no removal of riparian vegetation along Pine Creek at the Blue Bush Facility site. This would avoid the removal of raptor nests (If present) in these areas, however, could result in disturbance of breeding (if present).	Construction of the project would remove fauna habitats, predominantly comprising shrublands and grassland. Total area not yet confirmed. There would be no removal of riparian vegetation along Stirling Vale Creek at Inter-modal Site A. This would avoid the removal of raptor nests (If present) in these areas, however, could result in disturbance of breeding (if present).
Removal of hollow-bearing trees	The project has the potential to remove hollow-bearing trees that occur as scattered trees in shrubland areas. There would be no removal of riparian vegetation along Pine Creek at the Blue Bush Facility site. This would avoid the removal of hollow-bearing trees from these areas, which provide important potential breeding habitat for threatened species such as microbats and	The project has the potential to remove hollow-bearing trees that occur as scattered trees in shrubland areas. There would be no removal of riparian vegetation along Stirling Vale Creek at Inter-modal Site A. This would avoid the removal of hollow-bearing trees from these areas, which provide important potential breeding habitat for threatened species such as microbats and

Impact	Blue Bush Facility site	Blue Bush Inter-modal sites
	Major Mitchell's Cockatoo, however could result in disturbance of breeding (if present).	Major Mitchell's Cockatoo, however could result in disturbance of breeding (if present).
Injury and mortality	Construction works have the potential to result in the injury or mortality of some individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the site during clearing activities and unable to move out of the area. This could include nestlings, roosting bats, small terrestrial mammals, reptiles and frogs. More mobile native fauna such as birds and larger mammals such as kangaroos are likely to evade injury during works as they are likely to move away into adjoining areas.	Construction works have the potential to result in the injury or mortality of some individuals of less mobile fauna species and other small terrestrial fauna that may be sheltering in vegetation within the site during clearing activities and unable to move out of the area. This could include nestlings, roosting bats, small terrestrial mammals, reptiles and frogs. More mobile native fauna such as birds and larger mammals such as kangaroos are likely to evade injury during works as they are likely to move away into adjoining areas.
Fragmentation and isolation of habitat.	The project would require the removal of vegetation and habitats. The vegetation within the site is predominantly shrubland, with scattered canopy trees. Woodland occurs as narrow bands along larger drainage lines. These movement corridors would be retained. It is unlikely that the project would create an additional barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds.	The project would require the removal of vegetation and habitats. The vegetation within Inter-modal Site A is predominantly shrubland, with scattered canopy trees. Woodland occurs as narrow bands along larger drainage lines. These movement corridors would be retained. It is unlikely that the project would create an additional barrier to the movement of pollinator and seed dispersal vectors, such as insects and birds.
Impact on aquatic habitat	The project may remove some artificial dams and first order drainage lines that provide habitat for a range of fauna species. No key fish habitat is present in the study site.	The project may remove some artificial dams and first order drainage lines that provide habitat for a range of fauna species. No key fish habitat is present in the study site.
Impact on aquatic EECs	Retention of riparian areas and avoidance of direct impacts on creeks would limit impacts on the Lowland Darling River EEC.	Retention of riparian areas and avoidance of direct impacts on creeks would limit impacts on the Lowland Darling River EEC.
Impact on aquatic GDEs	Retention of riparian areas and avoidance of direct impacts on creeks would limit impacts on areas of low potential aquatic GDE associated with Pine Creek	Retention of riparian areas and avoidance of direct impacts on creeks would limit impacts on areas of low potential aquatic GDE associated with Stirling Vale Creek.

6.2 Indirect impacts

Indirect impacts on biodiversity values have the potential to occur during all phases of the project. A summary of potential indirect impacts is provided in Table 6-2.

Table 6-2 Indirect impacts on biodiversity values

Impact	Description
Edge effects	'Edge effects' include increased noise and light, erosion and sedimentation, and introduction of weeds. These effects cause degradation of vegetation at the interface of intact vegetation and cleared areas. Edge effects may result in impacts such as changes to vegetation type and structure, increased growth of exotic plants, increased predation of native fauna or avoidance of habitat by native fauna. Altered environmental conditions along new edges can allow invasion by pest animals specialising in edge habitats and/or change the behaviour of resident animals. Edge effects would result from construction activities and then continue to affect vegetation and habitats adjoining the site. Land within the study sites is predominantly shrubland, with narrow riparian corridors present. These are already edge effected and subject to weed invasion. The project would create few novel edge effects and is unlikely to result in a significant increase in the impact of existing edge effects.
Spread of weeds	The construction, operation and decommissioning phases all have the potential to spread weeds through movement of vehicles, machinery and soil. As noted above, weeds are present at the sites. Mitigation measures are recommended to minimise the risk of introduction and spread of weeds.
Light, noise and vibration	The construction, operation and decommissioning phases would require the use of vehicles and plant on the sites. Many fauna that occupy habitats within the sites and adjacent areas are likely to become accustomed to novel light, noise and vibration levels. Some fauna species may move away to new areas to avoid the disturbance, which could result in competition for resources, and potentially mortality of some individuals.
Sedimentation, erosion and pollution	The construction, operation and decommissioning phases have the potential to result in sedimentation and erosion and mobilisation of contaminants into adjoining native vegetation and aquatic habitats associated with Pine Creek, through soil disturbance and remediation activities. Sediment laden runoff to waterways can alter water quality and adversely affect aquatic life. Mitigation measures are recommended to minimise the risk of indirect impacts from these events.
Aquatic disturbance and pollution	Construction of the project has the potential to result in indirect impacts on Pine Creek, Rantyga Creek and other drainage lines such as the mobilisation of contaminated sediments into waterways, or chemical spills from vehicles or plant, if suitable mitigation measures are not adopted. The introduction of pollutants from the project into the surrounding environment, if uncontrolled, could potentially impact on water quality further downstream. Encapsulation of contaminated material on site at completion of the project would minimise future impacts from pollution.

6.3 Potential impacts on threatened biota listed under the BC Act and FM Act

6.3.1 Threatened ecological communities

There is potential for clearing small patches of *Acacia loderi* shrublands EEC at the Blue Bush Inter-modal Site A. No areas of this EEC have been recorded at the Blue Bush Facility site. Impacts on this vegetation would be assessed and ecosystem credits calculated under the BAM.

Drainage lines at the study sites are part of the Lowland Darling River EEC. Impacts on the large ephemeral watercourses at the Blue Bush Facility site and Blue Bush Inter-modal Site A would be avoided. There may be impacts on small drainage lines, predominantly 1st order streams. Indirect impacts would be managed via appropriate set-backs, and sediment and erosion control. As such, a significant impact is unlikely for this EEC.

6.3.2 Threatened flora species

One threatened flora species is known to occur south of the Blue Bush Facility site (outside of the proposed development envelope) – Purple-wood Wattle. Direct impacts on this species would be purposely avoided, and measures are recommended to protect this stand during construction and operation. No species credits would be required for this species.

Potential habitat is present for a number of other threatened species, which would require targeted survey in the appropriate season and conditions to confirm absence, or determine the species polygon for species credits, if present.

A summary of the potential for impacts is provided in Table 6-3.

Table 6-3 Potential for impacts on threatened flora species listed under the BC Act

Scientific Name	Common Name	BC Act Status/SAII	Likelihood of impacts (Blue Bush Facility site)	Likelihood of impacts (Blue Bush Inter-modal Site A)
Acacia carneorum	Purple-wood Wattle	V SAII	None. Development envelope positioned to avoid impacts on this species. No species credits required to be calculated.	Impacts on potential habitat associated with PCT 41 and 61 likely to be avoided through placement of construction area. Impacts on potential habitat associated with patches of PCT 150. No known records at the site. No serious and irreversible impacts likely.
Acacia notabilis	Mallee Golden Wattle	E	Limited potential for impacts given association with riparian areas (PCT 61). Potential for impacts on other woodland habitat (PCT 41, 60). No records near the Blue Bush Facility site. Targeted surveys required to identify if species is present at the site.	Limited potential for impacts given association with riparian areas (PCT 41, 123). Few records in the locality of Inter-modal Site A. Not previously recorded on site. Targeted surveys required to identify if species is present at the site.
Acacia rivalis	Creek Wattle	E SAII	Limited potential for impacts given association with riparian areas (PCT 41 and adjacent areas). No records near the Blue Bush Facility site. Targeted surveys required to identify if SAII entity is present at the site.	Limited potential for impacts given association with riparian areas (PCT 41 and 136 and adjacent areas). One record in the locality of the Inter-modal Site A. Not previously recorded on site Targeted surveys required to identify if SAII entity is present at the site.
Atriplex infrequens	A saltbush	V	Potential loss of suitable habitat associated with PCT 60. Impacts in riparian areas (PCT 41) would be avoided. Similar habitat	Impacts on potential habitat associated with drainage lines and adjacent areas likely to be

Scientific Name	Common Name	BC Act Status/SAII	Likelihood of impacts (Blue Bush Facility site)	Likelihood of impacts (Blue Bush Inter-modal Site A)
			present throughout the locality. No local records.	avoided. Similar habitat present throughout the locality. No local records.
Calotis moorei	A burr-daisy	E SAII	Potential impacts on habitat associated with sandy soils and chenopod shrublands (PCT 60, 154, 155, 158, 222). Similar habitat present throughout the locality. No local records. Site heavily grazed. Targeted surveys required to identify if SAII entity is present at the site.	Potential impacts on habitat associated with sandy soils and chenopod shrublands (PCT 61, 150, 154, 155, 156). Similar habitat present throughout the locality. No local records. Targeted surveys required to identify if SAII entity is present at the site.
Swainsona flavicarinata	Yellow-keeled Swainsona	E SAII	Potential impacts on habitat associated with saltbush areas (PCT 158 and 220 near Pine Creek, and PCT 60 in scattered patches). Impacts on riparian areas associated with Pine Creek would be avoided. Similar habitat present throughout the locality. No local records. Site heavily grazed. Targeted surveys recommended to identify if SAII entity is present at the site.	**Possible.** Suitable habitat present in saltbush areas (PCT 61 and 156 in the south of the site). Impacts on riparian areas associated with Stirling Vale Creek would be avoided. Similar habitat present throughout the locality. No local records. Targeted surveys recommended to identify if SAII entity is present at the site.
Swainsona murrayana	Slender Darling Pea	V	Potential impacts on habitat associated with bladder saltbush communities (PCT 222). No local records.	Potential impacts on habitat associated with bladder saltbush (PCT 156) and grassland communities (PCT 61 and 150).

Scientific Name	Common Name	BC Act Status/SAII	Likelihood of impacts (Blue Bush Facility site)	Likelihood of impacts (Blue Bush Inter-modal Site A)
			Targeted surveys recommended to identify if species is present at the site.	No local records. Not previously recorded at site. Targeted surveys recommended to identify if species is present at the site.
Swainsona viridis	Creeping Darling Pea	E	Potential impacts on riparian areas (PCT 41) likely to be avoided. Similar habitat present throughout the locality. No local records.	Potential impacts on riparian areas (PCT 41 and 136) likely to be avoided. Similar habitat present throughout the locality. No local records.

KEY: CE – critically endangered, E – endangered, V – vulnerable, SAII – serious and irreversible impacts

6.3.3 Threatened fauna species

Four threatened fauna species listed as vulnerable species under the BC Act are known to occur at the Blue Bush Facility site: the White-fronted Chat, Yellow-bellied Sheathtail-bat, Inland Forest Bat, and Little Pied Bat. All are highly mobile species that would not be expected to be substantially impacted by the development, and indirect impacts through habitat loss would be marginal due to the intact vegetation of the landscape surrounding the site.

One threatened fauna species is known from Blue Bush Inter-modal Site A, the Rufous Fieldwren, listed as a vulnerable species under the BC Act. This species has the potential to suffer habitat loss depending on the size and placement of clearing at the Inter-modal site and should be considered further in the design of the site if possible to avoid and minimise impacts to suitable habitat. Impacts on habitat for this species would be offset via ecosystem credits.

Potential habitat is present for a number of threatened birds (such as raptors and cockatoos) and microbats (including Corben's Long-eared Bat and others) that may roost and breed in River Red Gums along the riparian corridors. Set-backs are proposed to avoid the risk of impacts on water quality, and this would also allow for avoidance of removal of potential breeding habitat for these species. The project would remove foraging habitat for these species, however impacts through habitat loss would be marginal due to the intact vegetation of the landscape surrounding the site. Microbats that are known to occur or may occur do not require calculation of species credits. Species credits are unlikely to be required for the Black-breasted Buzzard, Little Eagle and Major Mitchell's Cockatoo, as appropriate set-backs are likely to be possible for any nest trees (if present). Targeted surveys are recommended for these latter species to identify if any species credits or set-backs are required for the Black-breasted Buzzard, Little Eagle and Major Mitchell's Cockatoo.

Impacts are unlikely for other species credit threatened fauna species/SAII entities such as the Plains-wanderer and Thick-billed Grasswren. These species are restricted in their distribution, and the Blue Bush Facility site and Blue Bush Inter-modal sites are located well away from known records. Surveys are recommended for these species to confirm their absence from the sites.

A summary of threatened fauna species that may require species credits to be calculated is provided in Table 6-4.

There would be no direct impacts on large ephemeral watercourses. No threatened species listed under the FM Act are likely to occur or be impacted by the project.

Table 6-4 Potential for impacts on species credit fauna species listed under the BC Act

Scientific Name	Common Name	BC Act Status	Credit type / SAII	Likelihood of impacts at the Blue Bush Facility site and requirement for species credits	Likelihood of impacts at Blue Bush Inter-modal Site A and requirement for species credits
Amytornis modestus	Thick-billed Grasswren (central NSW subspecies)	CE	Species SAII. Any impact on the species from development could be potentially serious and irreversible	Potential impacts on suitable habitat associated with saltbush habitat. No local records. Generally thought to be extinct in NSW until recently located in the Packsaddle area, around 100 km north of Broken Hill. Further surveys recommended to confirm absence from the site.	Potential impacts on suitable habitat associated with saltbush habitat. No local records. Generally thought to be extinct in NSW until recently located in the Packsaddle area, around 100 km north of Broken Hill. Further surveys recommended to confirm absence from the site.
Pedionomus torquatus	Plains-wanderer	E	Species credit (mapped important areas) SAII (mapped important areas)	No important habitat areas are mapped in the study site. No species credits required to be calculated if this species is found to occur at the site.	No important habitat areas are mapped in the study site. No species credits required to be calculated if this species is found to occur at the site.
Hamirostra melanosternon	Black-breasted Buzzard	V	Breeding habitat only	Direct impacts on nest trees unlikely given avoidance of clearing in riparian areas. Appropriate set back recommended to avoid offsets (if nest tree present)	Direct impacts on nest trees unlikely given avoidance of clearing in riparian areas. Appropriate set back recommended to avoid offsets (if nest tree present)
Hieraaetus morphnoides	Little Eagle	V	Breeding habitat only	Direct impacts on nest trees unlikely given avoidance of clearing in riparian areas.	Direct impacts on nest trees unlikely given avoidance of clearing in riparian areas.

Scientific Name	Common Name	BC Act Status	Credit type / SAII	Likelihood of impacts at the Blue Bush Facility site and requirement for species credits	Likelihood of impacts at Blue Bush Inter-modal Site A and requirement for species credits
				Potential for impacts if nesting in Belah woodland. Appropriate set back recommended to avoid offsets (if nest tree present)	Appropriate set back recommended to avoid offsets (if nest tree present)
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	Breeding habitat only	Direct impacts on nest trees unlikely given avoidance of clearing in riparian areas. Appropriate set back recommended to avoid offsets (if nest tree present)	Direct impacts on nest trees unlikely given avoidance of clearing in riparian areas. Appropriate set back recommended to avoid offsets (if nest tree present)

KEY: CE – critically endangered, E – endangered, V – vulnerable, SAII – serious and irreversible impacts

6.3.4 Serious and irreversible impacts

A number of threatened flora species are also SAII entities. Serious and irreversible impacts are unlikely to occur as a result of the project given:

- Direct impacts on Purple-wood Wattle would be purposely avoided, and indirect impacts would be minimised through mitigation measures. No individuals of this species have been recorded at Blue Bush Inter-modal Site A.
- Avoidance of impacts on riparian habitat would also minimise the risk of impacts on a SAII flora species including *Acacia rivalis, Calotis moorei*, and *Swainsona flavicarinata*.
- There are no local records of *Calotis moorei* and *Swainsona flavicarinata* at either site and local records are not known for *Acacia rivalis* at the Blue Bush Facility site.
- No important habitat for the Plains-wanderer is present.
- Impacts on the Thick-billed Grasswren are unlikely, given nearest records are 100 kilometres north of Broken Hill.

Further targeted surveys are recommended for SAII entities to confirm absence of these species in the study sites.

6.4 Potential impacts on MNES

6.4.1 Threatened ecological communities

No threatened communities listed under the EPBC Act would be impacted.

6.4.2 Threatened flora species

One threatened flora species is known to occur south of the Blue Bush Facility site, Purple-wood Wattle. Direct impacts on this species would be purposely avoided and indirect impacts are unlikely. The project has the potential to impact three other threatened flora species listed under the EPBC Act (Table 6-5). There are no local records of these species, and similar habitats occur outside the study sites. The project is therefore unlikely to have a significant impact on any threatened flora species (see assessments of significance in Appendix C).

Table 6-5 Potential for significant impacts on threatened flora species listed under the EPBC Act

Species	Common name	EPBC Act status	Potential impacts (Blue Bush Facility site)	Potential impacts (Blue Bush Inter-modal Site A)	Significant impact likely?
Acacia carneorum	Purple-wood Wattle	V	Impacts on the known population would be avoided. Protective measures during construction and operation would minimise indirect impacts.	Impacts on potential habitat associated with PCT 150. Impacts on potential habitat associated with PCT 41 and 61 likely to be avoided through placement of construction area. No known records at the site.	No
Atriplex infrequens	A saltbush	V	Potential loss of suitable habitat associated with PCT 60. Impacts in riparian and adjacent areas (PCT 41, 222) would mostly be avoided. Similar habitat present throughout the locality. No local records.	Impacts on potential habitat associated with drainage lines and adjacent areas likely to be avoided. Similar habitat present throughout the locality. No local records.	No
Calotis moorei	A burr-daisy	E	Potential impacts on habitat associated with sandy soils and chenopod shrublands (PCT 154, 222). Similar habitat present throughout the locality. No local records. Site heavily grazed.	Potential impacts on habitat associated with sandy soils and chenopod shrublands (PCT 154). Similar habitat present throughout the locality. No local records.	No
Swainsona murrayana	Slender Darling Pea	V	Potential impacts on habitat associated with bladder saltbush communities (PCT 222). Similar habitat present throughout the locality. No local records. Site heavily grazed.	Potential impacts on habitat associated with bladder saltbush (PCT 156) and grassland communities (PCT 61 and 150). Similar habitat present throughout the locality. No local records. No local records.	No

KEY: E – endangered, V – vulnerable

6.4.3 Threatened fauna species

Potential habitat is present for Corben's Long-eared Bat, which may roost and breed in River Red Gums along the riparian corridors and would also forage across the sites. As noted above, the project would avoid removal of riparian habitat at Pine Creek at the Blue Bush Facility site and Stirling Vale Creek at Blue Bush Inter-modal Site A where there is a high incidence of hollow-bearing trees, and thus potential impacts would be minimised. The project may remove occasional hollow-bearing trees elsewhere in the Blue Bush Facility site and Blue Bush Inter-modal Site A.

Limited potential habitat for the Australian Painted Snipe is present at the sites. The removal of farm dams is unlikely to have a significant impact on this species.

Impacts are unlikely for other threatened fauna species listed under the EPBC Act such as the Dusky Hopping Mouse, Plains-wanderer and Thick-billed Grasswren. These species are restricted in their distribution, and the Blue Bush Facility site and Blue Bush Inter-modal Site A are located well away from known records. No important breeding habitat for the Plains-wanderer would be impacted. There is limited potential for impacts on the Dusky Hopping Mouse, Plains-wanderer and Thick-billed Grasswren given the lack of local records, limited habitat present, and presence of similar habitat types throughout the locality.

The project is unlikely to have a significant impact on these species (see assessments of significance in Appendix C). A summary is provided in Table 6-6.

6.4.4 Migratory species

No important habitat for any migratory species would be impacted by the project. Any migratory species that may occur would be transient individuals and would not rely on the limited wetland habitat present in the study sites. No assessments of significance are considered necessary for these species.

Table 6-6 Potential for significant impacts on threatened fauna species listed under the EPBC Act

Common name	EPBC Act status	Potential impacts (Blue Bush Facility site)	Potential impacts (Blue Bush Inter-modal Site A)	Significant impact likely?
Corben's Long-eared Bat	V	Potential loss of hollow-bearing trees and foraging habitat. Main area of potential habitat (Pine Creek) would be retained.	Potential loss of hollow-bearing trees and foraging habitat. Main area of potential habitat (Stirling Vale Creek) would be retained.	No
Dusky Hopping Mouse	V	No known populations occur near the study sites. Low potential for the species to occur and be impacted given lack of preferred sand dune habitat. Similar atypical habitats (chenopod shrubland) occurs outside the site.	Sand-dune habitat present in the western portion of the site unlikely to be impacted. Atypical habitat in areas dominated by chenopods would be cleared. Low potential for the species to occur and be impacted given main population occurs well north of Broken Hill. Similar habitats occur outside the study sites.	No
Australian Painted Snipe	E	Limited loss of low-quality potential habitat associated with farm dams. Riparian habitat to be retained.	Limited loss of low-quality potential habitat associated with farm dams. Riparian habitat to be retained.	No
Plains-wanderer	CE	No known populations occur near the sites. No important habitat mapped near the site. Low potential for the species to occur and be impacted. Similar habitats occur outside the site.	No known populations occur near the sites. No important habitat mapped near the site. Low potential for the species to occur and be impacted. Similar habitats occur outside the site.	No

Common name	EPBC Act status	Potential impacts (Blue Bush Facility site)	Potential impacts (Blue Bush Inter-modal Site A)	Significant impact likely?
Thick-billed Grasswren	CE	Known populations occur over 100 km to the north of the site. Low potential for the species to occur and be impacted. Similar habitats occur outside the site.	Known populations occur over 100 km to the north of the site. Low potential for the species to occur and be impacted. Similar habitats occur outside the site.	No

7. Mitigation and offsetting

7.1 Avoiding impacts

The following recommendations are made to avoid impacts on biodiversity values:

- Avoid direct impacts on riparian vegetation associated with Pine Creek at the Blue Bush Facility site and the Blue Bush Inter-modal Site A. This would avoid or minimise impacts on roosting and breeding habitat for threatened microbats, raptors and cockatoos.
- Avoid any disturbance to the stand of Purple Wood Wattle located to the south of the Blue Bush Facility site.
- Avoid clearing of *Acacia loderi* shrublands where possible at the Blue Bush Inter-modal Site A.
- Locate construction areas to avoid impacts on populations of threatened flora if found to be present, where practicable.

7.2 Mitigating impacts

Mitigation measures would be required to minimise the risk of indirect impacts on biodiversity values at the study sites. Mitigation measures recommended as a minimum are detailed in Table 7-1.

Table 7-1 Recommended mitigation measures

Impact	Mitigation measure	Timing
Vegetation clearing	Set-backs from large creek lines and riparian areas	Detailed design and construction planning
	Set-backs where or if required around nest trees	Detailed design and construction planning
Impacts on fauna	Minimise the construction footprint and avoid impacts hollow-bearing trees and nest trees as far as practicable	Detailed design and construction planning
	Fauna management protocols to be implemented during clearing of vegetation to minimise the risk of mortality of fauna	Construction
Impacts on aquatic habitat and EECs	Erosion and sediment control to minimise the risk of indirect impacts on aquatic habitats and *Acacia loderi* shrubland EEC	Construction and operation
Weed management	Control and management of weeds on site	Construction and operation
Rehabilitation	Rehabilitation of landform and vegetation post-decommissioning	Decommissioning

7.3 Offsetting impacts

7.3.1 BC Act

The BAM calculator provides metrics for calculating credit requirements for direct impacts on native vegetation and threatened species. Ecosystem credits would be calculated for impacts on PCTs as part of the BDAR. Species credits would be calculated if the project impacts known habitat for any species credit species identified at the sites or considered likely to occur following completion of targeted surveys and detailed habitat assessments.

An assessment of the potential for serious and irreversible impacts would be provided for SAII entities. Based on current information, no SAII entities are likely to be impacted, however limited potential habitat is present for species such as the Thick-billed Grasswren and threatened flora species.

7.3.2 EPBC Act

The NSW and Australian Governments have entered into a bilateral agreement under the EPBC Act that accredits certain NSW assessment processes which allows the Australian Government Minister for the Environment to rely on NSW environmental impact assessment processes to assess actions under the EPBC Act. The NSW Biodiversity Offsets Scheme (BOS) is an endorsed state policy for the purposes of the EPBC Act Condition-setting policy. The BOS has specific settings to ensure offsetting is aligned with Australian Government requirements and like-for-like offsets are achieved for Commonwealth-listed threatened species and communities.

Offsets are required to be calculated in accordance with the BAM for any threatened biota listed under the EPBC Act that are likely to be significantly impacted by the project. Based on current information, the project is unlikely to have a significant impact on any threatened species listed under the EPBC Act. No threatened ecological communities listed under the EPBC Act would be impacted.

8. Recommendations for further surveys

Further surveys are required for preparation of the BDAR to meet the requirements of the BAM and threatened species survey guidelines. These includes survey of the minimum number of plot-transects for each PCT, and targeted surveys for threatened species that could not be surveyed for in autumn.

8.1 Vegetation surveys

The BAM requires staged vegetation surveys. Stage 1 surveys (vegetation mapping) was completed for the Blue Bush Facility site during the May 2020 surveys, and previously at the Blue Bush Inter-modal Site A by GHD in 2017. Stage 2 surveys would comprise mapping of vegetation zones (condition classes within a PCT) and vegetation integrity (plot) surveys.

Plot surveys would need to be conducted in accordance with the BAM (OEH 2017) to obtain vegetation integrity data for the calculation of biodiversity credits. A PCT can have more than one vegetation zone accounting for the variance in vegetation condition across the PCT. Each vegetation zone then has a minimum number of plots that are required to be surveyed depending on the area of the vegetation zone (see Table 8-1).

Table 8-1 Minimum number of plot requirements per vegetation zone

Vegetation zone (ha)	Minimum number of plots
<2	1 plot
>2-5	2 plots
>5-20	3 plots
>20-50	4 plots
>50-100	5 plots
>100-250	6 plots
>250-100	7 plots; more plots may be needed if the condition of the vegetation varies across the zone
>1000	8 plots; more plots may be needed if the condition of the vegetation varies across the zone

8.2 Threatened species surveys

All threatened flora with the potential to occur would require targeted surveys in appropriate season and conditions.

The BAM identifies two classes of threatened fauna species:

- Predicted, or ecosystem credit species that can be reliably predicted to occur within the subject site based on the site location, PCT(s) present, patch size and other habitat criteria specified in the BAM and the threatened species data collection administered by BCD.
- Species credit entities, comprising threatened fauna species or specific habitat resources such as occupied breeding habitat that cannot be reliably predicted.

Under the BAM, targeted surveys are not required for ecosystem credit species. These species are assumed to be present within certain PCTs, given a certain patch size and condition. Targeted surveys may be required however for ecosystem species that are also listed as threatened species under the EPBC Act, in order to meet the Commonwealth survey requirements for these species.

Species that are likely to require targeted surveys are detailed in Table 8-2. Note that the Dusky Hopping Mouse is likely to be subject to a detailed habitat assessment, with trapping only recommended if conditions are suitable (i.e. following substantial rain creating a population boom). This species can be present at very low densities for extended periods of time during dry conditions, making it virtually impossible to detect under such conditions (DEWHA 2011). A variety of methods other than trapping can be used to target this species.

Table 8-2 Threatened species that may require targeted surveys

Scientific Name	Common Name	BC Act Status	EBPC Act Status	BAM Credit type	Survey months	Survey techniques
Flora						
Acacia carneorum	Purple-wood Wattle	V	V	Species	All year	Targeted searches
Acacia notabilis	Mallee Golden Wattle	E		Species	All year	Targeted searches
Acacia rivalis	Creek Wattle	E		Species	All year	Targeted searches
Atriplex infrequens	A saltbush	V	V	Species	Nov-Feb	Targeted searches
Calotis moorei	A burr-daisy	E	E	Species	Sep-Nov	Targeted searches
Swainsona flavicarinata	Yellow-keeled Swainsona	E		Species	Jun-Oct, survey 4-7 weeks after above average rainfall	Targeted searches
Swainsona murrayana	Slender Darling Pea	V	V	Species	Sep	Targeted searches
Swainsona viridis	Creeping Darling Pea	E		Species	Sep - Oct, after average to wet seasonal conditions	Targeted searches
Birds						
Amytornis modestus	Thick-billed Grasswren (central NSW subspecies)	CE	CE	Species	Jul-Sep	Diurnal bird surveys

Scientific Name	Common Name	BC Act Status	EBPC Act Status	BAM Credit type	Survey months	Survey techniques
Hamirostra melanosternon	Black-breasted Buzzard	V		Dual (breeding habitat)	Sep-Nov	Nest tree surveys, diurnal bird surveys
Hieraaetus morphnoides	Little Eagle	V		Dual (breeding habitat)	Aug-Oct	Nest tree surveys, diurnal bird surveys
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V		Dual (breeding habitat)	Sep-Dec	Nest tree surveys, diurnal bird surveys
Rostratula australis	Australian Painted Snipe	E	E	Ecosystem	All year	Diurnal bird surveys, Call playback
Pedionomus torquatus	Plains-wanderer	E	CE	Dual (mapped important areas)	All year	Diurnal bird surveys
Mammals						
Notomys fuscus	Dusky Hopping-mouse	E	V	Ecosystem	All year, or as conditions allow	Detailed habitat assessment Daytime searches for signs such as tracks Collection of predator scats Camera traps Elliot, pitfall trapping
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Ecosystem	Spring to early autumn	Harp netting

8.3 Summary of surveys required

The following surveys are recommended:

- Mapping of vegetation zones.
- Plot-transect surveys for each vegetation zone.
- Searches for nest trees of raptors and Major Mitchell's Cockatoo in spring. These surveys would focus on riparian areas.
- Targeted searches for threatened flora species. Species with the potential to occur at the sites can be generally surveyed for in spring. Additional survey may be recommended in other seasons if there is substantial rainfall, as some threatened flora species only flower after appropriate rainfall.
- General fauna surveys, including trapping for Corben's Long-eared Bat and diurnal bird surveys. This is recommended in spring, when weather is warm but not hot.

9. Conclusion

Tellus propose to construct and operate a near-surface geological waste repository and associated infrastructure south of Broken Hill.

9.1 Constraints and opportunities

An ecological constraints and opportunities assessment has identified high constraint areas that should be avoided, and areas of low and medium constraint that are more suitable for development. The project would be designed to avoid direct impacts on riparian habitats associated with Pine Creek and Stirling Vale Creek, and to have an appropriate set-back to avoid or minimise indirect impacts on these watercourses. The project would be designed to avoid impacts on the stand of Purple-wood Wattle listed under the BC Act and EPBC Act. Opportunities exist for placement of the Blue Bush Inter-modal Site to minimise impacts on threatened species, if present.

9.2 Impacts on aquatic habitats and GDEs

All creeks and drainage lines at the Blue Bush Facility Site and the two Inter-modal sites are part of the Lowland Darling River aquatic ecological community listed under the FM Act. No key fish habitat is mapped in the study sites. No threatened aquatic species are likely to occur at the study sites.

Pine Creek and its floodplain at the Blue Bush Facility site is mapped as a low potential aquatic GDE. In addition, the floodplain associated with Rantyga Creek to the east of the site is mapped as a low potential aquatic GDE. No aquatic GDEs are mapped within Blue Bush Inter-modal Site A or B.

9.3 Potential impacts on threatened biota listed under the BC Act

No threatened ecological communities listed under the BC Act are present at the site of the proposed Blue Bush Facility. Small patches of the *Acacia loderi* shrubland EEC listed under the BC Act is present at Blue Bush Inter-modal Site A.

A stand of *Acacia carneorum* (Purple-wood Wattle) occurs outside the development envelope, to the south of the Blue Bush Facility site, near the existing homestead. There is potential for various other threatened flora species to occur at the Blue Bush Facility site and Blue Bush Inter-modal Site A, although there are few existing local records of these species. Avoidance of impacts on riparian habitats would minimise the potential for impacts on some species, which are often associated with ephemeral waterbodies. Chenopod shrubland habitat is widespread in the locality and impacts on this habitat is not likely to significantly impact any threatened flora species given the extent of suitable habitat present in the locality and general lack of records. Impacts on species credit flora species and SAII entities identified under the BC Act are unlikely, however, further survey is required to confirm their absence.

Four threatened fauna species listed as ecosystem credit species under the BC Act have been recorded at the Blue Bush Facility site, including the White-fronted Chat and three microbat species. Avoidance of impacts along Pine Creek would minimise the potential for roost trees of microbats to be removed. Chenopod shrubland habitat is widespread in the locality and impacts on this habitat at the Blue Bush Facility site are not likely to significantly impact the White-fronted Chat. No offsets are required for these species under the BC Act.

There is potential for impacts on nesting habitat for threatened raptors and cockatoos listed under the BC Act. Avoidance of impacts on riparian habitats would minimise the potential for impacts on species credit breeding habitat. Further surveys would identify if breeding habitat is present and if set-backs are required.

9.4 Significance of impacts under the EPBC Act

No threatened ecological communities listed under the EPBC Act are present at the Blue Bush Facility site or Inter-modal Site B.

Impacts on the stand of stand of *Acacia carneorum* near the Blue Bush Facility site would be avoided (the stand is outside of the proposed development envelope). There is potential habitat for three other threatened flora species listed under the EPBC Act. Significant impacts on flora species listed under the EPBC Act are unlikely, assuming avoidance of impacts on high quality riparian habitats, avoidance of impacts on the Purple-wood Wattle, and future targeted seasonal surveys not recording local populations of threatened species.

The project is unlikely to have a significant impact on any fauna species listed under the EPBC Act such as Corben's Long-eared Bat, Australian Painted Snipe, Dusky Hopping Mouse, Plains-wanderer and Thick-billed Grasswren. Avoidance of impacts along Pine Creek and Stirling Vale Creek would minimise the potential for roost trees of Corben's Long-eared Bat to be removed. Removal of farm dams would have limited impacts on habitat for the Australian Painted Snipe. The sites are outside the main distribution of the Dusky Hopping Mouse, Plains-wanderer and Thick-billed Grasswren, and impacts on potential habitat for these species would be limited.

Further surveys will be undertaken in late winter and spring as part of the BDAR to assess vegetation clearing and potential impacts on threatened species, and to calculate credits required to offset impacts of the project. Ecosystem credits would be calculated in the BDAR for impacts on native vegetation. Species credits would be calculated where necessary if species credit species are recorded or considered likely to occur.

9.5 Mitigation and offsets

Mitigation measures are proposed for the construction, operation and rehabilitation phases to avoid and minimise impacts on biodiversity values.

Biodiversity offsets would be calculated as part of the BDAR. This would include ecosystem credits associated with native vegetation and threatened species habitats to be removed, and species credits if required for impacts on species credit species or their habitat.

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Appendices

Appendix A - Assessment of the likelihood of occurrence of threatened and migratory biota

Thirty-one fauna and 14 flora species listed under the EPBC Act and/or the BC Act were identified from the desktop assessment of the Wildlife Atlas and PMST search (with a 10 km buffer of the locality) and from the field survey. Of these, 21 fauna and eight flora species are considered to have the potential to occur within the locality. One threatened flora species was recorded to the south of the site of the proposed Blue Bush Facility – the Purple-wood Wattle (*Acacia carneorum*) listed as a vulnerable under the EPBC Act and BC Act. Four threatened fauna species were recorded at the site of the proposed Blue Bush Facility. These included:

- White-fronted Chat (*Epthianura albifrons*) – Vulnerable under the BC Act.
- Inland-forest Bat (*Vespadelus baverstocki*) – Vulnerable under the BC Act.
- Little Pied Bat (*Chalinolobus picatus*) – Vulnerable under the BC Act.
- Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*) – Vulnerable under the BC Act.

One threatened species was previously recorded during surveys for another project at the proposed Blue Bush Inter-modal (Site A). This species was the Rufous Fieldwren (*Calamanthus campestris*) listed as a vulnerable species under the BC Act.

Not all of the threatened species identified during this assessment are equally likely to occur at the locality, due to the geographic location or context of the site, or the habitat type and condition. For each species, the likelihood of occurrence was evaluated using the following rationale:

PRESENT – Species known to occur within the locality, or detected during the field surveys.

POSSIBLE – Potentially suitable habitat occurs within the locality and species' known range encompasses the area. Species recorded historically in the 20 km search area, and generally within the last 20 years.

UNLIKELY – Species' known range encompasses the locality, but suitable habitat does not occur within these, or occurs within these but with generally low quality and quantity. Species recorded historically within 20 km of the sites but generally not within the last 20 years.

HIGHLY UNLIKELY – No historical records of the species and/or no suitable habitat within 20 km of the locality.

The following assessment of likelihood of occurrence and impact to threatened flora and fauna considers the potential to occur within the locality, based on the Wildlife Atlas and PMST searches, the habitat requirements of the species, and the habitat values observed within the locality.

Likelihood of occurrence of threatened flora at the study sites

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act* status	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Sites	Habitat description	Likelihood of occurrence
Acacia carneorum	Purple-wood Wattle	V	Species (all year)	V	10 records within 20km (OEH 2020a)	5 records within 20km, last recorded 1994 (OEH 2020a);Species or species' habitat known to occur within 20km (DoEE 2020a)	Occurs in the far western plains, south from west of Tibooburra to the Menindee area in NSW. Grows in grassland and woodland in red, sandy soil; also found in Mulga communities on sand dunes, level sandy sites and alluvial accumulations along watercourses; recorded from inland semi-arid Acacia and Casuarina shrublands and woodlands.	Present. Species recorded on sand dunes on the southern boundary of the Blue Bush Facility site, with approximately 100 plants present. Potential habitat present at the Blue Bush Inter-modal site A. Records known from the localities of the various study sites.
Acacia notabilis	Mallee Golden Wattle	E	Species (all year)		No local records	2 records within 20km (OEH 2020a)	Occurs west from Menindee in the far western plains of NSW. Early collections come from Byrnedale Station near Menindee and a locality south of Broken Hill. The species grows in mallee communities and open woodland on stony and rocky hills; soils types include brown lateritic loam, red clay-loam, shallow stony sands and red silty gravely sand. Associated species include Eucalyptus camaldulensis, E. gracilis, E. socialis, E. calycogona, E. leptophylla, Melaleuca uncinata, Acacia spp., Sclerolaena diacantha and Beyeria opaca.	Possible. Suitable habitat present in woodland at the study sites. Few records in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Acacia rivalis	Creek Wattle	E	Species (all year)		No local records	1 record within 20km, last recorded 1992 (OEH 2020a)	Acacia rivalis has been recorded from the Broken Hill district, but originally found in SA, where described as being endemic and confined to the northern part of the Flinders Ranges region. There is a possibility that the species did not occur naturally in New South Wales but has become naturalised in a restricted area near Broken Hill. In NSW, Acacia rivalis is confined to woodland communities bordering ephemeral creeks and streams and along watercourses. The species grows in a variety of stony soils, often with limestone content. Associated species include Callitris glaucophylla, Eucalyptus camaldulensis, Acacia victoriae, A. tetragonophylla, Hakea ednieana and Eremophila spp.	Possible. Suitable habitat present in riparian areas at the study sites. One record in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Atriplex infrequens	A saltbush	V	Species (Nov-Feb)	V	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Confined to the NSW far western plains. North western records recorded from east of Tibooburra, south east of Brewarrina and near Wilcannia with isolated collections from the Pooncarie area in the south. Atriplex infrequens is associated with broad drainage tracts, clay flats and	Possible. Suitable habitat present near drainage lines at the study sites. No local records.

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act* status	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Sites	Habitat description	Likelihood of occurrence
							possibly occasionally inundated habitats. Very little ecological information is available for this species so it's critical habitat components can only be speculated as relatively undisturbed and ungrazed drainage lines and flats.	
Austrostipa metatoris	A spear-grass	V	Species (Oct-Nov)	V	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Most records in the Murray Valley, scattered records also from central NSW, including Lake Cargelligo, east of Goolgowi, Condobolin and southwest of Nymadgee. Grows in sandy areas with red to red-brown clay-loam to sandy-loam soils. Associated species include Bimble Box, Gum Coolibah, White Cypress Pine, Belah, Sweet Quandong and Sticky Hop-bush.	Unlikely. Outside usual distribution. Habitat associations unlikely to be present.
Brachyscome papillosa	Mossgiel Daisy	V	Species (Sep-Nov)	V	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	The Mossgiel Daisy is endemic to NSW and chiefly occurs within the Riverina Bioregion, from Mossgiel in the north, Murrumbidgee Valley (Yanga) National Park in the south west to Urana in the south east. Sites are scattered across this Bioregion, including the Jerilderie area, the Hay Plain and around Darlington Point. The species has been recorded primarily in clay soils on Bladder Saltbush (Atriplex vesicaria) and Leafless Bluebush (Maireana aphylla) plains, but also in grassland and in Inland Grey Box (Eucalyptus microcarpa) - Cypress Pine (Callitris spp.) woodland.	Unlikely. Sites are outside the known and predicted distribution of this species.
Calotis moorei	A burr-daisy	E	Species (Sep-Nov)	E	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	The species is confined to NSW and is known from only four populations in NSW, the type locality north-west of Louth near the homestead of Mt Mulyan sheep station, west of Wilcannia, around the Menindee area and an old record at Zara Station near Deniliquin. The species grows in sandy soil and appears to be associated with Acacia woodlands and chenopod shrublands. At Mt Mulyah, it grows in an area cleared of original Acacia cambagei woodland and subsequently invaded by Dodonaea viscosa subsp. angustissima which repressed the growth of herbaceous species.	Possible. Suitable habitat present in Acacia shrublands and chenopod shrublands at the study sites. No local records.

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act* status	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Sites	Habitat description	Likelihood of occurrence
Frankenia plicata				E	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Occurs in South Australia, from north of Port Augusta along the Stuart Highway to the Northern Territory border and from Port Augusta north-east to Maree. Frankenia plicata grows in a range of habitats, including on small hillside channels, which take the first run-off after rain. In the Simpson Desert, the species has been found predominantly from swales of loamy sands to clay	Highly unlikely. Not known to occur in NSW
Indigofera longibractea	Showy Indigo	E	Species (all year)		No local records	1 record within 20km, last recorded 1993 (OEH 2020a)	The species is restricted to an area just north of Broken Hill known as the Waukeroo Hills. It is found on rocky hills and creek beds, growing in limited numbers in shallow stony soils among rock outcrops. Across its range it occupies a variety of rocky habitats, ranging from creeks to scree slopes and ridges. Soils are skeletal and sandy. Associated species and vegetation include Acacia tetragonophylla, Callitris, grass species dominated by Triodia and a diversity of low shrubs amongst granitic rocks.	Unlikely. Outside usual distribution. Habitat associations unlikely to be present.
Solanum karsense	Menindee Nightshade	V	Species (Oct-Nov)	V	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Menindee Nightshade is a species of Solanum endemic to NSW, restricted to the far south-western plains, extending up the Darling River to the Menindee and Wilcannia districts. Mainly restricted to the area between the Darling and Lachlan Rivers. Localities include Kars Station, Lake Tandou, Lake Cawndilla, Oxley area, between Broken Hill and Menindee, and the Darling River. Grows in occasionally flooded depressions with heavy soil, including level river floodplains of grey clay with Black Box and Old Man Saltbush, and open treeless plains with solonized brown soils.	Unlikely. Suitable habitat not present
Swainsona flavicarinata	Yellow-keeled Swainsona	E	Species (Jun-Oct, survey 4-7 weeks after above average rainfall)		No local records	No local records	Grows in deep red sand, recorded from a roadside on a treeless plain in NSW. In central Australia, the species grows in Mulga communities on red earths and on stony soils supporting Bladder Saltbush. Recorded in riparian areas in South Australia.	Possible. Suitable habitat present in chenopod and saltbush vegetation. No local records.

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act* status	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Sites	Habitat description	Likelihood of occurrence
Swainsona murrayana	Slender Darling Pea	V	Species (Sep)	V	No local records	No local records	Grows in a variety of vegetation types including bladder saltbush, black box and grassland communities on level plains, floodplains and depressions. Plants have been found in remnant native grasslands or grassy woodlands that have been intermittently grazed or cultivated	Possible. Suitable habitat present in chenopod shrubland and acacia shrubland at the study sites. No local records.
Swainsona pyrophila	Yellow Swainson-pea	V	Species (Sep-Nov)	V	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	In NSW, it occurs within the south-western plains. Grows in mallee scrub on sandy or loamy soil, usually found only after fire. Sites include cleared and burnt mallee scrub on red loam to sand, previously burnt Eucalyptus dumosa mallee, disturbed woodland in sheltered aspects, a bulldozed firebreak adjacent to wheat paddocks, roadsides, claypans and at the edge of fire ash.	Unlikely. Mallee habitat not present
Swainsona viridis	Creeping Darling Pea	E	Species (Sep - Oct, after average to wet seasonal conditions)		No local records	No local records	Grows in dry, sandy or stony areas on the banks or in the beds of creeks. Found in the Broken Hill area on sandy soils near watercourses. Also collected along a roadside sandplain in sandy-loam soil.	Possible. Suitable habitat present in riparian areas at the study sites. No local records.

*..V – Vulnerable E – Endangered

Likelihood of occurrence of threatened fauna at the study sites

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Rostratula australis	Australian Painted Snipe	E	Ecosystem	E	No local records	1 record within 20km (OEH 2020a)	Normally found in permanent or ephemeral shallow inland wetlands, either freshwater or brackish. Nests on the ground amongst tall reed-like vegetation near water. Feeds on mudflats and the water's edge taking insects, worm and seeds. Prefers fringes of swamps, dams and nearby marshy areas with cover of grasses, lignum, low scrub or open timber.	Possible. Some suitable habitat present at dams and low-lying depressions at the study sites following local heavy rain. One record in the locality of the inter-modal sites. None in the locality of the Blue Bush Facility site.
Falco subniger	Black Falcon	V	Ecosystem		No local records	1 record within 20km (OEH 2020a)	The Black Falcon is widely, but sparsely, distributed in New South Wales, mostly occurring in inland regions. Some reports of 'Black Falcons' on the tablelands and coast of New South Wales are likely to be referable to the Brown Falcon. Occurs in plains, grasslands, foothills, timbered watercourses, wetland environs, crops, and occasionally over towns and cities. Breeding occurs along timbered waterways in in land areas.	Possible. Suitable foraging habitat present across the study sites and potential breeding habitat in River Red Gums along Pine Creek and boundary of Blue Bush inter-modal Site A. One record in the locality of the inter-modal sites. None in the locality of the Blue Bush Facility site.
Hamirostra melanosternon	Black-breasted Buzzard	V	Dual (Sep-Nov)		No local records	2 records within 20km (OEH 2020a)	Sparsely distributed in areas of less than 500 mm rainfall, north from north-western NSW. Inhabits a range of inland habitats, especially along timbered watercourses which is the preferred breeding habitat. Also hunts over grasslands and sparsely timbered woodlands. Breeds from August to October near water in a tall tree.	Possible. Suitable foraging habitat present across the study sites and potential breeding habitat in River Red Gums along Pine Creek at the site of the Blue Bush Facility and boundary of Blue Bush Inter-modal site A. Few records in the locality of the inter-modal sites. None in the locality of the Blue Bush Facility site.
Manorina melanotis	Black-eared Miner	E	Species (Aug-Jan)	E	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	In NSW, this species is restricted to old growth mallee in the Scotia region, particularly within Scotia Sanctuary. It occurs in mature, unfragmented mallee on the more fertile soils and occupies vegetation with a post fire age of greater than 25 years, but is most abundant in areas with a post fire age of 50 years or more. They breed communally in groups of between eight and 40 birds and use a cup-shaped nest constructed from grasses and sticks within mallee eucalypts located in a fork or mistletoe clump.	Unlikely. Suitable habitat not present
Oxyura australis	Blue-billed Duck	V	Ecosystem		No local records	1 record within 20km, last recorded 1992 (OEH 2020a)	Partly migratory, travels short distances between breeding swamps and over-wintering lakes. Young birds disperse in April-May from breeding swamps in inland NSW to Murray River system and coastal lakes. Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation. Nests in Cumbungi over deep water or in trampled Lignum, sedges or spike-rushes. Completely aquatic, swimming along the edge of dense cover.	Unlikely. Suitable habitat not present

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Burhinus grallarius	Bush Stone-curlew	E	Species		No local records	1 record within 20km, last recorded 1995 (OEH 2020a)	Scattered distribution across NSW. Inhabits lowland grassy woodland and open forest and, in coastal areas, Casuarina and Melaleuca woodlands, saltmarsh and mangroves. Requires a low, sparse groundcover, some fallen timber and leaf litter, and a general lack of a shrubby understory (DEC 2006).	Unlikely. Suitable habitat not present
Calidris ferruginea	Curlew Sandpiper	E	Dual (mapped important areas)	CE	Species or species' habitat known to occur within 20km (DoEE 2020a) No local records	Species or species' habitat known to occur within 20km (DoEE 2020a) No local records	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Unlikely. No coastal wetland habitat present.
Pomatostomus halli	Hall's Babbler	V	Ecosystem		No local records	1 record within 20km (OEH 2020a)	Occurs in central-eastern Australia, from Cobar north into south-western Queensland, particularly along or west of the Warrego River. Inhabits dry Acacia scrub, mainly Mulga, with a grassy understorey including spinifex, on ridges and plains with either sandy or stony soils. Occasionally occurs in open dry Eucalyptus (Bimblebox) woodland, and mulga- or eucalypt-lined watercourses.	Unlikely. Suitable habitat not present
Hieraaetus morphnoides	Little Eagle	V	Dual (Aug-Oct)		No local records	4 records within 20km, last recorded 1995 (OEH 2020a)	Occurs throughout NSW except most densely forested parts of the Dividing Range escarpment. Occupies habitats rich in prey within open eucalypt forest, woodland or open woodland. Sheoak or acacia woodlands and riparian woodlands of interior NSW are also used. For nest sites it requires a tall living tree within a remnant patch, where pairs build a large stick nest in winter and lay in early spring.	Possible. Suitable foraging habitat present across the study sites and potential breeding habitat in River Red Gums along Pine Creek at the site of the Blue Bush Facility and the boundary of the Blue Bush Inter-modal site A. Few records in the locality of the inter-modal sites. None in the locality of the Blue Bush Facility site.
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	Dual (Sep-Dec)		1 record within 20km (OEH 2020a)	3 records within 20km (OEH 2020a)	Occupies habitat in arid semi-desert scrublands, savannahs and sparse woodlands, where there is fresh surface water and large hollow trees for nesting. These birds have been recorded in forest, woodland and shrub land, including mulga, mallee, Acacia, Eucalyptus and Callitris associations. It has also been recorded in cropping areas throughout its range. Large areas of suitable habitat are required for a viable population to exist.	Possible. Suitable foraging habitat present across the study sites and potential breeding habitat in River Red Gums along Pine Creek at the site of the Blue Bush Facility and boundary of the site of the Blue Bush Inter-modal Site A. Few records in the localities of the study sites

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Leipoa ocellata	Malleefowl	E	Ecosystem	V	Species or species' habitat likely to occur within 20km (DoEE 2020a) No local records	Species or species' habitat likely to occur within 20km (DoEE 2020a) No local records	Occurs in semi-arid to arid mallee country in the south-west of NSW. Its NSW stronghold is centred on Mallee Cliffs NP, extending east to Balranald and with scattered records north to Mungo NP. There are also populations in the Scotia mallee (W of the Darling River), central NSW, and Dubbo. Inhabits predominately mallee communities, apparently preferring areas of sandy soil, abundant leaf litter, dense canopy and an abundance of food shrubs and herbs (especially legumes). Less frequently found in other eucalypt woodlands such as Eucalyptus microcarpa, Ironbark and E. populnea woodlands with thick understorey, and Mulga and native Cypress Pine communities.	Unlikely. Suitable habitat not present
Certhionyx variegatus	Pied Honeyeater	V	Ecosystem		No local records	1 record within 20km (OEH 2020a)	Widespread throughout acacia, mallee and spinifex scrubs of arid and semi-arid Australia. Occasionally occurs further east, typically during periods of drought. Highly nomadic, following the erratic flowering of shrubs; can be locally common at times.	Possible. Wide-ranging species, may feed opportunistically in shrubs and Acacias of the study sites. One record in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Pedionomus torquatus	Plains-wanderer	E	Dual (mapped important areas)	CE	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	The vast majority (>99%) of records of Plains-wanderers in NSW over the past 30 years come from an area of the western Riverina bounded by Hay and Narrandera on the Murrumbidgee River in the north, the Cobb Highway in the west, the Billabong Creek in the south, and Urana in the east. Plains-wanderers live in semi-arid, lowland native grasslands that typically occur on hard red-brown soils. Most of the grassland habitat of the Plains-wanderer is <5 cm high, but some vegetation up to a maximum of 30 cm is important for concealment, as long as grass tussocks are spaced 10-20 cm apart.	Possible. Suitable low open habitat present across the study sites. No local records.
Pyrrholaemus brunneus	Redthroat	V	Ecosystem		4 records within 20km (OEH 2020a)	25 records within 20km (OEH 2020a)	In NSW, the species is confined to the far west of the state, with populations known from four main areas. There are records from around Broken Hill extending at least as far north as Mutawintji NP. The species has been recorded mainly in chenopod shrublands including Old Man Saltbush, Black Bluebush and Dillon Bush shrublands. Around Broken Hill it appears to be associated with the denser vegetation, particularly Acacias, found in drainage lines that run from the rocky hills.	Possible. Suitable habitat of chenopod shrublands present across the study sites. Preferred habitat of Acacia-lined drainage lines on stony/rocky slopes present at the Blue Bush Inter-modal Site A. Many records in the locality of the Blue Bush Inter-modal sites. Fewer records near the Blue Bush Facility site.

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Calamanthus campestris	Rufous Fieldwren	V	Ecosystem		4 records within 20km (OEH 2020a)	12 records within 20km (OEH 2020a)	Rufous Fieldwren are distributed through arid and in the west coastal southern Australia. In NSW most records are of the subspecies isabellinus and are centred in the Broken Hill/Mutawintji/Fowlers Gap area. The species inhabits low shrublands, particularly saltbush and bluebush communities, and also areas around inland saline lakes. Forages by working through the undergrowth and over the ground, feeding on insects and seeds.	Present. At Blue Bush Inter-modal Site A, detected by GHD in previous surveys in 2017. Possible. Suitable habitat of taller bluebush shrubland across the Blue Bush Facility study site. Many records in the locality of the Blue Bush Inter-modal sites. Fewer records near the Blue Bush Facility site.
Circus assimilis	Spotted Harrier	V	Ecosystem		4 records within 20km (OEH 2020a)	1 record within 20km (OEH 2020a)	The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. The species occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands.	Possible. Suitable foraging habitat present across the study sites and potential breeding habitat in River Red Gums along Pine Creek at the site of the Blue Bush Facility and boundary of Blue Bush Inter-modal Site A. Few records in the localities of the study sites.
Amytornis modestus	Thick-billed Grasswren (central NSW subspecies)	E	Species (Jul-Sep)	CE	Species or species' habitat likely to occur within 20km (DoEE 2020a) No local records	Species or species' habitat likely to occur within 20km (DoEE 2020a) No local records	Formerly occurred in central and western NSW, from the lower reaches of the Namoi River, south to Mossgiel. Generally thought to be extinct in NSW until recently located in the Packsaddle area. Sedentary, usually inhabiting dense, low saltbush, cottonbush, bluebush and nitre-bush areas on sandy plains or depressions in gibber; also occurs along watercourses in clumps of Canegrass.	Possible. Suitable low saltbush habitat present in some patches at both Blue Bush Facility and Blue Bush Inter-modal sites. No previous local records.
Epthianura albifrons	White-fronted Chat	V	Ecosystem		No local records	1 record within 20km, last recorded 1995 (OEH 2020a)	This species occurs from southern Queensland to Western Australia and down to Tasmania, mostly in temperate to arid climates and very rarely in sub-tropical areas. It is found in damp open habitats, particularly wetlands containing saltmarsh areas that are bordered by open grasslands. Inland, they are often observed in grassy plains, salt lakes and saltpans along waterway margins.	Present. Observed on Blue Bush Facility site during field survey. Potentially suitable open habitat across the site, with smaller areas of suitable damp open habitats around the two dams and parallel to Pine Creek at the site of the Blue Bush Facility. Potential habitat present at Blue Bush Intermodal Site A. One record in the locality of the Blue Bush Inter-modal sites.
Mammals								
Pseudomys bolami	Bolam's Mouse	E	Ecosystem		No local records	2 records within 20km (OEH 2020a)	This species is found in southern Western Australia and South Australia, extending east into the south-western corner of NSW. Records in NSW are centred on the Scotia Mallee including Tarawi Nature Reserve, Nanya Station, Scotia Sanctuary and surrounding properties. Recorded in a wide variety of habitats, with a preference for chenopod shrubland plains or low mallee woodland where	Unlikely. Suitable habitat not present

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
							there is a developed understorey of Acacia, Dodonaea or Eremophila species. It seems to especially favour plains areas, spillways and along valley bottoms where loam or clay soils occur.	
Notomys fuscus	Dusky Hopping-mouse	E	Ecosystem	V	No local records	1 record within 20km (OEH 2020a)	Formerly presumed extinct in NSW, the species was rediscovered in Sturt National Park in the State's far north west corner in 2003. Since then, the species has been recorded from around 50 km south of Sturt National Park, and from around 80 km north of Broken Hill. Most records are from sand dunes, hills and ridges associated with perennial Sandhill Canegrass (Zygochloa paradoxa), Dillon Bush (Nitraria billardierei) and Acacia species, characteristic of the Simpson Strzelecki Dunefields Bioregion. In contrast, the southern-most record in NSW was from the Broken Hill Complex Bioregion, and collected in Bluebush (Maireana pyramidata) chenopod shrubland near a drainage line with River Red Gums (Eucalyptus camaldulensis), Prickly Wattle (Acacia victoriae) and Western Boobiala (Myoporum montanum).	Possible. Limited suitable habitat present at the study sites. One record in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Sminthopsis macroura	Stripe-faced Dunnart	V	Ecosystem		No local records	1 record within 20km (OEH 2020a)	Widespread across northern and central Australia. In NSW rare on the Central and North West Slopes. Inhabits native dry grasslands and low dry shrublands, often along drainage lines. Shelter in soil cracks, grass tussocks or under rocks and logs. Prefers relatively ungrazed habitats with higher diversity and understorey cover.	Possible. Suitable habitat present at the study sites. One record in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Dasyurus maculatus maculatus	Spotted-tailed Quoll	V	Ecosystem	E	Species or species' habitat known to occur within 20km (DoEE 2020a) No local records	Species or species' habitat known to occur within 20km (DoEE 2020a) No local records	The Spotted-tailed Quoll is found in eastern NSW, eastern Victoria, south-east and north-eastern Queensland, and Tasmania. The species has been recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline. Individual animals use hollow-bearing trees, fallen logs, small caves, rock outcrops and rocky-cliff faces as den sites. Females occupy home ranges of 200-500 hectares, while males occupy very large home ranges from 500 to over 4000 hectares. Are known to traverse their home ranges along densely vegetated creeklines.	Unlikely. Suitable habitat not present

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Nyctophilus corbeni	Corben's Long-eared Bat	V	Ecosystem	V	Species or species' habitat likely to occur within 20km (DoEE 2020a) No local records	Species or species' habitat likely to occur within 20km (DoEE 2020a) No local records	Distribution covers theMurray-Darling Basin and western slopes in south-eastern Australia. Occurs in a wide range of habitats including River Red Gum, Black Box, Allocasuarina, Belah, Mallee, open woodlands and savannahs, but are most common in box, ironbark and cypress open forests and buloke woodlands of inland northern NSW. In SA known to roost in tree hollows less than 3m above the ground with multiple small entrances, elsewhere they roost in fissures in branches and under exfoliating bark. Tree hollows are used as maternity sites.	Possible. Possible calls recorded during Anabat surveys at Blue Bush Facility. Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah. Suitable habitat also present in River Red Gums along Stirling Vale Creek at Blue Bush Inter-modal Site A. No local records.
Vespadelus baverstocki	Inland Forest Bat	V	Ecosystem		No local records	No local records	The distribution of this species, particularly in NSW, is very poorly known due to its difficulty in identification. It is believed to occur generally in areas with annual rainfall less than 400 millimetres. The Inland Forest Bat roosts in tree hollows and abandoned buildings. It is known to roost in very small hollows in stunted trees only a few metres high. It has been recorded from a variety of woodland formations, including Mallee, Mulga and River Red Gum. Most records are from drier woodland habitats with riparian areas.	Present. Recorded at Pine Creek during surveys. Could roost in hollow-bearing trees in River Red Gums and Belah at site of Blue Bush Facility. Suitable habitat also present in River Red Gums along Stirling Vale Creek at Blue Bush Inter-modal Site A. No local records.
Chalinolobus picatus	Little Pied Bat	V	Ecosystem		No local records	2 records within 20km (OEH 2020a)	Found in caves, rock outcrops, mine shafts, tunnels, tree hollows and buildings in dry open forest and woodland, mulga woodlands, chenopod shrublands, cypress-pine forest, mallee, and Bimble box communities. They feed on moths and other flying invertebrates.	Present. Recorded by Anabat at Pine Creek. Could roost in hollow-bearing trees in River Red Gums and Belah at site of Blue Bush Facility. Suitable habitat also present in River Red Gums along Stirling Vale Creek at Blue Bush Inter-modal Site A. Few records in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	Ecosystem		2 records within 20km (OEH 2020a)	2 records within 20km (OEH 2020a)	The Yellow-bellied Sheathtail-bat is a wide-ranging species found across northern and eastern Australia. In the most southerly part of its range - most of Victoria, south-western NSW and adjacent South Australia - it is a rare visitor in late summer and autumn. Forages across a range of habitats including those with and without trees, from wet and dry sclerophyll forest, open woodland, Acacia shrubland, mallee, grasslands and desert. Roosts communally in large tree hollows and buildings.	Present. Recorded by Anabat at Pine Creek. Suitable habitat present. Could roost in hollow-bearing trees in River Red Gums and Belah at the site of the Blue Bush Facility. Suitable habitat also present in River Red Gums along Stirling Vale Creek at Blue Bush Inter-modal Site A. Few records in the locality of the study sites.
Reptiles								

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Ctenophorus mirrityana	Barrier Range Dragon	E	Species (Oct-Mar)		No local records	3 records within 20km (OEH 2020a)	Currently known from three highly restricted and fragmented sites near Mutawintji National Park and Broken Hill. The species is restricted to rock outcrops in ranges and gorges. It is absent from apparently suitable habitat in NSW.	Unlikely. Suitable habitat of rocky outcrops in ranges and gorges not present.
Pseudonaja modesta	Ringed Brown Snake	E	Ecosystem		No local records	2 records within 20km (OEH 2020a)	Determined on the basis of only limited records until recently, it is thought to occupy the north-west portion of the state having been recorded from Tarawi Nature Reserve, 140km south of Broken Hill, Silverton, Tibooburra, Wanaaring and from Kilberoo, 140km north-west of Bourke. Recent surveys have identified a large population in the Scotia Sanctuary-Tarawi NR region. A terrestrial species that inhabits drier areas including rocky outcrops and dry watercourses. Occurs in a variety of vegetation types including woodlands, shrublands, mallee and grasslands.	Possible. Suitable watercourse habitat present at the study sites. Few records in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Tiliqua occipitalis	Western Blue-tongued Lizard	V	Ecosystem		No local records	3 records within 20km (OEH 2020a)	This species is known from scattered records across central western and western NSW. There has been no observations from northwest NSW to date. The Western Blue-tongued Lizard inhabits plains, swales, ranges and sometimes dunes of loamy or clayey/sandy soils vegetated by woodlands, especially mallee, shrublands (including chenopods), heaths or hummock grasslands. Preferred vegetation type appears to be mixed mallee/Triodia communities. They diurnally forage for insects, native vegetation and carrion.	Possible. Suitable shrubland and grassland habitat present at the study sites. Few records in the locality of the Blue Bush Inter-modal sites. None in the locality of the Blue Bush Facility site.
Fish								
Galaxias rostratus	Flathead Galaxias	CE (FM Act)		CE	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Species or species' habitat may occur within 20km (DoEE 2020a) No local records	Known from the southern part of the Murray Darling Basin. They have been recorded in the Macquarie, Lachlan, Murrumbidgee and Murray Rivers in NSW. The species is now only known from the upper Murray River near Tintaldra and wetland areas near Howlong. Flathead Galaxias are found in still or slow moving water bodies such as wetlands and lowland streams. They have been associated with a range of habitats including rock and sandy bottoms and aquatic vegetation.	Highly Unlikely. No permanent water present.

Scientific Name	Common Name	BC Act status*	BAM Credit type	EBPC Act status*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Maccullochella peelii	Murray Cod	-			Species or species' habitat known to occur within 20km (DoEE 2020a) No local records	Species or species' habitat known to occur within 20km (DoEE 2020a) No local records	Occurs throughout the Murray-Darling Basin. Can live in a wide range of habitats, from clear, rocky streams in the upper western slopes regions of New South Wales to the slow flowing, turbid rivers and billabongs of the western plains. Generally, they are found in waters up to 5m deep and in sheltered areas with cover from rocks, timber or overhanging banks. The presence of wood debris has been shown to be the primary factor determining Murray cod presence.	Highly Unlikely. No permanent water present.

* V – Vulnerable E – Endangered CE – Critically Endangered M – Migratory

Likelihood of occurrence of migratory fauna at the study sites

Scientific Name	Common Name	EBPC Act*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Actitis hypoleucos	Common Sandpiper	C,J,K	Species or species' habitat known to occur within 20km (DoEE 2020a)	Species or species' habitat known to occur within 20km (DoEE 2020a)	Does not breed in Australia. When in Australia it is found on all coastlines and in inland areas, but is concentrated in the north and west with important areas in WA, the NT and Qld. Utilises a wide range of coastal and inland wetlands with varying salinity levels.	Possible. Low quality suitable habitat present at farm dams in the study sites.
Calidris ferruginea	Curlew Sandpiper	CE,C,J,K	Species or species' habitat known to occur within 20km (DoEE 2020a)	Species or species' habitat known to occur within 20km (DoEE 2020a)	Breeds in northern hemisphere. In Australia generally occupies littoral and estuarine habitats. In NSW mainly found in intertidal mudflats on sheltered coasts. Roosts on beaches, spits or islands on the coast/in wetlands, or in saltmarsh on rocky shores.	Unlikely. No coastal wetland habitat present
Apus pacificus	Fork-tailed Swift	C,J,K	Species or species' habitat likely to occur within 20km (DoEE 2020a)	Species or species' habitat likely to occur within 20km (DoEE 2020a)	Recorded in all regions of NSW. Non-breeding, and almost exclusively aerial while in Australia. Occurs over urban and rural areas as well as areas of native vegetation.	Possible. May forage on occasion over the study sites.
Motacilla cinerea	Grey Wagtail	C,J,K	Species or species' habitat may occur within 20km (DoEE 2020a)	Species or species' habitat may occur within 20km (DoEE 2020a)	A widespread species, the grey wagtail is found across much of northern Africa, Europe and Asia, ranging from western Europe to the Far East. Conspicuous inhabitant of freshwater systems.	Unlikely. Suitable habitat not present
Gallinago hardwickii	Latham's Snipe	C,J,K	Species or species' habitat may occur within 20km (DoEE 2020a)	Species or species' habitat may occur within 20km (DoEE 2020a)	Occurs along the coast and west of the great dividing range. Non breeding visitor to Australia. Inhabit permanent and ephemeral wetlands up to 2000 m asl. Typically in open, freshwater wetlands with low, dense vegetation (incl. swamps, flooded grasslands and heathlands). Can also occur in saline/brackish habitats and in modified or artificial habitats close to human activity.	Possible. Low quality suitable habitat present at farm dams at the study sites.
Calidris melanotos	Pectoral Sandpiper	J,K	Species or species' habitat may occur within 20km (DoEE 2020a)	Species or species' habitat may occur within 20km (DoEE 2020a)	Widespread but scattered records across NSW, east of the divide and in the Riverina and Lower Western regions. Breeds in the northern hemisphere. In Australasia, prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Usually in coastal or near-coastal habitats, and prefers wetlands with open mudflats and low emergent or fringing vegetation such as grass or samphire.	Possible. Low quality suitable habitat present at farm dams at the study sites.

Scientific Name	Common Name	EBPC Act*	Source: Blue Bush Facility Site	Source: Blue Bush Inter-modal Site	Habitat description	Likelihood of occurrence
Calidris acuminata	Sharp-tailed Sandpiper	C,J,K	Species or species' habitat likely to occur within 20km (DoEE 2020a)	Species or species' habitat likely to occur within 20km (DoEE 2020a)	Spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. In Australasia, prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. Breeds in northern Siberia.	Possible. Low quality suitable habitat present at farm dams at the study sites.
Motacilla flava	Yellow Wagtail	C,J,K	Species or species' habitat may occur within 20km (DoEE 2020a)	Species or species' habitat may occur within 20km (DoEE 2020a)	This species breeds in temperate Europe and Asia. They occur within Australia in open country habitat with disturbed ground and some water. Recorded in short grass and bare ground, swamp margins, sewage ponds, saltmarshes, playing fields, airfields, ploughed land and town lawns.	Unlikely. Suitable habitat not present

* Key: C – China-Australia Migratory Bird Agreement, J - Japan-Australia Migratory Bird Agreement, K – Republic of Korea-Australia Migratory Bird Agreement

Appendix B – Fauna species recorded during field surveys

Summary of species recorded during field surveys, 21, 25 & 26 May 2020.

Scientific name	Common name	BC Act Status	EPBC Act Status	Observation Type
Birds				
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	-	-	O
Acanthiza apicalis	Inland Thornbill	-	-	O
Acanthiza uropygialis	Chestnut-rumped Thornbill	-	-	O
Aphelocephala leucopsis	Southern Whiteface	-	-	O
Artamus cinereus	Black-faced Woodswallow	-	-	O
Barnardius zonarius	Australian Ringneck	-	-	O
Cacatua sanguinea	Little Corella	-	-	O
Chalcites basalis	Horsfield's Bronze-Cuckoo	-	-	O
Chenonetta jubata	Australian Wood Duck	-	-	O
Corvus coronoides	Australian Raven	-	-	O
Corvus mellori	Little Raven	-	-	O
Cracticus nigrogularis	Pied Butcherbird	-	-	O
Cracticus tibicen	Australian Magpie	-	-	O
Cracticus torquatus	Grey Butcherbird	-	-	O
Eolophus roseicapillus	Galah	-	-	O
Epthianura albifrons	White-fronted Chat	V	-	O
Epthianura tricolor	Crimson Chat	-	-	O
Falco cenchroides	Nankeen Kestrel	-	-	O
Gavicalis virescens	Singing Honeyeater	-	-	O
Grallina cyanoleuca	Magpie-lark	-	-	O
Hirundo neoxena	Welcome Swallow	-	-	O
Malurus assimilis	Purple-backed Fairy-wren	-	-	O
Malurus leucopterus	White-winged Fairy-wren	-	-	O
Manorina flavigula	Yellow-throated Miner	-	-	O
Microeca fascinans	Jacky Winter	-	-	O
Northiella haematogaster	Blue Bonnet	-	-	O
Ocyphaps lophotes	Crested Pigeon	-	-	O
Oreoica gutturalis	Crested Bellbird	-	-	O
Pardalotus striatus	Striated Pardalote	-	-	O
Petrochelidon nigricans	Tree Martin	-	-	O
Petroica goodenovii	Red-capped Robin	-	-	O
Pomatostomus ruficeps	Chestnut-crowned Babbler	-	-	O
Psephotus varius	Mulga Parrot	-	-	O
Psophodes cristatus	Chirruping Wedgebill	-	-	O
Rhipidura albiscapa	Grey Fantail	-	-	O
Rhipidura leucophrys	Willie Wagtail	-	-	O
Smicrornis brevirostris	Weebill	-	-	O
Struthidea cinerea	Apostlebird	-	-	C
Taeniopygia guttata	Zebra Finch	-	-	O
Mammals				
Felis catus	Cat*	-	-	C
Oryctolagus cuniculus	Rabbit*	-	-	O
Sus scrofa	Pig*	-	-	C

Scientific name	Common name	BC Act Status	EPBC Act Status	Observation Type
Vulpes vulpes	Fox*	-	-	C, O
Macropus fuliginosus	Western Grey Kangaroo	-	-	O
Macropus rufus	Red Kangaroo	-	-	O
Tachyglossus aculeatus	Short-beaked Echidna	-	-	O
Austronomus australis	White-striped Freetail Bat	-	-	A (D)
Chalinolobus gouldii	Gould's Wattled Bat	-	-	A (D)
Chalinolobus morio	Chocolate Wattled Bat	-	-	A (D)
Chalinolobus picatus	Little Pied Bat	V	-	A (Pr)
Nyctophilus sp.	A long-eared bat	-	-	A (D)
Saccolaimus flaviventris	Yellow-bellied Sheath-tail Bat	V	-	A (D)
Scotorepens balstoni	Inland Broad-nosed Bat	-	-	A (D)
Vespadelus baverstocki	Inland Forest Bat	V	-	A (D)
Vespadelus vulturnus	Little Forest Bat	-	-	A (D)

Key: V - Vulnerable under NSW BC Act 2006.* - Exotic species

A (D) – definite identification of an Anabat call, A (Pr) – probable identification of an Anabat call, C – camera, O - observed

Anabat analysis

- ***Analysis method***

Bat calls were recorded during field surveys using Anabat Express Zero Crossing detectors (Titley Scientific).

The full night zero crossing analysis file (zca file) recorded using the detector was converted to zc sequence files using Anabat Insight (version 1.9.3) for analysis and in order to add metadata (e.g. species label etc). During the conversion process a filter was applied to identify bat sequences and remove noise files. Noise files were moved to a separate folder for later checking.

The *Bat calls of NSW: Region based guide to the echolocation calls of microchiropteran bats* (Pennay et al. 2004) was used to assist call analysis. Call identification was also assisted by consulting distribution information for potential species (Pennay et al 2011; Churchill 2008; Van Dyck et al. 2013) and records from BioNet (May 2020). No reference calls were collected during the survey.

A call (pass) was defined as a sequence of three or more consecutive pulses of similar frequency and shape. Calls with less than three defined consecutive pulses of similar frequency and shape were not unambiguously identified to a species but were used as part of the activity count for the survey area. Due to variability in the quality of calls and the difficulty in distinguishing some species the identification of each call was assigned a confidence rating (see Mills *et al.* 1996 & Duffy *et al.* 2000 for similar process) as summarised in the table below. Due to the absence of reference calls from the study area, high level of variability within a bat call and overlap in call characteristics between some species, a conservative approach was taken when analysing calls.

Species nomenclature follows van Dyck et al. (2013) and Reardon et al (2104).

Confidence ratings applied to calls

Identification	Description
D - Definite	Species identification not in doubt.
PR - Probable	Call most likely to represent a particular species, but there exists a low probability of confusion with species of similar call type or call lacks sufficient detail.
SG - Species Group	Call made by one of two or more species. Call characteristics overlap making it too difficult to distinguish between species for e.g. *Chalinolobus gouldii /Mormopterus ozimops* sp. *Nyctophilus* sp. The calls of *Nyctophilus geoffroyi / gouldi* cannot be distinguished during the analysis process and are therefore lumped together.

Summary of results and survey effort

Anabat detector surveys were completed within the Blue Bush Facility site at six locations for a total of 4 nights during May 2020. Approximately 9607 zc files were recorded and analysed of which approximately 18% (n=1727) were identified as bat calls of some description. Seven species were positively (Definite) identified of the 15 or so species that are known to occur from the locality of the study site (BioNet 2020, Pennay et al, 2011; Van Dyck et al. 2013). As many as four other species may also have been recorded, but poor data quality and/or interspecific call similarities precluded reliable identification of additional species.

Site	Anabat 6	Anabat 6	Anabat 5	Anabat 5	Anabat 5	Anabat 5	Anabat 5	Anabat 4	Anabat 4	Anabat 4	Anabat 4	Anabat 1	Anabat 2	Anabat 2	Anabat 2	Anabat 2	Anabat 2
Anabat Unit/Species/Species Groups	**Anabat1 SN445932 2020-05-22**	**Anabat1 SN445932 2020-05-23**	**Anabat 2 SN507209 2020-05-21**	**Anabat 2 SN507209 2020-05-22**	**Anabat 2 SN507209 2020-05-23**	**Anabat 2 SN507209 2020-05-24**	**Anabat 2 SN507209 2020-05-25**	**Anabat 3 SN507300 2020-05-21**	**Anabat 3 SN507300 2020-05-22**	**Anabat 3 SN507300 2020-05-23**	**Anabat 3 SN507300 2020-05-24**	**Anabat 3 SN507300 2020-05-25**	**Anabat 4 SN528768 2020-05-21**	**Anabat 4 SN528768 2020-05-22**	**Anabat 4 SN528768 2020-05-23**	**Anabat 4 SN528768 2020-05-24**	**Anabat 4 SN528768 2020-05-25**
	22/05/2020	**23/05/2020**	**21/05/2020**	**22/05/2020**	**23/05/2020**	**24/05/2020**	**25/05/2020**	**21/05/2020**	**22/05/2020**	**23/05/2020**	**24/05/2020**	**25/05/2020**	**21/05/2020**	**22/05/2020**	**23/05/2020**	**24/05/2020**	**25/05/2020**
Austronomus australis **D**	-	-	D	D	D	D	D	D	D		D	D	D	D	D	D	D
Austronomus australis/ Saccolaimus flaviventris	-	-	-	SG	-	SG	-	-	-	-	-	-	SG	SG	SG	SG	SG
Chalinolobus gouldii/ Mormopterus ozimops petersi/ planiceps	-	-	SG	SG	SG	SG	SG	SG	-	-	-	SG	SG	SG	SG	SG	SG
Chalinolobus gouldii/ Scotorepens balstoni	-	-	-	SG	SG	-	-	-	SG	SG			SG	SG	SG	-	SG
Chalinolobus picatus (v) **P**	-	-	-	-	-	PR (2 CALLS)	-	-	-	-	-	-	-	-	-	-	-
Chalinolobus gouldii **D**	-	-	D	-	D	D	D	D	D	D	-	D	D	D	D	D	D
Chalinolobus morio **D**	-	-	D	D	-	-	-	-	-	-	-	-	-	PR	D	-	-
Mormopterus ozimops planiceps/ petersi	-	-	SG	-	-	-	-	-	-	-	-	SG	-	-	-	-	-
Nyctophilus geoffroyi/ gouldi/ corbeni **D**	-	-	D	D	-	D	-	-	D	-	-	D	D	D	-	D	-
Saccolaimus flaviventris (v) **D**	-	-	-	-	-	PR (1 CALL)	-	-	-	-	-	-	-	D (2 CALLS)	-	D (1 CALL)	-
Scotorepens balstoni **D**	-	-	-	-	-	-	-	-	D	-	-	-	-	PR	-	-	D
Scotorepens balstoni/ greyii	-	-	SG	-	-	-	-	-		-	-	-	-	-	-	-	SG
Scotorepens greyii/ Chalinolobus picatus	-	-	-	-	-	-	-	-	SG	-	-	-	-	-	-	-	-
Vespadelus baverstocki (v) **D**	-	-	-	-	-	D	-	-	-	-	-	D (5 CALLS)	-	-	-	-	D (1 CALL)
Vespadelus baverstocki/ vulturnus	-	-	SG	SG	-	-	SG	-	SG	-	SG	SG	-	-	-	SG	-
Vespadelus vulturnus **D**	-	-	D	D	D	-	-	-	-	-	-	D	-	-	-	-	D
Vespadelus vulturnus / Chalinolobus morio	-	-	SG	SG	SG	SG	SG	-	-	-	-	-	-	SG	SG	-	SG
Other bats	SG	SG	SG	SG	SG	SG	SG	SG	SG			SG	SG	SG	SG	SG	SG
Number of species	0	0	**5**	4	3	4	2	2	4	1	1	5	3	4	3	3	5
Bat call(s)	1	2	119	187	38	236	28	20	45	28	3	55	314	270	53	186	140

Table Notes: Total number of species recorded for each night/site is based on definite (D) identification only. Total number of D species for each night includes one *Nyctophilus* species where recorded.

See Table above for confidence rating e.g. D or Pr. ce, e, v - species listed under the *NSW Biodiversity Conservation Act 2016*. CE, E, VU – species listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Appendix C – EPBC Act Assessments of significance

Assessments of significance have been provided for the following threatened species listed under the EPBC Act that have the potential to occur at the Blue Bush Facility site:

- *Acacia carneorum* (Purple-wood Wattle)
- *Atriplex infrequens*
- *Swainsona murrayana* (Slender Darling Pea)
- *Calotis moorei*
- *Nyctophilus corbeni* (Corben's Long-eared Bat)
- *Notomys fuscus* (Dusky Hopping Mouse)
- *Rostratula australis* (Australian Painted Snipe)
- *Pedionomus torquatus* (Plains-wanderer)
- *Amytornis modestus* (Thick-billed Grasswren).

Acacia carneorum

Criteria	Purple-wood Wattle *Acacia carneorum* (vulnerable species)
According to the DotE (2013) 'significant impact criteria' an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	A population is defined as an occurrence of a species in a particular geographical area. There are no guidelines as to the size of a population or the area the population is contained in, but usually it would cover a relatively uniform area of habitat or terrain (i.e. vegetation and geology) and have distinctive geographical boundaries. On this basis, the occurrence recorded in the Blue Bush Facility site are considered to be one population. An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. The population recorded south of the Blue Bush Facility is regarded as being an 'important population' as it includes a relatively large population and would contribute to genetic diversity within the species. Various other populations are known in the region, including elsewhere along the Silver City Highway. Purple-wood Wattle has not previously been recorded at Inter-modal Site A. Further surveys would be conducted at Inter-modal Site A to determine if any populations occur at this site.
Lead to a long-term decrease in the size of an important population	The project would not directly impact any known populations of the Purple-wood Wattle. The development envelope at the Blue Bush Facility site would be located away from riparian habitat, and the stand of Purple-wood Wattle south of the site purposefully avoided. Potential habitat is present at Inter-modal Site A. A small portion of the site would be cleared, and similar habitat is present throughout the area. Suitable habitat at this site is located in the western portion of the site, which is unlikely to be impacted. As such, the project would not lead to a long-term decrease in the size of an important population of this species.
Reduce the area of occupancy of an important population	There would be no direct impacts on the stand of Purple-wood Wattle, and impacts on similar habitats along Pine Creek at the Blue Bush Facility and the main creekline at Inter-modal Site A would also be avoided. As such, the project would not reduce the area of occupancy of an important population.

Criteria	Purple-wood Wattle *Acacia carneorum* (vulnerable species)
Fragment an existing important population into two or more populations	There would be no direct impacts on the stand of Purple-wood Wattle, and impacts on similar habitats along Pine Creek at the Blue Bush Facility and the main creekline at Inter-modal Site A would also be avoided. As such, the project would not fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. There would be no direct impacts on the stand of Purple-wood Wattle, and impacts on similar habitats along Pine Creek at the Blue Bush Facility and the main creekline at Inter-modal Site A would also be avoided. As such, no adverse effects on habitat critical to the survival of the species are expected.
Disrupt the breeding cycle of an important population	The Purple-wood Wattle tends to occur in colonies of 20 to 60 plants, which are clonal; seed viability is generally low and the majority of seeds are non-dormant. New suckers are produced either annually or biannually in two growth pulses in autumn and spring, independent of root disturbance (DPIE 2020b). The development envelope at the Blue Bush Facility would be located away from riparian habitat, and the stand of Purple-wood Wattle purposefully avoided. A small portion of the Inter-modal Site A would be cleared, and similar habitat is present throughout the area. Suitable habitat at this site is located in the western portion of the site, which is unlikely to be impacted. As such, the project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project would not directly impact any known populations of the Purple-wood Wattle. The development envelope at the Blue Bush Facility site would be located away from riparian habitat, and the stand of Purple-wood Wattle purposefully avoided. Suitable habitat at Inter-modal Site A is located in the western portion of the site, which is unlikely to be impacted. The project is unlikely to cause the species to decline.

Criteria	Purple-wood Wattle *Acacia carneorum* (vulnerable species)
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduced plant species, including African Boxthorn and Devils Apple, were recorded at the Blue Bush Facility site. Purple-wood Wattle occurred on sandy red soils adjacent to ephemeral watercourses dominated by either Prickly Wattle or River Red Gum. These nutrient poor sandy soils support a very low level of groundcover species diversity and cover. Construction is unlikely to further encourage weed growth, including the spread of invasive species, in areas of potential habitat. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management will be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline	No diseases are known to impact this species. The project is unlikely to introduce any disease to the area that may cause the species to decline.
Interfere substantially with the recovery of the species	To date, a recovery plan for the species has not been developed. A targeted strategy for managing this species has been developed by OEH under the Saving Our Species program, however this strategy only relates to specific management sites. Other activities recommended by OEH to assist this species and relevant to this project include: • Exclude mining and destructive mineral exploration from any areas containing this species – the development envelope at the Blue Bush Facility site would be located away from riparian habitat, and the stand of Purple-wood Wattle purposefully avoided. • Baseline surveys are required to confirm known populations and to locate new ones –targeted surveys for this species have been undertaken as part of this assessment and additional surveys will be conducted for the BDAR. The project is unlikely to substantially interfere with the recovery of the species given the protection of the known population at the site. Suitable habitat at Inter-modal Site A is located in the western portion of the site, which is unlikely to be impacted.
Conclusion	

Criteria	Purple-wood Wattle *Acacia carneorum* (vulnerable species)
	It is concluded that the proposed action is unlikely to result in a significant impact on the Purple-wood Wattle for the following reasons: • The stand of Purple-wood Wattle at the Blue Bush Facility site would be purposefully avoided and protected from potential indirect impacts associated with construction and operation • The development envelope at the Blue Bush Facility would be located away from other potential habitat associated with riparian areas. • Suitable habitat at Inter-modal Site A is located in the western portion of the site, which is unlikely to be impacted. • There would be no fragmentation of known habitat.

Atriplex infrequens (vulnerable species)

Criteria	*Atriplex infrequens* (vulnerable species)
According to the DotE (2013) 'significant impact criteria' an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	A population is defined as an occurrence of a species in a particular geographical area. There are no guidelines as to the size of a population or the area the population is contained in, but usually it would cover a relatively uniform area of habitat or terrain (i.e. vegetation and geology) and have distinctive geographical boundaries. An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. Surveys to date have not been conducted in the appropriate season. Targeted surveys are proposed in late spring to determine if any populations are present and would be impacted. If a population of either of these species is recorded in the study area it would be regarded as being an 'important population' as there are no local records and any population would contribute to genetic diversity within the species.
Lead to a long-term decrease in the size of an important population	The project would not directly impact any known populations of these species. The development envelope at the Blue Bush Facility site and Inter-modal Site A would be located away from the large creek lines which would avoid preferred habitat for this species. Given the lack of evidence of these species near the Blue Bush Facility and Inter-modal Site A, and limited impact on riparian habitat, the project is unlikely to lead to a long-term decrease in the size of an important population of this species.
Reduce the area of occupancy of an important population	No local populations of this species are known. Impacts on potential habitats along Pine Creek and Stirling Vale Creek at Inter-modal Site A would be avoided. Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. Given the avoidance of impacts on potential habitat, the project would not reduce the area of occupancy of an important population.

Criteria	*Atriplex infrequens* (vulnerable species)
Fragment an existing important population into two or more populations	No local populations of these species are known. Impacts on potential habitats along Pine Creek and Stirling Vale Creek at Inter-modal Site A would be avoided. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. Given the avoidance of impacts on potential habitat associated with riparian areas, the project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. No local populations of this species are known. Impacts on potential habitats associated with the main drainage lines would be avoided, and impacts elsewhere would comprise a small proportion of habitat available in the locality. As such, no adverse effects on habitat critical to the survival of the species are expected.
Disrupt the breeding cycle of an important population	The development envelope at the Blue Bush Facility and Inter-modal Site A would be located away from riparian habitat which would limit potential impacts on habitat for *Atriplex infrequens*. This species is wind pollinated, and construction elsewhere on the sites is unlikely to affect the breeding cycle of the species. Given the lack of local records and limited potential for impacts, the project is unlikely to disrupt the breeding cycle of an important population of this species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project would not directly impact any known populations of this species. Impacts on potential habitats along main riparian areas would be avoided. Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. Given the lack of local records and limited potential for impacts, the project is unlikely to cause this species to decline.

Criteria	*Atriplex infrequens* (vulnerable species)
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduced plant species, including African Boxthorn and Devils Apple, were recorded at the Blue Bush Facility site. Construction is unlikely to further encourage weed growth, including the spread of invasive species, in areas of potential habitat. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management will be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline	No diseases are known to impact these species. The project is unlikely to introduce any disease to the area that may cause these species to decline.
Interfere substantially with the recovery of the species	To date, a recovery plan for these species has not been developed. Priority actions for this species include: • Manage any changes to drainage-line hydrology that adversely affect this species. The development envelope at the Blue Bush Facility and Inter-modal Site A would be located away from riparian habitat which would limit potential impacts on habitat for *Atriplex infrequens*. The project is unlikely to substantially interfere with the recovery of the species given the avoidance of impacts on the main drainage lines.
Conclusion	
	It is concluded that the proposed action is unlikely to result in a significant impact on *Atriplex infrequens* for the following reasons: • No local populations of this species are known • The development envelope at the Blue Bush Facility and Inter-modal Site A would be located away from potential habitat associated with riparian areas. • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. • Construction would be unlikely to impact pollination of a population if present. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to assess potential impacts if present.

Swainsona murrayana

Criteria	*Swainsona murrayana* (vulnerable species)
According to the DotE (2013) 'significant impact criteria' an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	A population is defined as an occurrence of a species in a particular geographical area. There are no guidelines as to the size of a population or the area the population is contained in, but usually it would cover a relatively uniform area of habitat or terrain (i.e. vegetation and geology) and have distinctive geographical boundaries. An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. Surveys to date have not been conducted in the appropriate season. Targeted surveys are proposed in spring to determine if any populations are present and would be impacted. If a population of this species is recorded in the study area it would be regarded as being an 'important population' as there are no local records and any population would contribute to genetic diversity within the species.
Lead to a long-term decrease in the size of an important population	The project would not directly impact any known populations of this species. Most records are from the Murray-Darling Basin, and located well away from the sites. The project would impact areas of heavily grazed bluebush vegetation at the Blue Bush Facility. Similar bluebush shrubland habitat occurs throughout the wider area. Potential habitat comprising bluebush shrubland and grassland habitat is present at Inter-modal Site A. Construction at this site would comprise a small portion of the site. Given the lack of evidence of this species in the locality, high levels of existing disturbance of potential habitat at the Blue Bush Facility and limited areas of impacts at Inter-modal Site A, and large areas of similar habitat in the locality, the project is unlikely to lead to a long-term decrease in the size of an important population of this species.
Reduce the area of occupancy of an important population	No local populations of this species are known. Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. As such, the project would not reduce the area of occupancy of an important population.

Criteria	*Swainsona murrayana* (vulnerable species)
Fragment an existing important population into two or more populations	Clearing of bluebush vegetation and grassland habitats has the potential to fragment a population if present. No local populations of this species are known, with known records mainly associated with the Murray-Darling Basin. Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of habitat, given the lack of any nearby records, the fragmentation of an important population is considered unlikely.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. No local populations of this species are known, with most populations associated with the Murray-Darling Basin, and located well away from the sites. Impacts on bluebush and grassland habitats would comprise a small proportion of habitat available in the locality. As such, no adverse effects on habitat critical to the survival of the species are expected.
Disrupt the breeding cycle of an important population	*Swainsona* species are largely perennials, resprouting in suitable conditions from a persistent rootstock. Copious flowers and abundant quantities of seed can be produced under favourable conditions. The species is generally is generally described as locally common to abundant in New South Wales (DAWE 2020b). If present, construction could impact breeding at the sites, however based on the information above, a population is likely to be widespread in a local area. Bluebush shrubland and grassland habitats are present throughout the locality, and impacts at the sites would comprise a small proportion of this habitat type. There are no local records, and the species is mainly confined to the Murray-Darling Basin. While potential habitat is present, the species is not considered likely to occur at the sites. A such, the breeding cycle of an important population is unlikely.

Criteria	*Swainsona murrayana* (vulnerable species)
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project would not directly impact any known populations of these species. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of habitat, given the lack of any nearby records, the fragmentation of an important population is considered unlikely. The project is therefore unlikely to cause this species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Introduced plant species, including African Boxthorn and Devils Apple, were recorded at the Blue Bush Facility site. Construction is unlikely to further encourage weed growth, including the spread of invasive species, in areas of potential habitat. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management will be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline	No diseases are known to impact this species. The project is unlikely to introduce any disease to the area that may cause these species to decline.
Interfere substantially with the recovery of the species	To date, a recovery plan for these species has not been developed. Management actions that will support recovery include: • Ensure that surveys are undertaken during the flowering season. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to assess potential impacts if present. The project is unlikely to substantially interfere with the recovery of the species given that there are no local records, and large areas of similar quality habitat are present throughout the locality.
Conclusion	

Criteria	*Swainsona murrayana* (vulnerable species)
	It is concluded that the proposed action is unlikely to result in a significant impact on *Swainsona murrayana* for the following reasons: • No local populations of this species are known, with the main area of occurrence associated with the Murray-Darling Basin • Potential habitat at the Blue Bush Facility if heavily grazed • Clearing at Inter-modal Site A would comprise a small portion of this site • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to assess potential impacts if present.

Calotis moorei

Criteria	*Calotis moorei* (endangered species)
According to the DotE (2013) 'significant impact criteria' an action is likely to have a significant impact on an endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The project would not directly impact any known population of this species. Similar chenopod shrubland occurs throughout the wider area. Given the lack of evidence of this species in the locality, and limited impact on chenopod shrubland habitat, the project is unlikely to lead to a long-term decrease in the size of a population of this species.
Reduce the area of occupancy of a population	No local populations of this species are known. *Calotis moorei* is currently known from two distinct geographic areas, with a population at "Mount Mulyah" north-west of Louth, and three populations near Menindee, both located well away from the study sites. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. Given the lack of local records and extent of similar habitats in the locality, the project is unlikely to reduce the area of occupancy of a population.
Fragment an existing population into two or more populations	No local populations of this species are known. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of habitat, given the lack of any nearby records, the fragmentation of a population is considered unlikely.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. There would be no impact on known populations of the species. Chenopod shrubland habitat at the site would comprise a small proportion of habitat available in the locality. No adverse effects on habitat critical to the survival of the species are expected.

Criteria	*Calotis moorei* (endangered species)
Disrupt the breeding cycle of a population	*Calotis moorei* is a perennial herb which flowers in the first year of growth. Chenopod shrubland is present throughout the locality, and impacts at the site would comprise a small proportion of this habitat type. If present, construction could impact breeding at the sites, however based on the information above, a population is unlikely to occur given there are no local records. As such, the project is unlikely to disrupt the breeding cycle of an important population of this species.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The project would not directly impact any known populations of this species. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of habitat, given the lack of any nearby records, the fragmentation of a population is considered unlikely. The project is therefore unlikely to cause this species to decline.
Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat	Introduced plant species, including African Boxthorn and Devils Apple, were recorded at the Blue Bush Facility site. Construction is unlikely to further encourage weed growth, including the spread of invasive species, in areas of potential habitat. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management will be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline	No diseases are known to impact this species. The project is unlikely to introduce any disease to the area that may cause these species to decline.
Interfere substantially with the recovery of the species	A recovery plan has been prepared for this species. Recovery actions include undertaking further survey and to monitor existing populations. The project is unlikely to substantially interfere with the recovery of the species given that there are no known populations in the locality, and similar quality habitats occur throughout the locality.
Conclusion	
	The proposed action is unlikely to result in a significant impact on *Calotis moorei* for the following reasons: • There would be no impacts on known populations • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality.

Criteria	*Calotis moorei* (endangered species)
	Further targeted surveys are proposed to confirm if the species is absent from the sites, or to assess potential impacts if present.

Corben's Long-eared Bat

Criteria	Corben's Long-eared Bat (Vulnerable)
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	An 'important population' is a population that is necessary for a species' long-term survival and recovery, and includes populations that are near the limit of the species' range (DotE 2013). Corben's Long-eared Bat has a scattered distribution mostly within the Murray-Darling Basin. Individuals may occur in the study sites, which are located near the western edge of the species range'. Records of a *Nyctophilus* species were recorded on Anabats at the Blue Bush Facility. Given the location of the sites on the edge of the species range, any individuals that may occur in the study sites are taken to be part of an important population.
Lead to a long-term decrease in the size of an important population of a species	Construction would require the permanent removal of native vegetation from within the Blue Bush Facility site and the Inter-modal Site A. This is likely to include clearing of hollow-bearing trees that may provide roosting and breeding habitat for this species as well as foraging habitat. Where possible, impacts on riparian habitat containing high densities of hollow-bearing trees would be avoided. Alternate roosting and breeding habitat would be present within the riparian corridor of Pine Creek and other areas in the locality. Foraging habitat that would be impacted would comprise a small proportion of the home range of individuals, and a negligible proportion of foraging habitat in the locality. Given the limited impact on potential breeding and foraging habitat, the project is unlikely to lead to a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy of an important population	Corben's Long-eared Bat is known from a large area of central NSW, within the Murray-Darling Basin. The loss of a relatively small area of potential habitat would not reduce the area of occupancy of the important population.
Fragment an existing important population into two or more populations	Corben's Long-eared Bat is a slow flying agile bat, utilising the understorey to hunt non-flying prey. This species would forage along riparian corridors in the locality. Where possible, impacts on riparian habitat would be avoided. Given the mobility of the species and large area of available habitat, the project is unlikely to fragment an existing important population into two or more populations.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of Corben's Long-eared Bat comprises hollow-bearing trees, which are a limiting resource. Impacts on riparian habitat containing high densities of hollow-bearing trees would be avoided. Alternate roosting and breeding habitat would be present within the riparian corridor of Pine Creek outside the study sites and within other areas in the locality. There may be a loss of a limited number of hollow-

Criteria	Corben's Long-eared Bat (Vulnerable)
	bearing trees associated with woodland habitat elsewhere in the Blue Bush Facility. This loss is unlikely to adversely affect habitat critical to the survival of the species, given the retention of high density areas of hollow-bearing trees.
Disrupt the breeding cycle of an important population	Corben's Long-eared Bat mates in autumn, and young are born in late spring to early summer. Hollow-bearing trees are required for breeding. Where possible, impacts on riparian habitat containing high densities of hollow-bearing trees would be avoided. Noise from construction and operation may impact breeding success in areas immediately adjacent to the project site. Alternate roosting and breeding habitat would be present within the riparian corridor of Pine Creek and other areas in the locality. Given the small number of hollow-bearing trees likely to be affected, and localised noise from construction and operation, the project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Construction would require the permanent removal of potential foraging habitat and the loss of some hollow-bearing trees. Where possible, impacts on riparian habitat containing high densities of hollow-bearing trees would be avoided. Alternate roosting and breeding habitat would be present within the riparian corridor of Pine Creek and other areas in the locality. Foraging habitat that would be impacted would comprise a small proportion of the home range of individuals, and a negligible proportion of foraging habitat in the locality. Given the limited impact on potential breeding and foraging habitat, the project is unlikely to lead to a decline of the species.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The project is unlikely to result in invasive species that are harmful to this species becoming established in the area. Cats and foxes are already present at the Blue Bush Facility, and are likely to be present at the Inter-modal Site A.
Introduce disease that may cause the species to decline	The project is unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	The key threats to the viability of this species are loss, fragmentation and degradation of habitat. Construction would require the permanent removal of a relatively small area of potential foraging habitat compared to extensive tracts of similar surrounding habitat, and the loss of some hollow-bearing trees from near the edge of the species' range. The loss of this habitat is unlikely to substantially interfere with the recovery of the species.
Conclusion	The project is unlikely to have a significant impact on Corben's Long-eared Bat as:

Criteria	Corben's Long-eared Bat (Vulnerable)
	• Impacts on riparian habitat containing high densities of hollow-bearing trees would be avoided • The project would remove a relatively small area of potential foraging habitat compared to extensive tracts of similar surrounding habitat • The project would not fragment or isolate habitat for this species.

Dusky Hopping Mouse

Criteria	Dusky Hopping Mouse (Vulnerable)
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	An 'important population' is a population that is necessary for a species' long-term survival and recovery, and includes populations that are near the limit of the species' range (DotE 2013). Formerly presumed extinct in NSW, the species was rediscovered in Sturt National Park in the State's far north west corner in 2003. Since then, the species has been recorded from around 50 km south of Sturt National Park, from around 80 km north of Broken Hill and recently a single individual was found killed by a cat in the Broken Hill urban area (DPIE 2020b). The project sites are at or beyond the known limit of distribution of the species. If present, a population would be an important population.
Lead to a long-term decrease in the size of an important population of a species	The project is located at or beyond the known limit of distribution of the species. No preferred habitat (sand dunes) is present within the Blue Bush Facility, however is present to the south of the site. Sand dune habitat is located in the west of Inter-modal Site A, an area that is unlikely to be cleared given the presence of Stirling Vale Creek in this area. The species could potentially occur in chenopod shrublands at the sites during eruptive periods if present in better quality habitat elsewhere. The loss of this atypical habitat is not likely to lead to a long-term decrease in the size of an important population of a species given the lack of preferred habitat and location of the sites well away from most known records in the Strzelecki Ranges bioregion.
Reduce the area of occupancy of an important population	Limited preferred habitat (sand dunes) is present at Inter-modal Site A, and none is present within the Blue Bush Facility. A population of the species is unlikely to reside in the areas to be impacted, but could occur on occasion during eruptive periods in response to good conditions if a local population is present. The loss of potential marginal habitat at the site would not reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Limited preferred habitat (sand dunes) is present at Inter-modal Site A, and none is present within the Blue Bush Facility. Large areas of chenopod shrubland are present throughout the locality which would provide habitat for dispersal. Construction and operation of the project is unlikely to fragment an existing important population into two or more populations.

Criteria	Dusky Hopping Mouse (Vulnerable)
Adversely affect habitat critical to the survival of a species	The Dusky Hopping-mouse inhabits arid areas of Australia with sand dunes or sand plains with hummocks and water nearby. The species is predominantly restricted to the dune crests. After seasons of good rainfall the species may occur in atypical habitat such as chenopod shrubland on gibber plains, acacia shrubland and sandy creek lines. Sand dune habitat is located in the west of Inter-modal Site A, an area that is unlikely to be cleared given the presence of Stirling Vale Creek in this area. No direct impacts on sand dune habitat near the Blue Bush Facility would occur. The project would result in the loss of potential marginal habitat at the sites. This habitat type occurs extensively in the locality. Given the lack of impacts on sand dune habitat the project is unlikely to adversely affect habitat critical to the survival of a species.
Disrupt the breeding cycle of an important population	The Dusky Hopping-mouse breeds throughout the year, including during summer months and in wet and dry conditions. After seasons of good rainfall the species numbers increase substantially, however substantial density reductions and local extinction can occur during dry periods (DAWE 2020b). Habitat in the site may be utilised in seasons with good rainfall, if a population is present. Sand dune habitat is located in the west of Inter-modal Site A, an area that is unlikely to be cleared given the presence of Stirling Vale Creek in this area. No direct impacts on sand dune habitat near the Blue Bush Facility would occur. The project would remove areas of atypical chenopod habitat. Large areas of chenopod shrubland are present throughout the locality would provide habitat for dispersal if a population is present. As such, the project is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No preferred habitat (sand dunes) is likely to be impacted. The species could potentially occur in chenopod shrublands at the site during eruptive periods. Construction and operation of the project is unlikely to substantially reduce or fragment habitat for the species, particularly given the location of the site well away from most known records in the Strzelecki Ranges bioregion.

Criteria	Dusky Hopping Mouse (Vulnerable)
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The project is unlikely to result in invasive species that are harmful to this species becoming established in the area. Foxes, cats and pigs are already present at the Blue Bush Facility, and likely present at Inter-modal Site A.
Introduce disease that may cause the species to decline	The project is unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	A targeted strategy for managing this species has been developed under the NSW Saving Our Species program. Recovery activities are focussed in the priority management area in the north-west of the state. The loss of an area of marginal habitat outside the main known distribution of the species is unlikely to substantially interfere with the recovery of the species.
Conclusion	The project is unlikely to result in a significant impact on the Dusky Hopping Mouse given: • The Blue Bush Facility is located outside the main known distribution of the species in the north-west of the State. • No direct impacts on sand dune habitat near the Blue Bush Facility would occur. • Sand dune habitat is located in the west of Inter-modal Site A, an area that is unlikely to be cleared given the presence of Stirling Vale Creek in this area. • The project would result in the loss of potential marginal habitat at the sites. This habitat type occurs extensively in the locality.

Australian Painted Snipe

Criteria	Australian Painted Snipe (vulnerable)
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:	An 'important population' is a population that is necessary for a species' long-term survival and recovery. The Australian Painted Snipe is considered to occur in a single, contiguous breeding population (DAWE 2020b). As such, any individuals that may occur would be part of this important population.
Lead to a long-term decrease in the size of an important population of a species	The project will have no impacts on good quality wetland habitat. Areas of low quality potential habitat associated with farm dams and small ephemeral creeks would be removed at the sites. Given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of an important population	The Australian Painted Snipe has been recorded at wetlands in all states of Australia and is most common in eastern Australia. The area of occupancy has undoubtedly declined as approximately 50% of wetlands in Australia have been removed since European settlement (DAWE 2020b). The removal of low quality potential habitat associated with farm dams and small ephemeral creeks is not likely to reduce the area of occupancy of an important population.
Fragment an existing important population into two or more populations	Movement patterns are poorly known for this species and it is possibly dispersive or migratory (DAWE 2020b). The removal or disturbance of low quality potential habitat associated with farm dams and small ephemeral creeks is not likely to fragment the population of this mobile species.
Adversely affect habitat critical to the survival of a species	Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are all, or nearly all, from or near small islands in freshwater wetlands, provided that these islands are a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (Rogers et al. 2005). No preferred breeding habitat (islands in freshwater wetlands) is present. The project would have limited impacts on low quality potential habitat associated with farm dams and small ephemeral creeks. Given the small area of wetland habitat present, the project is unlikely to adversely affect habitat critical to the survival of the species.

Criteria	Australian Painted Snipe (vulnerable)
Disrupt the breeding cycle of an important population	The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. The nest is usually placed in a scrape in the ground, normally concealed in thick marshy vegetation (DAWE 2020b). No preferred breeding habitat (islands in freshwater wetlands) is present. The project will have limited impacts on low quality potential habitat associated with farm dams and small ephemeral creeks that are unlikely to provide breeding habitat for this species. Given the above points, the project is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Removal of low quality potential habitat associated with farm dams and ephemeral creeks is unlikely to affect movement of this species between wetland habitats or affect breeding habitat. Given the small area of wetland habitat that would be impacted, limited number of records present, and lack of good quality breeding habitat, the project is unlikely to affect habitat such that the species declines.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Construction and operation of the project has the potential to spread weeds in riparian areas, but is unlikely to introduce invasive aquatic weeds. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the project is unlikely to substantially increase their numbers in wetland and riparian habitats.
Introduce disease that may cause the species to decline	The project is unlikely to introduce disease that may cause the species to decline.
Interfere substantially with the recovery of the species	The Australian Painted Snipe has primarily been impacted by the loss of wetland habitat (DAWE 2020b). The project would have limited impacts on wetland habitat. No key breeding habitat (large freshwater wetlands) is located in the sites or would be affected by the project. Few local records are known. As such, the project is unlikely to interfere with the recovery of the species.

Criteria	Australian Painted Snipe (vulnerable)
Conclusion	The project is unlikely to have a significant impact on the Australian Painted Snipe as: • No key breeding habitat is located in the sites or would be affected by the project • The project would have limited impacts on low quality wetland habitat • The project would not isolate any habitat or interrupt movements of the species between wetland habitats.

Thick-billed Grasswren (critically endangered)

Criteria	Thick-billed Grasswren (critically endangered)
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The Thick-billed Grasswren was generally thought to be extinct in NSW until located in the Packsaddle area about 100 km north of Broken Hill in 2008. To date, the population near Packsaddle is the only known population of Thick-billed Grasswrens and repeated observations from 2008 to 2011 detected no more than 10 adult birds distributed in pairs across a maximum of five sites. Priority habitat appears to be shrubland dominated by Blackbush (*Maireana pyramidata*) (PCT 153) that is higher and denser than surrounding areas (DPIE 2020b). Other PCTs associated with this species comprise PCT 155 (present at both Inter-modal Site A and the Blue Bush Facility) and PCT 222 (present at the Blue Bush Facility). The species may still occur at other locations in the Upper Western Region. Potential bluebush habitat is present at the sites. No preferred blackbush habitat is present. Potential habitat at the Blue Bush Facility is heavily grazed and unlikely to be suitable for this species. Inter-modal Site A is located over 100 km south of known records, and the Blue Bush Facility over 150 km south of known records. Large areas of similar bluebush habitat is present throughout the locality. The project would remove potential bluebush habitat from Inter-modal Site A and the Blue Bush Facility. No priority habitat is present at these sites. No surveys have been conducted as yet for this species. Targeted surveys will be undertaken in the appropriate season for this species. Given the lack of recent local records, lack of priority habitat, presence of similar bluebush habitat in the locality, and high levels of grazing at the Blue Bush Facility, the project is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	The Thick-billed Grasswren is known to occur north of Broken Hill. No priority habitat would be removed. The removal of potential habitat for this species in an area where it is not known to occur would be unlikely to reduce the area of occupancy of the species.

Criteria	Thick-billed Grasswren (critically endangered)
Fragment an existing population into two or more populations	No known populations occur in or near the study sites. The project would remove potential habitat for this species, however no priority habitat would be removed. High levels of grazing are present at the Blue Bush Facility, which further limits its value for this species. Large areas of similar quality bluebush habitat occur in surrounding areas. As such, the project is unlikely to fragment a population into two or more populations.
Adversely affect habitat critical to the survival of a species	Priority habitat appears to be shrubland dominated by Blackbush (Maireana pyramidata) that is higher and denser than surrounding areas in the Packsaddle area north of Broken Hill. The study sites are located over 100 km outside this area, and there are no local records. Bluebush habitat at the Blue Bush Facility is subject to intense grazing, further limiting its potential value for this species. Impacts at Inter-modal Site A would be restricted to a small portion of the site. Large areas of similar quality bluebush habitat occur in surrounding areas. The project is therefore unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	The Thick-billed Grasswren is sedentary, with established pairs maintaining 20 - 40 hectare territories year-round. Nesting occurs in April in NSW. No known populations occur in or near the project sites. The project would not impact any priority habitat, and is not within an area where this species is known to occur and breed. The loss of potential bluebush habitat from an areas surrounded by similar habitat, and from well outside the known distribution of the species, is unlikely to disrupt the breeding cycle of a population of the Thick-billed Grasswren.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No priority habitat would be removed by the project and the project would not impact any habitat within an area where this species is known to occur. The project would remove potential bluebush habitat for this species. This habitat type is heavily grazed at the Blue Bush Facility. Impacts at Inter-modal Site A would be restricted to a small portion of the site. Large areas of similar quality bluebush habitat occur in surrounding areas. The project is unlikely to fragment any populations of the species. Given that no priority habitat would be impacted, the study sites are over 100 km from known populations, and that no areas of habitat would become isolated, it is unlikely that the project would result in the overall decline of the species.

Criteria	Thick-billed Grasswren (critically endangered)
Result in invasive species that are harmful to the species becoming established in the species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Cats and foxes are already present in the study sites. The project is unlikely to increase feral predators in the area. The project would not impact any habitat within an area where this species is known to occur. As such, there is little risk of impact from invasive species as a result of the project.
Introduce disease that may cause the species to decline	The project is unlikely to introduce disease into the study area that may cause the species to decline.
Interfere with the recovery of the species	Key threats to the species are habitat loss, inappropriate grazing, small population size and predation by feral predators. As noted above, the project would not impact any priority habitat or habitat within an area where this species is known to occur. The loss of potential habitat from the project sites is unlikely to interfere with the recovery of the species given the lack of any known populations in the area, and lack of any habitat critical to the survival of the species.
Conclusion	The project is unlikely to result in a significant impact on the Thick-billed Grasswren given: • there are no recent local records of the species • the project is located over 100 km from the only known records in NSW • there would be no impact on habitat critical to the survival of the species • no priority habitat is present in the study sites • the project is unlikely to fragment or isolate any habitat for the species • the project is unlikely to increase the threat of predation by feral species.

Plains-wanderer

Criteria	Plains-wanderer (critically endangered)
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The study sites are not mapped within any areas identified as the species being likely to occur (DAWE 2020b) or mapped important areas (email from BDC, 11 June 2020). Grassland habitat is present, and there is potential for the species to occur given the project site is within the current distribution of the species. The project would remove potential habitat for this species. Large areas of similar quality habitat occur in the Barrier Range Complex, where this species is predicted to occur. Given the lack of recent local records, lack of impact on areas where the species is likely to occur, and presence of similar habitat in the region, the project is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	Garnett et al. (2011) estimated the area of occupancy to be 330 km2, with a continuing declining trend. The removal of potential habitat for this species in an area where it is not mapped as likely to occur would be unlikely to reduce the area of occupancy of the species..
Fragment an existing population into two or more populations	No known populations occur in or near the project sites. The project would not impact any important habitat or habitat within an area where this species is mapped as likely to occur. The project would remove potential habitat for this species. Large areas of similar quality habitat occur in the Barrier Range Complex, where this species is predicted to occur. As such, the project is unlikely to fragment a population into two or more populations.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of the Plains-wanderer includes: • Any regions where the species is likely to occur; and • Any newly discovered locations that extend the likely range of the plains-wanderer. The species is mapped as likely to occur in the Riverina region near Hay, areas in South Australia including Kalabity, Boolcoomatta, Bundera and Mulyungarie Stations west of the NSW border, as well as locations in Victoria and QLD (DAWE 2020b). The sites are within an area where the species is mapped as potentially occurring, but not likely to occur.

Criteria	Plains-wanderer (critically endangered)
	Assuming no new populations are recorded in the vicinity of the sites, no habitat critical to the survival of the species would be impacted by the project.
Disrupt the breeding cycle of a population	Plains-wanderers a sedentary birds, that tend to breed in solitary pairs. No known populations occur in or near the project sites. The project would not impact any habitat within an area where this species is mapped as likely to occur. The loss of potential habitat from the sites is unlikely to disrupt the breeding cycle of a population of the Plains-wanderer.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	No known breeding habitat would be removed by the project and the project would not impact any habitat within an area where this species is mapped as likely to occur. The project would remove potential habitat for this species. Large areas of similar quality habitat occur in the Barrier Range Complex, where this species is predicted to occur. The project is unlikely to fragment any populations of the species. Given that no breeding habitat would be impacted, and that no areas of habitat would become isolated, it is unlikely that the project would result in the overall decline of the species.
Result in invasive species that are harmful to the species becoming established in the species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Cats and foxes are already present in the study sites. The project is unlikely to increase feral predators in the area. The project would not impact any habitat within an area where this species is mapped as likely to occur. As such, there is little risk of impact from invasive species as a result of the project.
Introduce disease that may cause the species to decline	The project is unlikely to introduce disease into the study sites that may cause the species to decline.

Criteria	Plains-wanderer (critically endangered)
Interfere with the recovery of the species	Key threats to the species are habitat loss, inappropriate grazing, small population size and predation by feral predators. As noted above, the project would not impact any habitat within an area where this species is mapped as likely to occur. The loss of potential habitat from the project sites is unlikely to interfere with the recovery of the species given the lack of any known populations in the area, and lack of any habitat critical to the survival of the species.
Conclusion	The project is unlikely to result in a significant impact on the Plains-wanderer given: • there are no recent local records of the species • the project would not impact any habitat within an area where this species is mapped as likely to occur • the project is unlikely to impact on habitat critical to the survival of the species • the project is unlikely to fragment or isolate any habitat for the species • the project is unlikely to increase the threat of predation by feral species.

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Disturbed areas at gravel pit B

PRELIMINARY BIODIVERSITY IMPACT ASSESSMENT

BLUE BUSH PROJECT – ACCESS TRACKS AND GRAVEL PITS

UNINCORPORATED FAR WEST, NSW

SEPTEMBER 2020

Report prepared by

OzArk Environment & Heritage

for Tellus Holdings Ltd

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Enquiries should be addressed to OzArk Environment & Heritage.

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OzArk acknowledge Traditional Owners of the area on which this assessment took place and pay respect to their beliefs, cultural heritage and continuing connection with the land. We also acknowledge and pay respect to the post-contact experiences of Aboriginal people with attachment to the area and to the elders, past and present, as the next generation of role models and vessels for memories, traditions, culture and hopes of local Aboriginal people.

ABBREVIATIONS AND GLOSSARY

BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BC Act	Biodiversity Conservation Act 2016 (NSW)
BDAR	Biodiversity Development Assessment Report
CEEC	Critically Endangered Ecological Community
CAMBA	China-Australia Migratory Bird Agreement
DoEE	Australian Government Department of Environment and Energy
DPIE	Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW).
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
FM Act	Fisheries Management Act 1994 (NSW)
HPV	High Productivity Vehicles
IBRA	Interim Biogeographic Regionalisation of Australia
JAMBA	Japan-Australia Migratory Bird Agreement
KFH	Key Fish Habitat
KTP	Key Threatening Process
LGA	Local Government Area
LLS	Local Land Services
MNES	Matters of national environmental significance
NPW Act	National Parks and Wildlife Act 1974 (NSW)
PCT	Plant Community Type
PoEO Act	Protection of the Environment Operations Act 1997
RAMSAR	Convention on Wetlands of International Importance
REF	Review of Environmental Factors
RF Act	Rural Fires Act 1997
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SEPP	State Environmental Planning Policy
SIS	Species Impact Statement
TEC	Threatened Ecological Community

FOREWORD AND EXECUTIVE SUMMARY

Tellus Holdings Ltd (Tellus) propose to construct and operate a near-surface geological waste repository, herein referred to as the 'Blue Bush Facility'. Two gravel borrow pits (Gravel Pit A and Gravel Pit B) and associated access tracks would be developed for infrastructure and road base construction to the north-east and south-east of the Blue Bush Facility. An off-site transfer station is also proposed to be developed and is herein referred to as the 'Blue Bush Transfer Station'. Collectively, the proposed facilities are referred to as 'the project' or 'the Blue Bush Project'. The project would be assessed as a State Significant Development (SSD) under Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

Tellus are currently in the scoping phase of the project, and plan to refer the project to the Commonwealth Minister for the Environment to determine whether the project should be a controlled action or not. A preliminary impact assessment report has been prepared for the Blue Bush Facility and two alternative sites for the Blue Bush Transfer Station (GHD, 2020) to inform the Referral. This preliminary impact assessment report has been prepared to provide the results of a desktop review of existing information and initial biodiversity field surveys of the two proposed gravel borrow pits and associated access tracks (the subject site) conducted by OzArk Environment and Heritage (OzArk).

The field survey was completed by Ecologists Dr Emma Gray and Coral Pearce over four days from 29/08/202 to 1/09/2020. Sixteen BAM vegetation plots were surveyed according to the Biodiversity Assessment Method (BAM). In addition, four timed 20 to 30-minute targeted fauna surveys were completed within the subject site.

In total, the subject site contains approximately 186.5 ha of native vegetation from four Plant Community Types (PCTs):

- PCT 60 – Black Oak - Western Rosewood - bluebush/saltbush low sparse woodland on gravel downs in the arid climate zone
- PCT 128 - Nelia tall open shrubland of semi-arid sandplains
- PCT 155 - Bluebush shrubland on stony rises and downs in the arid and semi-arid zones
- PCT 222- Low Bluebush - Bladder Saltbush open shrubland of the arid zone

PCT 128 was precautionarily determined to be part of the BC Act Endangered, *Acacia loderi* shrublands based on the presence of *Acacia loderi.* In addition, fourteen species credit species, 29 ecosystem credit species and four dual credit species have potential to occur on the subject site. A BDAR is currently being prepared by OzArk in accordance with the BAM to determine the clients offset obligations.

One Critically Endangered, Two Endangered, six Vulnerable, three Migratory and four Marine species listed under the EPBC Act have potential to occur on the subject site. Assessments of significance have been prepared in accordance with the EPBC Act significant impact guidelines

for these species. The assessments concluded that the project is unlikely to have a significant impact on any threatened biota listed under the EPBC Act.

Further targeted surveys will be conducted as part of preparation of the BDAR to confirm presence or absence of threatened species, and to assist with the design of the Blue Bush Facility and the location of the Blue Bush Transfer Station, gravel pits and access tracks.

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1 INTRODUCTION

1.1 INTRODUCTION

Tellus Holdings Ltd (Tellus) propose to construct and operate a near-surface geological waste repository, herein referred to as the 'Blue Bush Facility'. Two gravel borrow pits (Gravel Pit A and Gravel Pit B) and associated access tracks would be developed for infrastructure and road base construction to the north-east and south-east of the Blue Bush Facility. An off-site transfer station is also proposed to be developed and is herein referred to as the 'Blue Bush Transfer Station'. Collectively, the proposed facilities are referred to as 'the project' or 'the Blue Bush Project'. The project would be assessed as a State Significant Development (SSD) under Division 4.7 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

If approved, the Blue Bush Facility and gravel borrow pits would be located approximately 45 kilometres south of Broken Hill (**Figure 1-1**) and the Blue Bush Transfer Station would be located adjacent to the Adelaide-Sydney Railway Line and within or adjacent to the industrial precinct of Broken Hill in the far west of New South Wales (NSW) (**Figure 1-2**).

Tellus are currently in the scoping phase of the project, and plan to refer the project to the Commonwealth Minister for the Environment to determine whether the project should be a controlled action or not. A preliminary impact assessment report has been prepared for the Blue Bush Facility and two alternative sites for the Blue Bush Transfer Station (GHD, 2020) to inform the Referral. This preliminary impact assessment report has been prepared to provide the results of a desktop review of existing information and initial biodiversity field surveys of the two gravel borrow pits and associated access tracks conducted by OzArk Environment and Heritage (OzArk). The report focuses on ecological Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and 'species credit' threatened species listed under the NSW *Biodiversity Conservation Act 2016* (BC Act). A Biodiversity Development Assessment Report (BDAR) is currently being prepared by OzArk for the project in accordance with the Biodiversity Assessment Method (BAM, OEH 2017) to accompany the SSD application, and would include more detailed assessment of impacts of the project.

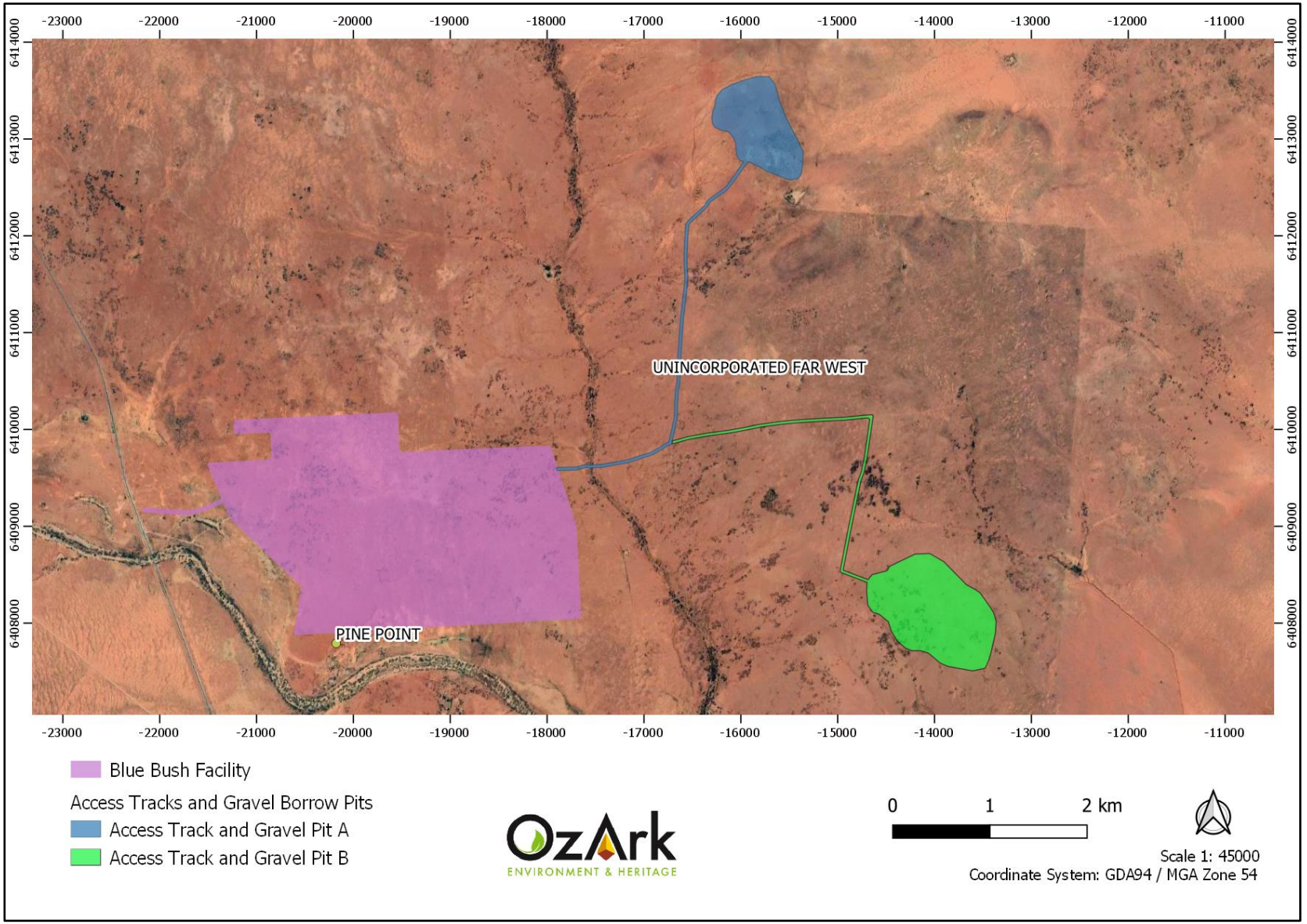

Figure 1-1. Location of the Blue Bush Facility and gravel borrow pits.

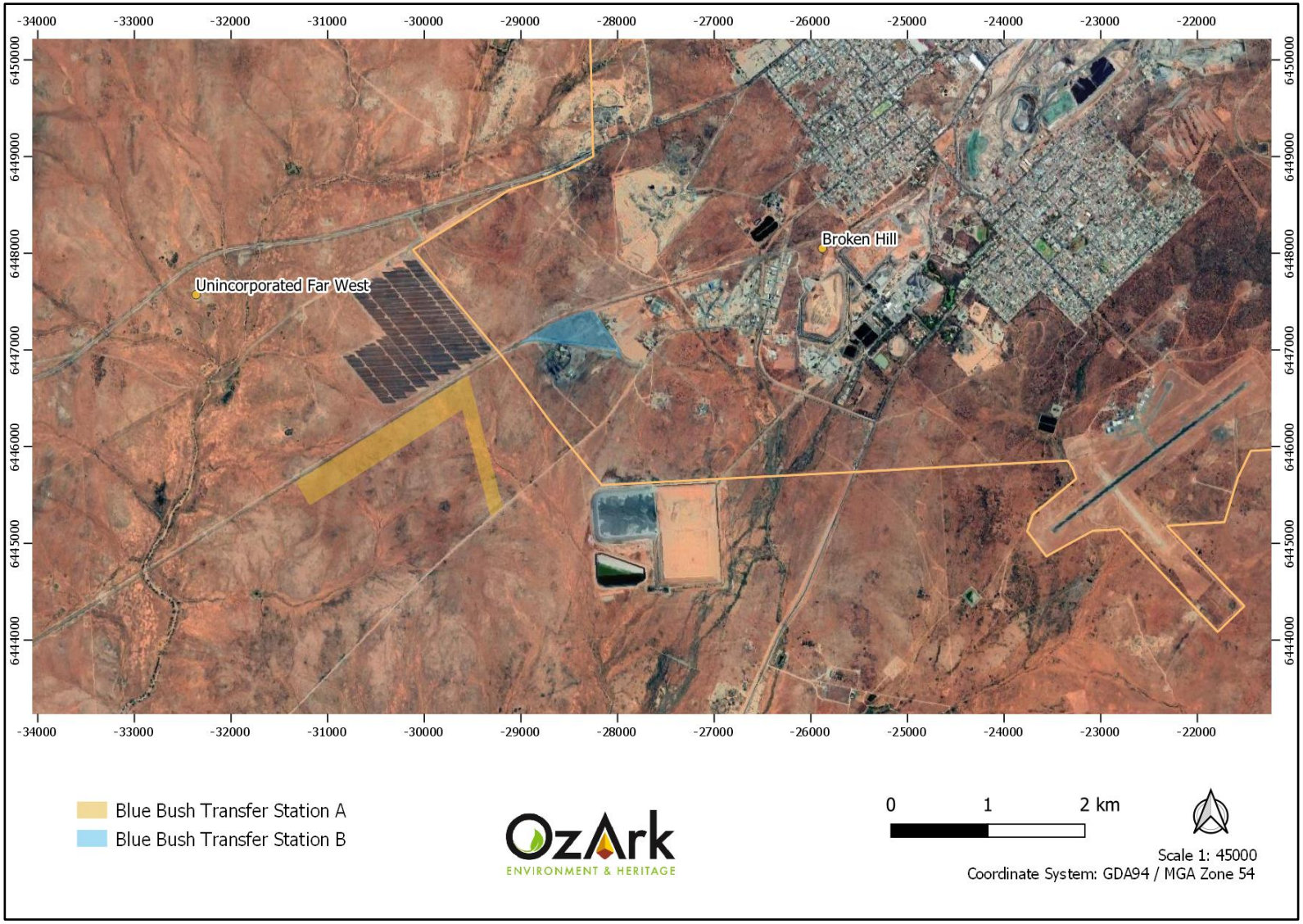

Figure 1-2. Location of Blue Bush Transfer Station sites.

1.2 THE PROJECT

1.2.1 Blue Bush Facility

Clay would be extracted from open-cut pits at the proposed Blue Bush Facility site. The voids created from this extraction would then be used for the storage and/or permanent isolation of hazardous waste. The Blue Bush Facility would receive up to a maximum of 200,000 tonnes per annum (tpa) of waste for approximately 25 years. The following infrastructure would be constructed at the proposed Blue Bush Facility site:

- Construction-related infrastructure – temporary laydown areas for construction equipment, construction accommodation village, gravel borrow pit(s).
- Operation-related infrastructure (waste infrastructure) – excavated pits to be used as waste cells; stockpile areas for topsoil, overburden and kaolin; container hardstand; waste inspection and unloading areas and warehouses; waste laboratory; waste immobilisation plant and/or chemical waste treatment and fixation pit; clay and kaolin processing equipment used on waste management, and a cell cover(s).
- Operation-related infrastructure (other infrastructure) – administration building, workshop, laydown yard including repair and maintenance facilities, mobile equipment re-fuelling and washdown, site access and internal haul roads, site fencing and gatehouse, wastewater treatment system and water tanks for raw and potable water, wastewater treatment system and effluent disposal equipment, diesel storage tanks, hydrocarbon/renewable hybrid power generation system, and permanent accommodation village (if required).
- Ancillary infrastructure – road upgrades at the intersection of the Silver City Highway and access road to the proposed Blue Bush Facility.

1.2.2 Blue Bush Transfer Station

The proposed Blue Bush Transfer Station would be used for the temporary storage of hazardous waste materials prior to their onward transfer to the Blue Bush Facility. Infrastructure, including a road and rail interchange area, a container storage area, office and maintenance and storage sheds would be constructed to support operations at the Blue Bush Transfer Station. Currently two sites (A and B) are being assessed to the west of Broken Hill.

1.2.3 Gravel borrow pits and access tracks

The gravel borrow pits would be used to source material for infrastructure and road base construction. The pits would be established to the north-east and south-east of the Bluebush Facility in areas that have been historically cleared and disturbed by quarrying / excavation activities. Existing unsealed access tracks to both gravel pits would be utilised. However, the tracks would be widened to meet safety requirements.

1.3 PURPOSE OF THIS REPORT

This report has been prepared to support the Referral of the project to the Australian Government Department of Agriculture, Water and the Environment (DAWE).

The aims of the report are to:

- Describe the existing environment at the subject site, including vegetation types and flora and fauna habitats present.
- Assess the value and conservation significance of native vegetation and habitats in the investigation area.
- Compile a list of threatened biota listed under the BC Act and *Fisheries Management Act 1994* (FM Act) and MNES listed under the EPBC Act previously recorded or predicted to occur in the locality and assess their potential to occur at the subject site.
- Provide a preliminary assessment of the likely impacts on threatened biota and migratory species from the proposed works.
- Identify potential design options or measures to avoid or minimise the identified impacts.
- Recommend further surveys that would be required to inform a future BDAR, including in particular targeted seasonal surveys for species credit species to satisfy the requirements of the BAM.
- Assess the likely significance of impacts on MNES, in accordance with the EPBC Act significant impact guidelines
- Provide concluding statements regarding the likely significance of impact of the proposed development on threatened biota listed under the BC Act and FM Act or MNES listed under the EPBC Act.

1.4 ASSESSMENT AREAS

This report uses the following terms to describe and contextualise the development location:

Subject site: The impact footprint being assessed in this report. The subject site includes Gravel Pit A and B, as well as their associated access tracks (**Figure 1-1**). The subject site occurs across three properties: Lot 2128 DP764014, Lot 2129 DP764015 and Lot 4965 DP43593.

Study area: the area within a 1,500 m radius of the subject site. Native vegetation has been mapped within this 1,500 m buffer to provide some context regarding the connectivity and cover of native vegetation in the local area affected by the proposal, and to inform the impact assessment of the proposal.

20 km search area: the area within a 20 km radius of the subject site. This 20 km buffer has been used to search information sources to establish the landscape context of the subject site. A broad search area was used as few records occur within 10 km of the subject site.

2 LEGISLATIVE CONTEXT

2.1 NEW SOUTH WALES LEGISLATION

2.1.1 Environmental Planning and Assessment Act 1979

The Blue Bush Project is classified as State Significant Development (SSD) and will require approval under Part 4, Division 4.7 of the EP&A Act. A Scoping Report is currently being prepared by Tellus to enable the NSW Planning Secretary to set the Secretary's Environmental Assessment Requirements (SEARs) that would scope the content of an Environmental Impact Statement (EIS) for the Blue Bush Project.

2.1.2 Biodiversity Conservation Act 2016

The BC Act provides legal status for biota of conservation significance in NSW. The BC Act provides for the listing of threatened species and communities, establishes a framework to avoid, minimise and offset the impacts of proposed development (the Biodiversity Offsets Scheme [BOS]), and establishes a scientific method for assessing the likely impacts on biodiversity values and calculating measures to offset those impacts (the Biodiversity Assessment Method [BAM]).

As noted in section 1.1, a BDAR is currently being prepared by OzArk in accordance with the BAM to accompany the SSD application.

2.1.3 Fisheries Management Act 1994

The objectives of the FM Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations. It provides for the listing of threatened species, populations and ecological communities, key threatening processes and requirements or otherwise for the preparation of a Species Impact Statement. One of the objectives of the FM Act is to 'conserve key fish habitats' which includes aquatic habitats that are important to the maintenance of fish populations generally and the survival and recovery of threatened aquatic species. To assist in the protection of key fish habitats, the Department of Primary Industries (DPI) has produced the *Policy and guidelines for fish habitat conservation and management* (DPI 2013).

Identification of threatened species and Key Fish Habitat (KFH) are discussed in Section 4-4 and will be included in the BDAR.

2.2 COMMONWEALTH LEGISLATION

The purpose of the EPBC Act is to ensure that actions likely to cause a significant impact on MNES or the environment of Commonwealth land undergo an assessment and approval process. Under the EPBC Act, an action includes a proposal, a development, an undertaking, an activity or a series of activities, or an alteration of any of these things. An action that 'has, will

have or is likely to have a significant impact on a matter of national environmental significance' or a significant impact to the environment of Commonwealth land is deemed to be a 'controlled action' and may not be conducted without prior approval from the Australian Minister for the Environment.

Potential ecological MNES of relevance to this assessment include:

- Threatened species and ecological communities.
- Migratory species.

MNES recorded or likely to occur on the subject site are detailed further in Section 4-8. The likelihood of significant impacts is discussed in Section 5. The results of these initial surveys and assessment will be used to inform the BDAR.

If the proposed action is determined to be a controlled action under the EPBC Act, the bilateral agreement between the NSW Government and the Australian Government would be implemented to streamline the approval process of the Blue Bush Project.

3 METHODS

The preliminary biodiversity impact assessment was carried out in three stages:

1. Desktop searches and review of ecological databases and information to identify threatened species, populations or ecological communities listed in the BC Act, FM Act or the EPBC Act that have the potential to occur in the study area.
2. Field survey of the subject site to collate species lists for the purposes of identifying the vegetation communities present and target predicted threatened species and ecological communities. Where a threatened species or community or habitat feature is identified, document the nature and extent of the protected matter and describe its 'viable local population' or occurrence.
3. Preparation of a report that describes the impacts of the proposed activity on native vegetation and threatened species, populations and ecological communities, and provides recommendations to avoid, minimise and mitigate these impacts.

3.1 PERSONNEL

OzArk operates under NSW Scientific Research License 101908, and NSW Department of Primary Industries (DPI) Accreditation of a corporation as an animal research establishment Ref No. AW2017/012.

The field survey was completed by Ecologists Dr Emma Gray and Coral Pearce over four days from 29/08/202 to 1/09/2020. The report was completed by Emma Gray and reviewed by Coral Pearce. Key details of personnel are provided in **Table 3-1**.

Table 3-1. Summary of OzArk personnel qualifications.

Name	Position	CV Details
Dr Emma Gray	Ecologist	• NSW BAM Accredited Assessor – BAAS19069 • Doctor of Philosophy • Bachelor of Applied Science – Ecology – Queensland University of Technology • 4WD Training • WH&S Induction Training for Construction Work • TfNSW Regional Maintenance Worker on Foot certification
Coral Pearce	Ecologist	• Doctor of Philosophy (in prep) • Masters of Applied Science (Research) – Mammal Ecology • Bachelor of Applied Science -Ecology – Queensland University of Technology • 4WD Training • WH&S Induction Training for Construction Work • TfNSW Regional Maintenance Worker on Foot certification

3.2 DESKTOP SEARCHES

Preliminary assessments drew on local experience, previous reporting and information held on government databases and archives. Results of database searches were used to assist in identifying distributions, suitable habitats and known records of threatened species to increase the effectiveness of field investigations. Information sources reviewed included the following:

- NSW Government online aerial imagery (www.maps.six.nsw.gov.au).
- Critical habitat register available on the OEH website at http://www.environment.nsw.gov.au/criticalhabitat/CriticalHabitatProtectionByDoctype.htm
- NSW Government Biodiversity Values Map which identifies land with high biodiversity value, as defined by the Biodiversity Conservation Regulation 2017 (https://www.lmbc.nsw.gov.au).
- Flora and fauna records and profiles contained in the NSW Threatened Species Database, EPBC Protected Matters Search Tool and DPI threatened fish distribution maps.
- BioNet (www.bionet.nsw.gov.au) Wildlife Atlas and Plant Community Type (VIS) databases.
- Flora of NSW (Harden 1991-2002) and Flora NSW Online (www.plantnet.rbgsyd.nsw.gov.au).
- Regional Scale State Vegetation Map: Western Region v1.0 VIS_ID 4492
- Field survey undertaken by OzArk, August 29th – September 1st 2020.

Database searches were undertaken before the field assessment to determine the predicted species and also those previously recorded within 20 km of the subject site. The results of these searches led to the identification of key species for field survey effort. Results of the database searches are provided in **Appendix A**.

A series of other background searches were performed to comply with legal standards (see **Table 3-2**).

Table 3-2. Presence and / or proximity of environmental considerations.

Environmental Considerations	In the study area?
Land identified on the Biodiversity Values Map under the *NSW BC Act 2016*	Yes – Rantyga Creek is identified as having Biodiversity Value.
Area of Outstanding Biodiversity Value (AOBV) under the *NSW BC Act 2016*	No
Critical habitat nationally?	No
An area reserved or dedicated under the *National Parks and Wildlife Act 1974*?	No
Is the proposal located within land reserved or dedicated within the meaning of the *Crown Lands Act 1989* for preservation of other environmental protection purposes?	No
A World Heritage Area?	No
Environmental Protection Zones in environmental planning instruments?	No
Lands protected under SEPP 44 – Koala Protection?	No
Lands protected under SEPP Sydney Drinking Water Catchment?	No
Land identified as wilderness under the *Wilderness Act 1987* or declared as wilderness under the *National Parks and Wildlife Act 1974*?	No
Aquatic reserves dedicated under the *Fisheries Management Act 1994*?	No
Aquatic Threatened Ecological Community?	Yes – Lowland Darling River Aquatic Ecological Community.
Wetland areas dedicated under the Ramsar Wetlands Convention?	No
Land subject to a conservation agreement under the *National Parks and Wildlife Act 1974*?	No
Land identified as State Forest under the *Forestry Act 1916*?	No
Acid sulphate area?	No
Protected riparian habitat?	No
Mapped Key Fish Habitat?	No

3.3 HABITAT ASSESSMENT

The results of the desktop review and the field investigations were collated and reviewed in the context of local ecological knowledge to determine the likelihood of occurrence of threatened species and ecological communities, and potential impacts of the proposal (**Appendix C**). For instance, some threatened species may be predicted to occur locally but, on assessment of the site, key habitat elements or conditions are not present, in which case the species is assessed as not being present or impacted.

The likelihood of occurrence of threatened species, populations or ecological communities was categorised as follows:

- 'Present' – Species known to occur within the locality, or detected during the field surveys
- 'Possible' – Potentially suitable habitat occurs within the locality and species' known range encompasses the area. Species recorded historically in the 20 km search area, and generally within the last 20 years.
- 'Unlikely' – Species' known range encompasses the locality, but suitable habitat does not occur within these, or occurs within these but with generally low quality and quantity. Species recorded historically within 20 km of the sites but generally not within the last 20 years
- 'Highly unlikely' – No historical records of the species and/or no suitable habitat within 20 km of the locality.

The species present or considered to possibly occur on the subject site were then considered as to whether the extent and type of development would be likely to impact on them. Tests of significance were then completed for these species and ecological communities under the EPBC Act (**Appendix D**), and the relevant guidelines for these assessments.

3.4 FIELD SURVEY

3.4.1 BAM Survey

Vegetation communities were identified in accordance with the online NSW Master Plant Community Type Classification (OEH, 2018a), which is the current state-wide vegetation classification system for Plant Community Types (PCT). This classification system is used for vegetation mapping, development assessment and site planning purposes. It describes over 1,500 PCTs across the state, and groups the vegetation communities into vegetation Class and Formation / Sub-formation as per Keith (2004).

In this study PCTs were identified on the basis of the following inputs:

- Regional Scale State Vegetation Map: Western Region v1.0 VIS_ID 4492, which provides predictive mapping of PCTs in and around the subject site. This mapping is

indicative only. It is not necessarily accurate at a fine scale for the purposes of the current study.

- Professional ecological knowledge about locally occurring vegetation types and landscape, soil and topographic patterns, including transitions from one community to another and potential for intergrades between plant communities.
- Field survey results confirming the flora species present, vegetation structure, landscape position and soil type at the subject site and the extent and condition of native vegetation.
- The BioNet Vegetation Classification database was used to identify the candidate vegetation communities likely to be present based on the site conditions (flora species present, vegetation structure, bioregion, and landscape position and soil type) and the relevant published PCT descriptions.

If any of the PCTs were identified as having potential to be part of a Threatened Ecological Community (TEC), the relevant identification guidelines (NSW Scientific Committee listing criteria and Commonwealth identification guides) were consulted to determine the status of the vegetation community present on the subject site. The guidelines provide the identification criteria required to positively identify communities as being part of a TEC. The criteria include location, species present, overstorey species, weed cover, number and type of native species, including whether certain 'important' native species are present etc.

Plant identification followed nomenclature in the Royal Botanic Gardens PlantNet online database (Royal Botanic Gardens and Domain Trust, 2018).

Sixteen vegetation plots were surveyed according to the Biodiversity Assessment Method (BAM) as follows:

- Each survey plot consisted of either 1) nested 20 m x 50 m and 20 m x 20 m plots or 2) nested 10 m x 100 m and 10 m x 40 m plots.
- Species composition and structure (species and percent cover) data collected from within 20 m x 20 m or 10 m x 40 m plots.
- Vegetation function data (size and number of trees, presence of hollow-bearing trees and woody debris) collected from within 20 m x 50 m or 10 m x 100 m plots.
- Percent of litter cover data collected within five 1m x 1m squares positioned at 5 m, 15 m, 25 m, 35 m and 45 m points of 50 m transect.
- Plots were positioned within or adjacent to the subject site and their GPS locations recorded (GDA 94 / MGA Zone 54).
- Plot locations were randomly selected whilst ensuring adequate survey effort within each vegetation zone (see **Table 3-3** and **Figure 3-1** to **3-3**).

Table 3-3 Minimum number of plots and transects required per zone area (OEH, 2017).

Vegetation zone area (ha)	Minimum number of plots/transects
<2	1 plot/transect
>2 – 5	2 plots/transects
>5 – 20	3 plots/transects
>20 – 50	4 plots/transects
>50 – 100	5 plots/transects
>100 – 250	6 plots/transects
>250 – 1000	7 plots/transects
>1000	8 plots/transects

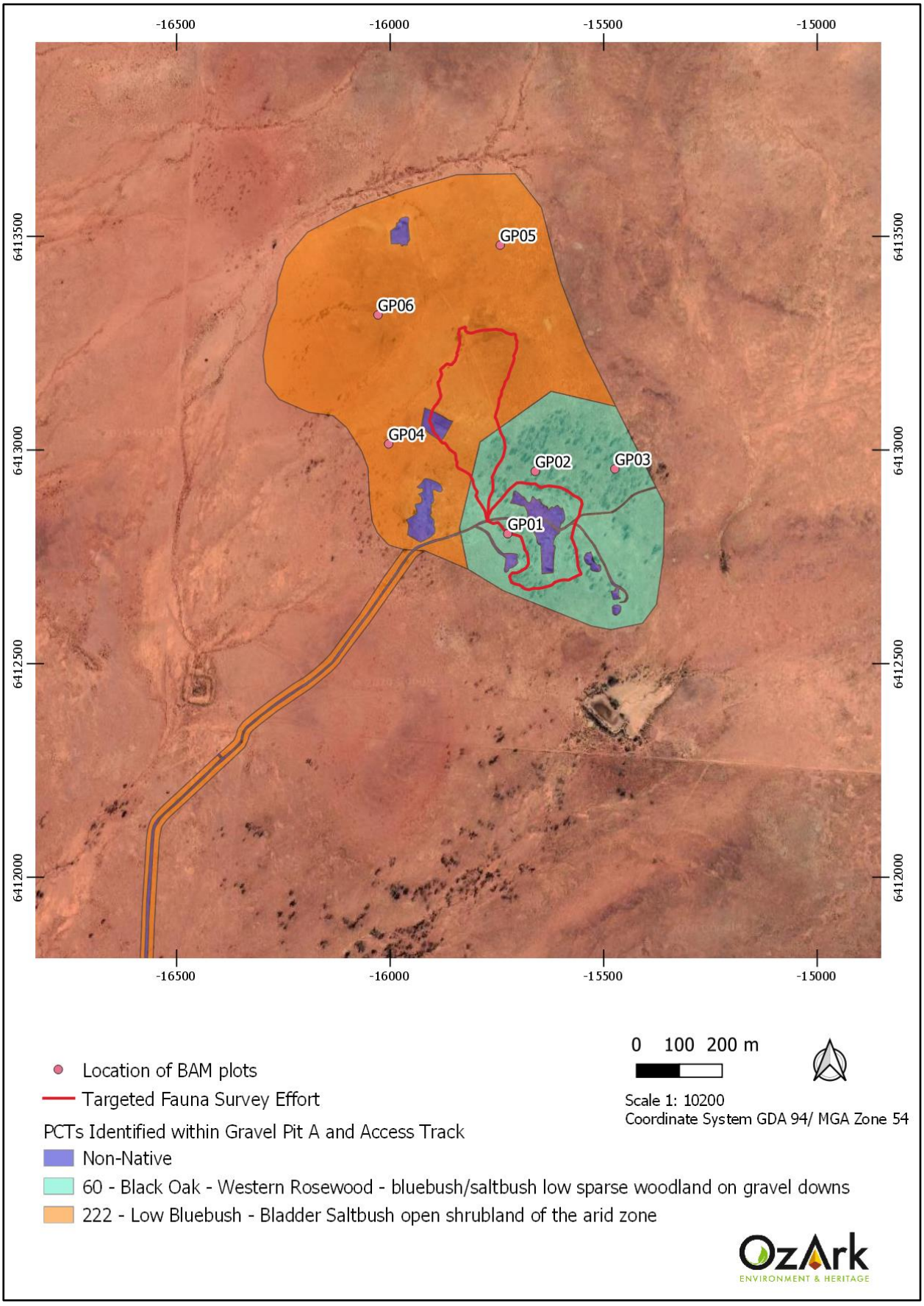

Figure 3-1. BAM plot locations and terrestrial fauna survey effort – Gravel Pit A (part 1 of 3).

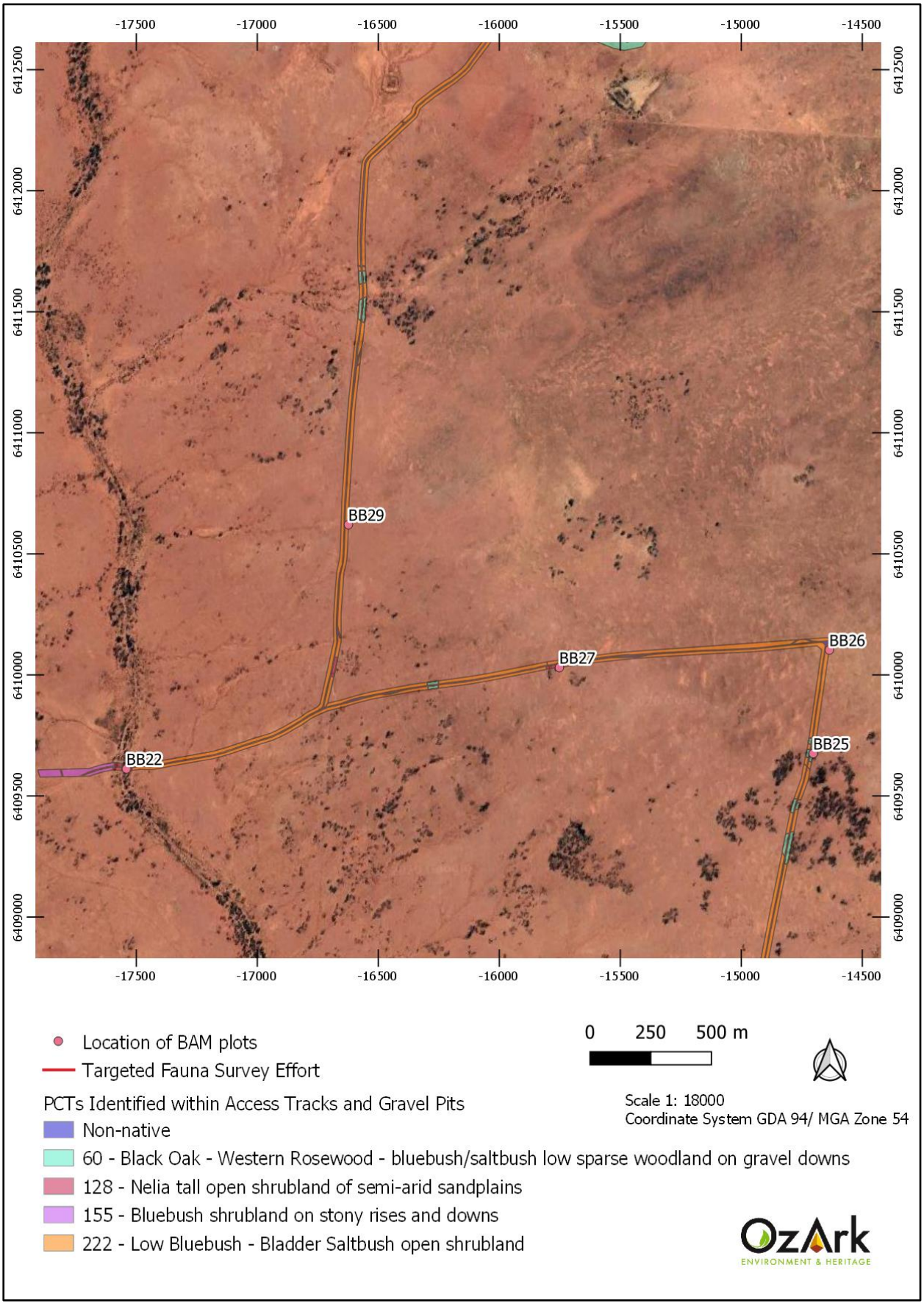

Figure 3-2. BAM plot locations and terrestrial fauna survey effort – access tracks (part 2 of 3).

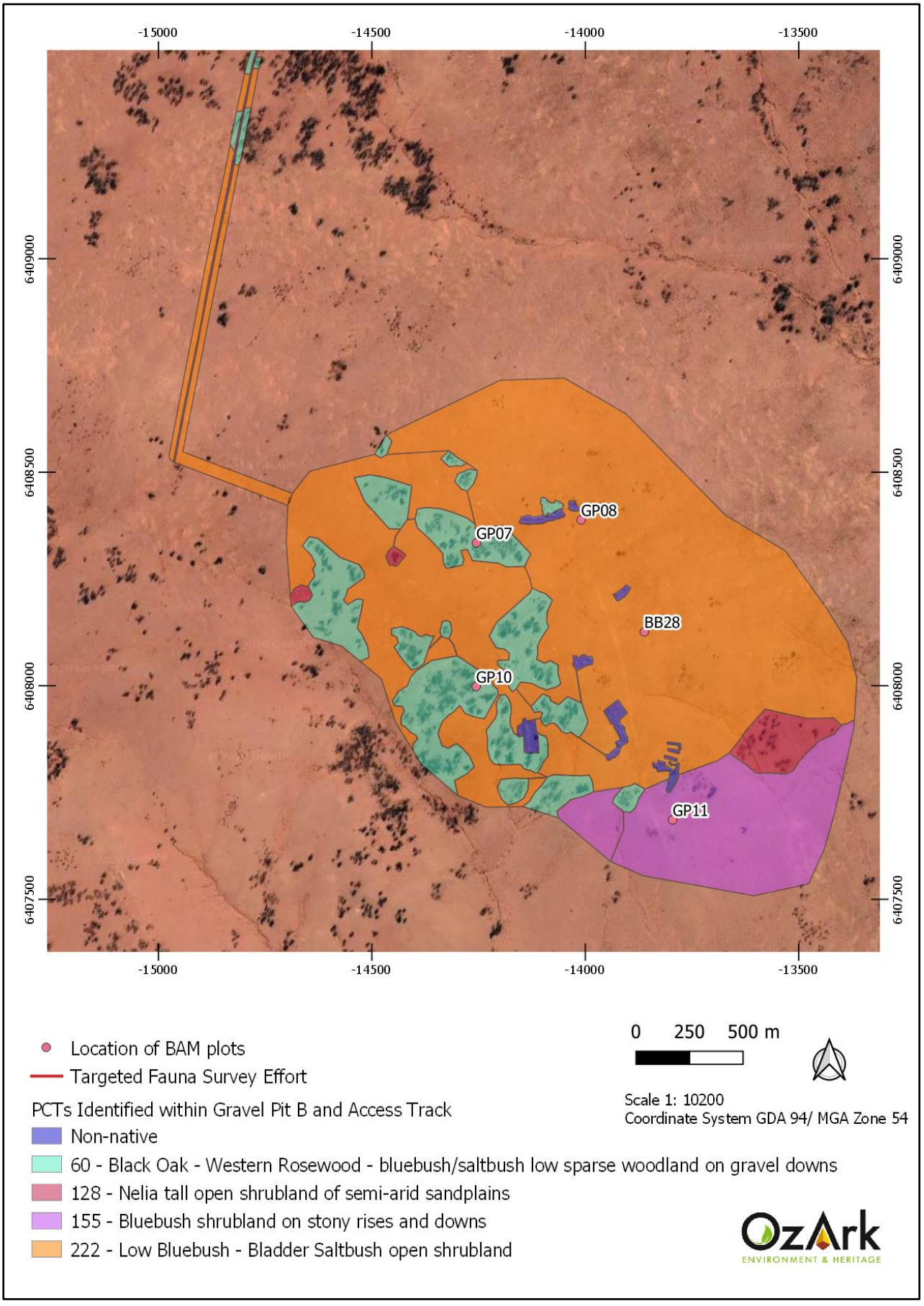

Figure 3-3. BAM plot locations and terrestrial fauna survey effort – Gravel Pit B (part 3 of 3).

3.4.2 Terrestrial Fauna Surveys

The subject site was searched for fauna while undertaking BAM plots and traversing the site to determine PCT boundaries. Any hollow-bearing trees or trees containing nests were GPS tagged. An effort was also made to record the size, number of hollows and/or type of nest for each tree. Habitat features such as rocks, loose bark and coarse woody debris were examined for cryptic species. Tracks and other areas of suitable substrate were searched for animal tracks. Other evidence of fauna presence on the subject site, such as scats, feathers, chewed casuarina cones, and sloughed skins were also recorded.

Four timed 20 to 30-minute targeted fauna surveys were completed within the subject site (see **Figure 3-1** and **3-3)**. These surveys used passive observation and recorded all fauna species encountered.

3.4.3 Aquatic Surveys

Desktop searches were undertaken before the field survey to identify the number and type of watercourses present on the subject site and within the wider study area, including whether the watercourses were listed as protected riparian and / or Key Fish Habitat (KFH). Rantyga Creek and other riparian vegetation was assessed during the August-September 2020 survey, with observations on condition and habitat recorded. Aquatic surveys (e.g. water quality testing) was not undertaken as part of this assessment.

3.5 SURVEY LIMITATIONS

This study is based upon the species data available at the time of the study, and the environmental conditions, season, and time constraints imposed by the project for the field survey. Specific limitations on this study include the following:

- An extended period of below average rainfall (i.e. drought conditions) during the previous years may have caused some species to be temporarily absent or difficult to detect; although at the time of the survey, there was evidence of recent standing water and many forbs were in flower
- Fauna trapping, call-playback, motion-sensing cameras and nocturnal spotlighting were not undertaken for the current assessment
- Microbat ultrasonic call capture and analysis was not undertaken
- It was not the usual flowering time for several of the candidate threatened plants predicted to occur, such as the Slender Darling Pea
- The field survey was undertaken in or very near to the subject site. Therefore, PCT extents were not confirmed and habitat assessments were not undertaken outside the subject site.

To overcome some of these limitations, a ‘precautionary approach’ for species presence has been adopted, where required. If suitable habitat for a particular threatened species is present on the subject site, then the species is assumed to also be present and the impact assessment is completed on that basis. The above-mentioned constraints were also considered when preparing the recommendations of avoiding, minimising and mitigating potential impacts. Note that additional targeted surveys will be undertaken by OzArk in Spring (September-October) 2020 in order to confirm the presence / absence of a number of candidate species credit and EPBC listed threatened species.

4 EXISTING ENVIRONMENT

4.1 BIOREGION

The subject site falls within the Broken Hill Complex Bioregion, Barrier Range and Barrier Range Outwash subregions as per the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Cresswell, 1995). The subregions are characterised by geology, landforms, soil types and vegetation as described in **Table 4-1**.

Table 4-1. Descriptions of the IBRA Subregions of the subject site.

Broken Hill Complex				
Subregion	**Geology**	**Landform**	**Soils**	**Vegetation**
Barrier Range	Ancient gneiss, schists, amphibolite, granites and pegmatites with north-east structural trends, overlain by Cambrian sediments with northwest trends.	Steep, low rocky ranges oriented to bedrock structure. Prominent fault scarps. Eroded footslopes extend to outwash fans.	A high proportion of rock outcrop with shallow stony soil on the crests. Soils become deeper and finer downslope. Texture contrast profiles are common and quality differs according to rock type.	Limited Mulga, Dead Finish and Bluebush on the ridges. Denser shrubs including Belah, Whitewood, Turpentine, Prickly Wattle, Punty Bush with Bluebush, grasses and forbs on the lower slopes. River Red Gum line larger creeks, shrubs and grasses increase on the outwash fans. Curly Mallee on limestone outcrops.

Barrier Range Outwash	Quaternary colluvial and alluvial slope deposits, floodplain and fan sediments, and aeolian sands.	Stream channels and floodplains, low angle alluvial fans and floodouts, extending to extensive sandplains and dunefields with lakes and claypans. Limited lunette development.	Deep red sands on sandplains and dunes, clayey sands in floodouts extending to dark coloured cracking clays in swamps and lake beds. Brown loamy sands on lunettes.	River Red Gum and some Black Box on the larger creek lines. Mulga, Belah, Rosewood with occasional Nelia and Leopardwood and an understorey of grasses and Bluebush on the sandplains and dunes. Some Porcupine Grass. Canegrass, chenopods and some lignum on lake beds with fringing Black Box. Mulga, Turpentine and Bluebush on lunettes.

4.2 MITCHELL LANDSCAPES

The landscapes of NSW, termed Mitchell Landscapes, were mapped in 2002 to provide a framework for reporting reserve establishment and for determining over-cleared landscapes (Mitchell, 2002). These landscapes broadly describe areas of similar topography, geology, soils and vegetation. The Barrier Downs and Barrier Sandplains Mitchell Landscapes occur within the subject site. The characteristics of these landscapes are described in **Table 4-2**.

Table 4-2. Mitchell Landscapes of the subject site.

Mitchell Landscape	Geology and soils Landform	Vegetation
Barrier Downs	A complex landscape of the low strike ridges of rock outcrop, slopes and outwash areas of the Barrier Ranges. Steeply rolling lowlands on pre-Cambrian dolomite and calcareous shale and steeply dipping Devonian sandstone and conglomerate, with dense incised drainage, relief to 30m. Lithosols or shallow calcareous sandy loams on ridges, contour banded slopes of alternating stony red desert loams and stone-free red clays or solonized brown soils on long slopes. Dunes of deep clayey sand. Stony reddish-brown calcareous sandy loams, along drainage tracts, alluvial flats with brown self-mulching cracking clays.	Ridges with scattered Mulga (*Acacia aneura*), Prickly Wattle (*Acacia victoriae*), Low Bluebush (*Maireana astrotricha*), scattered Black Bluebush (*Maireana pyramidata*), Dead Finish (*Acacia tetragonophylla*), some Pearl Bluebush (*Maireana sedifolia*) and isolated Harlequin Fuchsia (*Eremophila duttonii*). Slopes with isolated Mulga and Needlewood (*Hakea leucoptera*) with scattered shrubs; local stands of dense Low Bluebush, contour banded Bladder Saltbush (*Atriplex vesicaria*), Cabbage-tree Wattle (*Acacia cana*), Belah (*Casuarina cristata*), and Pearl Bluebush (*Maireana sedifolia*), with local clumps of moderately dense Belah (*Casuarina cristata*) and Mulga, abundant bottlewashers (*Enneapogon* sp.) and copperburr (*Sclerolaena* sp.). Flats with copperburr, Thorny Saltbush (*Rhagodia spinescens*) and grasses and drainage lines with Prickly Wattle, Western Boobialla (*Myoporum montanum*), Sandalwood (*Santalum lanceolatum*), Rosewood (*Alectryon oleifolium*), Belah (*Casuarina cristata*), White Cypress Pine (*Callitris glaucophylla*) and Black Box *(Eucalyptus largiflorens*). River Red Gum *(Eucalyptus camaldulensis*) along larger streams.

Barrier Sandplains	Extensive undulating Quaternary sandplains and alluvial plains with isolated low sandy rises and patches of broad east-west trending dunes and small and large drainage sinks occasional lakes, relief 5 to 10m. Sandy red earths and calcareous red earths, earthy pans at depth. Dunes of calcareous sandy earths or sands. Solonized brown soils in sinks with brown and grey cracking clay in pans.	Moderate to sparse Mulga (*Acacia aneura*), Belah (*Casuarina cristata*), Leopardwood (*Flindersia maculosa*), Nelia (*Acacia loderi*), Rosewood (*Alectryon oleifolium*), Punty Bush (*Senna eremophila*), clumps of Turpentine (*Eremophila sturtii*), moderate to dense Prickly Wattle (*Acacia victoriae*), Cabbage-tree Wattle (*Acacia cana*), Narrow-leaf Hopbush (*Dodonaea attenuata*), Emu Bush (*Eremophila longifolia*) and Boobialla (*Myoporum montanum*), Variable Speargrass (*Austrostipa variabilis*), copperburr (*Sclerolaena* sp.), Cannonball Burr (*Sclerolaena paradoxa*) and other grasses and forbs. Dunes with Rosewood, Red Mallee *(Eucalyptus socialis*), Narrow-leaf Hopbush, Turpentine and grasses. Fringing Black Box *(Eucalyptus largiflorens*), Bimble Box *(Eucalyptus populnea*) with Canegrass (*Eragrostis australasica*) and Lignum (*Muehlenbeckia cunninghamii*) on depressions.

4.3 CLIMATE

The field survey was undertaken from 29/08/202 to 1/09/2020. Weather conditions at the time of the survey were cool, ranging from a minimum temperature of 2.9ºC to 25.7ºC. No rain was recorded during the survey period. A total of 26.4 mm was recorded for the month of August, above the average total rainfall for August of 18.3 mm (BOM, 2020). There was also evidence of recent standing water. However, overall, the region is recovering from severe drought, having received the lowest rainfall on record in the previous 24 months according to BOM (2020).

4.4 WATERCOURSES AND AQUATIC HABITAT

In total, 10 watercourses transect the subject site:

- Rantyga Creek, a minor, non-perennial watercourse
- Nine Strahler 1st Order, un-named, minor, non-perennial watercourses (see **Figure 4-1**).

None of the watercourses are mapped as Key Fish Habitat (KFH) by the Department of Primary Industries - Fisheries (DPI Fisheries) or classified as Protected Riparian Habitat (DPI Fisheries). However, the watercourses are mapped within the distribution of the Lowland Darling River EEC. Therefore, an assessment of significance must be undertaken for this community in order to comply with the FM Act.

4.5 GROUNDWATER DEPENDENT ECOSYSTEMS

Groundwater plays an important ecological role in directly and indirectly supporting terrestrial and aquatic ecosystems. Groundwater sustains terrestrial and aquatic ecosystems by supporting vegetation and providing discharge to channels, lacustrine and palustrine wetlands, and both the estuarine and marine environment.

The degree of groundwater dependence of ecosystems falls into three broad categories:

- Non-dependent ecosystems that occur mostly in recharge areas and have no connection with groundwater
- Facultative Groundwater Dependent Ecosystems (GDEs) that require groundwater in some locations but not in others, particularly where an alternative source of water can be accessed to maintain ecological function. Minor changes to the groundwater regime in facultative GDEs with proportional or opportunistic groundwater dependence may not have any adverse impacts but these ecosystems can be damaged or destroyed if a lack of access to groundwater is prolonged
- Obligate GDEs that are restricted to locations of groundwater discharge and ecosystems located within aquifers (e.g. subterranean cave and stygofauna communities (Kuginis *et al*. 2012). Aquifer ecosystems are inherently groundwater dependent (QLD Department of Environment and Heritage Protection, 2017).

Groundwater dependant ecosystems have been classified into seven types under two broad categories as follows (Kuginis *et al*. 2012):

- Subsurface ecosystems – Underground ecosystems
- Karst systems and caves (limestone geology)
- Subsurface aquifer (phreatic) ecosystems
- Baseflow streams (hyporheic or subsurface component)
- Surface ecosystems – above ground ecosystems
- Groundwater dependent wetlands
- Baseflow surface streams (surface/free-water component)
- Estuarine and near shore marine ecosystems
- Groundwater dependent terrestrial ecosystems; dependent on subsurface groundwater (phreatophytic).

The Bureau of Meteorology Atlas of GDEs identified areas of low potential aquatic GDEs within the subject site and surrounding areas (**Figure 4-1**; Bureau of Meteorology, 2020). The aquatic GDEs are identified as floodplain waterbodies (wetlands). Thus, according to the definitions above they can be classed as facultative, groundwater dependent wetlands. The main floodplain wetland transects the proposed access track adjacent to Rantyga Creek.

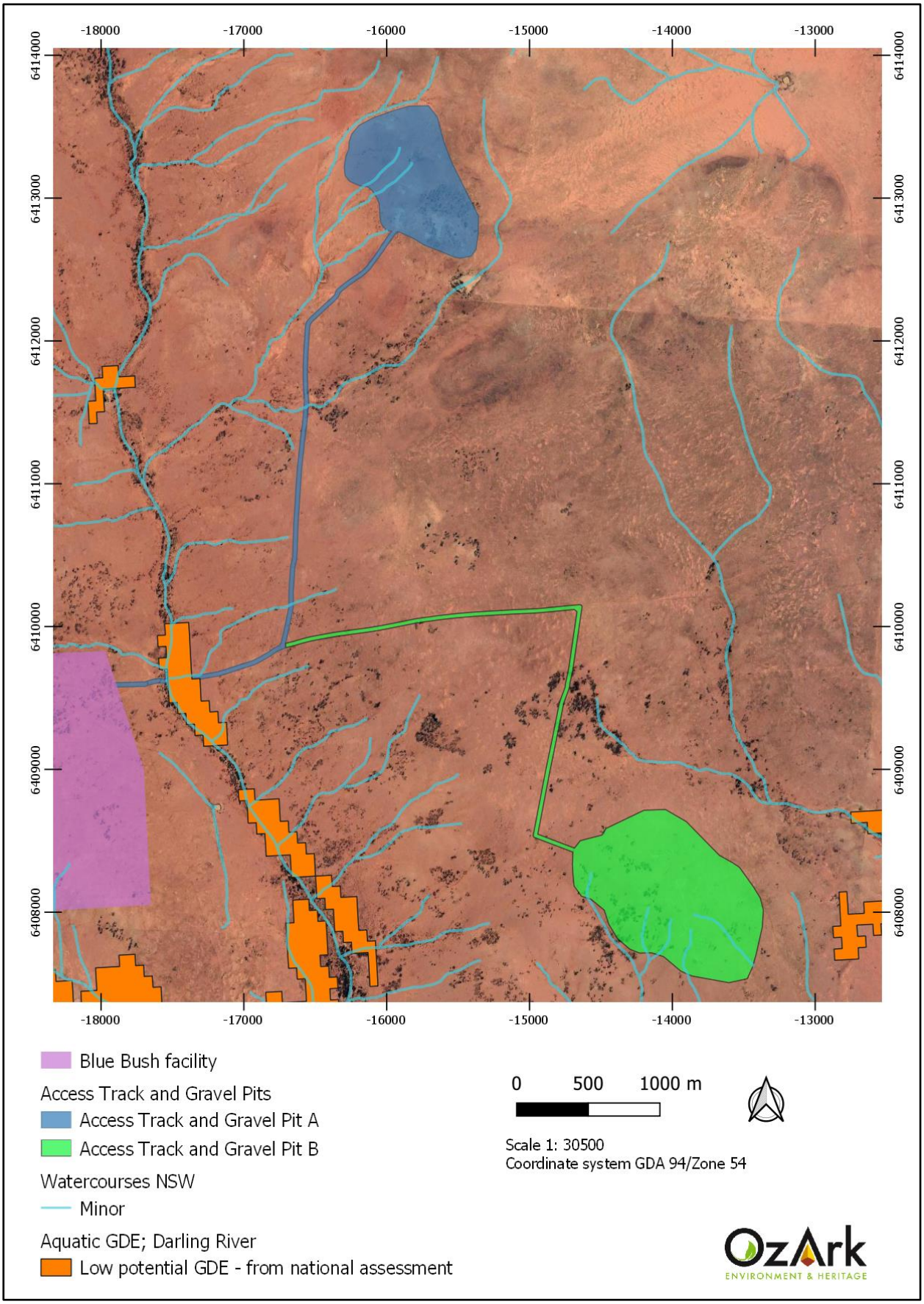

Figure 4-1. Watercourses and aquatic GDEs within the subject site.

4.6 PLANT COMMUNITY TYPES

A total of four PCTs were identified across the subject site and are summarised in **Table 4-3** and shown in **Figure 3-1** to **3-3**.

Table 4-3. Plant Community Types identified on the subject site.

PCT	Area (ha)	BAM plots	Location	Dominant Species	Condition / Notes	Example Image
PCT 60 - Black Oak - Western Rosewood - bluebush/saltbush low sparse woodland on gravel downs in the arid climate zone	36.4	GP01, GP02, GP03, GP07, GP10, BB25	Gravel Pit A Gravel Pit B Access Tracks	Black Oak (*Casuarina pauper*) dominated overstorey. Understorey shrub layer generally dominated by either Black Bluebush (*Maireana pyramidata*), Low Bluebush (*Maireana astrotricha*), Pearl Bluebush (*Maireana sedifolia*) or a combination. Small shrubs, grasses and forbs are sparse but include *Sclerolaena*, *Atriplex*, *Sida*, *Salsola*, *Rhodanthe*, and *Tetragonia sp*.	The PCT across the subject site occurs in poor-moderate condition with few weeds. The whole subject site showed signs of moderate-heavy grazing by livestock, kangaroos, feral goats and rabbits. Additionally, PCT 60 within Gravel Pit A and Gravel Pit B has been disturbed by previous extraction activities.	

PCT 128 - Nelia tall open shrubland of semi-arid sandplains	3.0	BB22, BB27	Gravel Pit B Access Tracks	Nelia (*Acacia loderi*) dominated overstorey with or without Black Oak (*Casuarina pauper*) and *Callitris gracilis subsp. murrayensis*. Understorey shrub layer generally contains Spiny Saltbush (*Rhagodia spinescens*), Black Bluebush (*Maireana pyramidata*) and / or Low Bluebush (*Maireana astrotricha*). *Austrostipa*, *Aristida*, *Atriplex* and *Salsola sp*. present in the understorey.	The identity of the needle-leaved Acacia was difficult to determine, as the trees were not in flower or contained pods. OzArk has precautionarily identified the species as Nelia (*Acacia loderi*), due to the length and width of the leaves more closely aligning with this species and as the area was identified as PCT 128 on the State Type Vegetation Mapping. OzArk will be returning to the site in September-October to conduct targeted surveys and will aim to verify the species if it begins to flower. The PCT across the subject site occurs in poor-moderate condition. The whole subject site showed signs of moderate-heavy grazing by livestock, kangaroos, feral goats and rabbits.	

PCT	Area (ha)	BAM plots	Location	Dominant Species	Condition / Notes	Example Image
					Additionally, PCT 128 within Gravel Pit B has been disturbed by previous extraction activities.	
PCT 155 - Bluebush shrubland on stony rises and downs in the arid and semi-arid zones	15.9	GP11, BB29	Gravel Pit B Access Tracks	Shrubland dominated by Black Bluebush (*Maireana pyramidata*) with or without Low Bluebush (*Maireana astrotricha*) and Pearl Bluebush (*Maireana sedifolia*). Understorey sparse but includes *Sclerolaena*, *Atriplex* and ephemeral forbs such as *Goodenia* and daisy *sp*.	The PCT across the subject site occurs in poor-moderate condition. Condition appears largely driven by the intensity of grazing and proximity to drainage lines. Additionally, PCT 155 within Gravel Pit B has been disturbed by previous extraction activities.	

PCT	Area (ha)	BAM plots	Location	Dominant Species	Condition / Notes	Example Image
PCT 222 - Low Bluebush - Bladder Saltbush open shrubland of the arid zone	131.2	GP04, GP05, GP06, GP08, BB26, BB28	Gravel Pit A Gravel Pit B Access Tracks	Shrubland dominated by Low Bluebush (*Maireana astrotricha*) with or without Black Bluebush (*Maireana pyramidata*). Understorey sparse but includes *Sclerolaena*, *Atriplex, Tetragonia, Rhodanthe, Daucus* and *Bulbine sp.*	The PCT across the subject site occurs in poor-moderate condition. Condition appears largely driven by the intensity of grazing and proximity to drainage lines. Additionally, PCT 222 within Gravel Pit A and B has been disturbed by previous extraction activities.	

4.7 WEEDS

In NSW all plants are regulated with a general biosecurity duty under the NSW *Biosecurity Act 2015* to prevent, eliminate or minimise any biosecurity risk they may pose. Some weeds are identified as 'priority weeds' for a particular region and have additional biosecurity duties. Under the National Weeds Strategy, 32 introduced plants have been identified as Weeds of National Significance (WONS). No WONS occur on the subject site.

4.8 CONSERVATION SIGNIFICANCE

4.8.1 Threatened Ecological Communities

Several of the PCTs present on the subject site are associated with Threatened Ecological Communities (TECs, **Table 4-4**). PCT 128 was precautionarily determined to be part of the BC Act Endangered, *Acacia loderi* shrublands based on the presence of *Acacia loderi* (see **Table 4-3** for additional notes regarding the identification of *Acacia loderi*).

Table 4-4. List of Threatened Ecological Communities associated with the subject site.

PCT	Associated TECs	Present / Absent	Notes
PCT 60	BC Act Endangered, *Acacia loderi* shrublands	Absent	No *Acacia loderi* occur within patches of this PCT
PCT 128	BC Act Endangered, *Acacia loderi* shrublands	Present	*Acacia loderi* occurs and is dominant within patches of this PCT
	BC Act Endangered, *Acacia melvillei* shrubland in the Riverina and Murray-Darling Depression Bioregions'	Absent	*Acacia melvillei* does not occur within patches of this PCT. The subject site is not within the Riverina or Murray-Darling Depression Bioregions.
PCT 155	BC Act Endangered, *Acacia loderi* shrublands	Absent	No *Acacia loderi* occur within patches of this PCT
PCT 222	None	-	-

4.8.2 Threatened Flora and Fauna

Seven threatened flora and 48 threatened fauna species listed under the EPBC Act and / or the NSW BC Act were assessed as having a moderate-high likelihood of occurring on the subject site based on the desktop review, habitat requirements, and the preliminary results of the field survey. These are listed in **Table 4-5**. See **Appendix C** for the full list of species assessed.

Table 4-5. Threatened species with potential to be impacted by the proposal.

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Flora							
Acacia carneorum	Purple-wood Wattle	V	V	Species (all year)	Yes. No threshold identified as yet.	Yes	**Possible.** Suitable habitat present (PCT 128). Not identified on site in OzArk 2020 surveys.
Acacia notabilis	Mallee Golden Wattle	E	-	Species (all year)	No	No	**Possible.** Suitable habitat present (PCT 60, 128 and 155). Not identified on site in OzArk 2020 surveys.
Atriplex infrequens	A saltbush	V	V	Species (Nov-Feb)	No	No	**Possible.** Suitable habitat present (PCT 222).
Calotis moorei	A burr-daisy	E	E	Species (Sep-Nov)	Yes. No threshold identified as yet.	No	**Possible.** Suitable habitat present (PCT 128 and 222).
Swainsona flavicarinata	Yellow-Keeled Swainsona	E	-	Species (Jun-Oct 4-7 weeks after above average rainfall)	Yes. No threshold identified as yet.	No	**Possible.** Suitable habitat present (PCT 128, 155 and 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Swainsona murrayana	Slender Darling Pea	V	V	Species (Sep)	No	No	**Possible.** Suitable habitat present (PCT 155 and 222).
Swainsona viridis	Creeping Darling Pea	E	-	Species (Sep-Oct, after average to wet seasonal conditions)	Yes. No threshold identified as yet.	No	**Possible.** Suitable habitat present (PCT 155 and 222).
Fauna ***Ave***							
Actitis hypoleucos	Common Sandpiper	-	C, J, K	N/A	N/A	No	Possible. Low quality suitable habitat present at farm dams in the study sites.
Amytornis modestus obscurior	Thick-billed Grasswren (north-west NSW subspecies)	CE	CE	Species (Jul-Sep)	Yes. Any impact on the species from the project could be potentially serious and irreversible	No	Possible. Suitable habitat present (PCT 155 and 222). Generally thought to be extinct in NSW until recently located in the Packsaddle area, around 100 km north of Broken Hill. No local records.

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Ardea alba	Great Egret	-	MA	N/A	N/A	No	Possible. Some suitable habitat present at dams and low-lying depressions at the subject site following local heavy rain.
Ardea ibis	Cattle Egret	-	MA	N/A	N/A	No	Possible. Some suitable habitat present at dams and low-lying depressions at the subject site following local heavy rain.
Ardeotis australis	Australian Bustard	E	-	Species (all year)	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Burhinus grallarius	Bush Stone-curlew	E	-	Species (all year)	No	No	Possible. Suitable habitat present (PCT 128).
Calamanthus campestris	Rufous Fieldwren	V	-	Ecosystem	No	Yes	Present. Suitable habitat present (PCT 155 and 222). Species recorded at the Facility Site during OzArk field surveys and assumed to be present within similar habitat at the proposed gravel pits and access tracks.
Calidris acuminata	Sharp-tailed Sandpiper	-	C, J, K	N/A	N/A	No	Possible. Low quality suitable habitat present at farm dams in the study sites.
Calidris melanotos	Pectoral Sandpiper	-	C, J, K	N/A	N/A	No	Possible. Low quality suitable habitat present at farm dams in the study sites.
Certhionyx variegatus	Pied Honeyeater	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128 and 155).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Chrysococcyx osculans	Black-eared Cuckoo	-	MA	N/A	N/A	No	Possible. The species is found in drier country where species such as mulga and mallee form open woodlands and shrublands. It is often found in vegetation along creek beds.
Circus assimilis	Spotted Harrier	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Daphoenositta chrysoptera	Varied Sittella	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60).
Epthianura albifrons	White-fronted Chat	V	-	Ecosystem	No	No	Present. Suitable habitat present (PCT 155 and 222). Species recorded at the Facility Site during GHD field surveys and assumed to be present within similar habitat at the proposed gravel pits and access tracks.
Falco hypoleucos	Grey Falcon	E	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Gallinago hardwickii	Latham's Snipe	-	C, J, K	N/A	N/A	No	Possible. Low quality suitable habitat present at farm dams in the study sites.
Hamirostra melanosternon	Black-breasted Buzzard	V	-	Dual (Sep-Nov)	No	No	Possible. Suitable habitat present (PCT 128 and 222).
Hieraaetus morphnoides	Little Eagle	V	-	Dual (Aug-Oct)	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Dual (Sep-Oct)	No	Yes	Possible. Suitable foraging habitat present (PCT 60, 128, 155 and 222). No hollow-bearing trees present for breeding.
Lophoictinia isura	Square-tailed Kite	V	-	Dual (Sep-Jan)	No	No	Possible. Suitable habitat present (PCT 60).
Merops ornatus	Rainbow Bee-eater	-	MA	N/A	N/A	No	Possible. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It occurs in farmland, orchards and vineyards, and is regularly recorded in other disturbed habitats including roadside vegetation and in quarries, mines or gravel pits, where they often breed.
Phaps histrionica	Flock Bronzewing	E	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60 and 155).
Pomatostomus halli	Hall's Babbler	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60).
Pyrrholaemus brunneus	Redthroat	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 155 and 222).
Rostratula australis	Australian Painted Snipe	E	E	Ecosystem	No	No	Possible. Some suitable habitat present at dams and low-lying depressions at the subject site following local heavy rain
Mammal							

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Antechinomys laniger	Kultarr	E	-	Ecosystem	No	No	Possible. Subject site within predicted (not known) distribution. However, suitable habitat is present (PCT 60, 128, 155 and 222).
Chalinolobus picatus	Little Pied Bat	V	-	Ecosystem	No	No	Present. Recorded by Anabat device at adjacent Blue Bush Facility site (GHD). Suitable habitat present (PCT 60, 128 and 155).
Grantiella picta	Painted Honeyeater	V	V	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60 and 128).
Leggadina forresti	Forrest's Mouse	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 155 and 222).
Notomys fuscus	Dusky Hopping-mouse	E	V	Ecosystem	No	No	Possible. Suitable habitat present (PCT 155 and 222).
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Ecosystem	No	No	Possible. Suitable habitat present (PCT 128). Possible calls recorded during Anabat surveys (GHD) at adjacent Blue Bush Facility site.
Pseudomys bolami	Bolam's Mouse	E	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 155).
Pseudomys hermannsburgensis	Sandy Inland Mouse	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Rattus villosissimus	Long-haired Rat	V	-	Ecosystem	No	No	Possible. Subject site within predicted (not known) distribution. However, suitable habitat is present (PCT 155).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Ecosystem	No	Yes	Present. Suitable habitat present (PCT 60, 128 and 222).
Sminthopsis macroura	Stripe-faced Dunnart	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Vespadelus baverstocki	Inland Forest Bat	V	-	Ecosystem	No	No	Present. Recorded by Anabat device at adjacent Blue Bush Facility site (GHD). Suitable habitat present (PCT 60 and 128).
Reptile							
Antaresia stimsoni	Stimson's Python	V	-	Species	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Aspidites ramsayi	Woma	V	-	Ecosystem	No	No	Possible. Subject site within predicted (not known) range. No nearby records. However, suitable habitat present (PCT 60, 128, 155 and 222).
Ctenophorus mirrityana	Barrier Range Dragon	E	-	Species (Oct-March)	No	No	Possible. Suitable habitat present (PCT 60 and 155).
Ctenotus brooksi	Wedgesnout Ctenotus	V	-	Ecosystem	No	No	Possible. Subject site within predicted (not known) range. No nearby records. However, suitable habitat present (PCT 60, 128 and 155).
Diplodactylus platyurus	Eastern Fat-tailed Gecko	E	-	Species (Oct-Dec)	No	No	Possible. Suitable habitat present (PCT 60 and 128).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Lerista xanthura	Yellow-tailed Plain Slider	V	-	Ecosystem	No	No	Possible. Subject site within predicted (not known) range. No nearby records. However, suitable habitat present (PCT 128).
Lucasium stenodactylum	Crowned Gecko	V	-	Species (Oct-Mar)	No	No	Possible. Suitable habitat present (PCT 60, 128 and 155).
Pseudonaja modesta	Ringed Brown Snake	E	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60, 128, 155 and 222).
Ramphotyphlops endoterus	Interior Blind Snake	E	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 60 and 222).
Simoselaps fasciolatus	Narrow-banded Snake	V	-	Ecosystem	No	No	Possible. Suitable habitat present (PCT 128, 155 and 222).

5 ASSESSMENTS OF SIGNIFICANCE

5.1.1 BC Act

A summary of BC Act listed threatened flora and fauna species that may occur on the subject site is provided in **Table 4-5**. There are 14 species credit species, 29 ecosystem credit species and four dual credit species with potential to occur. A BDAR is currently being prepared by OzArk in accordance with the BAM to determine the clients offset obligations. Targeted surveys for a number of the species credit species will be carried out in spring (Sep / Oct) to determine their presence / absence on the subject site.

5.1.2 EPBC Act

One Critically Endangered, Two Endangered, six Vulnerable, three Migratory and four Marine species listed under the EPBC Act have potential to occur on the subject site. The project is unlikely to have a significant impact on these species (see assessments of significance in **Appendix D**). A summary is provided in **Table 5-1**

Table 5-1. **Summary of the findings of EPBC Act significance assessments.**

EPBC Act significance assessments		
Threatened species, or communities	**Important population[2]**	**Likely significant impact?**
Threatened Flora		
Acacia carneorum (Purple-wood Wattle)	No	No
Atriplex infrequens (A saltbush)	No	No
Calotis moorei (A burr-daisy)	No	No
Swainsona murrayana (Slender Darling Pea)	No	No
Threatened Fauna ***Ave***		
Amytornis modestus obscurior (Thick-billed Grasswren (north-west NSW subspecies)	No	No
Grantiella picta (Painted Honeyeater)	No	No
Rostratula australis (Australian Painted Snipe)	No	No

Mammal		
Notomys fuscus (Dusky Hopping-mouse)	No	No
Nyctophilus corbeni (Corben's Long-eared Bat)	No	No
Migratory and Marine Species ***Aves***		
Actitis hypoleucos (Common Sandpiper)	No	No
Ardea alba (Great Egret)	No	No
Ardea ibis (Cattle Egret)	No	No
Calidris acuminata (Sharp-tailed Sandpiper)	No	No
Chrysococcyx osculans (Black-eared Cuckoo)	No	No
Gallinago hardwickii (Latham's Snipe)	No	No
Merops ornatus (Rainbow Bee-eater)	No	No

6 CONCLUSION

The following summary of findings and conclusions are provided to assist with ongoing project planning.

Up to approximately 186.5 ha of native vegetation would be cleared in association with the proposed development of the gravel pits and access tracks. The native vegetation consists of four PCTs:

- PCT 60 – Black Oak - Western Rosewood - bluebush/saltbush low sparse woodland on gravel downs in the arid climate zone
- PCT 128 - Nelia tall open shrubland of semi-arid sandplains
- PCT 155 - Bluebush shrubland on stony rises and downs in the arid and semi-arid zones
- PCT 222- Low Bluebush - Bladder Saltbush open shrubland of the arid zone

PCT 128 was precautionarily determined to be part of the BC Act Endangered, *Acacia loderi* shrublands based on the presence of *Acacia loderi.* There may be scope to alter the path of the access tracks and size / shape of the gravel pits to reduce / avoid the community within the subject site.

Fourteen species credit species, 29 ecosystem credit species and four dual credit species have potential to occur on the subject site. A BDAR is currently being prepared by OzArk in accordance with the BAM to determine the clients offset obligations.

One Critically Endangered, Two Endangered, six Vulnerable, three Migratory and four Marine species listed under the EPBC Act have potential to occur on the subject site. Assessments of significance have been prepared in accordance with the EPBC Act significant impact guidelines for these species. The assessments concluded that the project is unlikely to have a significant impact on any threatened biota listed under the EPBC Act.

Further targeted surveys would be conducted as part of preparation of the BDAR to confirm presence or absence of threatened species and to assist with the design of the Blue Bush Facility and the location of the Blue Bush Transfer Station, gravel pits and access tracks.

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APPENDIX A – DATABASE SEARCH RESULTS

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

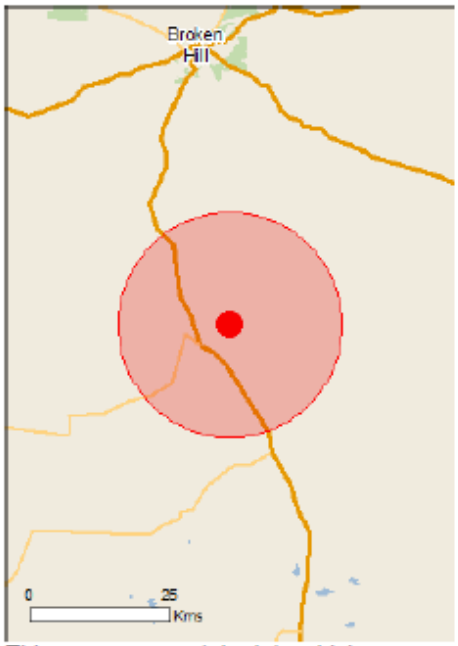
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 11/09/20 09:34:03

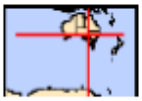
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 20.0Km



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:	11
Listed Migratory Species:	7

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:	12
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:	None
Regional Forest Agreements:	None
Invasive Species:	15
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		
Amytornis modestus Thick-billed Grasswren [84121]	Vulnerable	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Extinct within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Notomys fuscus Dusky Hopping-mouse, Wilkiniti [125]	Vulnerable	Species or species habitat may occur within area
Nyctophilus corbeni Corben's Long-eared Bat, South-eastern Long-eared Bat [83395]	Vulnerable	Species or species habitat may occur within area
Plants		
Acacia carneorum Needle Wattle, Dead Finish, Purple-wood Wattle [66685]	Vulnerable	Species or species habitat known to occur within area
Solanum karsense Menindee Nightshade [7776]	Vulnerable	Species or species habitat may 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 Terrestrial Species		

Name	Threatened	Type of Presence
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

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
Ardea alba Great Egret, White Egret [59541]		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 likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

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		
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
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
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Mammals		
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Capra hircus Goat [2]		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
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
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

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Carrichtera annua Ward's Weed [9511]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Prosopis spp. Mesquite, Algaroba [68407]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		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

-32.32875 141.51401

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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BioNET Atlas search – threatened species predicted to occur within the Barrier Range and Barrier Range Outwash IBRA subregions.

*NSW Status: P=Protected, P13=Protected native plant, V=Vulnerable, E1=Endangered, E2=Endangered population, E4=Extinct, E4A=Critically endangered, 2=Category 2 sensitive species, 3=Category 3 sensitive species.

+Comm. Status: C=CAMBA, J=JAMBA, K=ROKAMBA, CE=Critically endangered, E=Endangered, V=Vulnerable.

-Number of Records: P = predicted to occur.

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Aves	Amytornis modestus obscurior	Thick-billed Grasswren (north-west NSW subspecies)	E4A,P,2	CE	P
Aves	Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland subspecies)	V,P,2		2
Aves	Falco hypoleucos	Grey Falcon	E1,P,2		4
Aves	*Lophochroa leadbeateri*	Major Mitchell's Cockatoo	V,P,2		26
Aves	*Actitis hypoleucos*	Common Sandpiper	P	C,J,K	2
Aves	*Ardeotis australis*	Australian Bustard	E1,P		11
Aves	*Arenaria interpres*	Ruddy Turnstone	P	C,J,K	1
Aves	*Artamus cyanopterus cyanopterus*	Dusky Woodswallow	V,P		4
Aves	*Burhinus grallarius*	Bush Stone-curlew	E1,P		1
Aves	*Calamanthus campestris*	Rufous Fieldwren	V,P		47

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Aves	Calidris acuminata	Sharp-tailed Sandpiper	P	C,J,K	1
Aves	*Calidris ferruginea*	Curlew Sandpiper	E1,P	CE,C,J,K	K
Aves	Calidris ruficollis	Red-necked Stint	P	C,J,K	1
Aves	Calidris subminuta	Long-toed Stint	P	C,J,K	2
Aves	*Certhionyx variegatus*	Pied Honeyeater	V,P		21
Aves	*Circus assimilis*	Spotted Harrier	V,P		9
Aves	*Climacteris picumnus victoriae*	Brown Treecreeper (eastern subspecies)	V,P		6
Aves	*Daphoenositta chrysoptera*	Varied Sittella	V,P		1
Aves	*Epthianura albifrons*	White-fronted Chat	V,P		5
Aves	*Falco subniger*	Black Falcon	V,P		7
Aves	Gelochelidon nilotica	Gull-billed Tern	P	C	3
Aves	Geophaps scripta scripta	Squatter Pigeon (southern subspecies)	E4A,P	V	P
Aves	Grantiella picta	Painted Honeyeater	V,P	V	K
Aves	*Grus rubicunda*	Brolga	V,P		1

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Aves	*Hamirostra melanosternon*	Black-breasted Buzzard	V,P,3		3
Aves	*Hieraaetus morphnoides*	Little Eagle	V,P		12
Aves	*Hirundapus caudacutus*	White-throated Needletail	P	V,C,J,K	1
Aves	Hydroprogne caspia	Caspian Tern	P	J	3
Aves	Lophoictinia isura	Square-tailed Kite	V,P,3		2
Aves	*Melanodryas cucullata cucullata*	Hooded Robin (south-eastern form)	V,P		3
Aves	*Neophema splendida*	Scarlet-chested Parrot	V,P		1
Aves	Ninox connivens	Barking Owl	V,P,3		P
Aves	*Oxyura australis*	Blue-billed Duck	V,P		9
Aves	*Pedionomus torquatus*	Plains-wanderer	E1,P	CE	1
Aves	*Pezoporus occidentalis*	Night Parrot	E4,P	E	1
Aves	*Phaps histrionica*	Flock Bronzewing	E1,P		2
Aves	*Pomatostomus halli*	Hall's Babbler	V,P		2
Aves	*Pyrrholaemus brunneus*	Redthroat	V,P		41

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Aves	*Rostratula australis*	Australian Painted Snipe	E1,P	E	2
Aves	Stagonopleura guttata	Diamond Firetail	V,P		P
Aves	*Stictonetta naevosa*	Freckled Duck	V,P		23
Aves	*Tringa nebularia*	Common Greenshank	P	C,J,K	1
Aves	*Tyto longimembris*	Eastern Grass Owl	V,P,3		2
Aves	Tyto novaehollandiae	Masked Owl	V,P,3		P
Mammalia	Antechinomys laniger	Kultarr	E1,P		P
Mammalia	*Chalinolobus picatus*	Little Pied Bat	V,P		7
Mammalia	*Dasyurus maculatus*	Spotted-tailed Quoll	V,P	E	3
Mammalia	*Leggadina forresti*	Forrest's Mouse	V,P		32
Mammalia	*Leporillus conditor*	Greater Stick-nest Rat	E4,P	V	1
Mammalia	*Macrotis lagotis*	Bilby	E4,P	V	1
Mammalia	*Notomys fuscus*	Dusky Hopping-mouse	E1,P	V	2
Mammalia	Nyctophilus corbeni	Corben's Long-eared Bat	V,P	V	1

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Mammalia	*Petrogale xanthopus*	Yellow-footed Rock-wallaby	E1,P	V	4
Mammalia	*Pseudomys bolami*	Bolam's Mouse	E1,P		7
Mammalia	*Pseudomys hermannsburgensis*	Sandy Inland Mouse	V,P		3
Mammalia	*Rattus villosissimus*	Long-haired Rat	V,P		3
Mammalia	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	V,P		4
Mammalia	*Sminthopsis macroura*	Stripe-faced Dunnart	V,P		37
Mammalia	Vespadelus baverstocki	Inland Forest Bat	V,P		P
Reptilia	*Antaresia stimsoni*	Stimson's Python	V,P		1
Reptilia	*Aspidites ramsayi*	Woma	V,P		1
Reptilia	*Ctenophorus mirrityana*	Barrier Range Dragon	E1,P		259
Reptilia	Ctenotus brooksi	Wedgesnout Ctenotus	V,P		1
Reptilia	*Cyclodomorphus melanops elongatus*	Mallee Slender Blue-tongue Lizard	E1,P		5
Reptilia	*Delma australis*	Marble-faced Delma	E1,P		8

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Reptilia	*Diplodactylus platyurus*	Eastern Fat-tailed Gecko	E1,P		1
Reptilia	Lerista xanthura	Yellow-tailed Plain Slider	V,P		1
Reptilia	Liopholis whitii	White's Skink population in the Broken Hill Complex Bioregion	E2,P		P
Reptilia	*Lucasium stenodactylum*	Crowned Gecko	V,P		1
Reptilia	*Pseudonaja modesta*	Ringed Brown Snake	E1,P		3
Reptilia	Ramphotyphlops endoterus	Interior Blind Snake	E1,P		1
Reptilia	Simoselaps fasciolatus	Narrow-banded Snake	V,P		1
Reptilia	*Strophurus elderi*	Jewelled Gecko	V,P		P
Reptilia	*Tiliqua occipitalis*	Western Blue-tongued Lizard	V,P		4
Flora	Calotis moorei	A burr-daisy	E1	E	P
Flora	*Atriplex infrequens*	A saltbush	V	V	P
Flora	*Convolvulus tedmoorei*	Bindweed	E1		2
Flora	*Acacia rivalis*	Creek Wattle	E1		9
Flora	*Swainsona viridis*	Creeping Darling Pea	E1		8

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Flora	*Erodiophyllum elderi*	Koonamore Daisy	E1		1
Flora	*Acacia notabilis*	Mallee Golden Wattle	E1		6
Flora	Solanum karsense	Menindee Nightshade	V	V	5
Flora	Brachyscome papillosa	Mossgiel Daisy	V	V	P
Flora	Acacia carneorum	Purple-wood Wattle	V	V	34
Flora	*Indigofera longibractea*	Showy Indigo	E1		8
Flora	*Swainsona murrayana*	Slender Darling Pea	V	V	2
Flora	*Eleocharis obicis*	Spike-Rush	V	V	2
Flora	*Lepidium monoplocoides*	Winged Peppercress	E1	E	1
Flora	*Swainsona flavicarinata*	Yellow-Keeled Swainsona	E1		4
Flora	Atriplex acutiloba		E4		2
Flora	Dysphania platycarpa		E1		P
Community	Acacia loderi shrublands	Acacia loderi shrublands	E3		K

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Community	*Porcupine Grass—Red Mallee—Gum Coolabah hummock grassland/low sparse woodland in the Broken Hill Complex Bioregion*	Porcupine Grass—Red Mallee—Gum Coolabah hummock grassland/low sparse woodland in the Broken Hill Complex Bioregion	E4B		K
Threat	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	KTP		P
Threat	Anthropogenic Climate Change	Anthropogenic Climate Change	KTP	KTP	P
Threat	*Bushrock removal*	Bushrock removal	KTP		P
Threat	*Clearing of native vegetation*	Clearing of native vegetation	KTP	KTP	P
Threat	Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	Competition and grazing by the feral European Rabbit, Oryctolagus cuniculus (L.)	KTP	KTP	P
Threat	Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	Competition and habitat degradation by Feral Goats, Capra hircus Linnaeus 1758	KTP	KTP	P

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Threat	Competition from feral honey bees, Apis mellifera L.	Competition from feral honey bees, Apis mellifera L.	KTP		P
Threat	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	Forest eucalypt dieback associated with over-abundant psyllids and Bell Miners	KTP		P
Threat	Herbivory and environmental degradation caused by feral deer	Herbivory and environmental degradation caused by feral deer	KTP		P
Threat	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	KTP		P
Threat	Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	Importation of Red Imported Fire Ants Solenopsis invicta Buren 1972	KTP	KTP	P
Threat	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	Infection by Psittacine Circoviral (beak and feather) Disease affecting endangered psittacine species and populations	KTP	KTP	P
Threat	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	KTP	KTP	P

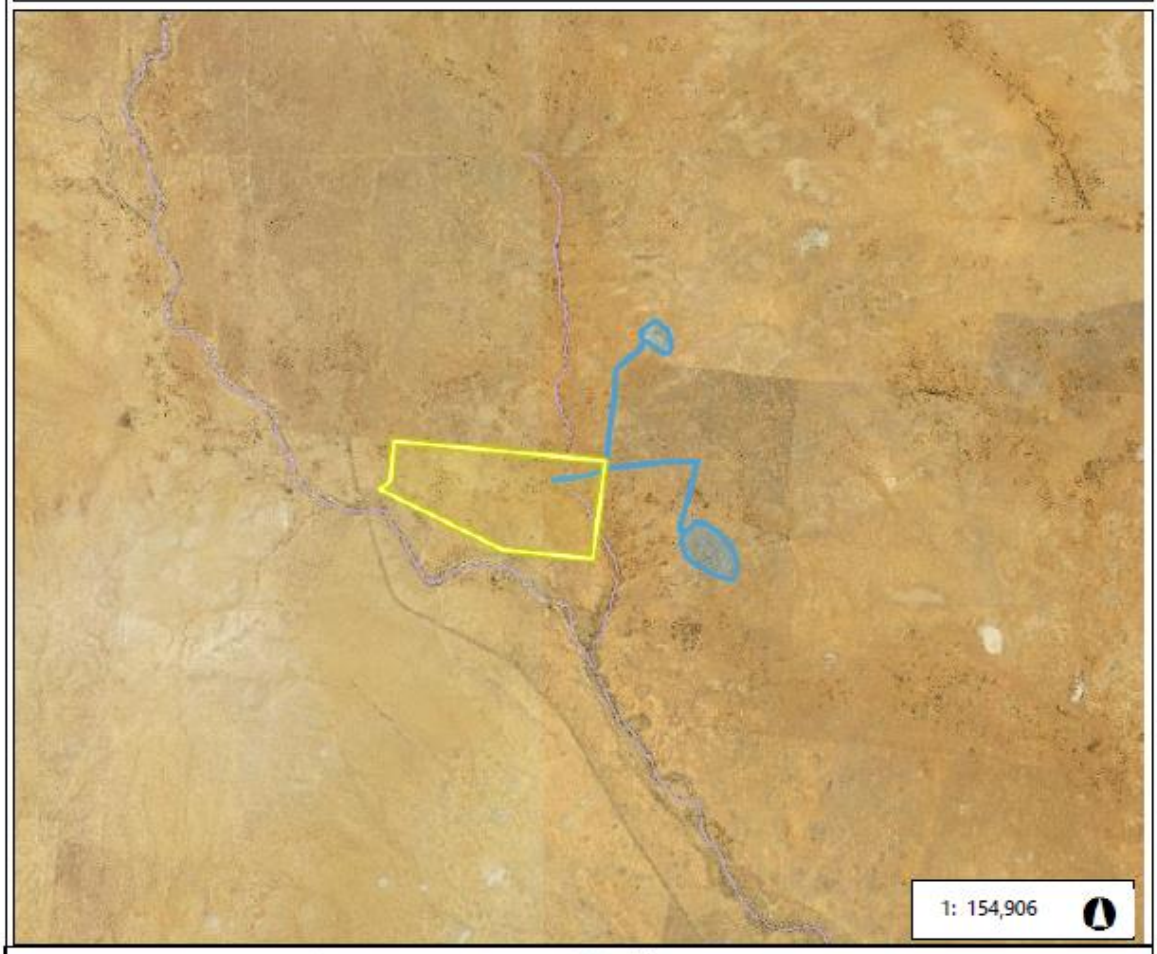
Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Threat	Infection of native plants by Phytophthora cinnamomi	Infection of native plants by Phytophthora cinnamomi	KTP	KTP	P
Threat	Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	Introduction of the Large Earth Bumblebee Bombus terrestris (L.)	KTP		P
Threat	Invasion and establishment of exotic vines and scramblers	Invasion and establishment of exotic vines and scramblers	KTP		P
Threat	Invasion and establishment of Scotch Broom (Cytisus scoparius)	Invasion and establishment of Scotch Broom (Cytisus scoparius)	KTP		P
Threat	Invasion and establishment of the Cane Toad (Bufo marinus)	Invasion and establishment of the Cane Toad (Bufo marinus)	KTP	KTP	P
Threat	Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.	Invasion of native plant communities by African Olive Olea europaea subsp. cuspidata (Wall. ex G. Don) Cif.	KTP		P
Threat	Invasion of native plant communities by Chrysanthemoides monilifera	Invasion of native plant communities by Chrysanthemoides monilifera	KTP		P

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Threat	Invasion of native plant communities by exotic perennial grasses	Invasion of native plant communities by exotic perennial grasses	KTP		P
Threat	Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	Invasion of the Yellow Crazy Ant, Anoplolepis gracilipes (Fr. Smith) into NSW	KTP		P
Threat	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	Invasion, establishment and spread of Lantana (Lantana camara L. sens. Lat)	KTP		P
Threat	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants	KTP	KTP	P
Threat	Loss of Hollow-bearing Trees	Loss of Hollow-bearing Trees	KTP		P
Threat	Loss or degradation (or both) of sites used for hill-topping by butterflies	Loss or degradation (or both) of sites used for hill-topping by butterflies	KTP		P
Threat	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	Predation and hybridisation by Feral Dogs, Canis lupus familiaris	KTP		P

Class	Scientific Name	Common Name	NSW status	Comm. status	Records
Threat	Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	Predation by Gambusia holbrooki Girard, 1859 (Plague Minnow or Mosquito Fish)	KTP		P
Threat	Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	Predation by the European Red Fox Vulpes Vulpes (Linnaeus, 1758)	KTP	KTP	P
Threat	Predation by the Feral Cat Felis catus (Linnaeus, 1758)	Predation by the Feral Cat Felis catus (Linnaeus, 1758)	KTP	KTP	P
Threat	Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	Predation, habitat degradation, competition and disease transmission by Feral Pigs, Sus scrofa Linnaeus 1758	KTP	KTP	P
Threat	Removal of dead wood and dead trees	Removal of dead wood and dead trees	KTP		P

NSW GOVERNMENT

Biodiversity Offset Scheme (BOS) Entry Threshold Map



7,869.2 0 3,934.62 7,869.2 Metres

WGS_1984_Web_Mercator_Auxiliary_Sphere

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- Biodiversity Values that have been mapped for more than 90 days
- Biodiversity Values added within last 90 days

Notes

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NSW GOVERNMENT

Biodiversity Values Map and Threshold Report

Results Summary

Date of Calculation	11/09/2020 9:27 AM		**BDAR Required***
Total Digitised Area	150.1	ha	
Minimum Lot Size Method	Lot size		
Minimum Lot Size	906.72	ha	
Area Clearing Threshold	1	ha	
Area clearing trigger Area of native vegetation cleared	Unknown #		Unknown #
Biodiversity values map trigger Impact on biodiversity values map(not including values added within the last 90 days)?	yes		yes
Date of the 90 day Expiry	N/A		

*If BDAR required has:

- at least one 'Yes': you have exceeded the BOS threshold. You are now required to submit a Biodiversity Development Assessment Report with your development application. Go to https://customer.lmbc.nsw.gov.au/assessment/AccreditedAssessor to access a list of assessors who are accredited to apply the Biodiversity Assessment Method and write a Biodiversity Development Assessment Report
- 'No': you have not exceeded the BOS threshold. You may still require a permit from local council. Review the development control plan and consult with council. You may still be required to assess whether the development is "likely to significantly affect threatened species' as determined under the test in s. 7.3 of the Biodiversity Conservation Act 2016. You may still be required to review the area where no vegetation mapping is available.

Where the area of impact occurs on land with no vegetation mapping available, the tool cannot determine the area of native vegetation cleared and if this exceeds the Area Threshold. You will need to work out the area of native vegetation cleared - refer to the BOSET user guide for how to do this.

On and after the 90 day expiry date a BDAR will be required.

Disclaimer

This results summary and map can be used as guidance material only. This results summary and map is not guaranteed to be free from error or omission. The State of NSW and Office of Environment and Heritage and its employees disclaim liability for any act done on the information in the results summary or map and any consequences of such acts or omissions. It remains the responsibility of the proponent to ensure that their development application complies will all aspects of the *Biodiversity Conservation Act 2016*.

The mapping provided in this tool has been done with the best available mapping and knowledge of species habitat requirements. This map is valid for a period of 30 days from the date of calculation (above).

Acknowledgement

I as the applicant for this development, submit that I have correctly depicted the area that will be impacted or likely to be impacted as a result of the proposed development.

Signature_____ Date: 11/09/2020 09:27 AM

APPENDIX B – FAUNA SPECIES RECORDED DURING THE FIELD SURVEYS

These species were identified on the subject site during the surveys:

Species Name	Common name	BC Act	EPBC Act	Native/Exotic	Notes
Barnardius zonarius	Australian Ringneck, race '*barnardi*'	-	-	N	Seen/heard
Corvus bennetti	Little Crow	-	-	N	Seen/heard
Ocyphaps lophotes	Crested Pigeon	-	-	N	Seen/heard
Pomatostomus ruficeps	Chestnut-crowned Babbler	-	-	N	Heard
Northiella haematogaster	Blue Bonnet	-	-	N	Heard
Artamus cinereus	Black-faced Woodswallow	-	-	N	Seen/heard
Anthus novaeseelandiae	Australasian Pipit	-	-	N	Seen/heard
Calamanthus campestris	Rufous Fieldwren	V	-	N	Seen/heard
Malurus leucopterus	White-winged Fairy-wren	-	-	N	Heard
Vanellus tricolor	Banded Lapwing	-	-	N	Seen/heard
Eolophus roseicapilla	Galah	-	-	N	Seen/heard

Species Name	Common name	BC Act	EPBC Act	Native/Exotic	Notes
Cracticus tibicen	Australian Magpie	-	-	N	Seen/heard
Psophodes cristatus	Chirruping Wedgebill	-	-	N	Seen/heard
Rhipidura leucophrys	Willie Wagtail	-	-	N	Seen/heard
Cacatua sanguinea	Little Corella	-	-	N	Heard
Aythya australia	Hardhead	-	-	N	Seen/heard
Dromaius novaehollandiae	Emu	-	-	N	Dead
Psephotus varius	Mulga Parrot	-	-	N	Seen
Falco cenchroides	Nankeen Kestrel	-	-	N	Seen
Manorina flavigula	Yellow-throated Miner	-	-	N	Seen
Acanthiza uropygialis	Chestnut-rumped Thornbill	-	-	N	Seen/heard
Milvus migrans	Black Kite	-	-	N	Seen/heard
Tiliqua rugosa	Shingleback Lizard	-	-	N	Dead
Ovis aries	Sheep	-	-	E	Dead

Species Name	Common name	BC Act	EPBC Act	Native/Exotic	Notes
Capra hircus	Goats	-	-	E	Seen
Bos taurus	Cattle	-	-	E	Dead
Canis lupus familiaris	Dog	-	-	E	Signs
Macropus fuliginosus	Western Grey Kangaroo	-	-	N	Seen
Macropus rufus	Red Kangaroo	-	-	N	Seen

APPENDIX C – HABITAT ASSESSMENTS

Likelihood of occurrence table for BC Act listed threatened species and communities. List generated by conducting a vegetation associations report for the Broken Hill Complex Bioregion, Barrier Range and Barrier Range Outwash subregions and filtering the results by the PCTs present within the subject site. To determine whether any threatened species occurred near the subject site, BioNet Atlas records of threatened species within the Barrier Range and Barrier Range Outwash IBRA subregions were downloaded and the records clipped to within 20 km of the subject site in QGIS.

NSW Status: P=Protected, P13=Protected native plant, V=Vulnerable, E1=Endangered, E2=Endangered population, E4=Extinct, E4A=Critically endangered, 2=Category 2 sensitive species, 3=Category 3 sensitive species.

Commonwealth Status: C=CAMBA, J=JAMBA, K=ROKAMBA, CE=Critically endangered, E=Endangered, V=Vulnerable.

Record within 10 km: PMST = Identified from the Protected Matters Search Tool

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Acacia loderi shrublands		E	-	-	-	P	**Present.** Present within PCT 128.
Acacia carneorum	Purple-wood Wattle	V	V	Species (all year)	Yes. No threshold identified as yet.	Yes	**Possible.** Suitable habitat present (PCT 128). Not identified on site in OzArk 2020 surveys.
Acacia notabilis	Mallee Golden Wattle	E	-	Species (all year)	No	No	**Possible.** Suitable habitat present (PCT 60, 128 and 155). Not identified on site in OzArk 2020 surveys.
Atriplex infrequens	A saltbush	V	V	Species (Nov-Feb)	No	No	**Possible.** Suitable habitat present (PCT 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Brachyscome papillosa	Mossgiel Daisy	V	V	Species (Sep-Nov)	No	No	**Unlikely.** Sites are outside the known and predicted distribution of this species.
Calotis moorei	A burr-daisy	E	E	Species (Sep-Nov)	Yes. No threshold identified as yet.	No	**Possible.** Suitable habitat present (PCT 128 and 222).
Swainsona flavicarinata	Yellow-Keeled Swainsona	E	-	Species (Jun-Oct 4-7 weeks after above average rainfall)	Yes. No threshold identified as yet.	No	**Possible.** Suitable habitat present (PCT 128, 155 and 222).
Swainsona murrayana	Slender Darling Pea	V	V	Species (Sep)	No	No	**Possible.** Suitable habitat present (PCT 155 and 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Swainsona viridis	Creeping Darling Pea	E	-	Species (Sep-Oct, after average to wet seasonal conditions)	Yes. No threshold identified as yet.	No	**Possible.** Suitable habitat present (PCT 155 and 222).
Ardeotis australis	Australian Bustard	E	-	Species (all year)	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Ctenophorus mirrityana	Barrier Range Dragon	E	-	Species (Oct-March)	No	No	**Possible.** Suitable habitat present (PCT 60 and 155).
Hamirostra melanosternon	Black-breasted Buzzard	V	-	Dual (Sep-Nov)	No	No	**Possible.** Suitable habitat present (PCT 128 and 222).
Pseudomys bolami	Bolam's Mouse	E	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 155).
Burhinus grallarius	Bush Stone-curlew	E	-	Species (all year)	No	No	**Possible.** Suitable habitat present (PCT 128).
Nyctophilus corbeni	Corben's Long-eared Bat	V	V	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 128). Possible calls recorded during Anabat surveys (GHD) at adjacent Blue Bush Facility site.

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Lucasium stenodactylum	Crowned Gecko	V	-	Species (Oct-Mar)	No	No	**Possible.** Suitable habitat present (PCT 60, 128 and 155).
Notomys fuscus	Dusky Hopping-mouse	E	V	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 155 and 222).
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Diplodactylus platyurus	Eastern Fat-tailed Gecko	E	-	Species (Oct-Dec)	No	No	**Possible.** Suitable habitat present (PCT 60 and 128).
Phaps histrionica	Flock Bronzewing	E	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60 and 155).
Leggadina forresti	Forrest's Mouse	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 155 and 222).
Falco hypoleucos	Grey Falcon	E	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Pomatostomus halli	Hall's Babbler	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60).
Vespadelus baverstocki	Inland Forest Bat	V	-	Ecosystem	No	No	**Present.** Recorded by Anabat device at adjacent Blue Bush Facility site (GHD). Suitable habitat present (PCT 60 and 128).
Ramphotyphlops endoterus	Interior Blind Snake	E	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60 and 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Antechinomys laniger	Kultarr	E	-	Ecosystem	No	No	**Possible.** Subject site within predicted (not known) distribution. However, suitable habitat is present (PCT 60, 128, 155 and 222).
Hieraaetus morphnoides	Little Eagle	V	-	Dual (Aug-Oct)	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Chalinolobus picatus	Little Pied Bat	V	-	Ecosystem	No	No	**Present.** Recorded by Anabat device at adjacent Blue Bush Facility site (GHD). Suitable habitat present (PCT 60, 128 and 155).
Rattus villosissimus	Long-haired Rat	V	-	Ecosystem	No	No	**Possible.** Subject site within predicted (not known) distribution. However, suitable habitat is present (PCT 155).
Lophochroa leadbeateri	Major Mitchell's Cockatoo	V	-	Dual (Sep-Oct)	No	Yes	**Possible.** Suitable foraging habitat present (PCT 60, 128, 155 and 222). No hollow-bearing trees present for breeding.
Simoselaps fasciolatus	Narrow-banded Snake	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 128, 155 and 222).
Grantiella picta	Painted Honeyeater	V	V	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60 and 128).
Certhionyx variegatus	Pied Honeyeater	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128 and 155).
Calyptorhynchus banksii samueli	Red-tailed Black-Cockatoo (inland subspecies)	V	-	Dual (May-Jul; Sep-Dec)	No	No	**Unlikely.** The species is essentially confined to the Darling Riverine Plains Bioregion.

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Pyrrholaemus brunneus	Redthroat	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 155 and 222).
Pseudonaja modesta	Ringed Brown Snake	E	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Calamanthus campestris	Rufous Fieldwren	V	-	Ecosystem	No	Yes	**Present.** Suitable habitat present (PCT 155 and 222). Species recorded at the Facility Site during OzArk field surveys and assumed to be present within similar habitat at the proposed gravel pits and access tracks.
Pseudomys hermannsburgensis	Sandy Inland Mouse	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Circus assimilis	Spotted Harrier	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Lophoictinia isura	Square-tailed Kite	V	-	Dual (Sep-Jan)	No	No	**Possible.** Suitable habitat present (PCT 60).
Antaresia stimsoni	Stimson's Python	V	-	Species	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).
Sminthopsis macroura	Stripe-faced Dunnart	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60, 128, 155 and 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Amytornis modestus obscurior	Thick-billed Grasswren (north-west NSW subspecies)	CE	CE	Species (Jul-Sep)	Yes. Any impact on the species from development could be potentially serious and irreversible.	No	**Possible.** Suitable habitat present (PCT 155 and 222). Generally thought to be extinct in NSW until recently located in the Packsaddle area, around 100 km north of Broken Hill. No local records.
Ctenotus brooksi	Wedgesnout Ctenotus	V	-	Ecosystem	No	No	**Possible.** Subject site within predicted (not known) range. No nearby records. However, suitable habitat present (PCT 60, 128 and 155).
Epthianura albifrons	White-fronted Chat	V	-	Ecosystem	No	No	**Present.** Suitable habitat present (PCT 155 and 222). Species recorded at the Facility Site during GHD field surveys and assumed to be present within similar habitat at the proposed gravel pits and access tracks.
Aspidites ramsayi	Woma	V	-	Ecosystem	No	No	**Possible.** Subject site within predicted (not known) range. No nearby records. However, suitable habitat present (PCT 60, 128, 155 and 222).
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V	-	Ecosystem	No	Yes	**Present.** Suitable habitat present (PCT 60, 128 and 222).

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Lerista xanthura	Yellow-tailed Plain Slider	V	-	Ecosystem	No	No	**Possible.** Subject site within predicted (not known) range. No nearby records. However, suitable habitat present (PCT 128).
Indigofera longibractea	Showy Indigo	E	-	Species (all year)	Yes. No threshold identified as yet.	No	**Very unlikely.** Subject site outside known and predicted distribution.
Daphoenositta chrysoptera	Varied Sittella	V	-	Ecosystem	No	No	**Possible.** Suitable habitat present (PCT 60).
Calidris ferruginea	Curlew Sandpiper	E	CE, C, J, K	Dual (no survey - mapped important areas)	Yes. Mapped important areas.	No	**Unlikely.** No coastal wetland habitat present.
Pedionomus torquatus	Plains-wanderer	E	CE	Dual (no survey – mapped important areas)	Yes. Mapped important areas.	No	**Unlikely.** Subject site within predicted (not known) range. No nearby records. No associated habitat.
Pezoporus occidentalis	Night Parrot	PE	E	N/A	N/A	No	**Very unlikely.** Extinct within area.

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Rostratula australis	Australian Painted Snipe	E	E	Ecosystem	No	No	**Possible.** Some suitable habitat present at dams and low-lying depressions at the study sites following local heavy rain.
Solanum karsense	Menindee Nightshade	V	V	Species (Sep-Nov)	No	No	**Unlikely.** No associated habitat present on the subject site.
Motacilla cinerea	Grey Wagtail	-	C, J, K	N/A	N/A	No	**Unlikely.** Suitable habitat not present.
Motacilla flava	Yellow Wagtail	-	C, J, K	N/A	N/A	No	**Unlikely.** Suitable habitat not present.
Actitis hypoleucos	Common Sandpiper	-	C, J, K	N/A	N/A	No	**Possible.** Low quality suitable habitat present at farm dams in the study sites.
Calidris acuminata	Sharp-tailed Sandpiper	-	C, J, K	N/A	N/A	No	**Possible.** Low quality suitable habitat present at farm dams in the study sites.
Calidris melanotos	Pectoral Sandpiper	-	C, J, K	N/A	N/A	No	**Possible.** Low quality suitable habitat present at farm dams in the study sites.
Gallinago hardwickii	Latham's Snipe	-	C, J, K	N/A	N/A	No	**Possible.** Low quality suitable habitat present at farm dams in the study sites.
Ardea alba	Great Egret	-	MA	N/A	N/A	No	**Possible.** Some suitable habitat present at dams and low-lying depressions at the study sites following local heavy rain.

Species Name	Common Name	NSW Status	Comm. Status	Credit type (survey months)	SAII entity	Record within 10 km	Likelihood of Occurrence
Ardea ibis	Cattle Egret	-	MA	N/A	N/A	No	**Possible.** Some suitable habitat present at dams and low-lying depressions at the study sites following local heavy rain.
Chrysococcyx osculans	Black-eared Cuckoo	-	MA	N/A	N/A	No	**Possible.** The species is found in drier country where species such as mulga and mallee form open woodlands and shrublands. It is often found in vegetation along creek beds.
Merops ornatus	Rainbow Bee-eater	-	MA	N/A	N/A	No	**Possible.** It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It occurs in farmland, orchards and vineyards, and is regularly recorded in other disturbed habitats including roadside vegetation and in quarries, mines or gravel pits, where they often breed.

APPENDIX D – EPBC ACT ASSESSMENTS OF SIGNIFICANCE

Assessments of significance have been provided for the following threatened species listed under the EPBC Act that have the potential to occur on the subject site:

- *Acacia carneorum* (Purple-wood Wattle) - Vulnerable
- *Atriplex infrequens* (A saltbush) – Vulnerable
- Calotis moorei (A burr-daisy) – Endangered
- Swainsona murrayana (Slender Darling Pea) – Vulnerable
- *Nyctophilus corbeni* (Corben's Long-eared Bat) – Vulnerable
- *Notomys fuscus* (Dusky Hopping-mouse) – Vulnerable
- *Grantiella picta* (Painted Honeyeater) – Vulnerable
- *Amytornis modestus obscurior* (Thick-billed Grasswren (north-west NSW subspecies) – Critically Endangered
- *Rostratula australis* (Australian Painted Snipe) – Endangered
- *Actitis hypoleucos* (Common Sandpiper) - Migratory
- *Calidris acuminata* (Sharp-tailed Sandpiper) - Migratory
- *Gallinago hardwickii* (Latham's Snipe) – Migratory
- *Ardea alba* (Great Egret) – Marine
- *Ardea ibis* (Cattle Egret) - Marine
- *Chrysococcyx osculans* (Black-eared Cuckoo) - Marine
- *Merops ornatus* (Rainbow Bee-eater) - Marine

Threatened Flora

Purple-wood Wattle	
Significant Impact Guideline	**Assessment**
Lead to a long-term decrease in the size of an important population of a species	An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. A population was recorded south of the Blue Bush Facility site and is regarded as being an 'important population' as it includes a relatively large population and would contribute to genetic diversity within the species. Various other populations are known in the region, including elsewhere along the Silver City Highway. Purple-wood Wattle was not recorded during OzArk surveys of the subject site. The Purple-wood Wattle is a distinctive species and can be detected at all times of year. Therefore, it is considered unlikely that the proposal would directly impact a population of this species. However, further targeted surveys of the entire subject site are required to confirm the species presence / absence.
Reduce the area of occupancy of an important population	The proposal would not directly impact any known populations of the Purple-wood Wattle. 3 ha of potential habitat is present on the subject site. However, similar habitat is present throughout the wider study area. As such, the project would not lead to a long-term decrease in the size of an important population of this species.
Fragment an existing important population into two or more populations	No known populations occur on the subject site. The proposal would remove a small area of potential habitat for this species. However, larger areas of similar habitat occur in the surrounding study area. As such, the proposal is unlikely to fragment a population into two or more populations.

Purple-wood Wattle	
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. No known populations occur on the subject site. The proposal would remove a small area of potential habitat for this species. However, larger areas of similar habitat occur in the surrounding study area. As such, no adverse effects on habitat critical to the survival of the species are expected.
Disrupt the breeding cycle of an important population	The Purple-wood Wattle tends to occur in colonies of 20 to 60 plants, which are clonal; seed viability is generally low and the majority of seeds are non-dormant. New suckers are produced either annually or biannually in two growth pulses in autumn and spring, independent of root disturbance (DPIE 2020b). The development envelope at the Blue Bush Facility would be located away from riparian habitat, and the stand of Purplewood Wattle purposefully avoided. A small portion of potential habitat (3 ha) at the subject site would be cleared, and similar habitat is present throughout the area. As such, the proposal is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal would not directly impact any known populations of this species. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of potential habitat, the fragmentation of a population is considered unlikely. The project is therefore unlikely to cause this species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline, or	No diseases are known to impact this species. The project is unlikely to introduce any disease to the area that may cause the species to decline.

Purple-wood Wattle	
Interfere with the recovery of the species.	To date, a recovery plan for the species has not been developed. A targeted strategy for managing this species has been developed by OEH under the Saving Our Species program; however, this strategy only relates to specific management sites. Other activities recommended by OEH to assist this species and relevant to this project include: • Exclude mining and destructive mineral exploration from any areas containing this species • Baseline surveys are required to confirm known populations and to locate new ones – The subject site was searched incidentally for the species while conducting BAM plots; however, targeted surveys for this species will be conducted for the BDAR in Sep-Oct. The project is unlikely to substantially interfere with the recovery of the species as no known population is present on the subject site and given the small area of potential habitat to be removed.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Purple-wood Wattle for the following reasons: • There would be no impacts on known populations • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to further assess potential impacts if present.

Atriplex infrequens	
Significant Impact Guideline	**Assessment**
Lead to a long-term decrease in the size of an important population of a species	An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. Surveys to date have not been conducted in the appropriate season. Targeted surveys are proposed in late spring to determine if any populations are present and would be impacted. If a population of this species is recorded in the study area it would be regarded as being an 'important population' as there are no local records and any population would contribute to genetic diversity within the species. The proposal would not directly impact any known populations of these species. Given the lack of evidence of these species near the subject site and limited impact on riparian habitat, the proposal is unlikely to lead to a long-term decrease in the size of an important population of this species.
Reduce the area of occupancy of an important population	The proposal would not directly impact any known populations of the species. 131.2 ha of potential habitat is present on the subject site. However, larger areas of similar habitat occur in the surrounding study area. As such, the proposal is unlikely to lead to a long-term decrease in the size of an important population of this species.
Fragment an existing important population into two or more populations	No known populations occur on the subject site. The proposal would remove potential habitat for this species. However, large areas of similar habitat occur in the surrounding locality. As such, the proposal is unlikely to fragment a population into two or more populations.

Atriplex infrequens	
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. No known populations occur on the subject site. The proposal would remove potential habitat for this species. However, large areas of similar habitat occur in the surrounding study area. As such, no adverse effects on habitat critical to the survival of the species are expected.
Disrupt the breeding cycle of an important population	The subject site minimises use of riparian habitat, which limits potential impacts on habitat for *Atriplex infrequens*. This species is wind pollinated, and construction elsewhere on the subject site is unlikely to affect the breeding cycle of the species. Given the lack of local records and limited potential for impacts, the project is unlikely to disrupt the breeding cycle of an important population of this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal would not directly impact any known populations of this species. Potential habitat on the site would comprise a small proportion of potential habitat in the locality i.e. larger areas of similar habitat occur in the surrounding study area. While there is potential for fragmentation of potential habitat, the fragmentation of a population is considered unlikely. The project is therefore unlikely to cause this species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline, or	No diseases are known to impact this species. The project is unlikely to introduce any disease to the area that may cause the species to decline.

Atriplex infrequens	
Interfere with the recovery of the species.	To date, a recovery plan for these species has not been developed. Priority actions for this species include: • Manage any changes to drainage-line hydrology that adversely affect this species. Apart from the widening of an access track across Rantyga Creek and several other minor, ephemeral watercourses / drainage lines, the development envelope would be located away from riparian habitat, which would limit potential impacts on habitat for *Atriplex infrequens*. The project is unlikely to substantially interfere with the recovery of the species given the avoidance / minimisation of impacts on the main drainage lines.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on *Atriplex infrequens* for the following reasons: • There would be no impacts on known populations • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality • Impacts to main drainage lines and watercourses to be avoided and / or minimised, wherever possible Further targeted surveys are proposed to confirm if the species is absent from the sites, or to further assess potential impacts if present.

Calotis moorei	
Significant Impact Guideline	**Assessment**
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The proposal would not directly impact any known population of this species. Larger areas of similar habitat occur in the surrounding study area. Given the lack of evidence of this species in the locality, and limited impact on chenopod shrubland habitat, the project is unlikely to lead to a long-term decrease in the size of a population of this species. No surveys have been conducted as yet for this species. Targeted surveys will be undertaken in the appropriate season for this species (Sep-Nov).
Reduce the area of occupancy of the species	No local populations of this species are known. *Calotis moorei* is currently known from two distinct geographic areas, with a population at "Mount Mulyah" north-west of Louth, and three populations near Menindee, both located ~80 km from the subject site. There is 134.2 ha of potential habitat on the subject site. Although large, this comprises a small proportion of potential habitat in the locality. Given the lack of local records and extent of similar habitats in the locality, the project is unlikely to reduce the area of occupancy of a population.
Fragment an existing population into two or more populations	No local populations of this species are known. Potential habitat on the subject site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of habitat, given the lack of any nearby records, the fragmentation of a population is considered unlikely.
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. There would be no impact on known populations of the species. Chenopod shrubland habitat at the site would comprise a small proportion of habitat available in the locality. No adverse effects on habitat critical to the survival of the species are expected.

Calotis moorei	
Disrupt the breeding cycle of a population	*Calotis moorei* is a perennial herb which flowers in the first year of growth. Chenopod shrubland is present throughout the locality and impacts at the site would comprise a small proportion of this habitat type. If present, construction could impact breeding at the sites, however based on the information above, a population is unlikely to occur given there are no local records. As such, the proposal is unlikely to disrupt the breeding cycle of an important population of this species.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal would not directly impact any known populations of this species. Potential habitat in the site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of habitat, given the lack of any nearby records, the fragmentation of a population is considered unlikely. The project is therefore unlikely to cause this species to decline.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline, or	No diseases are known to impact this species. The proposal is unlikely to introduce any disease to the area that may cause these species to decline.
Interfere with the recovery of the species.	A recovery plan has been prepared for this species. Recovery actions include undertaking further survey and to monitor existing populations. The project is unlikely to substantially interfere with the recovery of the species given that there are no known populations in the locality, and larger areas of similar habitat occur in the surrounding study area.
Conclusion	The proposed action is unlikely to result in a significant impact on *Calotis moorei* for the following reasons: • There would be no impacts on known populations • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to further assess potential impacts if present.

Slender Darling Pea	
Significant Impact Guideline	**Assessment**

Slender Darling Pea	
Lead to a long-term decrease in the size of an important population of a species	An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. Surveys to date have not been conducted in the appropriate season. Targeted surveys are proposed in late spring to determine if any populations are present and would be impacted. If a population of this species is recorded in the study area it would be regarded as being an 'important population' as there are no local records and any population would contribute to genetic diversity within the species. The proposal would not directly impact any known populations of this species. There are only two records of the species within the adjoining IBRA subregions, the closest being approximately 50 km north-west of the subject site from 1947. The project would impact areas of heavily grazed bluebush vegetation on the subject site. larger areas of similar habitat occur in the surrounding study area. Given the lack of evidence of this species in the locality, high levels of existing disturbance of potential habitat at the subject site and large areas of similar habitat in the locality, the proposal is unlikely to lead to a long-term decrease in the size of an important population of this species.
Reduce the area of occupancy of an important population	The proposal would not directly impact any known populations of the species. 147.1 ha of potential habitat is present on the subject site. However, larger areas of similar habitat occur in the surrounding study area. As such, the proposal is unlikely to lead to a long-term decrease in the size of an important population of this species.
Fragment an existing important population into two or more populations	No known populations occur on the subject site. The proposal would remove potential habitat for this species. However, large areas of similar habitat occur in the surrounding study area. As such, the proposal is unlikely to fragment a population into two or more populations.

Slender Darling Pea	
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of a species refers to areas that are necessary: • for activities such as breeding or dispersal. • for the long-term maintenance of the species including the maintenance of other species essential to the survival of the species, such as pollinators. • to maintain genetic diversity and long-term evolutionary development. • for the reintroduction of populations or recovery of the species. No known populations occur on the subject site. The closest record is approximately 50 km north-west of the subject site from 1947. Impacts on bluebush and grassland habitats would comprise a small proportion of habitat available in the locality. As such, no adverse effects on habitat critical to the survival of the species are expected.
Disrupt the breeding cycle of an important population	*Swainsona* species are largely perennials, resprouting in suitable conditions from a persistent rootstock. Copious flowers and abundant quantities of seed can be produced under favourable conditions. The species is generally is generally described as locally common to abundant in New South Wales (DAWE 2020b). If present, construction could impact breeding at the subject site. However, based on the information above, it is considered unlikely that the species occurs. The closest record is approximately 50 km north-west of the subject site from 1947 and impacts on the subject site would comprise a small proportion of the species preferred habitat type i.e. larger areas of similar habitat occur in the surrounding study area. As such, the breeding cycle of an important population is unlikely to be disrupted.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal would not directly impact any known populations of this species. Potential habitat in the subject site would comprise a small proportion of potential habitat in the locality. While there is potential for fragmentation of potential habitat, the fragmentation of a population is considered unlikely. The project is therefore unlikely to cause this species to decline.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules.
Introduce disease that may cause the species to decline, or	No diseases are known to impact this species. The project is unlikely to introduce any disease to the area that may cause the species to decline.

Slender Darling Pea	
Interfere with the recovery of the species.	To date, a recovery plan for these species has not been developed. Management actions that will support recovery include: • Ensure that surveys are undertaken during the flowering season. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to assess potential impacts if present. The proposal is unlikely to substantially interfere with the recovery of the species given that there are no local records, and large areas of similar quality habitat are present throughout the locality.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Slender Darling Pea for the following reasons: • No local populations of this species are known, with the main area of occurrence associated with the Murray-Darling Basin • Potential habitat on the subject site is moderately - heavily grazed • Potential habitat on the sites would comprise a small proportion of potential habitat in the locality. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to further assess potential impacts if present.

Threatened Fauna

Ave

Thick-billed Grasswren	
Significant Impact Guideline	**Assessment**
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The Thick-billed Grasswren was generally thought to be extinct in NSW until located in the Packsaddle area about 100 km north of Broken Hill in 2008. To date, the population near Packsaddle is the only known population of Thick-billed Grasswrens and repeated observations from 2008 to 2011 detected no more than 10 adult birds distributed in pairs across a maximum of five sites. Priority habitat appears to be shrubland dominated by Blackbush (*Maireana pyramidata*) (PCT 153) that is higher and denser than surrounding areas (DPIE 2020b). Other PCTs associated with this species comprise PCT 155 and PCT 222 (both present on the subject site). The species may still occur at other locations in the Upper Western Region. Potential bluebush habitat is present at the sites. No preferred Blackbush habitat is present. Potential habitat within the subject site is heavily grazed and unlikely to be suitable for this species and the subject site is over 150 km south of known records. Large areas of similar bluebush habitat is present throughout the locality. The proposal would remove 147.1 ha of potential bluebush habitat from the subject site. No priority habitat is present at these sites. No surveys have been conducted as yet for this species. Targeted surveys will be undertaken in the appropriate season for this species (September). Given the lack of recent local records, lack of priority habitat, presence of similar bluebush habitat in the locality, and high levels of grazing throughout the subject site, the proposal is unlikely to lead to a long-term decrease in the size of a population.
Reduce the area of occupancy of the species	The Thick-billed Grasswren is known to occur north of Broken Hill. No priority habitat would be removed. The removal of potential habitat for this species in an area where it is not known to occur would be unlikely to reduce the area of occupancy of the species.

Thick-billed Grasswren	
Fragment an existing population into two or more populations	No known populations occur in or near the study sites. The proposal would remove potential habitat for this species. However, no priority habitat would be removed. High levels of grazing occur throughout the subject site, which further limits its value for this species. Large areas of similar quality bluebush habitat occur in surrounding areas. As such, the proposal is unlikely to fragment a population into two or more populations.
Adversely affect habitat critical to the survival of a species	Priority habitat appears to be shrubland dominated by Blackbush (*Maireana pyramidata*) that is higher and denser than surrounding areas in the Packsaddle area north of Broken Hill. The study sites are located over 150 km outside this area, and there are no local records. Bluebush habitat within the subject site has and continues to be subjected to intense grazing, further limiting its potential value for this species. Large areas of similar quality bluebush habitat occur in surrounding areas. The project is therefore unlikely to adversely affect habitat critical to the survival of the species.
Disrupt the breeding cycle of a population	The Thick-billed Grasswren is sedentary, with established pairs maintaining 20 - 40 hectare territories year-round. Nesting occurs in April in NSW. No known populations occur in or near the subject site. The proposal would not impact any priority habitat and is not within an area where this species is known to occur and breed. The loss of potential bluebush habitat from an areas surrounded by similar habitat, and from well outside the known distribution of the species, is unlikely to disrupt the breeding cycle of a population of the Thick-billed Grasswren.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Given that no priority habitat would be impacted, the subject site is over 150 km from known populations, and that no areas of habitat would become isolated, it is unlikely that the project would result in the overall decline of the species.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. The subject site is already habitat for a range of pest species, including rabbits (*Oryctolagus cuniculus*), and goats (*Capra hircus*). The facility site is unlikely to increase feral predators in the area. The project would not impact any habitat within an area where this species is known to occur. As such, there is little risk of impact from invasive species as a result of the proposal.

Thick-billed Grasswren	
Introduce disease that may cause the species to decline, or	The project is unlikely to introduce disease into the study area that may cause the species to decline.
Interfere with the recovery of the species.	Key threats to the species are habitat loss, inappropriate grazing, small population size and predation by feral predators. As noted above, the project would not impact any priority habitat or habitat within an area where this species is known to occur. The loss of potential habitat from the project sites is unlikely to interfere with the recovery of the species given the lack of any known populations in the area, and lack of any habitat critical to the survival of the species.
Conclusion	The project is unlikely to result in a significant impact on the Thick-billed Grasswren given: • there are no recent local records of the species • the project is located over 150 km from the only known records in NSW • there would be no impact on habitat critical to the survival of the species • no priority habitat is present in the study sites • The proposal is unlikely to fragment or isolate any habitat for the species • the project is unlikely to increase the threat of predation by feral species. Further targeted surveys are proposed to confirm if the species is absent from the sites, or to further assess potential impacts if present.

Painted Honeyeater	
Significant Impact Guideline	**Assessment**
Lead to a long-term decrease in the size of an important population of a species	The subject site is not identified as occurring within a Priority Management Area for this species. The species is nomadic, and the subject site does not contain a suitable abundance of mistletoe for the species. Therefore, the subject site is unlikely to support an important population of the species.
Reduce the area of occupancy of an important population	No. The subject site is unlikely an important population (see above).
Fragment an existing important population into two or more populations	No. The subject site is unlikely an important population (see above).
Adversely affect habitat critical to the survival of a species	The proposal would remove up to 39.4 ha of habitat for the species. However, the subject site does not contain a suitable abundance of mistletoe for the species and is therefore unlikely to provide habitat critical to the survival of the species.
Disrupt the breeding cycle of an important population	No. The subject site is unlikely an important population (see above).
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	The proposal would remove 39.4 ha of associated native habitat for this species. The species is nomadic and given the mobility of the species and large area of available habitat in the locality, the proposal is unlikely to fragment an existing important population into two or more populations.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The project is unlikely to result in invasive species that are harmful to this species becoming established in the area. Cats and foxes are already present at the Blue Bush Facility site, and are likely to be present on the subject site.
Introduce disease that may cause the species to decline, or	The project is unlikely to introduce disease that may cause the species to decline.

Painted Honeyeater	
Interfere with the recovery of the species.	There are no current recovery plans for this species, however a NSW 'Saving our Species' Strategy has been published, which lists clearing of woodlands and open forests as a threat to the species. No known populations occur on the subject site. The proposal would remove potential habitat for this species. However, larger areas of similar habitat occur in the surrounding locality. As such, the proposal is unlikely to impact the species recovery at a regional population scale.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Painted Honeyeater for the following reasons: • No local populations of this species are known • Potential habitat on the subject site does not contain a suitable abundance of mistletoe • Potential habitat on the sites would comprise a small proportion of potential habitat in the locality.

Australian Painted Snipe	
Significant Impact Guideline	**Assessment**
According to the DotE (2013) 'significant impact criteria', an action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:	
Lead to a long-term decrease in the size of a population	The project would have no impact on good quality wetland habitat. Areas of low quality potential habitat associated with Rantyga Creek and several small ephemeral creeks would be removed at the sites. However, given there is already an existing access track across Rantyga Creek, the impact is expected to be minimal. In summary, given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Reduce the area of occupancy of the species	The Australian Painted Snipe has been recorded at wetlands in all states of Australia and is most common in eastern Australia. The area of occupancy has undoubtedly declined as approximately 50% of wetlands in Australia have been removed since European settlement (DAWE 2020b). The removal of low quality potential habitat associated with small ephemeral creeks is not likely to reduce the area of occupancy of an important population.
Fragment an existing population into two or more populations	Movement patterns are poorly known for this species and it is possibly dispersive or migratory (DAWE 2020b). The removal or disturbance of low quality potential habitat associated with small ephemeral creeks is not likely to fragment the population of this mobile species.
Adversely affect habitat critical to the survival of a species	Australian Painted Snipe breeding habitat requirements may be quite specific: shallow wetlands with areas of bare wet mud and both upper and canopy cover nearby. Nest records are all, or nearly all, from or near small islands in freshwater wetlands, provided that these islands are a combination of very shallow water, exposed mud, dense low cover and sometimes some tall dense cover (Rogers et al. 2005). No preferred breeding habitat (islands in freshwater wetlands) is present. The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks. Given the small area of wetland habitat present, the proposal is unlikely to adversely affect habitat critical to the survival of the species.

Australian Painted Snipe	
Disrupt the breeding cycle of a population	The Australian Painted Snipe may breed in response to wetland conditions rather than during a particular season. The nest is usually placed in a scrape in the ground, normally concealed in thick marshy vegetation (DAWE 2020b). No preferred breeding habitat (islands in freshwater wetlands) is present. The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks that are unlikely to provide breeding habitat for this species. Given the above points, the project is unlikely to disrupt the breeding cycle of a population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Removal of low quality potential habitat associated with ephemeral creeks is unlikely to affect movement of this species between wetland habitats or affect breeding habitat. Given the small area of wetland habitat that would be impacted, limited number of records present, and lack of good quality breeding habitat, the project is unlikely to affect habitat such that the species declines.
Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Introduce disease that may cause the species to decline, or	The project is unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species.	The Australian Painted Snipe has primarily been impacted by the loss of wetland habitat (DAWE 2020b). The project would have limited impacts on wetland habitat. No key breeding habitat (large freshwater wetlands) are located on the subject site or would be affected by the proposal. Few local records are known. As such, the project is unlikely to interfere with the recovery of the species.

Australian Painted Snipe	
Conclusion	The project is unlikely to have a significant impact on the Australian Painted Snipe as: • No key breeding habitat is located in the sites or would be affected by the project • The project would have limited impacts on low quality wetland habitat • The project would not isolate any habitat or interrupt movements of the species between wetland habitats.

Mammal

Dusky Hopping-mouse
Assessment
An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. Formerly presumed extinct in NSW, the species was rediscovered in Sturt National Park in the State's far north west corner in 2003. Since then, the species has been recorded from around 50 km south of Sturt National Park, from around 80 km north of Broken Hill and recently a single individual was found killed by a cat in the Broken Hill urban area (DPIE 2020b). The project sites are at or beyond the known limit of distribution of the species. If present, a population would be an important population. The project is located at or beyond the known limit of distribution of the species. No preferred habitat (sand dunes) is present within the subject site; however, is present in the wider study area. The species could potentially occur in chenopod shrublands at the subject site during eruptive periods if a local population is present. The loss of this atypical habitat is not likely to lead to a long-term decrease in the size of an important population of a species given the lack of preferred habitat and location of the sites well away from most known records in the Strzelecki Ranges bioregion.
No preferred habitat (sand dunes) is present on the subject site. A population of the species is unlikely to reside in the areas to be impacted but could occur on occasion during eruptive periods in response to good conditions if a local population is present. The loss of potential marginal habitat at the site would not reduce the area of occupancy of an important population.
No preferred habitat (sand dunes) is present on the subject site. Large areas of chenopod shrubland are present throughout the locality which would provide habitat for dispersal. Construction and operation of the project is unlikely to fragment an existing important population into two or more populations.
The Dusky Hopping-mouse inhabits arid areas of Australia with sand dunes or sand plains with hummocks and water nearby. The species is predominantly restricted to the dune crests. After seasons of good rainfall the species may occur in atypical habitat such as chenopod shrubland on gibber plains, acacia shrubland and sandy creek lines. The proposal would result in the loss of potential marginal habitat at the sites. This habitat type occurs extensively in the locality. Given the lack of impacts on sand dune habitat the proposal is unlikely to adversely affect habitat critical to the survival of a species.

Dusky Hopping-mouse
The Dusky Hopping-mouse breeds throughout the year, including during summer months and in wet and dry conditions. After seasons of good rainfall the species numbers increase substantially, however substantial density reductions and local extinction can occur during dry periods (DAWE 2020b). Habitat in the site may be utilised in seasons with good rainfall, if a population is present. No direct impacts on sand dune habitat would occur. The project would remove areas of atypical chenopod habitat. Large areas of chenopod shrubland are present throughout the locality and would provide habitat for dispersal if a population is present. As such, the project is unlikely to disrupt the breeding cycle of an important population.
No preferred habitat (sand dunes) is likely to be impacted. The species could potentially occur in chenopod shrublands at the site during eruptive periods. Construction and operation of the project is unlikely to substantially reduce or fragment habitat for the species, particularly given the location of the site well away from most known records in the Strzelecki Ranges bioregion.
The proposal is unlikely to result in invasive species that are harmful to this species becoming established in the area. Foxes, cats and pigs are already present at the Blue Bush Facility, and likely present on the subject site.
The project is unlikely to introduce disease that may cause the species to decline.
A targeted strategy for managing this species has been developed under the NSW Saving Our Species program. Recovery activities are focussed in the priority management area in the north-west of the state. The loss of an area of marginal habitat outside the main known distribution of the species is unlikely to substantially interfere with the recovery of the species.
The project is unlikely to result in a significant impact on the Dusky Hopping Mouse given: • The subject site is located outside the main known distribution of the species in the north-west of the State. • No direct impacts on sand dune habitat near the subject site would occur. • The project would result in the loss of potential marginal habitat at the sites. This habitat type occurs extensively in the locality.

Corben's Long-eared Bat	
Significant Impact Guideline	**Assessment**
Lead to a long-term decrease in the size of an important population of a species	An 'important population' is defined by DotE (2013) as a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in Recovery Plans, and/or that are: • key source populations either for breeding or dispersal; • populations that are necessary for maintaining genetic diversity; and/or • populations that are near the limit of the species range. Corben's Long-eared Bat has a scattered distribution mostly within the Murray-Darling Basin. Records of a *Nyctophilus* species were recorded on Anabats at the Blue Bush Facility site. Given the close proximity of the facility site to the subject site it is considered likely that the species also occurs there. Due to the location of the subject site on the edge of the species range, any individuals that may occur in the study sites are taken to be part of an important population. Construction would require the permanent removal of native vegetation from within the subject site, including 3 ha of potential habitat. No hollow-bearing trees were recorded within potential habitat or within the subject site as a whole. Therefore, the subject site is unlikely to provide breeding habitat. Given that breeding habitat would not be impacted and only a small proportion of foraging habitat would be cleared, the proposal is unlikely to lead to a long-term decrease in the size of an important population of a species.
Reduce the area of occupancy of an important population	Corben's Long-eared Bat is known from a large area of central NSW, within the Murray-Darling Basin. The loss of a relatively small area of potential foraging habitat would not reduce the area of occupancy of the important population.
Fragment an existing important population into two or more populations	Corben's Long-eared Bat is a slow flying agile bat, utilising the understorey to hunt non-flying prey. This species would forage along riparian corridors in the locality. Widening of the access track across Rantyga Creek would impact a small patch of riparian habitat. However, where possible, impacts on riparian habitat would be purposely avoided. Given the mobility of the species and large area of available habitat, the proposal is unlikely to fragment an existing important population into two or more populations.

Corben's Long-eared Bat	
Adversely affect habitat critical to the survival of a species	Habitat critical to the survival of Corben's Long-eared Bat comprises hollow-bearing trees, which are a limiting resource. No hollow-bearing trees were recorded within potential habitat or within the subject site as a whole.
Disrupt the breeding cycle of an important population	Corben's Long-eared Bat mates in autumn, and young are born in late spring to early summer. Hollow-bearing trees are required for breeding. Given that no hollow-bearing trees would be impacted, the proposal is unlikely to disrupt the breeding cycle of an important population.
Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Construction would require the permanent removal of potential foraging habitat. Where possible, impacts on riparian habitat has been avoided and / or minimised. Foraging habitat that would be impacted would comprise a small proportion of the home range of individuals, and a negligible proportion of foraging habitat in the locality. Given the limited impact on potential foraging habitat, the project is unlikely to lead to a decline of the species.
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat	The project is unlikely to result in invasive species that are harmful to this species becoming established in the area. Cats and foxes are already present at the Blue Bush Facility site, and are likely to be present on the subject site.
Introduce disease that may cause the species to decline, or	The project is unlikely to introduce disease that may cause the species to decline.
Interfere with the recovery of the species.	The key threats to the viability of this species are loss, fragmentation and degradation of habitat. Construction would require the permanent removal of a relatively small area of potential foraging habitat compared to extensive tracts of similar surrounding habitat. The loss of this habitat is unlikely to substantially interfere with the recovery of the species.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on Corben's Long-eared Bat for the following reasons: • Impacts on riparian habitat would be avoided / minimised • Potential habitat in the sites would comprise a small proportion of potential habitat in the locality • The proposal would not fragment or isolate habitat for this species.

Migratory and Marine Species

Aves

Common Sandpiper	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	In Australia, the Common Sandpiper is found in coastal or inland wetlands, both saline or fresh. It is found mainly on muddy edges or rocky shores. During the breeding season in the northern hemisphere, it prefers freshwater lakes and shallow rivers. The project would have no impacts on good quality wetland habitat. Areas of low quality potential habitat associated with small ephemeral creeks would be removed at the site. Given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The species does not breed in Australia. The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks. Given the small area of wetland habitat present, the proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Common Sandpiper for the following reasons: • The species does not breed in Australia • The project would have no impacts on good quality wetland habitat.

Great Egret	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Great Egrets prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. The project would have no impacts on good quality wetland habitat. Areas of low quality potential habitat associated with small ephemeral creeks would be removed at the site. Given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks. Given the small area of wetland habitat present, the proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Common Sandpiper for the following reasons: • The project would have no impacts on good quality wetland habitat. • The project would impact a small area of low quality wetland habitat

Cattle Egret	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Cattle Egrets are now primarily associated with anthropogenic disturbance, particularly livestock grazing, following their rapid range expansion in the early 20th century. The study area contains a large amount of pastural area and cattle were recorded during the field survey, so the species potentially uses the subject site as a foraging resource. The project would have no impacts on good quality wetland habitat. Areas of low quality potential habitat associated with small ephemeral creeks would be removed at the site. Given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks. Given the small area of wetland habitat present, the proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Cattle Egret for the following reasons: • The project would have no impacts on good quality wetland habitat. • The project would impact a small area of low quality wetland habitat

Sharp-tailed Sandpiper	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	In Australasia, the Sharp-tailed Sandpiper is associated with muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. The species is widespread throughout both coastal and inland Australia and inhabits lagoons, swamps, dams, waterholes, soaks, bore drains and bore swamps, saltworks and sewage farms. The project would have no impacts on good quality wetland habitat. Areas of low quality potential habitat associated with small ephemeral creeks would be removed at the site. Given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The species does not breed in Australia. The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks. Given the small area of wetland habitat present, the proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Common Sandpiper for the following reasons: • The species does not breed in Australia • The project would have no impacts on good quality wetland habitat.

Black-eared Cuckoo	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The Black-eared Cuckoo widespread throughout Australia and is primarily associated with drier habitat where species such as mulga and mallee form open woodlands and shrublands. It is often found in vegetation along creek beds. The species avoids dense vegetation, preferring open and disturbed wooded areas. Given the limited riparian habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The Black-eared Cuckoo breeds throughout Australia (but particularly in southern areas) during the summer. As with most cuckoos the species is a nest parasite relying on the presence of dome-nesting host species such as Speckled Warbler in order to breed. It is likely that the species is at least occasionally present on the subject site; however, it is unlikely that the proposal would have a significant impact on the lifecycle of this species.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Black-eared Cuckoo for the following reasons: • There are no recent local records of the species • The species is considered secure in NSW • The project would have limited impacts on preferred riparian habitat.

Latham's Snipe	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture. The project would have no impacts on good quality wetland habitat. Areas of low quality potential habitat associated with small ephemeral creeks would be removed at the site. Given the limited habitat present, the project is unlikely to lead to a long-term decrease in the size of an important population.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The species does not breed in Australia. The proposal would have limited impacts on low quality potential habitat associated with small ephemeral creeks. Given the small area of wetland habitat present, the proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Common Sandpiper for the following reasons: • The species does not breed in Australia • The project would have no impacts on good quality wetland habitat.

Rainbow Bee-eater	
Significant Impact Guideline	**Assessment**
Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will be found on farmland with remnant vegetation and in orchards and vineyards. It will use disturbed sites such as quarries, cuttings and mines to build its nesting tunnels. The proposal is not likely to have a significant impact on this species when it is present during its spring/summer breeding season and is not likely to impact the migratory nature of this species.
Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species, or	Construction and operation of the project has the potential to spread weeds into areas of potential habitat for this species via vehicle movement. Mitigation measures would be implemented to minimise impacts from sedimentation and altered hydrology regimes. Weed management would be implemented during the construction phase of the project to limit the spread of introduced weed species, including appropriate disposal of introduced vegetative material and propagules. Feral species, such as foxes and cats, are a threat to this species. These species already occur in the study area, and the proposal is unlikely to substantially increase their numbers in wetland and riparian habitats.
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The Rainbow Bee-eater breeds throughout Australia (but particularly in southern areas) during the summer. The species is ground nesting, burrowing into dry soils often on slopes. The species has not been recorded within 20 km of the subject site but could potentially utilize the site as a foraging area. It is unlikely that the proposal would have a significant impact on the lifecycle of this species.
Conclusion	It is concluded that the proposed action is unlikely to result in a significant impact on the Rainbow Bee-eater for the following reasons: • There are no recent local records of the species • The species is considered secure in NSW • The project would have limited impacts on preferred habitat near water.

APPENDIX E: ABORIGINAL CULTURAL HERITAGE DUE DILIGENCE ASSESSMENT

Blue Bush Project, Broken Hill NSW

Aboriginal Cultural Heritage Due Diligence Assessment

FINAL

July 2020

Navin Officer

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EXECUTIVE SUMMARY

Tellus Holdings Ltd proposes to construct and operate a near-surface geological waste repository and associated infrastructure (the 'Blue Bush Facility'), and develop an off-site inter-modal transit station (the 'Blue Bush Inter-modal'). These are collectively known as 'the project' or 'the Blue Bush Project'.

Navin Officer Heritage Consultants (NOHC) was commissioned to prepare an Aboriginal Cultural Heritage Due Diligence Assessment prior to exploratory drilling at the site of the proposed Blue Bush Facility at EL8818 within Pine Point Station on the Silver City Highway, approximately 45 km south of Broken Hill in the Unincorporated Area of New South Wales (NSW).

This assessment addresses the requirements in the brief to identify the potential to disturb any known Aboriginal cultural heritage sites within the subject area; determine, in consultation with relevant stakeholders, the significance of the sites to the Aboriginal community; and identify appropriate measures to avoid those impacts. No Aboriginal sites have previously been registered within the Blue Bush Facility project envelope.

A field inspection of the proposed exploratory drilling sites and access track was undertaken on 25–26 May 2020 by NOHC archaeologists and Aboriginal stakeholders. Forty-two new Aboriginal sites were identified and recorded, consisting of 33 isolated artefacts and nine low-density surface artefact scatters. Based on current information and comparison with the findings of previous studies, the sites are representative of similar types of artefact sites which are common in the region and are considered likely to be of low cultural significance. The location of drill sites and access track will be modified to avoid impact on the sites identified. However, the results of the field survey indicate that there is a high likelihood of additional Aboriginal objects – primarily stone artefacts – to be present within the Blue Bush Facility development envelope and further investigation of the Aboriginal heritage will need to be undertaken to assess the significance of the Aboriginal cultural heritage and the potential impact of the proposed development.

Should the Blue Bush Project be declared State Significant Development (SSD), further Aboriginal cultural heritage investigation and assessment will still be necessary. It is considered likely that the Planning Secretary's Environmental Assessment Requirements will require preparation of an Aboriginal Cultural Heritage Assessment Report for the project area, and consultation with Aboriginal stakeholders in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010).

The exploratory drilling may proceed with caution if access routes and the proposed location of exploration drill holes and boreholes for groundwater monitoring wells can avoid impacts to identified Aboriginal sites.

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ABBREVIATIONS

AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
DECCW	NSW Department of Environment, Climate Change and Water
DPIE	NSW Department of Planning, Industry and Environment (formerly OEH)
ICOMOS	International Council on Monuments and Sites
NOHC	Navin Officer Heritage Consultants Pty Ltd
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales
OEH	NSW Office of Environment and Heritage (now DPIE)
PAD	potential archaeological deposit
SEAR	Planning Secretary's Environmental Assessment Requirement
SSD	State Significant Development

1 INTRODUCTION

1.1 Assessment framework

This assessment has been undertaken to satisfy the requirements of the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (Department of Environment, Climate Change and Water (DECCW) 2010a).

The Code of Practice helps individuals and organisations to exercise due diligence when conducting activities that may harm Aboriginal objects, and sets out steps to take in order to identify whether or not Aboriginal objects are, or likely to be, present in an area; determine whether or not a proposed activity is likely to harm Aboriginal objects (if present); and determine whether an Aboriginal Heritage Impact Permit (AHIP) application is required (DECCW 2010a:2).

The steps are steps are illustrated in Fig. 1.1, and comprise the following:

Step 1: Determine if the activity will disturb the ground surface

Step 2a: Search the Aboriginal Heritage Information Management System (AHIMS) database and use any other sources of information of which you are already aware

Step 2b: Determine if the activity is in area where landscape features indicate the presence of Aboriginal objects

Step 3: Determine if you can avoid harm to the object or disturbance of the landscape feature.

Step 4: Desktop assessment and visual inspection

Step 5: Further investigation and impact assessment

This report documents the results of an Aboriginal Cultural Heritage Due Diligence Assessment of exploration drill holes, groundwater monitoring points and access tracks within the proposed Blue Bush Facility at EL8818 within Pine Point Station on the Silver City Highway, approximately 45 km south of Broken Hill, New South Wales (NSW).

The report was commissioned by Tellus Holdings Ltd.

1.2 Contributors

This report was prepared by Ngaire Richards (Senior Heritage Consultant, Navin Officer Heritage Consultants Pty Ltd (NOHC)) and Madeline van Ewyk (Research Assistant, NOHC). It was reviewed by Dr Susan McIntyre-Tamwoy (Associate Director, NOHC).

NOHC acknowledges the contribution of the Broken Hill Local Aboriginal Land Council and Barkandji Native Title Group Aboriginal Corporation. The following representatives of these organisations participated in the field inspection undertaken on 25–26 May 2020:

- Dulcie O'Donnell, Raymond O'Donnell, Regan O'Donnell, and Peter Farnham (Broken Hill Local Aboriginal Land Council)
- Gerald Quayle (Barkandji Native Title Group Aboriginal Corporation).

1.3 This Report

1.3.1 Outline

This report:

- describes the Aboriginal Cultural Heritage Due Diligence Assessment framework (Section 1)
- describes the proposed activity (Section 2)
- describes the methodology employed in the desktop review, and provides an Aboriginal archaeological context for the subject area (Section 3)
- describes the landscape context of the subject area (Section 4)
- describes the results of the field survey conducted in the context of the assessment (Section 5)
- provides a preliminary assessment of significance of the Aboriginal sites identified (Section 6), and
- provides management recommendations based on the results of the investigation (Section 0).

1.3.2 Restricted Information

Information in this report relating to the exact location of Aboriginal sites should not be published or promoted in the public domain. The following images and report sections should be restricted in any public version of this document:

- Fig. 3.1
- Section 5.4 (grid references and site location information)
- Appendix 1 (AHIMS Search Results)
- Appendix 2 (Aboriginal site descriptions).

The Aboriginal representative Mr Gerald Quayle requested that access to certain information for artefact site 'PP BBF Artefact 19' contained in the AHIMS database should have a gender restriction (i.e. that site information can only be accessed by males) pending further discussion and consideration by the Barkandji people. Following discussions during the survey regarding the preferred protocol for recording the site, it was agreed that Mr Gerald Quayle, representing the Barkandji Native Title Group Aboriginal Corporation, would review and submit the Aboriginal site recording form for this site to AHIMS.

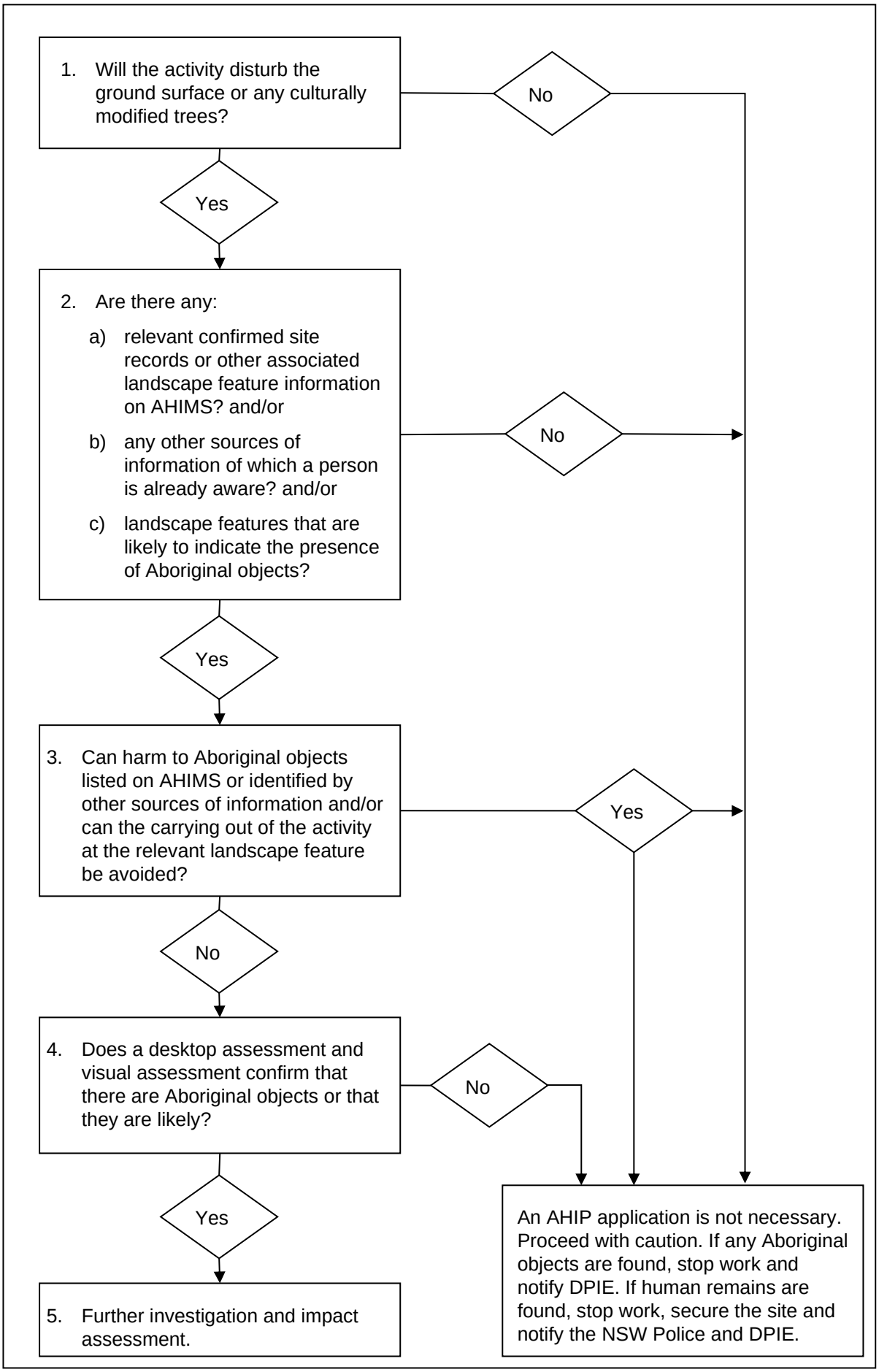

Fig. 1.1 The generic due diligence process (DECCW 2010a:10)

2 PROJECT DESCRIPTION

Tellus Holdings Ltd (Tellus) proposes to construct and operate a near-surface geological waste repository and associated infrastructure (hereafter referred to as the 'Blue Bush Facility'), and develop an off-site inter-modal transit station (the 'Blue Bush Inter-modal'), collectively known as 'the project' or 'the Blue Bush Project'. It is considered likely that the project will be assessed as State Significant Development (SSD) under Part 4 (Division 4.7) of the *Environmental Planning and Assessment Act 1979*.

The Blue Bush Facility is located at EL8818 within Pine Point Station on the Silver City Highway, approximately 45 km south of Broken Hill, NSW. The Blue Bush Inter-modal would be located adjacent to the Adelaide–Sydney Railway Line and within or adjacent to the industrial precinct of Broken Hill.

2.1 Will the activity disturb the ground surface? (Step 1)

Navin Officer Heritage Consultants Pty Ltd (NOHC) has been commissioned by Tellus to prepare a desktop study and undertake a targeted field survey to consider potential impacts on Aboriginal heritage prior to exploratory drilling at the site of the proposed Blue Bush Facility.

The proposed activity consists of drilling 67 exploratory boreholes, and 7 boreholes for groundwater monitoring wells (Fig. 2.1).

The proposed activity will disturb the ground surface.

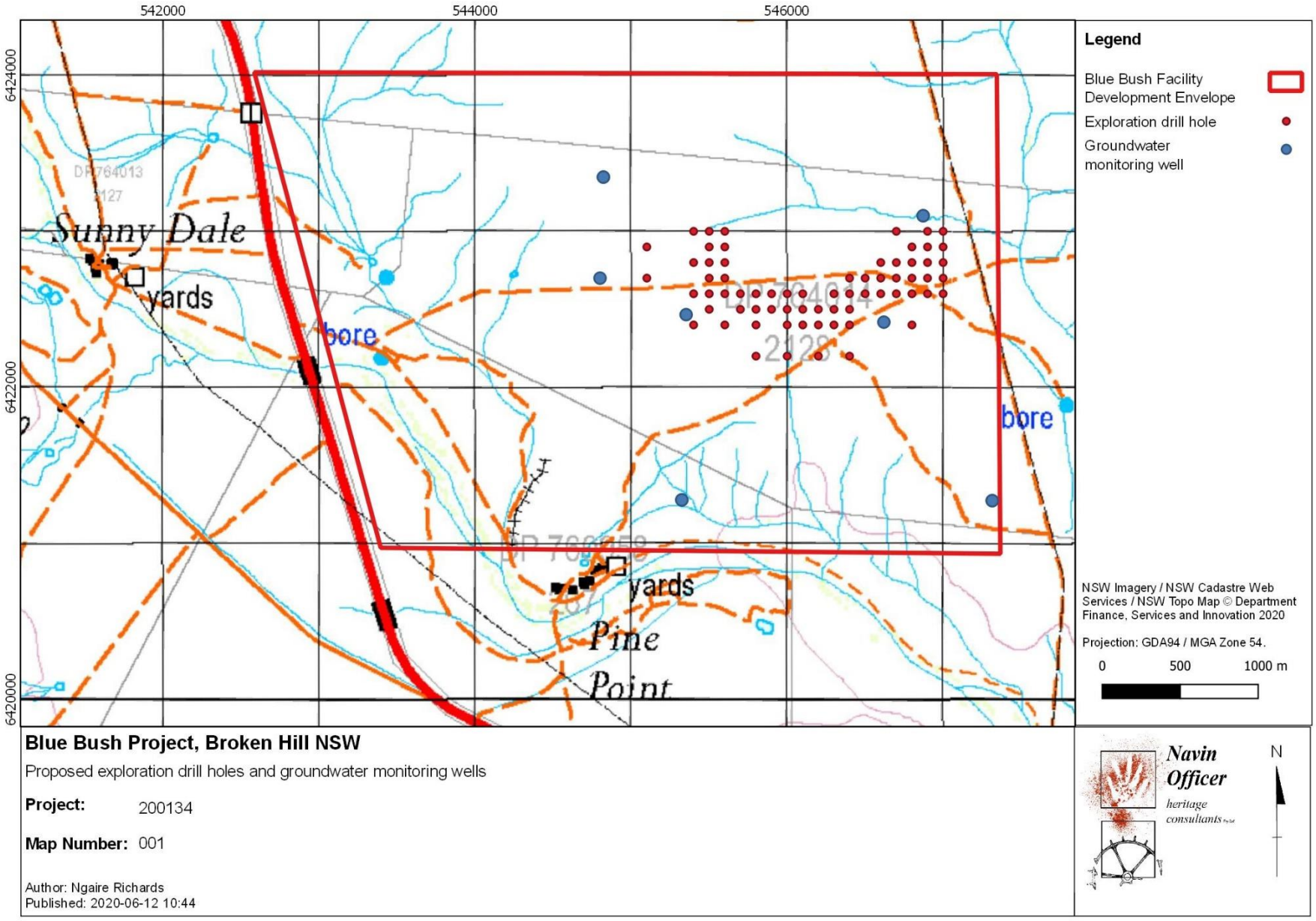

Fig. 2.1 Proposed exploration drill holes and groundwater monitoring wells based on information supplied by Tellus

3 ABORIGINAL HERITAGE INFORMATION MANAGEMENT SYSTEM SEARCH AND LITERATURE REVIEW

3.1 Methodology

A review of the findings of previous archaeological investigations has been undertaken in order to place Aboriginal occupation of the landscape in a local and regional context. The review of documentary sources included a search of the AHIMS database, archaeological reports and academic theses. The review was used to determine if known Aboriginal sites were located within or in the vicinity of the area under investigation, to facilitate site prediction on the basis of known regional and local site patterns, and to place the area within an archaeological and heritage management context.

3.2 AHIMS Search Results

AHIMS was established to collate information on known Aboriginal objects, sites and places. AHIMS is a database maintained by the NSW Department of Planning, Industry and Environment (DPIE) which contains information about Aboriginal objects and places in NSW, including site records and cultural heritage assessment reports. If an Aboriginal object is found that is not already recorded on the AHIMS database, it is a requirement under s.89A of the *National Parks and Wildlife Act 1974* (NSW) (NPW Act) to notify DPIE of the object's location.

An extensive search of the AHIMS database was undertaken on 20 May 2020 (Client Service ID 506679). Seventy-seven Aboriginal sites have previously been registered within a 25 km x 15 km area centered on the proposed Blue Bush Facility and bounded by the following coordinates (GDA94/MGA Zone 54): Eastings: 535000 – 560000, Northings: 6415000 – 6430000 (**Table 3.1**).

Table 3.1 Summary of Aboriginal sites

Aboriginal site feature	Number of sites	% of total
Artefact	68	88.31%
Artefact; Hearth	4	5.19%
Artefact; Hearth; Potential Archaeological Deposit	2	2.60%
Artefact; Potential Archaeological Deposit	2	2.60%
Artefact; Stone Quarry	1	1.30%
Grand Total	**77**	**100.00%**

No Aboriginal sites have previously been registered within the Blue Bush Facility development envelope. No AHIPs have been previously issued within this area.

All 77 sites recorded in the vicinity of the subject area are artefact sites, with a small number identified in association with other Aboriginal site features including hearths, Potential Archaeological Deposits (PADs) and a stone quarry (Fig. 3.1). Of the 77 sites, 23 are listed as destroyed, and 17 as partially destroyed.

A copy of the AHIMS search is provided in Appendix 1.

Sensitive information not for public release - redacted

Fig. 3.1 Location of registered Aboriginal sites in the vicinity of the Blue Bush Facility development envelope

3.3 Previous Aboriginal Archaeological Research

A number of Aboriginal archaeological studies have been undertaken in the vicinity of the subject area. Summaries of these studies are presented below.

Archaeological Investigations at Pine Point and Langwell Stations (Shiner 2003; 2004; 2009)

Justin Shiner carried out archaeological research examining the formation history of stone artefact scatters and heat-retainer hearths on Pine Point and Langwell Stations (of which the subject area is a part). His PhD thesis (2004) and associated reports and publications (for example, see Shiner 2003; 2009) identified that these Aboriginal site features dominate the surface archaeological record in semi-arid western New South Wales. Shiner made the following observations regarding the nature and distribution of these sites:

- artefact scatters mostly occur as deflated and spatially extensive distributions of varying density with occasional hearths
- artefact scatters typically lack clear and readily definable boundaries
- surface deposits contain numerous artefacts often representing multiple stages of core reduction, tool manufacture and discard
- artefacts found on an eroded surface may have been deposited at different times during the past, and do not necessarily represent a one-off discard event
- artefact assemblages are dominated by quartz and two types of silcrete (clast and non-clast), with a small percentage of other raw material including crystal quartz, chert, hornfels, ironstone, quartzite, sandstone and schist
- the raw material types reflect the exploitation of both local and non-local stone sources. Quartz is a local raw material available as cobbles in creek beds and as gibber pavements. Silcrete is a non-local raw material. Outcrops of clast silcrete are known to occur in the low hills approximately 6 km north of Pine Creek. No sources of non-clast silcrete have been identified in the vicinity of the project.

Charcoal samples from 16 heat-retainer hearths at four sampling locations were radiocarbon-dated to establish the time-depth of occupation of the sites, and the period over which different sites were potentially occupied. Two sampling locations were situated on an alluvial terrace adjacent to Pine Creek in the Conservation/Fowlers land system, and two were situated adjacent to Rantyga Creek in the Kars land system (Shiner 2009:27-28). The oldest date obtained was 2004 ± 73 years BP (Wk-10831), and the youngest 261± 49 years BP (Wk-9994). A Bayesian analysis was used to establish whether the dates obtained indicated continuous occupation of the landscape, or whether discontinuities in occupation could be detected. The radiocarbon determinations clustered into groups rather than forming a continuous sequence, and it was concluded that this represented repeated use of the landscape by Aboriginal people in the late Holocene, punctuated by hiatuses during which there was no evidence of hearth construction (Shiner 2003:54-50).

Aboriginal Cultural Heritage Management Plan for the Stephens Creek to Pine Creek section of the River Murray to Broken Hill Pipeline (Niche Environment and Heritage 2017)

Niche Environment and Heritage (2017) prepared an Aboriginal Cultural Heritage Management Plan for the Stephens Creek to Pine Creek section of the River Murray to Broken Hill Pipeline. Part of the pipeline alignment runs along the western boundary of the Blue Bush Facility project envelope. 116 Aboriginal sites were identified within the impact footprint of the pipeline; the majority of which were stone artefact scatters consisting of locally sourced quartz. Eleven hearths were also recorded, in alluvial landscapes associated with the major drainage line of Pine Creek. The hearths were identified in both surface and subsurface contexts (Niche Environment and Heritage 2017:30).

The archaeological potential of the colluvial landscapes (depositional plains, lower slopes and erosional rises) between Broken Hill and Pine Creek was characterised by test excavations. No deep

soil profiles were identified during the testing, which found that the A-horizon soils were typically shallow and rarely deeper than 300 mm. No Aboriginal objects were recovered from depths below 150 mm, and most surface finds were interpreted to be lag deposits (Niche Environment and Heritage 2017:32).

A small sample of alluvial plains or alluvial over-bank deposits in proximity to Pine Creek were also tested. The results of the investigation suggest that well-defined drainage lines in alluvial deposits had potential to preserve Aboriginal objects in stratified deposits, including heat retainer hearths with charcoal from *in situ* deposits (samples of which could be used to date the site). Aboriginal objects were also recovered from less well-defined drainage lines; however, these occurred in smaller volumes (Niche 2017 Environment and Heritage:30-32).

A regional framework for assessing the cultural significance of Aboriginal cultural heritage sites was adopted for this project. Among the criteria used to assess significance; sites with high artefact densities (defined as >20 artefacts per m^2) or evidence of multiple intact knapping events were considered likely to have high significance; sites with moderate artefact densities (>10 artefacts per m^2) or evidence of an intact knapping event were considered likely to have moderate significance, and sites with low artefact densities (<10 artefacts per m^2) were considered likely to have low significance. Sites where Aboriginal people held specific cultural knowledge of a person, event, ceremonial activity, or mythological story relating to the site were also considered likely to have moderate or high significance (Niche Environment and Heritage 2017:138-139).

Hawsons Iron Project (Navin Officer Heritage Consultants 2014)

NOHC (2014) prepared a preliminary Aboriginal heritage constraints assessment and undertook an archaeological field survey for the Hawsons Iron Project, a proposed open-cut magnetite mine and associated infrastructure including rail loop, slurry pipeline and access road (approximately 60 km southwest of the Blue Bush facility project envelope). A large number of archaeological sites were recorded across the surveyed areas. No sites had been previously identified. Over 420 sites were mapped ranging from isolated finds, PADs and hearths; through to major site complexes extending continuously over several hectares. It was noted that site visibility, site condition and reliability of the surface survey findings was strongly influenced by post-depositional environmental factors including soil erosion, channel changes, alluviation and deposition of wind-blown deposits.

3.4 Are there any relevant confirmed site records or other associated landscape feature information on AHIMS? (Step 2a) and/or any other sources of information of which a person is already aware? (Step 2b)

No Aboriginal sites have previously been registered within the subject area. The results of the literature review indicate that there is a high likelihood of Aboriginal objects – primarily stone artefacts, and heat retainer hearths – to be present within the Blue Bush Facility development envelope.

4 LANDSCAPE CONTEXT

A review of the landscape can assist in predicting the ways in which Aboriginal people have used the subject area in the past. It establishes a context for the distribution of material traces of past Aboriginal occupation by identifying natural resources and landscape features that may have been focal points for activities and settlement. In addition, identification of site formation and post-depositional processes can assist in determining if Aboriginal objects are likely to be preserved below the ground surface, and if potential archaeological deposits are likely to be relatively intact or disturbed. The environmental context of the subject area is summarised below.

Australia's landscapes have been classified into bioregions as part of a national and regional framework for conservation planning and assessment. The classification system is based on physical environmental attributes including climate, lithology, geology, landforms and vegetation (Thackway and Cresswell 1995). These large, geographically distinct areas of land have been further refined into more localised and homogenous geomorphological units known as subregions (Department of Agriculture, Water and the Environment, n.d.).

The Blue Bush Facility project envelope is in the Barrier Range Outwash subregion of the Broken Hill Complex bioregion, in the far west of NSW. It is located in the transitional zone between the foothills of the Barrier Ranges to the north, and the alluvial sandplains of the Murray Darling Depression to the south (Shiner 2009:27). The Barrier Range Outwash subregion is characterised by stream channels and floodplains, low angle alluvial fans and floodouts, extending to extensive sandplains and dunefields with lakes and claypans. Soils are typically deep red sands on sandplains and dunes, with clayey sands in floodouts (Morgan and Terrey 1992).

The Barrier Range Outwash subregion encompasses parts of 23 land systems. The Blue Bush Facility project envelope includes four of these; the Nuntherungie, Kars, Conservation, and Fowlers land systems (Table 4.1 and Fig. 4.1). The proposed exploratory drilling locations are wholly within the Kars land system.

Table 4.1 Land systems in the vicinity of the Blue Bush Facility project envelope (Office of Environment and Heritage (OEH) 2020)

Land System	Geomorphology	Soils	Erosion
Nuntherungie	Rolling downs with prominent contour patterns of stonier and less stony bands and minor low strike ridges; relief to 15 m; dense dendritic drainage; steeply dipping Precambrian shale, partly calcareous, with bands of quartzite and dolomite	Shrubland country with desert loams, calcareous loams, clays and texture-contrast soils	Water-sheeting and gullying
Kars	Sandplain with isolated low sandy rises and drainage depressions; relief to 2 m	Calcareous red earths and solonized brown soils, with minor texture-contrast soils and clays	Minor wind-sheeting
Conservation	Stable alluvial plains to 8 km wide, between active floodplains; extensively scalded, traversed by sub-parallel ill-defined depressed drainage zones; Quaternary alluvium	Frontage country with texture-contrast soils and brown clays	Scalding with localised drift

Land System	Geomorphology	Soils	Erosion
Fowlers	Floodplains to 3 km wide along mid-sectors of larger creeks, with scalded back plains and uneven channel tracts. sinuous, commonly braiding sandy channels; Quaternary alluvium	Frontage country and minor areas of lowland shrubland country with texture-contrast soils, brown clays and red earths	Scalding with localised drift

Native vegetation in the subject area consists of Aeolian Chenopod Shrubland; dominated by bluebushes that are generally <1 m tall and other perennial shrubs, interspersed with an open cover of herbs and grasses. There has been limited change to this vegetation class since European settlement. Although it is considered modified (disturbed by grazing) there has been little clearing, and while bluebushes can be thinned if they are overgrazed, they readily regenerate (Keith 2006:284-285; DECCW 2010a:4-7).

The subject area is located in the lower Murray-Darling catchment area. There are no permanent fresh water sources within the subject area. Surface drainage is dominated by ephemeral and shallow channels, with the major drainage lines being Rantyga Creek in the east and Pine Creek in the south and west. The nearest major watercourse is the Darling River, located approximately 70 km to the east (Shiner 2003:4).

4.1 Is the activity in an area where landscape features indicate the presence of Aboriginal objects? (Step 2b)

The *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* identifies particular landscape features that are likely to indicate the existence of Aboriginal objects, as they are known to have been used by Aboriginal people in their everyday lives and for traditional cultural activities (DECCW 2010a:12). This includes areas that are:

- *within 200 m of waters*
- *located within a sand dune system*
- *located on a ridge top, ridge line or headland, or*
- *located within 20 m below or above a cliff face, or*
- *within 20 m of or in a cave, rock shelter, or a cave*

and is on land that is not disturbed.

The Blue Bush Facility project envelope contains a number of unnamed, ephemeral, first- and second-order drainage channels feeding into Rantyga Creek and Pine Creek; however, these major drainage lines are outside the project envelope, and more than 200 m away from the proposed exploratory drilling locations.

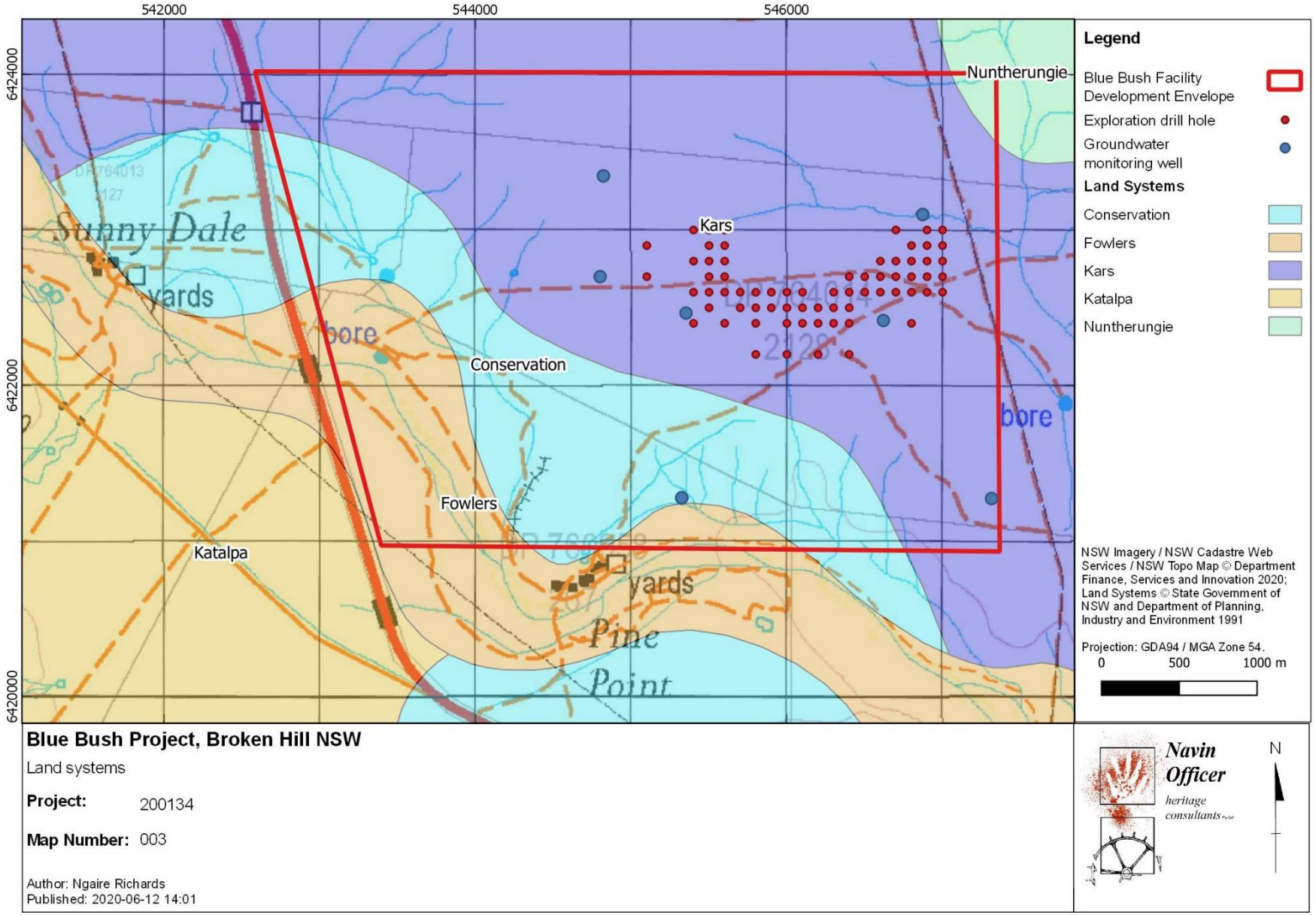

Fig. 4.1 Land systems within the Blue Bush Facility project envelope

5 VISUAL ASSESSMENT

5.1 Results Summary

The field inspection identified 42 Aboriginal sites, consisting of 33 isolated artefacts and nine low-density artefact scatters (named 'PP BBF Artefact 1' – 'PP BBF Artefact 42'). Lithic materials were predominantly quartz, with smaller quantities of silcrete and quartzite.

5.2 Field Methodology

A field inspection of the subject area was undertaken on 25–26 May 2020 by NOHC archaeologists Ngaire Richards and Madeleine Van Ewyk, accompanied by Endeavour Geophysics geoscientist Caleb Ames, and representatives of the following Aboriginal organisations:

Organisation	Representative
Broken Hill Local Aboriginal Land Council	Dulcie O'Donnell
	Raymond O'Donnell
	Regan O'Donnell
	Peter Farnham
Barkandji Native Title Group Aboriginal Corporation	Gerald Quayle

The survey methodology consisted of 20 m wide pedestrian transects in straight lines between existing unsealed Pine Point Station vehicle access tracks, and the exploratory drilling sites. Survey participants were spaced at intervals of approximately 5 m. The survey coverage incorporated a 40 m x 40 m area around the proposed locations of exploration drill holes and groundwater monitoring points, and 20 m wide access routes.

5.3 Recording Parameters

The field inspection aimed at identifying material evidence of Aboriginal occupation as revealed by the presence of Aboriginal sites within the landscape. Frequently encountered Aboriginal site features in the Far West region include artefact sites (including isolated finds and open artefact scatters), hearths, and PADs. Based on the results of the AHIMS search, stone quarries are also known to occur in the region, although these are generally constrained to areas where suitable stone outcrops are present. Definitions of these features are provided below in Table 5.1.

Table 5.1 Aboriginal site feature definitions (OEH 2012:8-10).

Aboriginal site feature	Description
Artefact	Objects such as stone tools, and associated flaked material, spears, manuports, grindstones, discarded stone flakes, modified glass or shell demonstrating evidence of use of the area by Aboriginal people
Hearth	Cultural deposit sometimes marked by hearth stones, usually also contains charcoal and may also contain heat treated stone fragments
PAD	An area where Aboriginal objects may occur below the ground surface

Stone Quarry	Usually a source of good quality stone which is quarried and used for the production of stone tools

Aboriginal objects identified during the survey were recorded in detail in accordance with the artefact and attribute recording requirements in the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (Requirements 18 and 19). A Garmin Rino 700 handheld GPS was used to record the location of the Aboriginal sites, with coordinates accurate to ±3 m. Photographs were taken using a Canon PowerShot SX430 IS digital camera to document the artefacts and their context in relation to the wider landscape.

5.4 Survey Results

Ground surface visibility across the area during the field survey was generally good. The area is characterised by an extensive, generally level sandplain, with some surface gravel. Ground cover consisted of scattered low blue bush and occasional sparse trees (including rosewood/bullock bush), with occasional small patches of forbs and/or grasses in ruts along former station tracks.

The field survey identified 42 Aboriginal sites. The sites were all artefactual in composition, consisting of 33 isolated artefacts and nine low-density artefact scatters (named 'PP BBF Artefact 1' – 'PP BBF Artefact 42') (Fig. 5.1–Fig. 5.5). The boundaries of the sites and approximate site area have been defined by the spatial extent of the visible objects.

A summary of the sites is presented in Table 5.2. Descriptions and photographs of the sites identified during the survey are provided in Appendix 2.

Table 5.2 Summary of Aboriginal sites identified during the survey

Site Name	Easting	Northing	Datum/ Zone	Feature(s)	Artefact Count	Approximate site area (m^2)	Landform
PP BBF Artefact 1	Redacted	Redacted	GDA94/ MGA Zone 54	Artefact	2	54	Sandplain
PP BBF Artefact 2			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 3			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 4			GDA94/ MGA Zone 54	Artefact	4	54	Sandplain
PP BBF Artefact 5			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 6			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain

Site Name	Easting	Northing	Datum/ Zone	Feature(s)	Artefact Count	Approximate site area (m^2)	Landform
PP BBF Artefact 7			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 8			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 9			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 10			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 11			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 12			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 13			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 14			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 15			GDA94/ MGA Zone 54	Artefact	2	135	Sandplain
PP BBF Artefact 16			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 17			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 18			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 19			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 20			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain

Site Name	Easting	Northing	Datum/ Zone	Feature(s)	Artefact Count	Approximate site area (m^2)	Landform
PP BBF Artefact 21			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 22			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 23			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 24			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 25			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 26			GDA94/ MGA Zone 54	Artefact	5	32	Sandplain
PP BBF Artefact 27			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 28			GDA94/ MGA Zone 54	Artefact	4	40	Sandplain
PP BBF Artefact 29			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 30			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 31			GDA94/ MGA Zone 54	Artefact	6	34	Sandplain
PP BBF Artefact 32			GDA94/ MGA Zone 54	Artefact	5	389	Sandplain
PP BBF Artefact 33			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 34			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain

Site Name	Easting	Northing	Datum/ Zone	Feature(s)	Artefact Count	Approximate site area (m^2)	Landform
PP BBF Artefact 35			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 36			GDA94/ MGA Zone 54	Artefact	8	288	Sandplain
PP BBF Artefact 37			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 38			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 39			GDA94/ MGA Zone 54	Artefact	14	605	Sandplain
PP BBF Artefact 40			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 41			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain
PP BBF Artefact 42			GDA94/ MGA Zone 54	Artefact	1	1	Sandplain

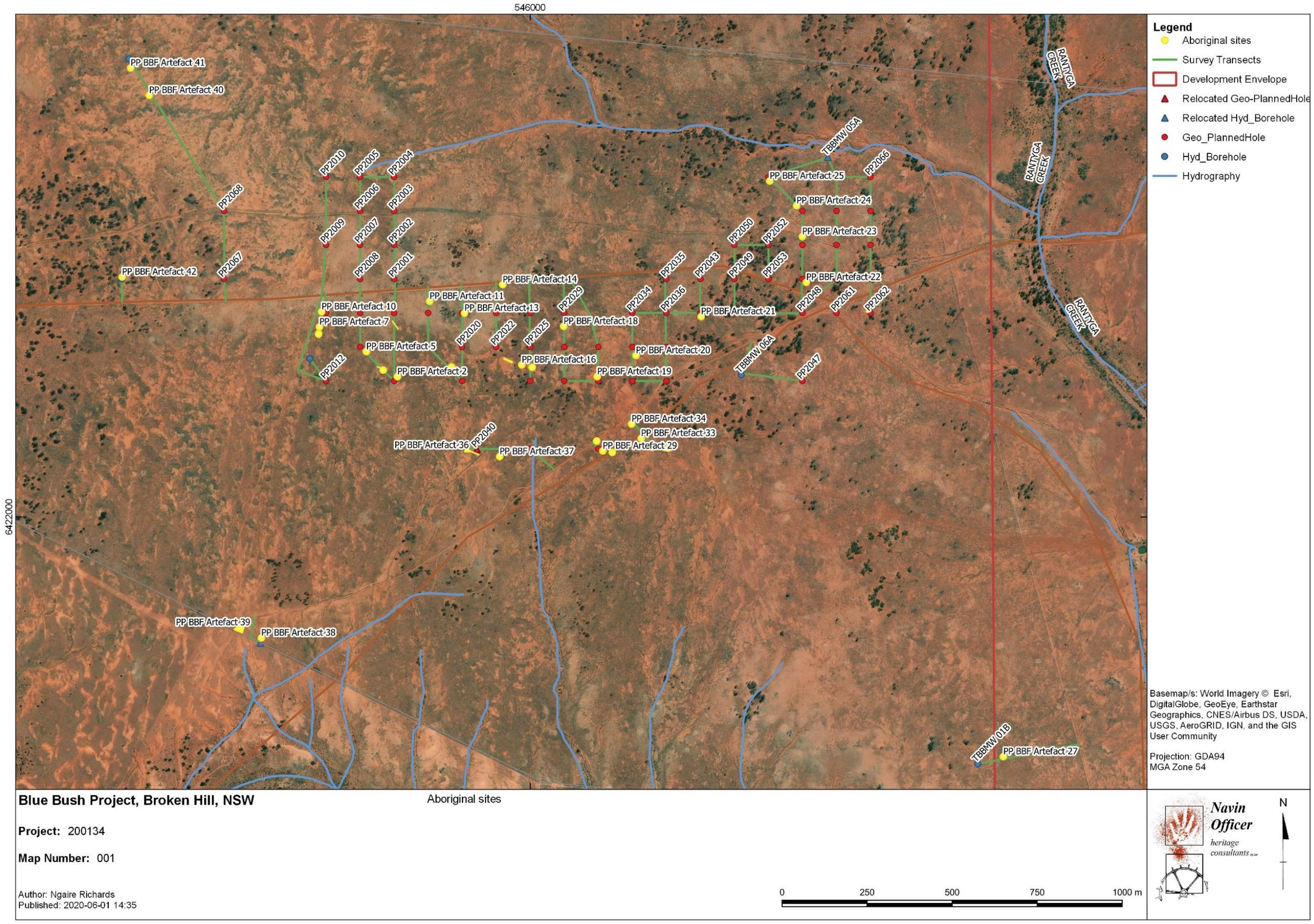

Fig. 5.1 Aboriginal site locations (overview)

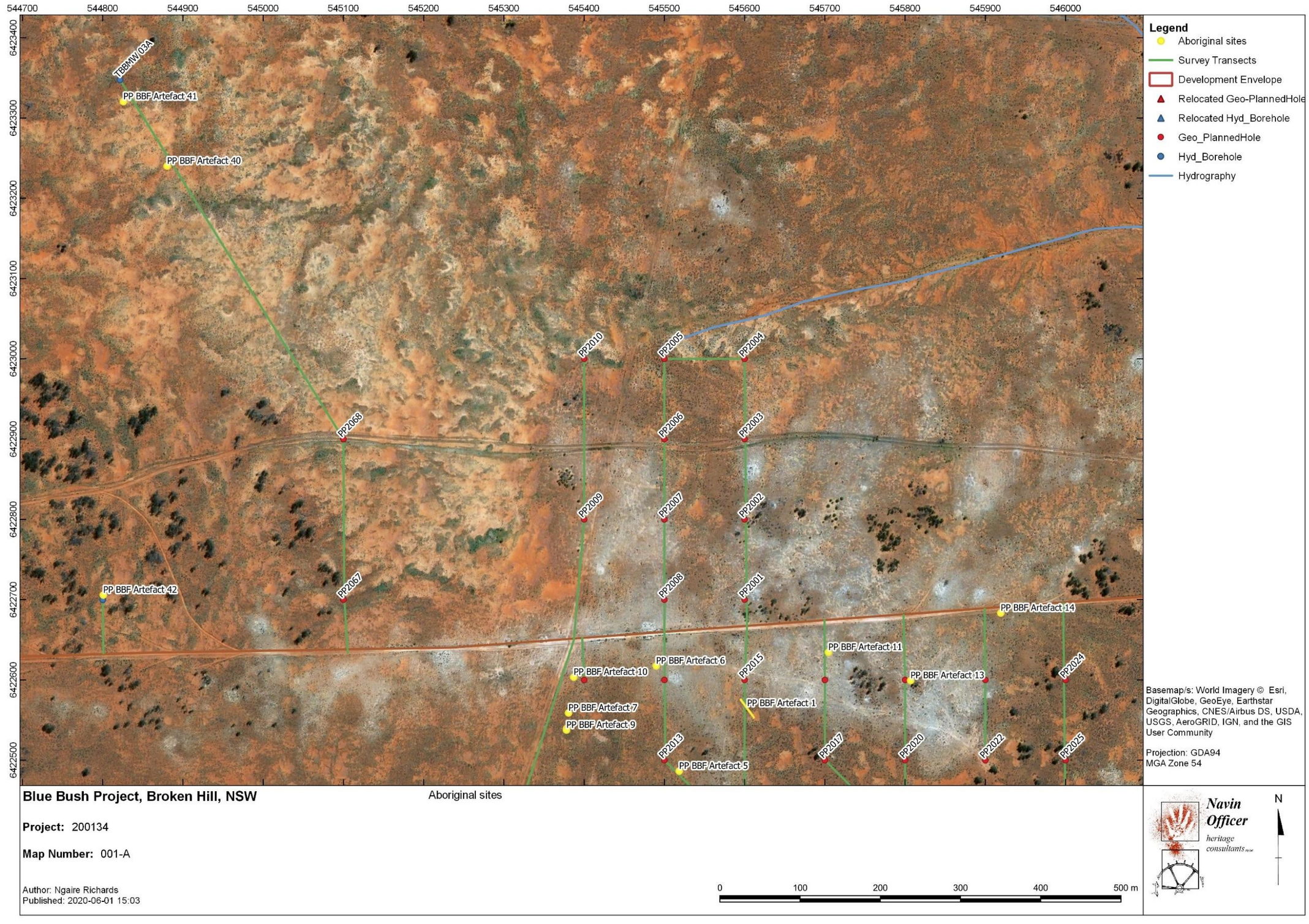

Fig. 5.2 Aboriginal site locations (detail)

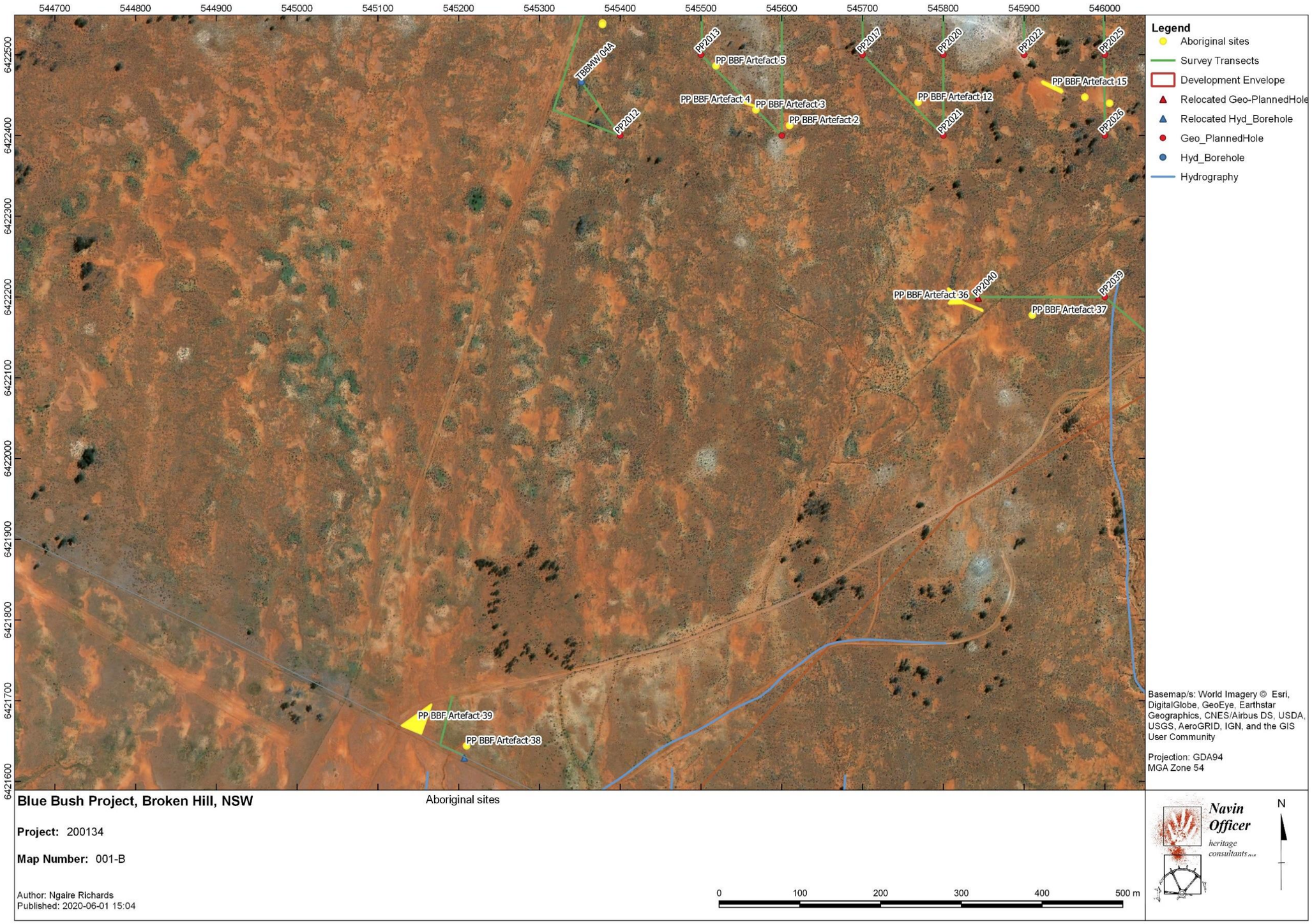

Fig. 5.3 Aboriginal site locations (detail)

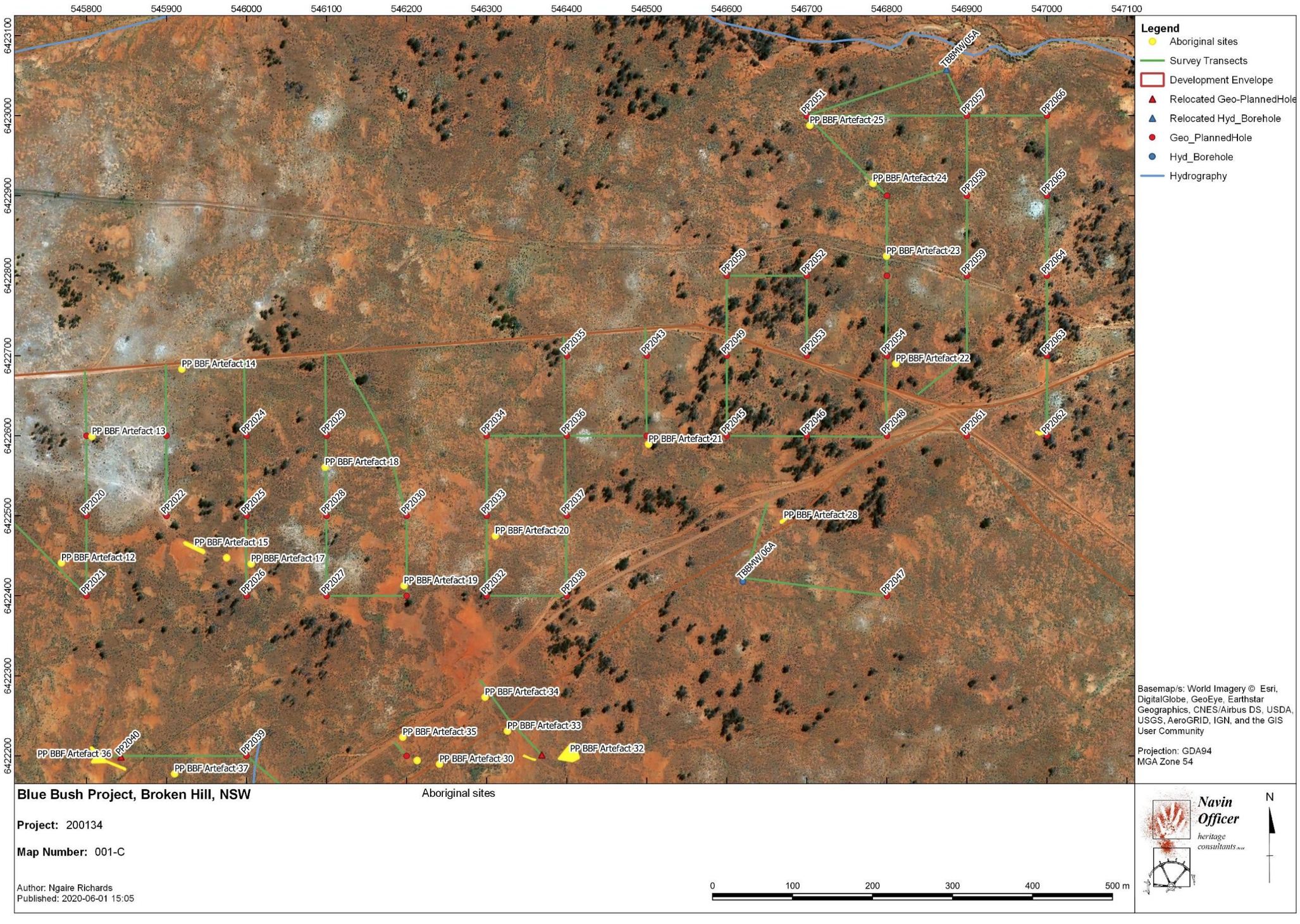

Fig. 5.4 Aboriginal site locations (detail)

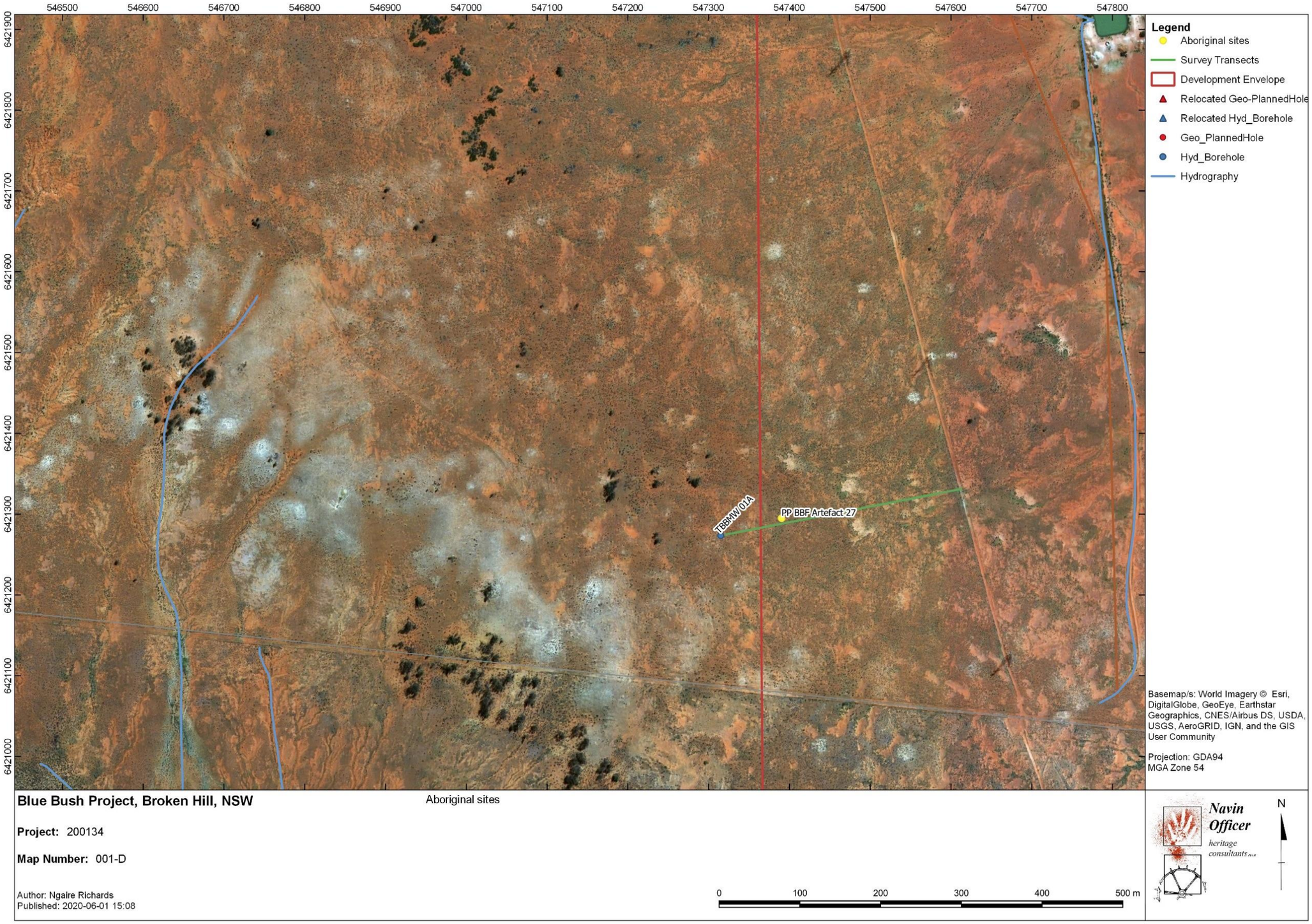

Fig. 5.5 Aboriginal site locations (detail)

6 SIGNIFICANCE ASSESSMENT

6.1 Assessment Criteria

The Burra Charter: The Australia ICOMOS Charter for Places of Cultural Significance defines cultural significance as 'aesthetic, historic, scientific, social or spiritual value for past, present or future generations' (Australia ICOMOS 2013a).

Assessing the Aboriginal cultural significance of a place involves identifying the range of values that are present and assessing them against relevant criteria, in order to define why a place is important and inform future planning and management. Table 6.1 provides definitions of these values and outlines the criteria for assessment.

Table 6.1 Criteria used to assess the cultural significance of a place

Definition of value	Assessment criteria (after OEH 2011:10)
Historic value refers to the associations of a place with a historically important person, event, phase or activity in an Aboriginal community (OEH 2011:9).	Is the subject area important to the cultural or natural history of the local area and/or region and/or State?
Scientific (or archaeological) value refers to the information content of a place and its ability to reveal more about an aspect of the past through examination or investigation of the place, including the use of archaeological techniques (Australia ICOMOS 2013b). Sites may meet this criterion because they: contain intact archaeological deposits, have potential to answer research questions on past human behaviour, are very old or contain significant time depth, contain large artefactual assemblages or material diversity, are well preserved, or form part of a larger site complex or cultural landscape.	Does the subject area have potential to yield information that will contribute to an understanding of the cultural or natural history of the local area and/or region and/or State?
Aesthetic value refers to refers to the sensory and perceptual experience of a place – that is, how we respond to visual and non-visual aspects such as sounds, smells and other factors having a strong impact on human thoughts, feelings and attitudes. Aesthetic qualities may include the concept of beauty and formal aesthetic ideals (Australia ICOMOS 2013b:3).	Is the subject area important in demonstrating aesthetic characteristics in the local area and/or region and/or State?
Social value refers to the spiritual, traditional, historical or contemporary associations and attachments the place or area has for Aboriginal people. Social or cultural value is how people express their connection with a place and the meaning that place has for them (OEH 2011:8). Spiritual value is included in the definition of social value, and refers to the intangible values and meanings embodied in or evoked by a place which give it importance in the spiritual identity, or the traditional knowledge, art and practices of Aboriginal people (Australia ICOMOS 2013b:4).	Does the subject area have a strong or special association with a particular community or cultural group for social, cultural or spiritual reasons?

The *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* identify that 'Aboriginal people are the primary determinants of the cultural significance of their heritage' (DECCW 2010b: iii). The significance of a place can be the result of a number of factors including: continuity of tradition, occupation or action; historical association; custodianship or concern for the protection and maintenance of places; and the value of sites as tangible and meaningful links with the lifestyle and values of ancestors. Aboriginal cultural significance may or may not parallel the archaeological significance of a site.

6.2 Assessment of Significance

Based on the findings of previous studies and confirmed site records, stone artefact sites are likely to be found across the Blue Bush Facility project envelope; however, areas in alluvial landscapes in the vicinity of the major drainage lines of Pine Creek and Rantyga Creek have greater potential to contain additional site features, including hearths and stratified archaeological deposits.

With specific reference to the subject area, 42 newly identified Aboriginal sites have been recorded. Thirty-three of these are isolated artefacts, and nine are stone artefact scatters, generally of low densities. Based on initial observations these sites would be considered of low scientific value, lacking research potential and stratigraphic integrity.

A copy of this assessment was provided to the Broken Hill Local Aboriginal Land Council and Barkandji Native Title Group Aboriginal Corporation with a request for comment on the cultural value of archaeological sites within the subject area; however, no feedback has been received. The interim assessment of social value below is therefore based on the findings of other nearby studies, and it is considered unlikely that these sites would have high overall cultural significance.

Site Name	Site Feature	Historic Value	Scientific (or archaeological) Value	Aesthetic Value	Social Value (Interim)[1]	Cultural Significance[2]
PP BBF Artefact 1	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 2	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 3	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 4	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 5	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 6	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 7	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**

Site Name	Site Feature	Historic Value	Scientific (or archaeological) Value	Aesthetic Value	Social Value (Interim)[1]	Cultural Significance[2]
PP BBF Artefact 8	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 9	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 10	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 11	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 12	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 13	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 14	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 15	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 16	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 17	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 18	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 19	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 20	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**

Site Name	Site Feature	Historic Value	Scientific (or archaeological) Value	Aesthetic Value	Social Value (Interim)[1]	Cultural Significance[2]
PP BBF Artefact 21	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 22	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 23	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 24	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 25	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 26	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 27	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 28	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 29	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 30	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 31	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 32	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 33	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**

Site Name	Site Feature	Historic Value	Scientific (or archaeological) Value	Aesthetic Value	Social Value (Interim)[1]	Cultural Significance[2]
PP BBF Artefact 34	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 35	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 36	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 37	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 38	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 39	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 40	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 41	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**
PP BBF Artefact 42	Artefact	Does not meet criterion	Low	Does not meet criterion	Low	**Low**

[1, 2] Input from the Aboriginal community is required to confirm the social value and overall cultural significance of each of these sites.

7 IMPACT ASSESSMENT AND RECOMMENDATIONS

7.1 Can harm be avoided? (Step 3)

The Aboriginal heritage desktop study and field survey fulfil due diligence requirements in accordance with the *Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales* (DECCW 2010a). The exploratory drilling and installation of groundwater monitoring wells may proceed with caution if access routes and the proposed location of exploration drill holes and boreholes for groundwater monitoring wells can avoid impacts to identified Aboriginal sites. In order to facilitate this, the client has agreed to the following changes:

- PP2040 has been relocated 43 m east to avoid impacts to site 'PP BBF Artefact 36'
- PP2042 has been relocated 35 m west to avoid impacts to site 'PP BBF Artefact 32'
- TBBMW 02A has been relocated 369 m northwest within Lot 2028 DP 764014, to avoid proximity to the Pine Point homestead
- TBBMW 05B has been relocated 42 m south to avoid the bed of an unnamed second order tributary of Rantyga Creek.

Access routes cleared during the field survey should be marked with flagging tape for the duration of the works. Vehicles and machinery should not deviate from the flagged routes. The access routes between the following exploration drill holes should be aligned to avoid sites in the vicinity, incorporating a buffer of at least 3 m around the recorded site location:

- PP2013–PP2016 should be aligned to the northeast of 'PP BBF Artefact 3' and 'PP BBF Artefact 4'
- PP2015–PP2016 should be aligned to the west of 'PP BBF Artefact 1'
- PP2028–PP2029 should be aligned to the east of 'PP BBF Artefact 18'
- PP2051–PP2056 should be aligned to the northeast of 'PP BBF Artefact 24' and 'PP BBF Artefact 25'
- PP2055-PP2056 should be aligned to the east of 'PP BBF Artefact 23'.

This includes the following sites:

- 'PP BBF Artefact 2'
- 'PP BBF Artefact 5'
- 'PP BBF Artefact 6'
- 'PP BBF Artefact 10'
- 'PP BBF Artefact 13'
- 'PP BBF Artefact 19'
- 'PP BBF Artefact 21'
- 'PP BBF Artefact 22'
- 'PP BBF Artefact 25'
- 'PP BBF Artefact 26'

- ‘PP BBF Artefact 29’
- ‘PP BBF Artefact 30’
- ‘PP BBF Artefact 36’
- ‘PP BBF Artefact 42’

7.2 Recommendations

The following recommendations are made:

- An Aboriginal heritage induction should be included in the general site induction prior to commencement of works, so that all personnel involved with the project are aware of Aboriginal heritage requirements including relevant legislation protecting Aboriginal objects, procedures to avoid harming identified sites (i.e. following flagged access routes), and penalties for damage.

- If suspected Aboriginal object(s) are encountered during the proposed works, cease any further excavation or ground disturbance in the area of the find(s). Ensure that the area of the find(s) is adequately marked as a no-go area for machinery or further disturbance and report the find(s) to the Department of Planning, Industry and Environment (DPIE) in accordance with s89(A) of the *National Parks and Wildlife Act 1974*.

- If human remains are found during the proposed works, cease any further excavation or ground disturbance in the area of the find(s). Ensure that the area of the find(s) is adequately marked as a no-go area for machinery or further disturbance and immediately notify the NSW Police and the NSW Coroner’s Office. If the finds are Aboriginal or probably Aboriginal in origin, the DPIE North West Environmental Protection and Regulation Group regional office, Dubbo (02) 6883 5330, the Broken Hill Local Aboriginal Land Council and the Barkandji Native Title Group Aboriginal Corporation should also be notified. In such circumstances the advice of a specialist physical anthropologist is highly recommended.

- The results of the field survey indicate that there is a high likelihood of additional Aboriginal objects – primarily stone artefacts – to be present within the Blue Bush Facility development envelope and further investigation of the Aboriginal heritage will need to be undertaken to assess the significance of the Aboriginal cultural heritage and the potential impact of the proposed development. Should the Blue Bush Project be declared a State Significant Development, further Aboriginal cultural heritage investigation and assessment will still be necessary. It is considered likely that the Planning Secretary’s Environmental Assessment Requirements will require preparation of an Aboriginal Cultural Heritage Assessment Report for the project area, and consultation with Aboriginal stakeholders in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010b).

A copy of this assessment was provided by Tellus Holdings Ltd to the Broken Hill Local Aboriginal Land Council and Barkandji Native Title Group Aboriginal Corporation for review on 9 July 2020, with a request comment on the cultural value of archaeological sites within the subject area and the archaeological findings and recommendations in the report by 21 July 2020; however, no feedback was received. Any comments received after finalisation will be appended to this report.

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APPENDIX 1

AHIMS SEARCH RESULTS

Sensitive information not for public release - redacted

APPENDIX 2

ABORIGINAL SITE DESCRIPTIONS

Sensitive information not for public release - redacted

APPENDIX 3

LEGISLATIVE CONTEXT

***National Parks and Wildlife Act 1974* (NSW)**

Part 6 of the *National Parks and Wildlife Act 1974* (NSW) (NPW Act) provides protection for Aboriginal cultural heritage in New South Wales, including Aboriginal objects and declared Aboriginal places.

An **Aboriginal object** is defined as:

> *… any deposit, object or material evidence (not being a handicraft made for sale) relating to the Aboriginal habitation of the area that comprises New South Wales, being habitation before or concurrent with (or both) the occupation of that area by persons of non-Aboriginal extraction, and includes Aboriginal remains.*

An **Aboriginal place** is any area of land in New South Wales declared by the Minister for the Environment to be of special significance to Aboriginal culture.

It is a strict liability offence under s.86(4) of the NPW Act to harm (destroy, deface, or damage) or desecrate an Aboriginal object or place. The definition of harm includes moving an Aboriginal object from the land on which it is situated. Where harm cannot be avoided, an Aboriginal heritage impact permit (AHIP) issued by the NSW Department of Planning, Industry and Environment (DPIE) under s.90 of the NPW Act will be required. It should be noted that the granting of an AHIP cannot be assumed as there are several factors to be considered such as the cultural significance of the object or place to Aboriginal people, and the scientific significance or potential significance of archaeological deposits in which the object(s) are located.

The NPW Act provides that anyone who exercises due diligence in determining that their actions will not harm Aboriginal objects has a defense against prosecution if they later unknowingly harm an object without an AHIP. Due diligence may be exercised by complying with the 'Due Diligence Code of Practice for the Protection of Aboriginal Objects in New South Wales' (Department of Environment, Climate Change and Water (DECCW) 2010), or other industry-specific codes of practice adopted by the National Parks and Wildlife Regulation 2009 (NPW Regulation).

***Environmental Planning and Assessment Act 1979* (NSW)**

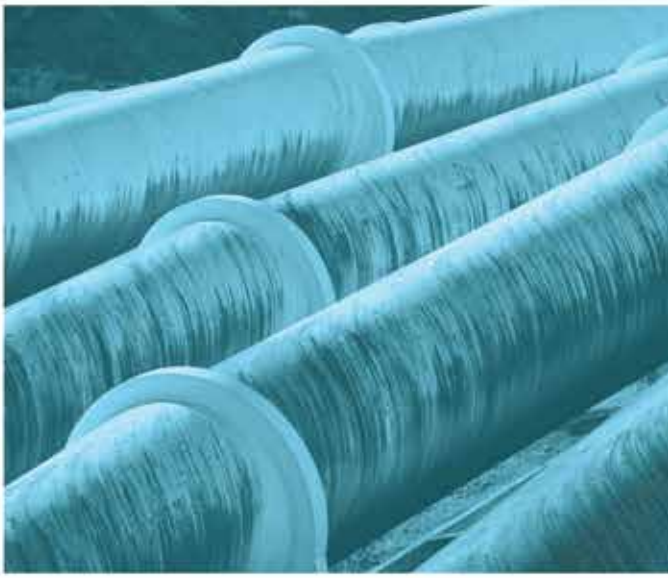
In the case of projects declared State Significant Development under Section 4.36 of the *Environmental Planning and Assessment Act 1979* (NSW), the identification and mitigation of potential heritage impacts is managed by the environmental impact assessment process. Key issues which require detailed assessment are specified in the Planning Secretary's Environmental Assessment Requirements (SEARs), and in the conditions of consent that are set when a project is approved.

APPENDIX F: AGRICULTURAL IMPACT STATEMENT AND BIOPHYSICAL STRATEGIC AGRICULTURAL LAND DESKTOP REVIEW

Blue Bush Facility

Scoping Report - AIS and BSAL Desktop Review

Prepared for Tellus Holdings
July 2020



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Blue Bush Facility

Scoping Report - AIS and BSAL Desktop Review

Report Number

J200253 RP6

Client

Tellus Holdings

Date

23 July 2020

Version

v3 Final

Prepared by

Harry Savage
Environmental Scientist - Soil and Rehabilitation
23 July 2020

Approved by

Nick Travers
Team Leader - Rehabilitation
23 July 2020

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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1 Introduction

1.1 Background

Tellus Holdings Limited (Tellus) is proposing to develop near-surface arid geological repository (Facility) for permanent isolation and long-term storage of hazardous chemical waste materials. To achieve this, overburden material including sands and kaolin clay will be excavated to create waste cells. The proposal and its supporting infrastructure are collectively known as the Blue Bush Facility (the Facility). The waste repository has capacity to receive up to 200,000 tonnes per annum of waste for up to 25 years.

The proposed Facility is located approximately 45 kilometres (km) south of Broken Hill in western NSW, within the Unincorporated Far West Region. The primary road access to the facility will be via the Silver City Highway. A preliminary development envelope for the facility has been prepared, and this is located entirely within Exploration Licence (EL) 8188.

Transport of product and supplies will most likely occur between a proposed inter-modal transfer facility, located in Broken Hill, and the proposed project location via the Silver City Highway. Consideration of the inter-modal transfer facility does not form part of this current investigation.

The Facility has been recognised by the NSW Government as a State Significant Development (SSD) under Part 4, Division 4.1 of the NSW *Environment Planning and Assessment Act 1979* (EPA Act 1979). Classification of SSD status is provided under Section 89C of the EPA Act 1979 and State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). As such, the proposal will be assessed by the NSW Department of Planning Industry and Environment (DPIE) through an Environmental Impact Statement (EIS) and against the Secretary's Environmental Assessment Requirements (SEARs). SEARs will be issued following review of the Environmental Scoping Report (ESR) to which this report is appended. Once the ESR is submitted, Tellus expect to receive SEARs by October 2020.

1.2 Report purpose

This report has been prepared as a summary desktop review to support the preparation of the ESR for the Project. Specifically, the enclosed report:

- assesses and provides justification as to why the Project does not require a formal Agricultural Impact Statement (AIS) (Section 2.1); and
- assesses and provides justification as to why the Project does not require a detailed assessment of impacts to Biophysical Strategic Agricultural Land (BSAL), that is, a field soil survey and assessment of soil considerations (Section 2.2).

2 Desktop assessment

2.1 Agricultural impact statement

Under the *Strategic Regional Land Use Policy (SRLUP) Guideline for Agricultural Impact Statements at the Exploration Stage* (DRE 2015), 'revised guidelines', an AIS is required for mineral or petroleum exploration activities that require submission of a Review of Environmental Factors (REF) for assessment under Part 5 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) and that may impact on agricultural resources or industries.

As the Project does not involve mineral or petroleum exploration, and is not being assessed under a REF, EMM considers that no formal AIS is required.

General impacts to agricultural land use will still be assessable under a 'land impact assessment' undertaken in accordance with *The land and soil capability assessment scheme*, 2nd approximation (OEH 2012).

2.2 Biophysical Strategic Agricultural Land

BSAL is defined in *the Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land* ('BSAL') (OEH 2013a), the 'Interim Protocol', as land with a rare combination of natural resources highly suitable for agriculture.

The State Environmental Planning Policy (Mining, Petroleum Production and Extraction) 2007 (Mining SEPP) requires certain types of developments to verify whether the proposed development is on BSAL. The Interim Protocol assists proponents and landholders to understand what is required to identify the existence of BSAL and outlines the technical requirements for the on-site identification and mapping of BSAL. While the Project is not classified as a mining project under the *Mining Act 1992*, and thus the Mining SEPP, the enclosed desktop BSAL review is provided to support this position within the ESR and to pre-empt any such requirement within the draft SEARs issued for the Project (ie as a unique condition imposed by DPIE).

The Interim Protocol assists proponents and landholders to understand what is required to identify the existence of BSAL and outlines the technical requirements for the on-site identification and mapping of BSAL.

The NSW Government has mapped BSAL across the whole of NSW, based on a desktop study. The BSAL shown on the maps comprises land which meets criteria described in the interim Protocol. The criteria used to measure BSAL under the original Strategic Regional Land Use Plans (SRLUP) were based on three regional scale parameters:

1. Soil Fertility – based on the regional scale Draft Inherent General Fertility of NSW (OEH 2013b).
2. Land and Soil Capability – based on the regional scale Land and Soil Capability Mapping of NSW.
3. Access to reliable water supply, defined as:
    a) rainfall of 350 mm or more per annum (9 out of 10 years);
    b) a regulated river (maps show those within 150 m);
    c) a 5th order or higher unregulated river (maps show those within 150 m);
    d) an unregulated river which flows at least 95% of the time (maps show those within 150 m); or

e) highly productive groundwater sources, as declared by the NSW Office of Water. These are characterised by bores having yield rates greater than 5 litres per second (L/s) and total dissolved solids (TDS) of less than 1,500 milligrams per litre (mg/L) and exclude miscellaneous alluvial aquifers, also known as small storage aquifers.

2.2.1 Desktop BSAL assessment

i BSAL mapping

Based on the Strategic Agricultural Land Map presented in the Interim Protocol, the Blue Bush Facility site and area is not mapped as BSAL. While this suggests that the site is unlikely to be BSAL, the assessment criteria outlined in the Interim Protocol must still be considered – refer Section 2.2.1ii below.

ii Interim Protocol BSAL assessment criteria

The initial steps to verify BSAL from the Interim Protocol are defined below.

a Step 1: Identify the project area which will be assessed for BSAL

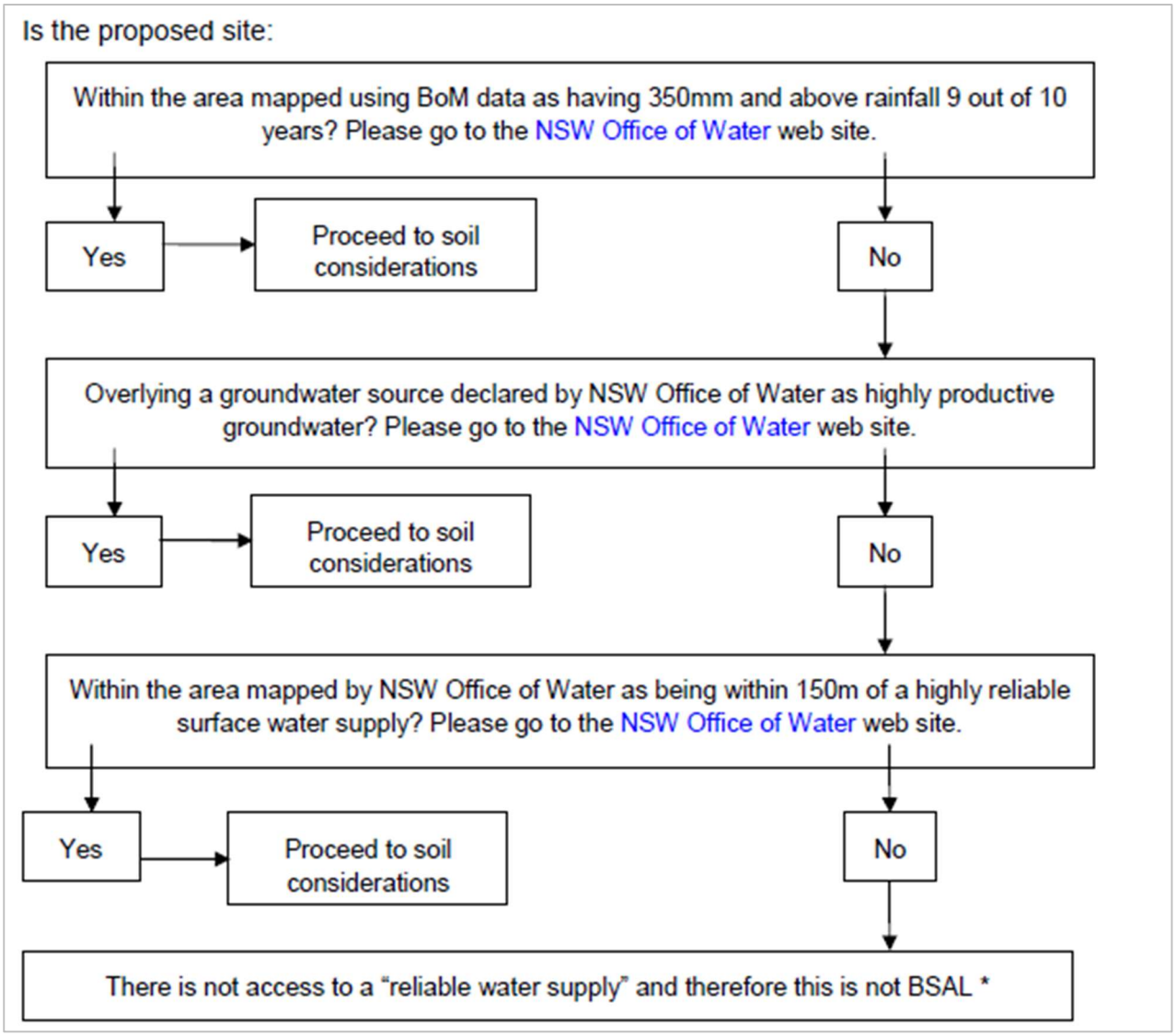
The assessment area should include the entire project area and include at least a 100 m buffer to take into account minor changes in design, surrounding disturbance and minor expansion. If BSAL is part of a larger contiguous mass of BSAL then the boundary of this area must also be identified.

The proposed disturbance areas for the Blue Bush Facility is approximately 938 ha. In addition to this disturbance area, the Interim Protocol requires a 100 m buffer surrounding the project area is included within the BSAL assessment area, to account for minor changes in design, surrounding disturbance and minor expansion.

With this buffer applied the BSAL assessment area is well within the Blue Bush Facility tenement area.

b Step 2: Confirm access to a reliable water supply

BSAL lands must have access to a "reliable water supply". Proponents seeking guidance for those project areas outside the Upper Hunter and the New England North West will need to work through Figure 1 of the Interim Protocol (see Figure 2.1).



Source: OEH 2013a.
*unless an on-site verification can show access to a reliable water supply by:
1. localised groundwater conditions or
2. alternate access to a highly reliable surface water supply via an easement.

Figure 2.1 BSAL Interim Protocol – flowchart to verify water reliability

As per Figure 2.1, if a project area does not have access to a reliable water supply the land cannot be BSAL and there is no need to proceed to soil considerations (ie the BSAL assessment concludes).

Regarding rainfall supply, the site is in the arid zone of NSW and as such is characterised by hot and persistently dry summers and cool winters with low average annual rainfall (EMM 2020a). Representative rainfall data for the area has been obtained from the Bureau of Meteorology (BOM) weather station located at:

- Broken Hill (Station 47048), mean annual rainfall of 248 mm (1947–2019); and
- Menindee (Station 47058), mean annual rainfall of 265 mm (1955–2019).

Data indicates that the study area experiences a low annual average annual rainfall of 200–250 mm per year, below the BSAL criteria threshold of 350 mm per year.

There are no regulated rivers in the vicinity of the site, with the nearest being the Darling River at Menindee, approximately 80 km east. The nearest surface water is Pine Creek, a 7th order stream which passes near the site, which is unregulated, ephemeral and highly unlikely to flow more than 95% of the time.

The local groundwater resource consists of regional deep fractured rock systems and alluvium, colluvium and unsaturated systems (EMM 2020b). These are both unlikely to satisfy the criteria as a beneficial groundwater supply for BSAL given that:

- the deeper fractured rock groundwater system is characterised as having limited beneficial use with low yields (<1 L/s) and generally high groundwater salinity (TDS concentrations ranging from 3,000–10,000 mg/L, well above the 1,500 mg/L BSAL classification for highly productive groundwater) (EMM 2020b); and

- the alluvium, colluvium and unsaturated systems are characterised as shallow, unconfined and temporary groundwater systems. These qualify as miscellaneous alluvial aquifers (or small storage aquifers) under the Interim Protocol and hence are not considered a productive groundwater resource for BSAL.

Unless current or planned groundwater investigations can show access to a reliable water supply by localised groundwater conditions, or alternate access via an easement to a highly reliable surface water supply, the site has no access to a reliable water supply and cannot be classified as BSAL per the criteria in the Interim Protocol.

2.2.2 Summary

A summary of the preliminary BSAL assessment is given in Table 2.1.

Based on this preliminary review EMM considers that the Blue Bush Facility site and area is not BSAL.

Table 2.1 Preliminary BSAL Assessment

BSAL Initial Verification	Yes	No	Justification
Site is mapped as BSAL		X	Area not mapped as BSAL under the Interim Protocol.
Reliable water supply – rainfall (>350 mm annual rainfall for 9 out of 10 years)		X	Average rainfall is 250 mm per year (less than the 350 mm/year BSAL threshold)
Reliable water supply – surface water (regulated river, a 5th order or higher unregulated river, or an unregulated river which flows at least 95% of the time within 150 m)		X	There are no regulated rivers in the vicinity of the site. The nearest unregulated waterway is Pine Creek, a 7th order creek. Pine Creek is also ephemeral and highly unlikely to flow more than 95% of the time.
Reliable water supply – groundwater (highly productive groundwater source)		X	No highly-productive groundwater resources exist in the area – available groundwater is low-yield and highly saline.
Proceed to soil considerations		X	Not required – there is no access to a reliable water supply and thus the Project site cannot be BSAL.

3 Conclusion

Based on the enclosed preliminary desktop reviews, and for purposes of supporting the Scoping Report for the Tellus Blue Bush Project, EMM considers that:

- No formal AIS is required as the Project does not trigger the requirement for an AIS under the SLRUP Guideline and EP&A Act.

- The Blue Bush Facility site does not meet the criteria for classification as BSAL in accordance with the criteria in the Interim Protocol (OEH 2013a) as it does not have access to a reliable water supply (either through rainfall, surface water or a suitable quality groundwater resource) and is not BSAL-mapped land. Based on this, no further BSAL verification (eg field-based soil sampling and characterisation, and visual assessment of BSAL-associated landform features) is likely to be required.

4 References

DRE 2015, Strategic Regional Land Use Policy Guideline for Agricultural Impact Statements at the Exploration Stage, August 2015. NSW Government.

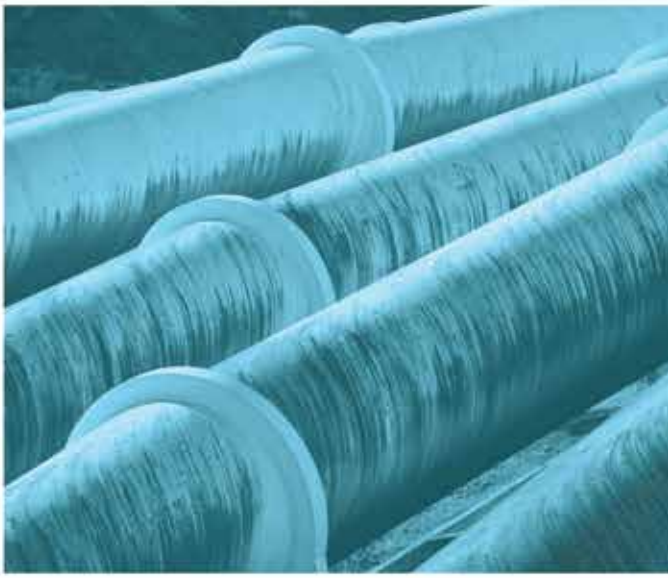
EMM 2020a, Blue Bush Facility – Preliminary Surface Water Investigation, prepared for Tellus Holdings, July 2020.

EMM 2020b, Blue Bush Facility: Scoping Report – Hydrogeological investigation, prepared for Tellus Holdings, July 2020.

OEH 2012, The land and soil capability assessment scheme, 2nd approximation. NSW Office of Environment and Heritage, Sydney NSW.

OEH 2013a, Interim Protocol for Site Verification and Mapping of Biophysical Strategic Agricultural Land, NSW Office of Environment and Heritage, Sydney NSW.

OEH 2013b, Inherent Fertility of Soils in NSW – Based on Soil Type (Great Soil Group Classification), Version 1.5, 4 October 2013, NSW Office of Environment and Heritage, Sydney NSW.



APPENDIX G: PRELIMINARY SURFACE WATER ASSESSMENT

Blue Bush Facility

Preliminary Surface Water Investigation

Prepared for Tellus Holdings Limited
July 2020

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Blue Bush Facility

Preliminary Surface Water Investigation

Report Number

J200253 RP2

Client

Tellus Holdings Limited

Date

23 July 2020

Version

v3 Final

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23 July 2020

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23 July 2020

This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

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Executive Summary

ES1 Overview

Tellus Holdings Limited (Tellus) is proposing to develop a near-surface arid geological repository for permanent isolation and long-term storage of hazardous chemical waste materials. To achieve this, overburden material including sands and kaolin clay will be excavated to create waste cells. The proposal and its supporting infrastructure are collectively known as the Blue Bush Facility (the facility). The waste repository has capacity to receive up to 200,000 tonnes per annum of waste for up to 25 years.

The proposed facility is located approximately 45 kilometres (km) south of Broken Hill in western NSW, within the Unincorporated Far West Region. The primary road access to the facility will be via the Silver City Highway. A preliminary development envelope for the facility has been prepared, and this is located entirely within Exploration Licence (EL) 8188.

This Preliminary Surface Water Investigation (PSWI) has been prepared to inform preparation of an Environmental Scoping Report, which will accompany a request for Secretary's Environmental Assessment Requirements (SEARs). The PSWI will also support early design development activities by Tellus, and assist with ongoing consultation with the community, regulators and other stakeholders around surface water issues and risks. The PSWI is intended to provide a concise overview of existing surface water features and related constraints, based on currently available data. Recommendations for additional baseline data collection and further investigations are provided where relevant.

ES2 Baseline characterisation

Chapter 2 provides a characterisation of the existing surface water environment and related aspects including climate, topography and soils.

The following table presents a summary of this information.

Table ES1 Characterisation summary

Aspect	Summary
Climate	The site is located in the arid zone of NSW, which is characterised by hot and persistently dry summers and cool winters. Average annual rainfall is low (200–250 mm per year), and potential evaporation rates are high (exceeding 2,500 mm per year) leading to generally low surface water availability. The temperature range is large with summer maximum temperatures routinely over 35°C and winter minimum temperatures typically reaching 5°C and lower, dropping below freezing on occasion. Several long-term daily read weather stations operated by the Bureau of Meteorology (BoM) are available to inform understanding of key variables related to hydrology including temperature, rainfall and evaporation. The closest pluviographic station that measures continuous rainfall is located at Menindee Lakes, approximately 75 km to the east of the site.

Table ES1 Characterisation summary

Aspect	Summary
Topography, landform and site features	The topography falls generally to the south from a regional ridgeline, forming part of the southern Barrier Ranges, which runs generally north-east to south-west through the town of Broken Hill. The ridgeline sits at an elevation of about 320 metres relative to Australian Height Datum (m AHD), whilst the site is situated at about 150 m AHD. The development envelope forms part of the Pine Point property, with the existing homestead located on the left (northern) overbank of Pine Creek just outside and to the south of the development envelope. The property was used for grazing through multiple generations dating back to the early 1900s. Grazing has ceased in recent years and whilst occupation of the homestead continues there is no current use of the land. Surrounding land use in the region is dominated by grazing and associated pastoral activities. Other existing infrastructure in the vicinity of the site is limited but includes the Silver City Highway immediately to the west, and the Wentworth to Broken Hill water supply pipeline, which is located in the highway corridor. A major electricity easement is located to the east of the development envelope and Rantyga Creek.
Hydrology	The regional hydrologic setting for the site is within the Lower Darling River catchment of the Murray Darling Basin. The site and surrounding area form part of a smaller sub-catchment that drains to Pine Creek, which ultimately flows into Kudgee Lake approximately 40 km to the south. Kudgee Lake, with a catchment area of about 1,500 km^2, is understood to be a terminal waterbody with no surface connectivity to the Lower Darling River system. The site is located immediately upstream of the confluence of Pine Creek and Rantyga Creek. The respective catchment areas are about 910 square kilometres (km^2) for Pine Creek, and 250 km^2 for Rantyga Creek. Pine Creek is a seventh-order watercourse where it runs through and to the south of the development envelope. The creek flows generally from north to south and is highly variable in width at top of bank, up to about 150 m. The creek bed is sandy and sparsely vegetated. Rantyga Creek is a fourth-order watercourse where it runs to the east of the development envelope. The creek forms one of the major tributaries of Pine Creek, flowing generally from north to south. Similar to Pine Creek, the bed of Rantyga Creek is sandy and sparsely vegetated. The confluence of Pine Creek and Rantyga Creek is located immediately downstream (south) of the development envelope. Several lower order unnamed watercourses are also mapped within the development envelope. Typically, these are mapped as first-order streams. However, higher order streams include a third-order unnamed tributary to Pine Creek, which runs north-west to south-east through the development envelope, and a second-order unnamed tributary to Rantyga Creek, which runs west to east. All watercourses in the region are ephemeral in nature with flows only occurring for a short time following rainfall events of sufficient total depth to generate surface runoff. No known flooding investigations have been undertaken in the vicinity of the site. Previous geomorphologic characterisation of Pine Creek and Rantyga Creek describes the watercourse reaches adjacent to the development envelope as laterally unconfined, with margin control provided by the floodplain. The creek channels here are continuous and typically with a sandy bed. Stream condition is rated as poor to moderate with low to moderate recovery potential and little to no instream refugia present. There is no existing water quality or streamflow monitoring in either the Pine Creek or Rantyga Creek catchments. The closest known monitoring locations in current operation are situated on the main arm or anabranches of the Darling River. In the context of the NSW Water Quality Objectives and River Flow Objectives Pine Creek, Rantyga Creek and all their tributaries are located within the *Barwon-Darling and Far Western Catchment* and would be classified as *uncontrolled streams* as they are free of structures that would otherwise regulate flows (eg dams). The site lies within the *Lower Murray – Darling Unregulated Water Source*, and surface water is managed through the *Water Sharing Plan for the Lower Murray-Darling Basin Unregulated and Alluvial Water Sources 2012*.

Table ES1 Characterisation summary

Aspect	Summary
Soils	Within the development envelope, in general the soils at higher elevations to the north and east are mapped as Calcarosols, trending to Chromosols are lower elevations approaching the creek lines. Soils along the Pine Creek riparian corridor are mapped as Sodosols. Potential constraints related to erosion and downstream water quality risks are typically higher for Sodosols and Chromosols due to potentially higher sodicity, salinity, pH and dispersiveness. Available land and soil capability mapping suggest that relatively high limitations are likely to exist for most potential land uses throughout the development envelope, based on the range of soil and landscape indicators considered. Hydrologic and topographic influence on overall erosion hazard in this region is typically low given the relatively low rainfall intensity and associated erosivity and generally flat to mild sloping terrain.

ES3 Preliminary flood investigation

ES3.1 Approach

A preliminary flood investigation was undertaken to assess mainstream flood behaviour along Pine Creek and Rantyga Creek, where they run in close proximity to the site. This involved development of a hydrologic model of the contributing catchment areas of Pine Creek and Rantyga Creek to their confluence immediately downstream of the site. A two-dimensional (2D) hydraulic model covering the development envelope was established using the TUFLOW software. The flood modelling considered the 5% and 1% annual exceedance probability (AEP) events as well as the Probable Maximum Flood (PMF) and was undertaken generally in accordance with *Australian Rainfall and Runoff 2019* (ARR2019) (Ball et al 2019).

Further details of the approach and flood models developed is described in Chapter 3.

ES3.2 Hydrologic model results

The critical duration for both the 5% and 1% AEP events was found to be 12 hours. The critical duration for the PMF was found to be 24 hours.

Peak flow rates for Pine Creek and Rantyga Creek at a location just upstream of their confluence are presented in Table ES2.

Table ES2 Summary of hydrologic model results

Event	Critical duration	Pine Creek - peak flow (m^3/s)	Rantyga Creek - peak flow (m^3/s)
5% AEP	12 hours	280	76
1% AEP	12 hours	760	220
PMP	24 hours	5,400	1,500

ES3.3 Hydraulic model results

TUFLOW model results showing indicative extents and depths of mainstream flooding for the 5% AEP, 1% AEP and PMF events are presented herein.

For the 5% AEP event, mainstream flooding in the vicinity of the development envelope is contained within the watercourses and immediate overbank areas. Flow along Rantyga Creek does not encroach within the development envelope.

For the 1% AEP event, more extensive out of banks flows are evident, particularly along Pine Creek. The Silver City Highway is overtopped in several locations over a total length of about 1 km, extending north from Pine Creek. Flow along Rantyga Creek remains relatively well confined to the creek, with the flood extent just reaching the eastern boundary of the development envelope.

For the PMF event, extensive out of banks flows are evident for both Pine Creek and Rantyga Creek. The Silver City Highway is overtopped over a total length of about 2 km, extending north from Pine Creek. Along Pine Creek the PMF event engages a broad floodplain in the order of 1 to 2 km wide. Flow along Rantyga Creek continues to follow the creek alignment with the flood extent clearly encroaching on the development envelope.

ES4 Conclusions and recommendations

Based on the outcomes of the preliminary flood investigation it is recommended that further assessment of local flooding conditions is undertaken to support further design development and subsequent environmental assessment. This should include:

- Refinement of the hydrologic modelling to consider parameter selection and sensitivity, particularly rainfall losses once Regional Flood Frequency Estimation (RFFE) model results become available. In the absence of RFFE information, consideration could be given to review of streamflow data from a remote gauging station with similar catchment and watercourse characteristics that could be used to refine and improve confidence in model parameter estimates.

- Incorporation of more accurate and contemporary LiDAR terrain data, which is currently being acquired by Tellus, into the hydraulic model. Other hydraulic model refinements to be considered should include review of model grid sizing once new LiDAR data becomes available, consideration of the need for breaklines and other topographic modifiers, and incorporation of the existing Silver City Highway bridge into the model.

- Use of anecdotal historic flood data to enable testing of combined hydrologic/hydraulic model performance in reproducing observed flood behaviour for historic events.

- Consideration of local overland flow and associated flooding mechanisms that may affect parts of the development envelope and therefore require consideration as part of future design development and environmental assessment.

To assist further characterisation of the existing surface water environment, which will aid future design development, support environmental assessment activities, and assist with subsequent development of monitoring and management plans for the facility, once approved, it is also recommended that:

- Baseline surface water quality monitoring is commenced to develop an understanding of the existing water quality for runoff generated both on site and conveyed in receiving watercourses. This will need to target wet weather conditions given the ephemeral nature of all watercourses in this area.

- Installation of a local weather station and streamflow gauging station be considered to improve understanding of local weather conditions and the local hydrologic regime and runoff response.

- Further specialist geomorphology and soils investigation, including testing of soils, be undertaken to improve understanding and spatial distribution of soils, land capability, erosion hazard and related constraints across the development envelope.

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1 Introduction

1.1 Project overview and background

Tellus Holdings Limited (Tellus) is proposing to develop a near-surface arid geological repository for permanent isolation and long-term storage of hazardous chemical waste materials. To achieve this, overburden material including sands and kaolin clay will be excavated to create waste cells. The proposal and its supporting infrastructure are collectively known as the Blue Bush Facility (the facility). The waste repository has capacity to receive up to 200,000 tonnes per annum of waste for up to 25 years.

The proposed facility is located approximately 45 kilometres (km) south of Broken Hill in western NSW within the Unincorporated Far West Region, as shown in Figure 1.1. The primary road access to the facility will be via the Silver City Highway. A preliminary development envelope for the facility has been prepared, and this is located entirely within Exploration Licence (EL) 8188 (refer Figure 1.1).

Transport of product and supplies will most likely occur between a proposed third-party operated inter-modal transfer facility, located in Broken Hill, and the proposed project location via the Silver City Highway. However, consideration of the inter-modal transfer facility does not form part of this current investigation.

EMM understands that the proposed project may be classified as State Significant Development (SSD) under Part 4, Division 4.1 of the NSW Environment Planning and Assessment Act 1979 (EPA Act 1979), with classification of SSD status provided under Section 89C of the EPA Act 1979 and State Environmental Planning Policy (State and Regional Development) 2011. As such, the proposal will be assessed by the NSW Department of Planning Industry and Environment (DPIE) through an Environmental Impact Statement (EIS) and against the Secretary's Environmental Assessment Requirements (SEARs), issued following review of an Environmental Scoping Report (ESR). Tellus is currently preparing an ESR for the proposed project. Once submitted, they expect to receive SEARs by September 2020.

1.2 Report purpose and structure

This Preliminary Surface Water Investigation (PSWI) has been prepared to inform preparation of an ESR. It provides a broad characterisation of the existing surface water environment and related aspects including climate, topography and soils. It also presents the methodology and outcomes from a preliminary flood investigation that was undertaken to assess mainstream flood behaviour along Pine Creek and Rantyga Creek (refer Figure 1.1) where they run in close proximity to the proposed facility.

The PSWI is intended to provide a concise overview of existing surface water features and related constraints, based on currently available data, suitable to inform an ESR and request for SEARs as well as to support early design development by Tellus. The PSWI is also intended to assist with ongoing consultation with the community, regulators and other stakeholders.

The report is structured as follows:

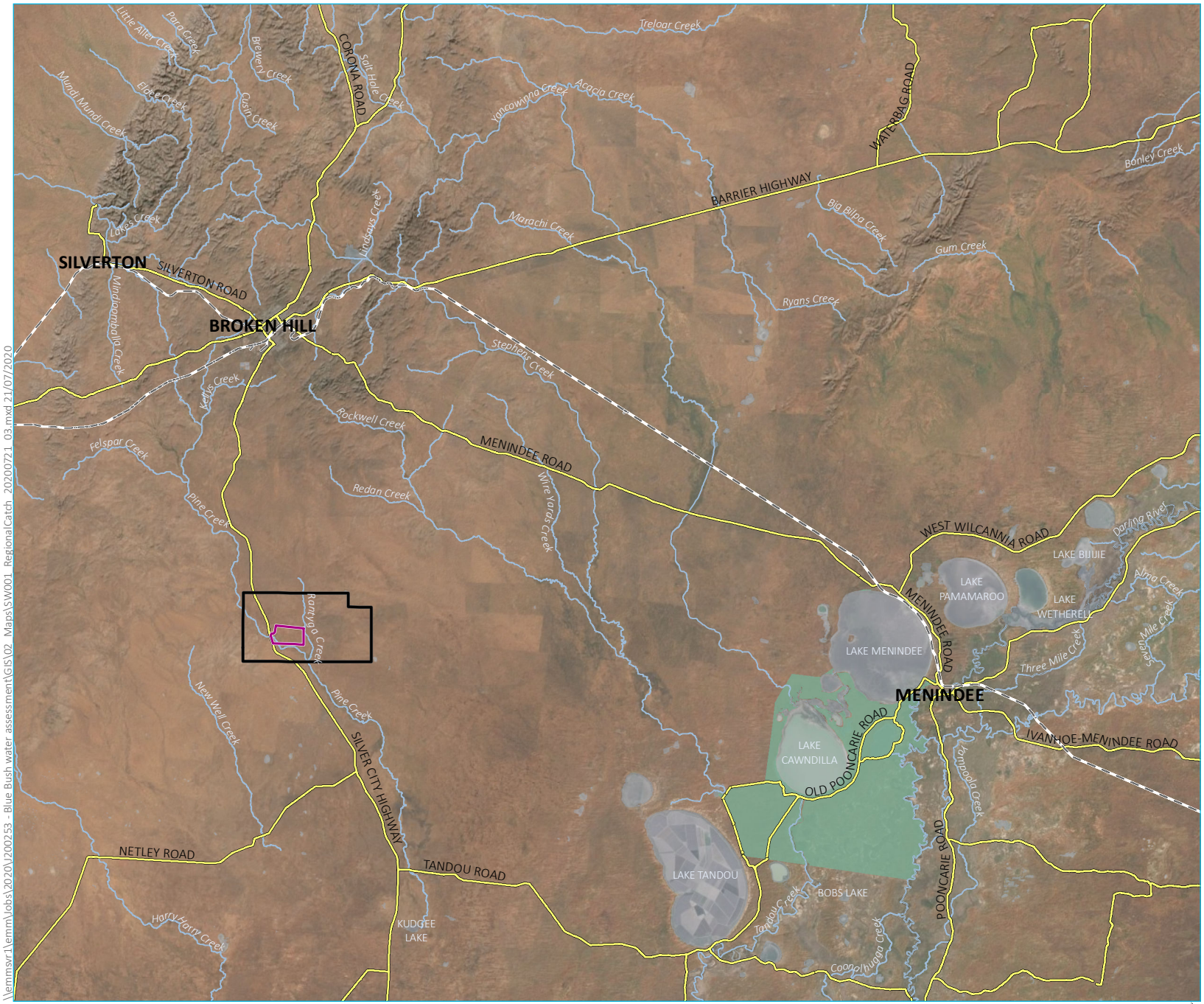
- Chapter 2 presents a characterisation of the existing surface water environment and related aspects including climate, topography and soils;
- Chapter 3 presents the methodology and outcomes of the preliminary flood investigation, including recommendations for further investigation; and
- Chapter 4 contains a list of references.

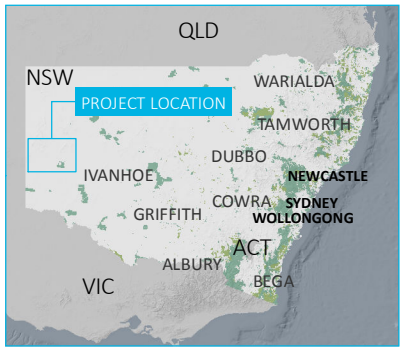
1.3 Available data

A summary of available data, including publicly available spatial datasets, that has been compiled and reviewed as part of the PSWI is presented in Table 1.1.

Table 1.1 Available data

Data	Details	Source
Climate data	Long-term monitoring of key variables related to hydrology including temperature, rainfall and evaporation	Bureau of Meteorology (BoM) - Climate Data Online: http://www.bom.gov.au/climate/data/
Topographic data	Two key datasets are available: • Digital elevation model (DEM) derived from the Shuttle Radar Topography Mission (SRTM), at 1-second (~30 m) resolution. SRTM data was acquired by NASA in February 2000.	Geoscience Australia – available via ELVIS platform: https://elevation.fsdf.org.au/
	• DEM derived from March 2015 LiDAR survey for Thackaringa and surrounding 1:100,000 map sheet coverages at 5 m resolution. Typical vertical accuracy is +/- 0.9 m on bare open ground at 95% confidence interval.	NSW Department of Finance, Services and Innovation (DFSI) Spatial Services - available via ELVIS platform: https://elevation.fsdf.org.au/
Base spatial mapping	Existing features including administrative boundaries, cadastre, terrain, place names, infrastructure, watercourses and waterbodies, and other natural/visible features	DFSI Spatial Services - NSW Digital Topographic Database (DTDB) and NSW Digital Cadastral Database (DCDB) 2017
Geomorphology	State-wide watercourse geomorphologic characterisation and condition database, including spatial mapping	NSW River Styles Database (DPIE 2019) – available via: https://www.industry.nsw.gov.au/water/science/surface-water/monitoring/river-health/river-styles
Soils	State-wide land and soil information, including Australian Soil Classification mapping	eSPADE v2.1 (DPIE 2020) – available via: https://www.environment.nsw.gov.au/eSpade2Webapp
Flood estimation inputs	Design rainfall data and associated design inputs for flood estimation purposes	Geoscience Australia - Australian Rainfall and Runoff (ARR) Data Hub: https://data.arr-software.org/





KEY

- EL 8188
- Development envelope
- Rail line
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest (refer to inset)

Regional setting

Tellus Holdings Limited – Blue Bush Facility
Preliminary surface water investigation
Figure 1.1

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2 Baseline characterisation

2.1 Introduction

This chapter provides a characterisation of the existing surface water environment and related aspects including climate, topography and landform, catchments, watercourses and drainage, water quality and soils.

2.2 Climate

2.2.1 Overview and available monitoring

The site is located in the arid zone of NSW, which is characterised by hot and persistently dry summers and cool winters. Average annual rainfall is low (200–250 mm per year), and potential evaporation rates are high (exceeding 2,500 mm per year) leading to generally low surface water availability. The temperature range is large with summer maximum temperatures routinely over 35°C and winter minimum temperatures below 5°C, dropping below zero on occasion.

Climate monitoring is less comprehensive in the inland, arid zone of NSW compared to coastal and other more highly populated areas. However, several long-term weather stations operated by the Bureau of Meteorology (BoM) are available to inform understanding of key variables related to hydrology, including temperature, rainfall and evaporation.

It is recommended that installation of a local weather station be considered to improve understanding of local weather conditions.

2.2.2 Temperature

At Broken Hill the mean monthly minimum and maximum temperature range is between about 5-16°C in winter and 17-34°C in summer (BoM 2020a). Figure 2.1 shows the monthly temperature profile for Broken Hill Airport AWS (BoM Ref. 47048).

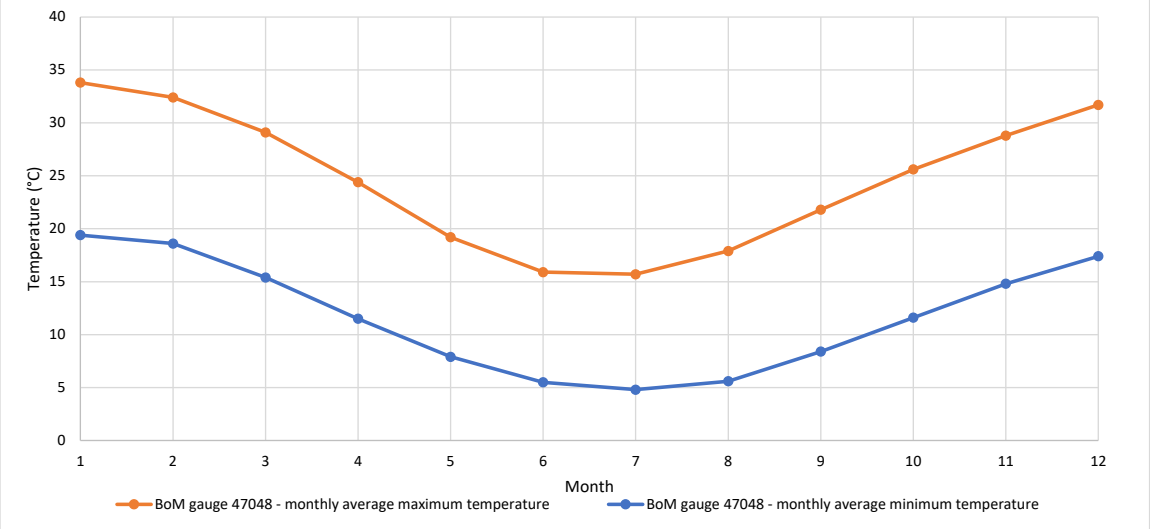


Figure 2.1 Monthly mean temperatures at Broken Hill

Daily maximum temperatures will routinely reach over 35°C in summer with multiple days on average per year exceeding 40°C.

2.2.3 Rainfall

There are three BoM daily read rainfall gauges located within 50 km of Broken Hill, which have an extended rainfall record. Details of these gauges are presented in Table 2.1. There is a rainfall gauge located closer to the site (Broken Hill (Langwell), BoM Ref. 47056) but it has less than 20 years of record. The closest pluviographic station that measures continuous rainfall appears to be located at Menindee Lakes, approximately 75 km to the east of the site.

Table 2.1 Rainfall summary

	BoM gauge 47048 Broken Hill Airport AWS, NSW	BoM gauge 47039 Umberumberka Reservoir, NSW	BoM gauge 20002 Cockburn SA
Period of record	1947 - 2020	1911 - 2019	1888 - 2020
Average annual rainfall (mm)	248	206	215
Minimum annual rainfall (mm)	68	41	25
10th percentile annual rainfall (mm)	126	109	98
Median annual rainfall (mm)	236	192	198
90th percentile annual rainfall (mm)	395	314	351
Maximum annual rainfall (mm)	714	561	523

Long-term rainfall records show that January is typically the wettest month, and June is generally the driest. Figure 2.2 shows the monthly cumulative deviation from the mean (CDFM) rainfall for each of the gauges. A CDFM chart shows long-term rainfall trends by comparing each monthly rainfall total to the long-term average rainfall for that month. A downwards trend on the chart corresponds with a drier than average period, whilst an upwards trend on the chart indicates a wetter than average period.

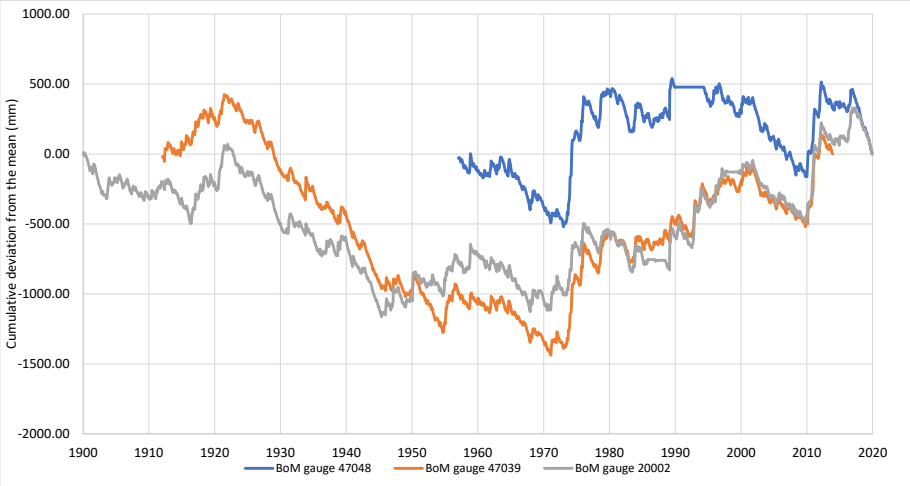


Figure 2.2 Cumulative deviation from the mean (rainfall)

Figure 2.2 indicates that the long-term trends at each gauge correlate reasonably well. Rainfall in the project area was lower than average for the majority of the 20th century, with a decreasing CDFM trend between 1920 and the mid-1970s. From the 1970s to 2000, rainfall tended to be slightly above average. The millennium drought of the early 2000s, which can be clearly seen on the figure, was broken by significant rainfall in the early 2010s.

The last three to four years show a return to drier than average conditions, with the summer of 2019-2020 providing very little rainfall and several record lowest monthly totals. This recent period has also corresponded with higher than average temperatures including record high minimum and maximum daily temperatures in the region in early 2019.

Design rainfall data for the site, which is required for flood estimation purposes, is presented in Chapter 3.

2.2.4 Evaporation

Potential evaporation in the arid zone typically far exceeds rainfall. Average annual pan evaporation is about 2,500 mm. Average monthly areal potential evapotranspiration for the site (BoM 2020b), which is typically a better measure of evaporation from vegetated land surfaces, is shown in Table 2.2.

Table 2.2 Average monthly areal potential evapotranspiration

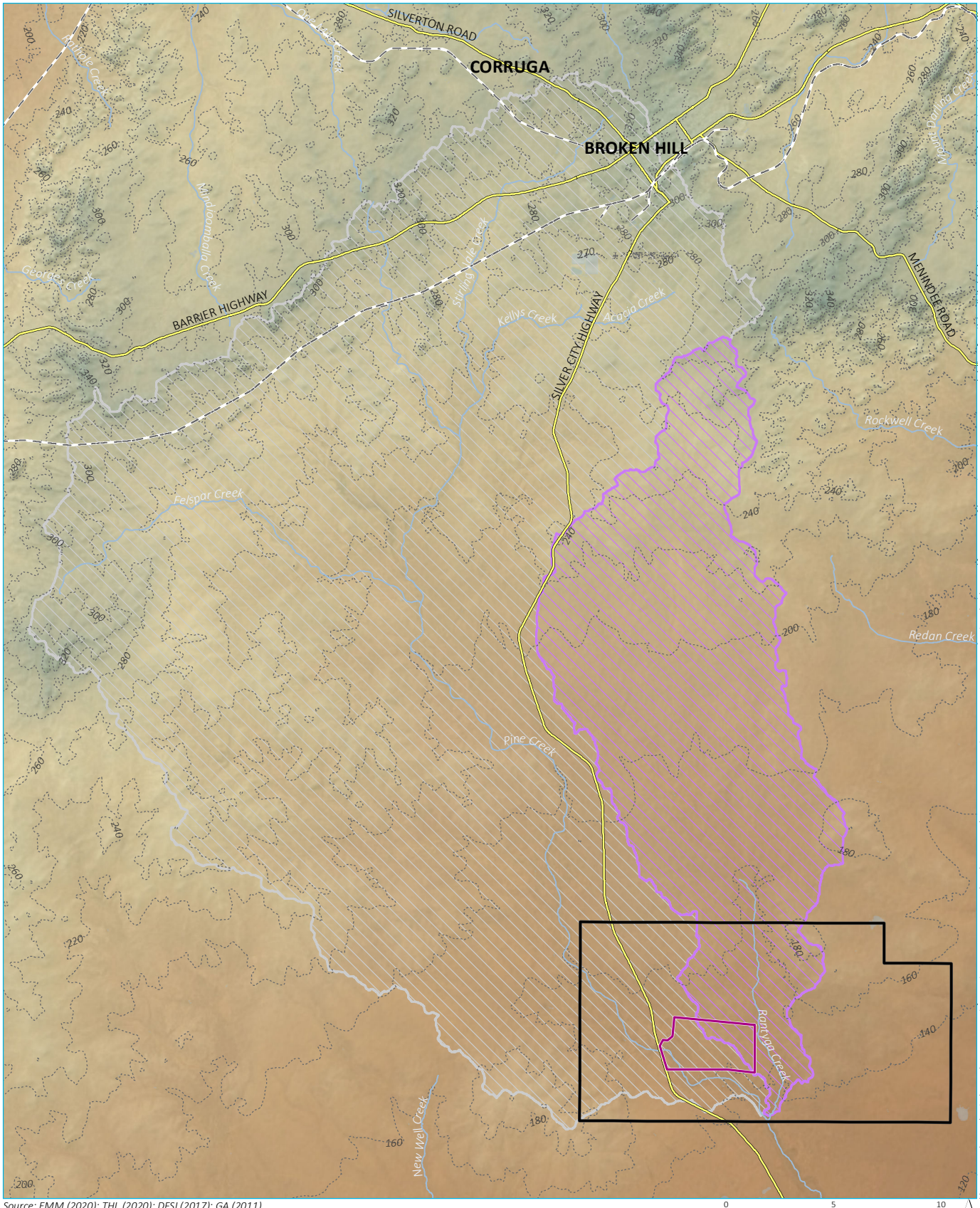
Month	Areal potential evapotranspiration (mm)
January	177
February	140
March	119
April	74
May	49
June	33
July	39
August	51
September	77
October	121
November	148
December	168
Annual total	1,196

2.3 Topography, landforms and site features

2.3.1 Regional context

Figure 2.3, which provides an overview of the regional topography, shows gridded ground surface elevations and contours derived from SRTM data (refer Table 1.1 for details).

The topography falls generally to the south from a regional ridgeline, forming part of the southern Barrier Ranges, which runs generally north-east to south-west through the town of Broken Hill. The ridgeline sits at an elevation of about 320 metres relative to Australian Height Datum (m AHD), whilst the site is situated at about 150 m AHD.



Source: EMM (2020); THL (2020); DFSI (2017); GA (2011)

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KEY

- EL 8188
- Development envelope
- Rail line
- Major road
- Contour (20 m increments)
- Named watercourse
- Waterbody

Major catchments

- Pine Creek
- Rantyga Creek

Elevation (mAHD)

462

58

Regional topography

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Preliminary surface water investigation
Figure 2.3

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The site is located in close proximity to Pine Creek and Rantyga Creek. The catchments of both watercourses are shown on Figure 2.3.

Figure 2.4 and Figure 2.5 show the longitudinal fall along each creek line, extending from the headwaters of the catchment to the site. The average grade for Pine Creek is low at about 0.30% and reasonably consistent along its length. The average grade for Rantyga Creek is also low at about 0.35%, falling more steeply in the headwaters before flattening out to the south. Further description of the watercourses and catchments is provided in Section 2.4.

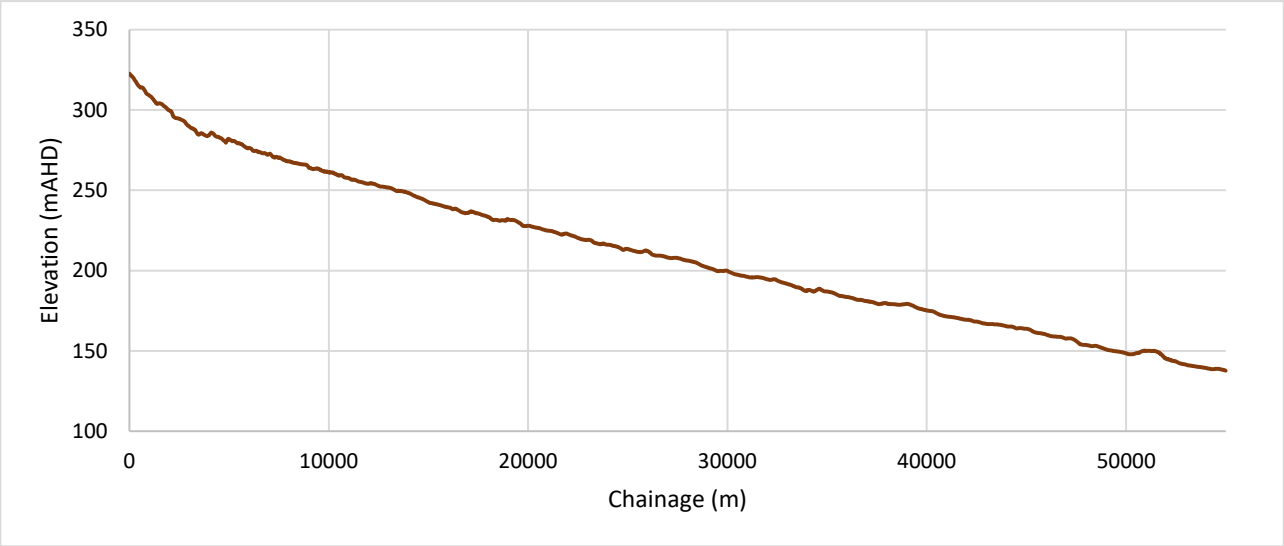


Figure 2.4 Pine Creek catchment long section

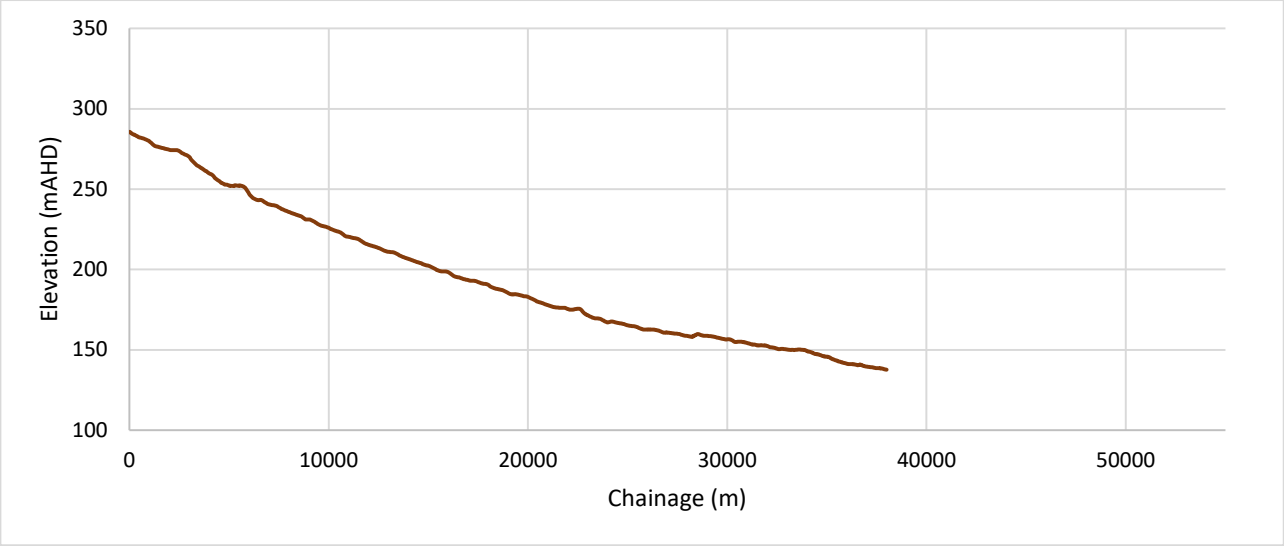


Figure 2.5 Rantyga Creek catchment long section

2.3.2 Local context

Figure 2.6 shows the local topography in the vicinity of the development envelope, based on gridded ground surface elevations and contours derived from available LiDAR data(refer Table 1.1 for details). Surface elevations within the development envelope reduce from about 158 m AHD along a central plateau, falling to approximately 140 m AHD to the south towards Pine Creek and to the east towards Rantyga Creek.

The development envelope forms part of the Pine Point property, with the existing homestead located on the left (northern) overbank of Pine Creek just outside and to the south of the development envelope. Also shown on Figure 2.6 are the approximate alignments of existing vehicular tracks across the site. The property was used for grazing through multiple generations dating back to the early 1900s. Grazing has ceased in recent years and whilst occupation of the homestead continues there is no current use of the land.

Other existing infrastructure in the vicinity of the site is limited but includes the Silver City Highway immediately to the west and the Wentworth to Broken Hill water supply pipeline. The pipeline, which supplies raw water from The River Murray to Broken Hill, is located within the highway corridor. A major electricity easement is also located to the east of the development envelope and Rantyga Creek.

2.4 Hydrology

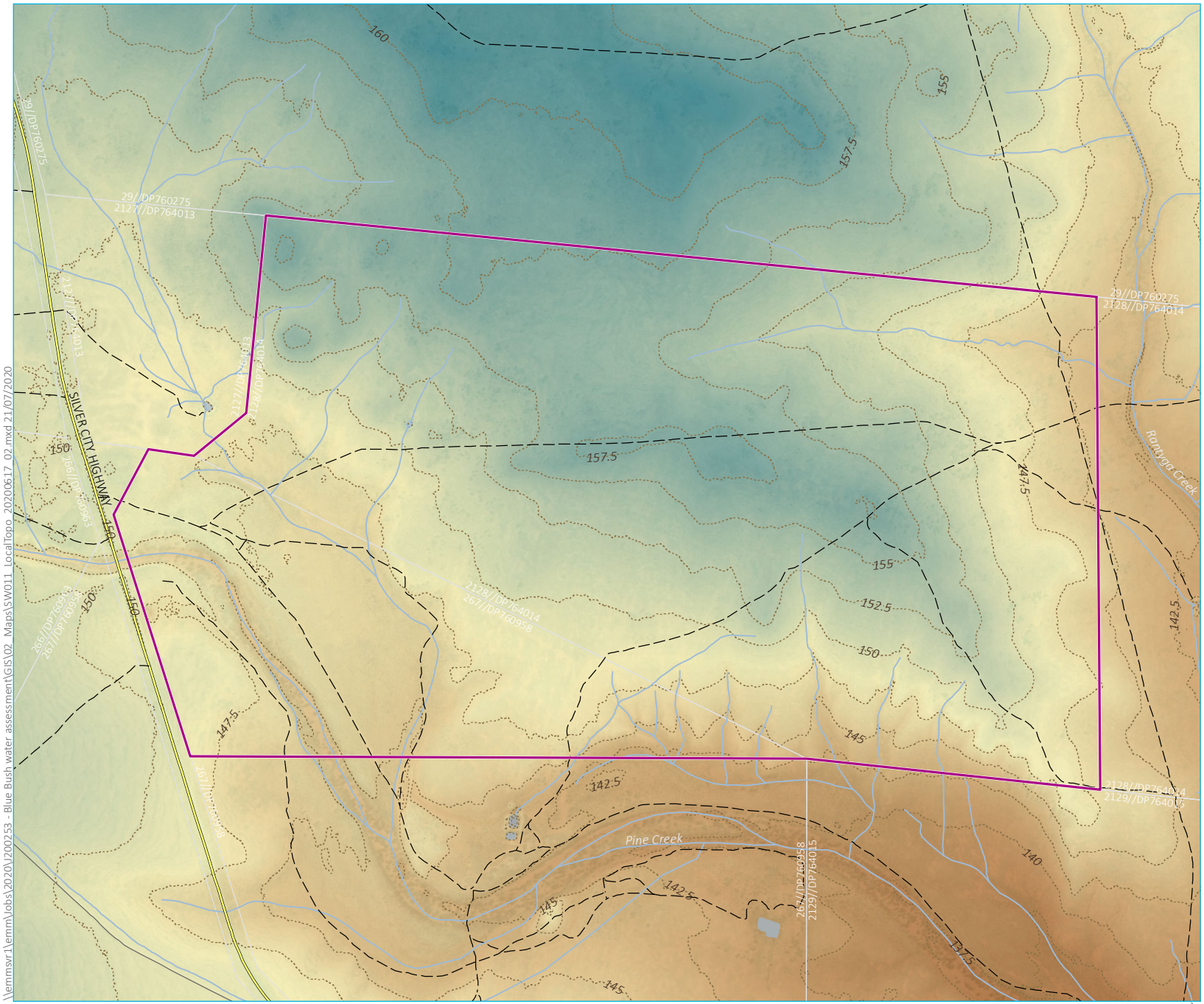
2.4.1 Catchment overview

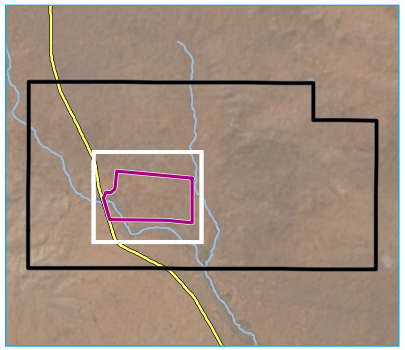
The regional hydrologic setting for the site is within the Lower Darling River catchment of the Murray Darling Basin. Figure 1.1 shows the location of the Darling River, which flows generally to the south, near Menindee some 75 km to the east of the site.

The site and surrounding area form part of a smaller sub-catchment that drains to Pine Creek, which ultimately flows into Kudgee Lake approximately 40 km to the south. Kudgee Lake is understood to be a terminal waterbody, with no surface connectivity to the Lower Darling River system.

The site is located immediately upstream of the confluence of Pine Creek and Rantyga Creek. The catchment area for each watercourse, mapped to the confluence, is shown on Figure 2.3. The respective catchment areas are about 910 square kilometres (km^2) for Pine Creek, and 250 km^2 for Rantyga Creek. For context, the total catchment area draining to Kudgee Lake is about 1,500 km^2.

Land use in the region is dominated by grazing and associated pastoral use. A small part of the urbanised area of Broken Hill is located at the very top of the Pine Creek catchment.





KEY

- EL 8188
- Development envelope
- Major road
- Minor road
- Vehicular track
- Contour (2.5 m increments)
- Watercourse/drainage line
- Waterbody
- Cadastral boundary

Elevation (mAHD)

162

134

Local topography

Source: EMM (2020); THL (2020); DFSI (2017); ICSM (2015)

0 0.5 1 km

GDA 1994 MGA Zone 54

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Preliminary surface water investigation
Figure 2.6

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2.4.2 Watercourses

The local hydrologic context relevant to the development envelope is shown on Figure 2.7. Key features include mapped watercourses and stream order. The regional catchment divide is also shown and roughly splits the development envelope in half, with the north-eastern portion falling generally towards Rantyga Creek and the balance falling towards Pine Creek.

Pine Creek is a seventh-order watercourse where it runs through and to the south of the development envelope. The creek flows generally from north to south and is highly variable in width at top of bank, up to about 150 m. The creek bed is sandy and sparsely vegetated. Representative photographs of Pine Creek near its crossing of the Silver City Highway, upstream of the development envelope, are shown in Photograph 2.1 and Photograph 2.2. The highway crosses Pine Creek on a timber bridge structure.

Rantyga Creek is a fourth-order watercourse where it runs to the east of the development envelope. The creek forms one of the major tributaries of Pine Creek, flowing generally from north to south. Similar to Pine Creek, the bed of Rantyga Creek is sandy and sparsely vegetated. Representative photographs of Rantyga Creek are shown in Photograph 2.3 and Photograph 2.4.

The confluence of Pine Creek and Rantyga Creek is located immediately downstream (south) of the development envelope.

Several lower order unnamed watercourses are also mapped within the development envelope (refer Figure 2.7). Typically, these are mapped as first-order streams. However, higher order streams include a third-order unnamed tributary to Pine Creek which runs north-west to south-east through the development envelope, and a second-order unnamed tributary to Rantyga Creek, which runs west to east.

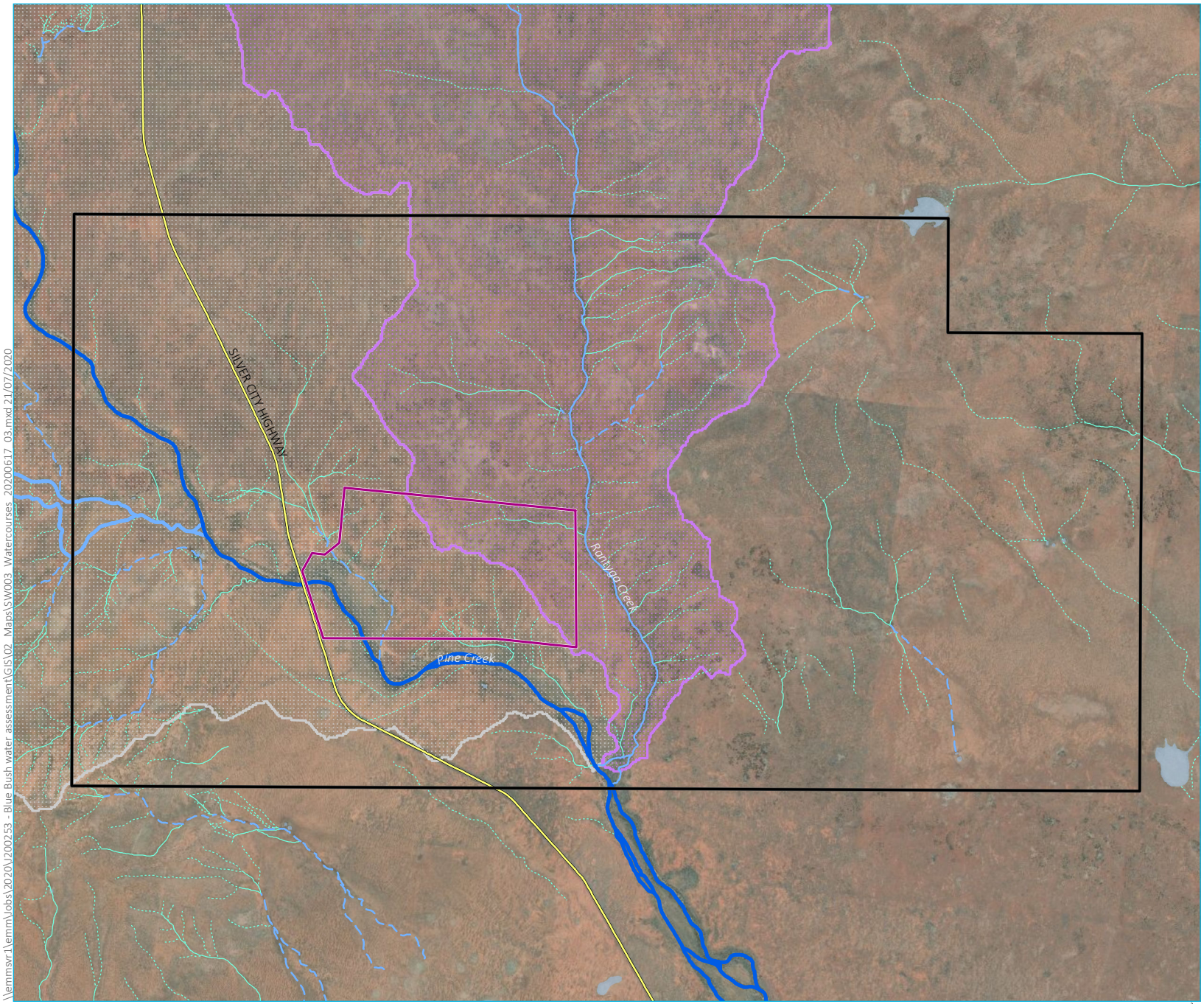
Ground-truthing to confirm the presence of these lower order watercourses is recommended as part of future site investigations.

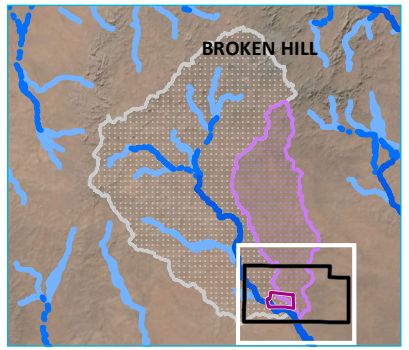
All watercourses in the region are ephemeral in nature with flows only occurring for a short time following rainfall events of sufficient total depth to generate surface runoff.

2.4.3 Streamflow monitoring

There is no existing streamflow monitoring in either the Pine Creek or Rantyga Creek catchments. The closest known streamflow monitoring locations in current operation are situated on the main arm or anabranches of the Darling River. However, this data is of limited use for the current assessment as the Darling River catchment is significantly different in scale and regulation to Pine Creek and Rantyga Creek.

It is recommended that installation of a permanent streamflow gauging station be considered to improve understanding of the local hydrologic regime and runoff response. Over time this would also provide a local flow record that would reduce uncertainty in estimates of larger floods that could potentially affect the site.





KEY

- EL 8188
- Development envelope
- Major road
- Waterbody

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order
- 7th order

Major catchments

- Pine Creek
- Rantyga Creek

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Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

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Watercourses and stream order

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Preliminary surface water investigation
Figure 2.7

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Photograph 2.1 Pine Creek view to east looking downstream from highway bridge

Photograph 2.2 Pine Creek view to north towards highway bridge

Photograph 2.3 **Rantyga Creek view to east**

Photograph 2.4 **Rantyga Creek view to north looking upstream**

2.4.4 Geomorphology

The NSW River Styles Database (DPIE 2019) provides an overview of geomorphic watercourse character, behaviour, condition and recovery potential targeting third and higher order watercourses throughout NSW. Geomorphic characterisation is based on the River Styles Framework, developed by Macquarie University, which classifies watercourses based on measurable geomorphic attributes and qualities that include river type, fragility, sensitivity to disturbance, condition, rarity and recovery potential.

Figure 2.8 shows the extent of River Styles characterisation and mapping in the vicinity of the site and upstream catchment. This is based on work undertaken for the former Lower Murray Darling Catchment Management Authority in 2012. Table 2.3 summarises relevant descriptions for reaches of Pine Creek and Rantyga Creek that run adjacent to the development envelope, that is expanded on below.

Table 2.3 Geomorphologic character of Pine Creek and Rantyga Creek within the development envelope

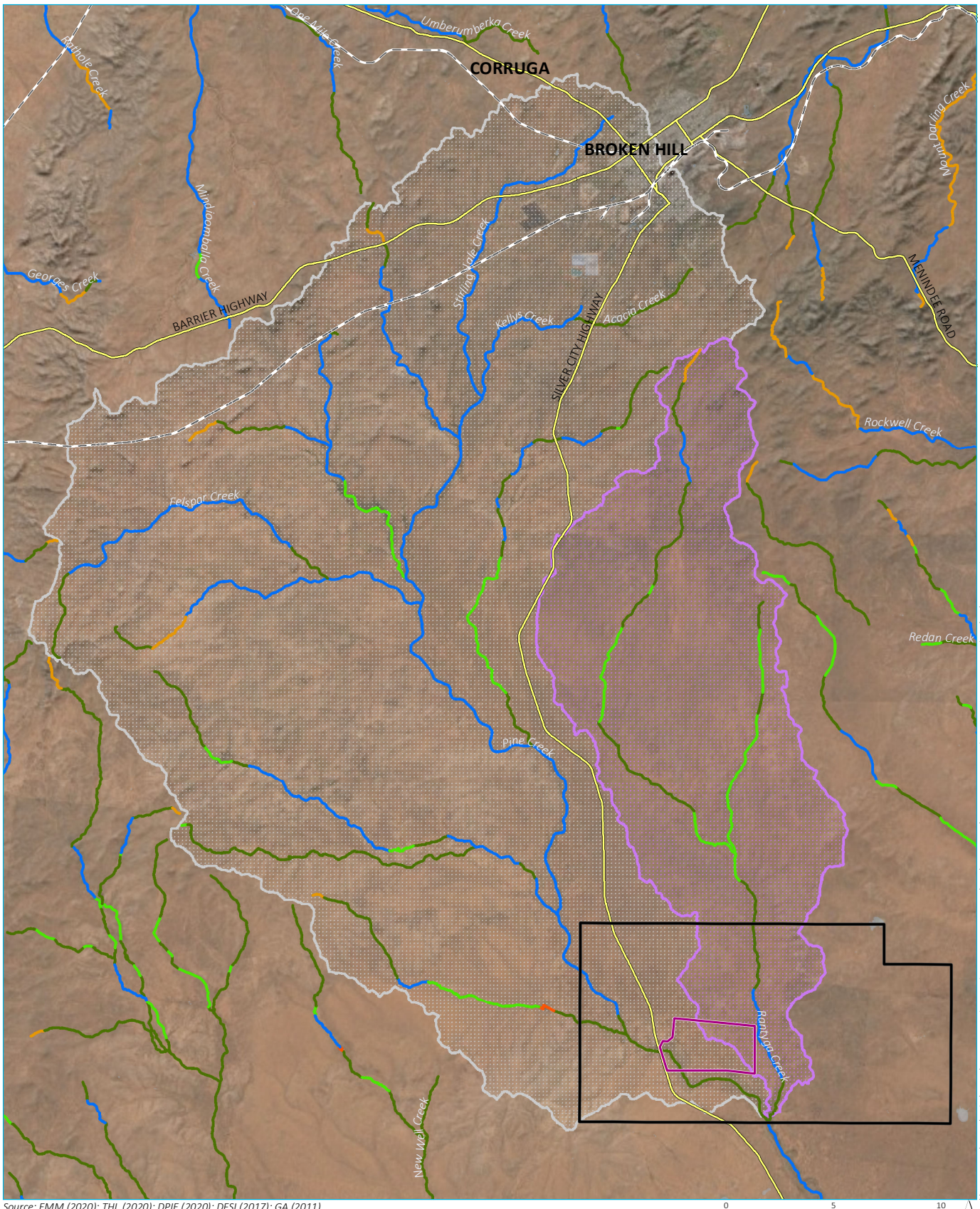
Attribute	Pine Creek	Rantyga Creek	
River Style description	Low sinuosity, sand	Planform controlled, low sinuosity, sand	Channelised fill
River style full name	Laterally unconfined, continuous channel, low sinuosity, sand bed	Partly confined, planform controlled, low sinuosity, discontinuous floodplain, sand bed	Laterally unconfined, continuous channel, low sinuosity, terrace constrained, gravel bed
Confinement	Laterally unconfined valley setting, continuous	Partly confined valley setting – continuous	Laterally unconfined valley setting – continuous
Margin control	Terrace or floodplain	Terrace or floodplain	Bedrock or terrace cohesive floodplain
Planform descriptor	Low sinuosity	Low sinuosity	Low sinuosity
Bed matrix	Sand	Sand	Variable
Stream condition	Moderate	Poor	Poor
Recovery potential	Moderate recovery potential	Moderate recovery potential	Low recovery potential
Fragility	High	High	moderate

Upstream of the site, Pine Creek is generally characterised as partly laterally confined, with lateral movement controlled by the valley floor. Tributaries to Pine Creek are generally similar to Pine Creek, with some sections laterally unconfined or with gravel beds. Watercourses in the catchment generally have low sinuosity throughout.

Closer to the site and through the development envelope, Pine Creek is characterised as laterally unconfined, with margin control provided by the floodplain. The creek is a continuous channel with a sandy bed.

Upstream of the site, Rantyga Creek is generally characterised as laterally unconfined and terrace constrained with gravel beds, with sections of fanning and anastomosing (ie connectivity between channels) through fine-grained beds. Adjacent to the development envelope, Rantyga Creek transitions to partly confined to the floodplain, with a continuous channel and sandy bed.

Due to the shallow grade and branching and fanning in the upper reaches of the catchments, as well as the potentially free-draining sandy and gravelly bed composition, water through the landscape is expected to flow relatively slowly, even during heavy rainfall events.



Source: EMM (2020); THL (2020); DPIE (2020); DFSI (2017); GA (2011)

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KEY

- EL 8188
- Development envelope
- Rail line
- Major road
- Waterbody

Major catchments

- Pine Creek
- Rantyga Creek

River style code

- CVS - Confined Valley Setting
- LUV CC - Laterally Unconfined Valley Setting - Continuous
- LUV DC - Laterally Unconfined Valley Setting - Discontinous
- PCVS - Partly Confined Valley Setting - Continuous
- SMG - Swampy Meadow Group

Geomorphic characterisation

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Figure 2.8

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Stream condition is rated as poor to moderate with low to moderate recovery potential and little to no instream refugia present.

It is recommended that further specialist investigation of geomorphology is undertaken to improve understanding of potential stream behaviour and associated risks to support further design development as well as future environmental assessment for the project.

2.4.5 Flooding

An initial desktop review showed that no known flooding investigations have been undertaken in the vicinity of the site. Therefore, preliminary flood modelling was undertaken as part of the PSWI to assess mainstream flooding conditions along Pine Creek and Rantyga Creek where they run in close proximity to the site. The methodology and findings are presented in Chapter 3.

Concurrently with the PSWI, Tellus consulted with the Pine Point landholder to better understand past flooding that has affected the site. A range of anecdotal information based on personal experience and observation was obtained, as summarised below:

- Pine Creek has only flooded above top of bank level on two occasions in the last 70 years - in 1992 (timing unknown) and again sometime after 1992 (year unknown, timing thought to be around February).
- Rantyga Creek rarely breaks its banks. The highest water levels observed along the creek are understood to extend an estimated 100 m from the creek line. The year and timing of this event are unknown.
- To the landholder's knowledge, neighbouring properties both upstream and downstream along Pine Creek have not experienced flooding above floor level.
    - The upstream homestead (Sunnydale), which is located about 4 km to the west of the site, is only a short distance from the creek, but on higher ground. This high ground has not flooded, but the surrounding lower lying land has been inundated on occasion.
    - The downstream homestead (Langwell), which is located about 10 km to the south of the site, is also situated on higher ground that is above the level of known historic flooding.

Timing prevented incorporation of this anecdotal flood data in the flood modelling that was undertaken for the PSWI. Therefore, it is recommended that further consideration of this information is made as part of subsequent investigations supporting design development and environmental assessment. This will help to improve confidence in model predictions of flood behaviour. This is discussed further in Section 3.6.2.

2.4.6 Water quality

i Existing water quality

No known water quality monitoring data is available for watercourses in the vicinity of the site, nor for upstream or downstream locations that are likely to be representative. Therefore, it is recommended that a baseline surface water monitoring program is established to develop an understanding of existing water quality for runoff generated both on site and in receiving watercourses. This will help to support further design development as well as future environmental assessment. The monitoring will need to target wet weather conditions given the ephemeral nature of all watercourses in this region. However, this is challenging in such a remote location. Site presence during upcoming drilling and other exploration/monitoring activities provides a good opportunity to commence this program.

ii NSW Water Quality and River Flow Objectives

The NSW Water Quality Objectives (WQOs) are the agreed environmental values and long-term goals for surface waters within the state. They set out the community's values and uses for our waterways as well as a range of water quality indicators to help assess whether the current condition of our waterways supports those values and uses.

The NSW River Flow Objectives (RFOs) are the agreed high-level goals for surface water flow management. They identify the key elements of the flow regime that protect river health and water quality for ecosystems and human use.

In the context of the NSW WQOs and RFOs, Pine Creek, Rantyga Creek and all their tributaries are located within the *Barwon-Darling and Far Western Catchment* and would be classified as *uncontrolled streams* as they are free of structures that would otherwise regulate flows (eg dams).

2.4.7 Water source and management

Water sharing plans set out rules for sharing water between various users, including the environment, and bring water users into a single licensing system managed under the *Water Management Act 2000*.

The site lies within the Lower Murray – Darling Unregulated Water Source. Surface water is managed through the *Water Sharing Plan for the Lower Murray-Darling Basin Unregulated and Alluvial Water Sources 2012*.

2.5 Soils

Available soils data and mapping is limited in this remote part of NSW. Mapping of the Australian Soil Classification (ASC) state-wide dataset is presented in Figure 2.9, which provides a broad understanding of soil types likely to be encountered at the site.

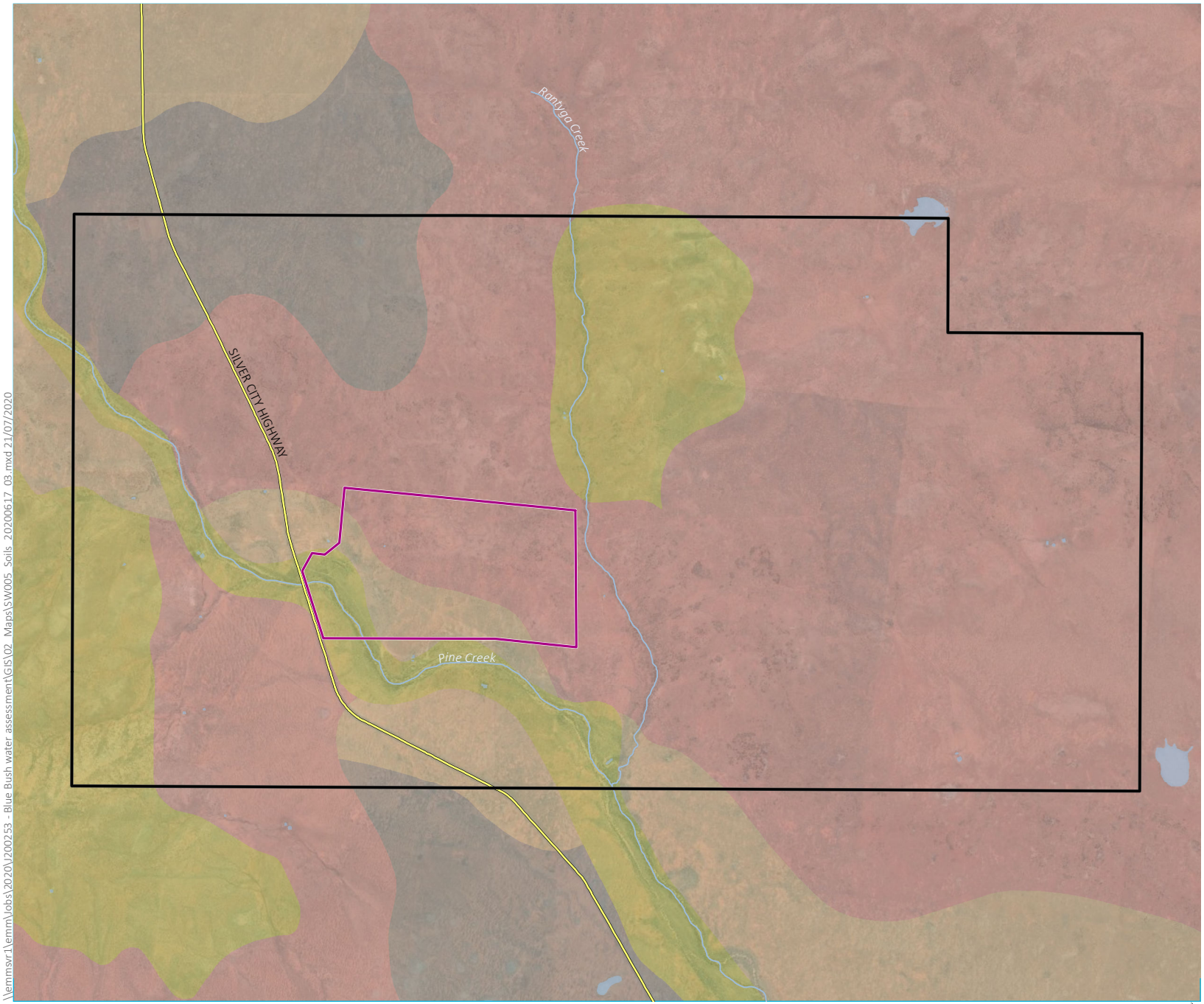
Within the development envelope, the soils at higher elevations to the north and east are generally mapped as Calcarosols, while trending to Chromosols at lower elevations approaching the creek lines. Soils along the Pine Creek riparian corridor are mapped as Sodosols. Vertosols are mapped within EL 8188 but outside the development envelope.

Further information describing these soil types and related constraints is summarised in Table 2.4.

Photograph 2.5 and Photograph 2.6 show soils at Rantyga Creek and towards the centre of the development envelope, respectively.

Available land and soil capability mapping (OEH 2017) is limited and broad-scale in this region but the available data suggests relatively high limitations are likely to exist for most potential land uses throughout the development envelope, based on the range of soil and landscape indicators considered. Potential constraints related to erosion and downstream water quality risks are typically higher for Sodosols and Chromosols due to potentially higher sodicity, salinity, pH and dispersiveness.

Soil erosion is evident at a number of locations at the site (refer previous photographs referenced). Hydrologic and topographic influence on overall erosion hazard in this region is typically low given the relatively low rainfall intensity and associated erosivity and generally flat to mild sloping terrain.



KEY

- EL 8188
- Development envelope
- Major road
- Named watercourse
- Waterbody

Australian Soil Classification - order level

- Calcarosols
- Chromosols
- Sodosols
- Vertosols

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Source: EMM (2020); THL (2020); DFSI (2017); OEH (2017); GA (2011)

0 1 2 km

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Soils characterisation

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Preliminary surface water investigation
Figure 2.9

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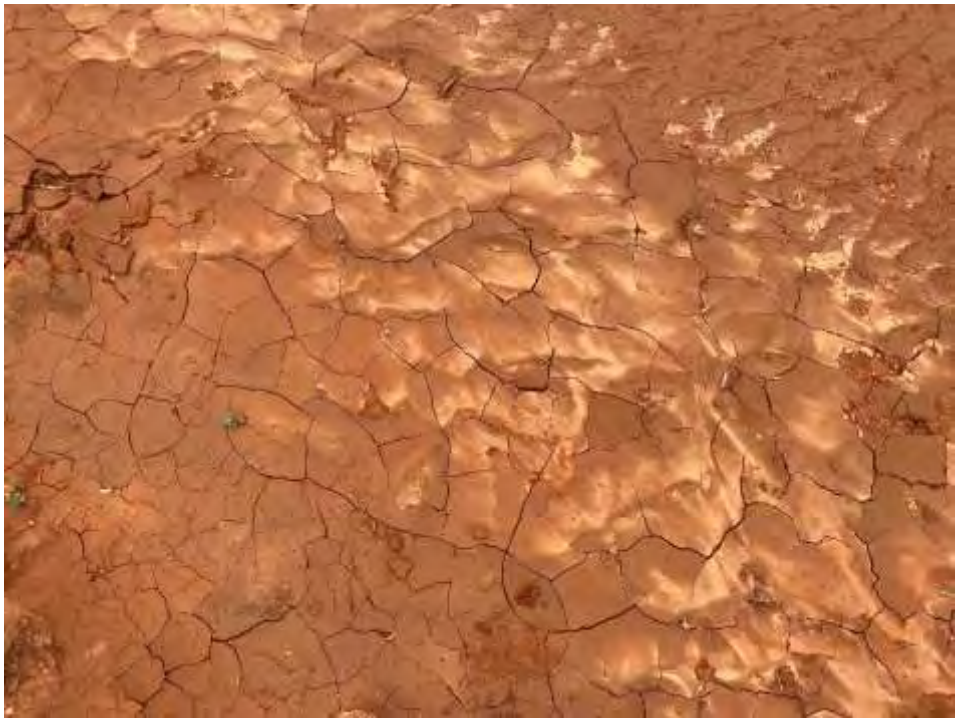
Table 2.4 Australian Soil Classifications

Locations	Australian Soil Classification	Description[1]	Comments
Pine Creek bed (entire reach through development envelope to confluence) Rantyga Creek (reach through development envelope)	Sodosols	Soils with strong texture contrast between A horizons and sodic B horizons which are not strongly acid.	Sodic soils are dispersive, meaning they may be highly erosive. Sodosols in the arid zone may also be strongly saline. With increase in clay content down the soil profile, these may impede site drainage.
Majority of development envelope	Calcarosols	Soils in this order are usually calcareous throughout the profile, often highly so.	Runoff from these areas may have high pH due to high carbonate content. High salinity and sodicity can also be associated with these soils.
Some northern sections of the development envelope	Vertosols	Clay soils with shrink–swell properties that exhibit strong cracking when dry and at depth have slickensides and/or lenticular structural aggregates.	Unlikely to have water quality issues.
Southern sections of the development envelope along Pine Creek	Chromosols	Soils with strong texture contrast between A horizons and B horizons. The latter are not strongly acid and are not sodic.	With increase in clay content down the soil profile, these may impede site drainage. Unlikely to have water quality issues.

Notes: 1. Descriptions from *Australian Soil Classification Revised Edition* (Isbell, R F 2002)



Photograph 2.5 Soil crusting/flaking at Rantyga Creek

Photograph 2.6 Soils in the central part of the development envelope

No known soil testing has been undertaken on the site, or for surrounding areas that are likely to be representative. As available mapping described above is broad-scale and considered of low confidence in this part of the state, it is typically used for high-level understanding only. Soil types may be highly variable on a local scale.

It is recommended that further specialist investigation including testing of soils be undertaken to improve understanding and spatial distribution of soils, land capability, erosion hazard and related constraints across the development envelope. This will help to support further design development as well as future environmental assessment of the project.

3 Preliminary flood investigation

3.1 Introduction

This chapter presents the methodology and outcomes of a preliminary flood investigation that was undertaken to assess mainstream flooding conditions along Pine Creek and Rantyga Creek, where they run in close proximity to the site.

The broad objectives of the investigation were to:

- develop an appreciation of the likely flooding conditions along these watercourses and interaction with the development envelope;
- consider a range of flood magnitudes including a very rare/extreme event; and
- identify flood-related risks and issues requiring further consideration as part of future design development and environmental assessment.

The following sections describe the modelling approach, development of hydrologic and hydraulic models, model results, discussion and recommendations for further investigation.

3.2 Approach

The adopted approach broadly involved the following:

- Development of a hydrologic model of the contributing catchment areas of Pine Creek and Rantyga Creek to their confluence immediately downstream of the site. The hydrologic model was established with the XP-RAFTS software.
- Development of a two-dimensional (2D) hydraulic model covering the development envelope. The hydraulic model was established using the TUFLOW software and considers mainstream flood behaviour along both Pine Creek and Rantyga Creek. The XP-RAFTS model was used to generate discharge hydrographs for application to the TUFLOW model.
- Mapping of indicative flood extents and depths based on TUFLOW model outputs, and interpretation of results.

The flood modelling considered the 5% and 1% annual exceedance probability (AEP) events as well as the Probable Maximum Flood (PMF).

The modelling was undertaken generally in accordance with *Australian Rainfall and Runoff 2019* (ARR2019) (Ball et al 2019) data and guidance on methods. Some reasonable simplifications were made as described herein which are appropriate for this initial stage of investigation, but which should be reviewed in future to ensure that the flood model results remain suitable for the intended use.

No calibration or verification of the modelling was undertaken due to the lack of available data. Therefore, the adopted model parameters are based on engineering judgement and prior experience.

The following sections provide more detailed description of the model development process, presentation/discussion of results, and recommendations for further investigation.

3.3 Hydrologic modelling

3.3.1 Model structure

The contributing catchments for Pine Creek and Rantyga Creek were subdivided into approximately thirty sub-catchment areas, based on the SRTM topography and available watercourse mapping. Figure 3.1 shows the sub-catchment layout that was adopted as the basis of the XP-RAFTS hydrologic model.

3.3.2 Model parameters

The following provides a summary of key sub-catchment data, assumptions and adopted XP-RAFTS model parameters:

- All sub-catchments were typically assumed pervious, with small impervious fractions used only to represent areas on the southern fringe of the urbanised area of Broken Hill.
- The vectored slope for each sub-catchment was determined based on consideration of representative flow paths with slopes derived using SRTM data.
- A global PERN roughness coefficient of 0.04 was adopted.
- Sub-catchment routing assumes translation based on lag times estimated from assumed streamflow velocity, which were verified against hydraulic model results.

3.3.3 Design rainfall

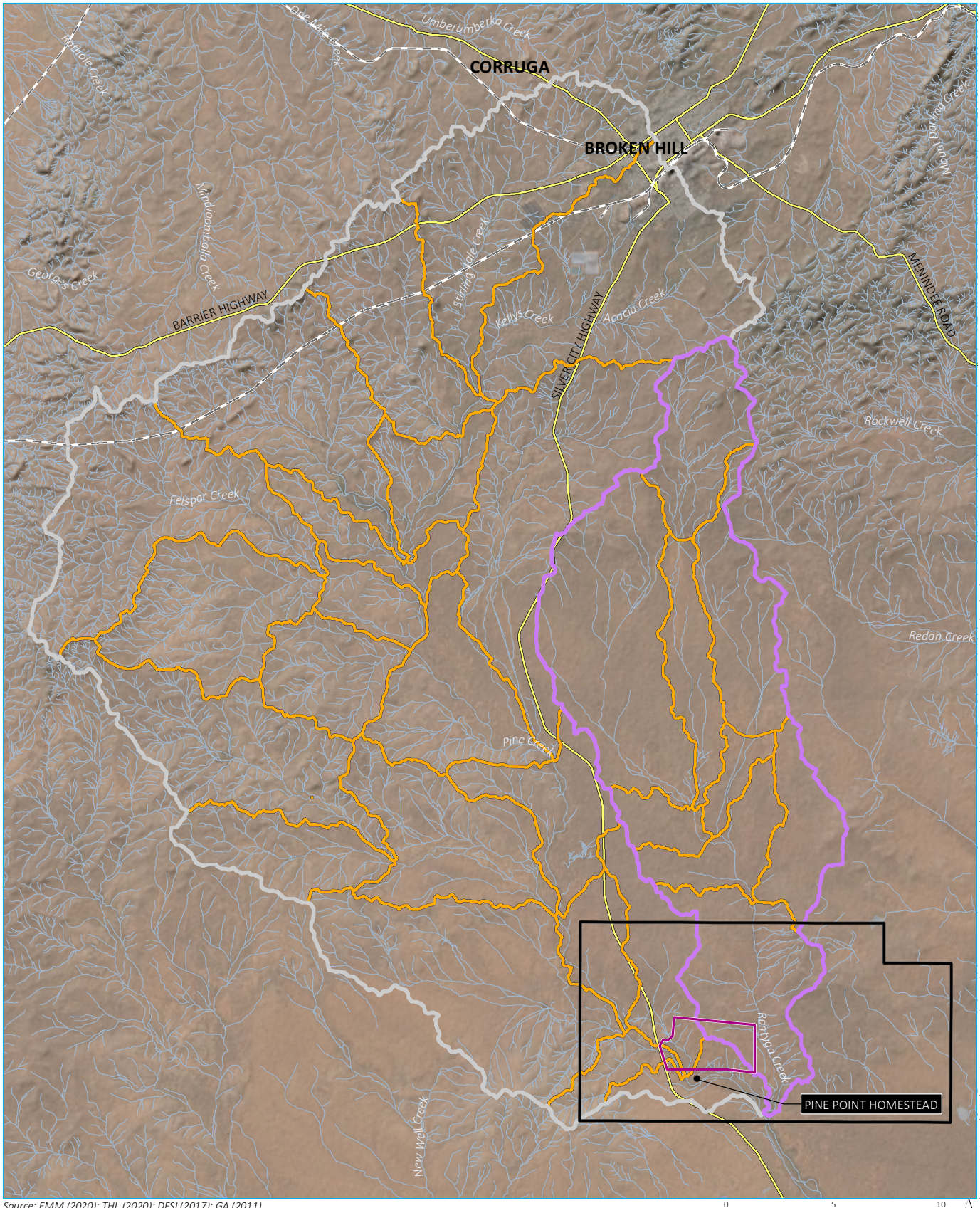
Design rainfall data, including temporal patterns, were obtained from the ARR Data Hub for the site location. Design rainfall depths for the 5% and 1% AEP events for durations ranging between 1 and 24 hours are presented in Table 3.1.

Table 3.1 Design rainfall depths

	Rainfall depth (mm)	
Storm duration (hrs)	**5% AEP**	**1% AEP**
1	37.3	57.1
3	50.8	69.1
4.5	57.2	77.4
6	62.4	86.9
9	70.5	94.5
12	76.7	106
24	92.1	136

The spatial variability of design rainfalls across the catchment areas was reviewed and found to be small, with the highest rainfall intensities found to occur in proximity to the site, while reducing to the north. Therefore, the data in Table 3.1 is considered to be representative for the entire catchment.

Temporal patterns comprising ten ensemble storms for each storm duration were applied for the Rangelands region per ARR Data Hub.



Source: EMM (2020); THL (2020); DFSI (2017); GA (2011)

0 5 10 km

GDA 1994 MGA Zone 54

N

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KEY

- EL 8188
- Development envelope
- Rail line
- Major road
- Watercourse/drainage line
- Waterbody
- Subcatchment boundary

Major catchments

- Pine Creek
- Rantyga Creek

Subcatchment layout

Tellus Holdings Limited – Blue Bush Facility
Preliminary surface water investigation
Figure 3.1

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3.3.4 Areal reductions factors

Areal reduction factors were derived and applied in accordance with the ARR Data Hub. These vary as a function of storm frequency and duration but typically are in the range 0.85 to 0.90 for the 5% and 1% AEP storm events.

3.3.5 Probable maximum precipitation

Probable maximum precipitation (PMP) inputs considered guidance and methods for both short and long duration storms in accordance with:

- *The Estimation of Probable Maximum Precipitation in Australia: Generalised Short-Duration Method* (BoM 2003) (GSDM); and
- *Guidebook to the Estimation of Probable Maximum Precipitation: Generalised Southeast Australia Method* (BoM 2006) (GSAM).

Both GSDM and GSAM methods where considered given the contributing catchment size is close to the recommended 1,000 km^2 threshold applying to the GSDM. The methods have different spatial and temporal patterns that were also applied to the XP-RAFTS model, along with estimated PMP rainfall depths. A range of storm durations was considered from 1 hour to 96 hours.

3.3.6 Rainfall losses

Design rainfall losses were derived using the hierarchical approach to loss and pre-burst estimation for NSW described in the ARR Data Hub, which is documented in detail in WMA 2019. In the absence of any known prior studies of relevance in either the Pine Creek catchment or similar adjacent catchments, and with FFA-reconciled losses also unavailable for this catchment, the probability neutral burst initial loss values determined in WMA 2019 and available through the ARR Data Hub were adopted.

Recommended probability neutral burst initial loss values vary based on storm frequency and duration. For example, at this site and for the 1% AEP events, recommended initial losses range from about 23 mm for the 1-hour storm up to about 49 mm for the 72-hour storm. For the 5% AEP events, recommended initial losses are slightly higher. For simplicity for the purposes of the present investigation, an initial loss of 30 mm was adopted for all storm durations and frequencies.

Continuing losses are not currently available from the ARR Data Hub for the site location. Based on review of continuing loss data available for other western regions, as well as previous experience, a continuing loss rate of 4 mm/hour was adopted for all storm durations and frequencies.

For simulation of the PMF event, zero initial loss was adopted along with a reduced continuing loss rate of 2.5 mm/hour applied to the PMP rainfall.

3.3.7 Model results

The XP-RAFTS model was run for the 5% and 1% AEP events for a range of storm durations, including the full suite of ensemble events for each duration.

The critical duration for both the 5% and 1% AEP events was found to be 12 hours. The critical duration for the PMF was found to be 24 hours.

Peak flow rates for Pine Creek and Rantyga Creek at a location just upstream of their confluence are presented in Table 3.2.

Table 3.2 Summary of hydrologic model results

Event	Critical duration	Pine Creek - peak flow (m^3/s)	Rantyga Creek - peak flow (m^3/s)
5% AEP	12 hours	280	76
1% AEP	12 hours	760	220
PMP	24 hours	5,400	1,500

3.4 Hydraulic modelling

3.4.1 Model structure and boundary conditions

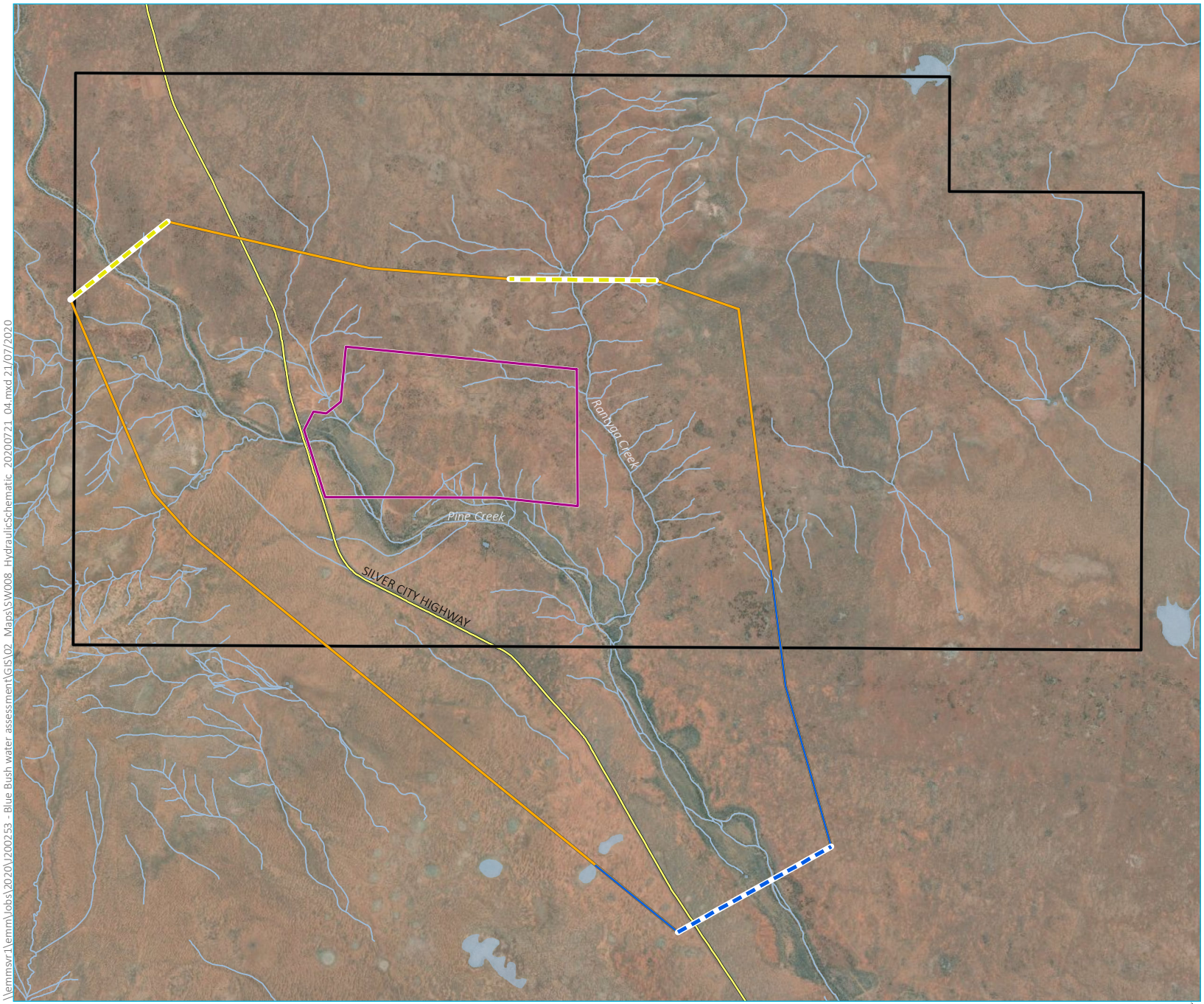
The layout of the TUFLOW model that was developed for the flood assessment is shown in Figure 3.2.

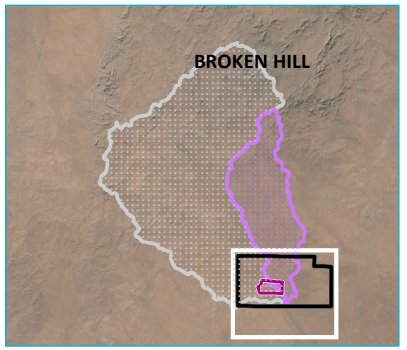
The model boundary defines the extent of the 2D model domain. Ground surface elevations were based on LiDAR data throughout the 2D model domain, applying a 5 m grid to define ground surface elevations. This was considered sufficient resolution to define watercourse conveyance and to represent the influence of floodplain landforms on flood behaviour. No topographic modifiers (eg in the form of breaklines or similar) were applied to the 2D model domain.

The potential influence of the Silver City Highway bridge crossing on flooding along Pine Creek was not considered for this stage of the investigation. However, the impact of the bridge should be included in future refinement of the flood modelling.

Two inflow boundaries were defined at the upstream (northern) limit of the model domain, representing flow along Pine Creek and Rantyga Creek. Discharge hydrographs were derived from the XP-RAFTS hydrologic model. This was done conservatively by assuming the total flow for each creek at the confluence is conveyed through the model domain.

A single downstream boundary condition was defined at the southern limit of the model domain, representing flow out of the model along Pine Creek, downstream from the confluence with Rantyga Creek. A rating curve in the form of a stage-discharge relationship was generated within TUFLOW for this boundary condition, based on an estimated flood slope of 0.2%.





KEY

- EL 8188
- Development envelope
- Major road
- Watercourse/drainage line
- Waterbody

Major catchments (refer to inset)

- Pine Creek
- Rantyga Creek

TUFLOW model

- Model boundary
- Inflow boundary
- Downstream model boundary
- Downstream model boundary - PMF

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Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

N

TUFLOW model layout

Tellus Holdings Limited – Blue Bush Facility
Preliminary surface water investigation
Figure 3.2

EMM
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3.4.2 Model parameters

The main physical parameter represented in the TUFLOW model is hydraulic roughness in the form of Manning's n values. In this case a global value of n = 0.04 was applied to all of the model domain. This was based on a review of aerial photography and site photographs similar to those presented in Section 2 of this report, which suggest there is no significant difference in surface roughness between the various watercourses and floodplain areas. Whilst much of the land surface could be considered relatively hydraulically 'smooth' with potentially lower Manning's n values, the adopted value effectively represents a composite figure that takes into account the influence of sparse vegetation, exposed rocks and eroded landforms.

Areas of potentially higher relative roughness, such as larger rocky outcrops and vegetated areas are generally well-spaced and likely to have very limited impact on flow patterns during large flood events, which is the focus of the present investigation.

3.5 Model calibration and verification

No calibration or verification of the flood modelling was undertaken due to the lack of available data at the time of investigation.

Typically, the Regional Flood Frequency Estimate (RFFE) model would be available via the ARR Data Hub to provide estimates of peak flow rates for rural catchments, which can then be compared to hydrologic model results. However, the RFFE model is currently unavailable for arid regions in Australia. Feedback on this issue has been sought but is unresolved at the time of writing.

As noted in Section 2.4.5, various anecdotal information regarding historic flooding in the vicinity of the site has been obtained by Tellus and could be used in the future to allow some limited testing of combined hydrologic/hydraulic model performance in reproducing observed flood behaviour for historic events. It is recommended that further consideration of this information is made as part of subsequent investigations supporting design development and environmental assessment, as this will help to improve confidence in model predictions of flood behaviour.

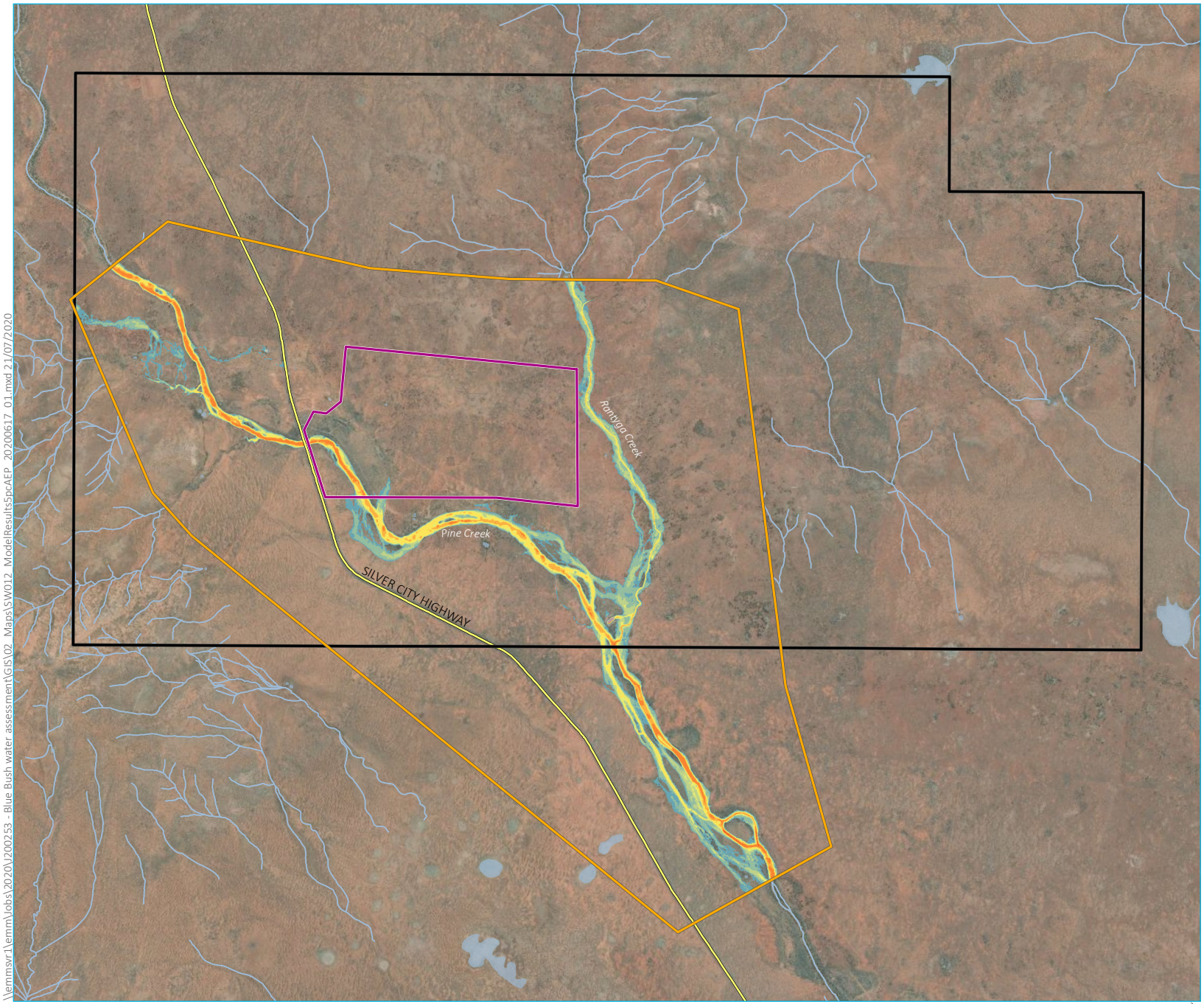
3.6 Model results and discussion

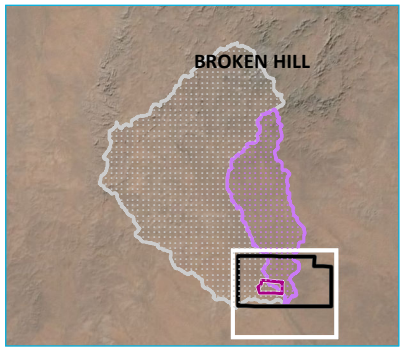
3.6.1 Presentation of results

TUFLOW model results showing indicative extents and depths of mainstream flooding are presented in the following figures:

- Figure 3.3 5% AEP
- Figure 3.4 1% AEP
- Figure 3.5 PMF

It should be noted that the results presented in these figures relate to mainstream flooding only along Pine Creek and Rantyga Creek. Local overland runoff and flows along lower order watercourses within and surrounding the development envelope are not intended to be accurately represented in the current hydraulic model. This issue is discussed further in Section 3.6.2.





KEY

- EL 8188
- Development envelope
- Major road
- Watercourse/drainage line
- Waterbody

Major catchments (refer to inset)

- Pine Creek
- Rantyga Creek

TUFLOW model

- Model boundary

Inundation depth (m) - 5% AEP

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 3
- 3 - 4
- >4

Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

N

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Indicative extent and depth of inundation – 5% AEP event

Tellus Holdings Limited – Blue Bush Facility
Preliminary surface water investigation
Figure 3.3

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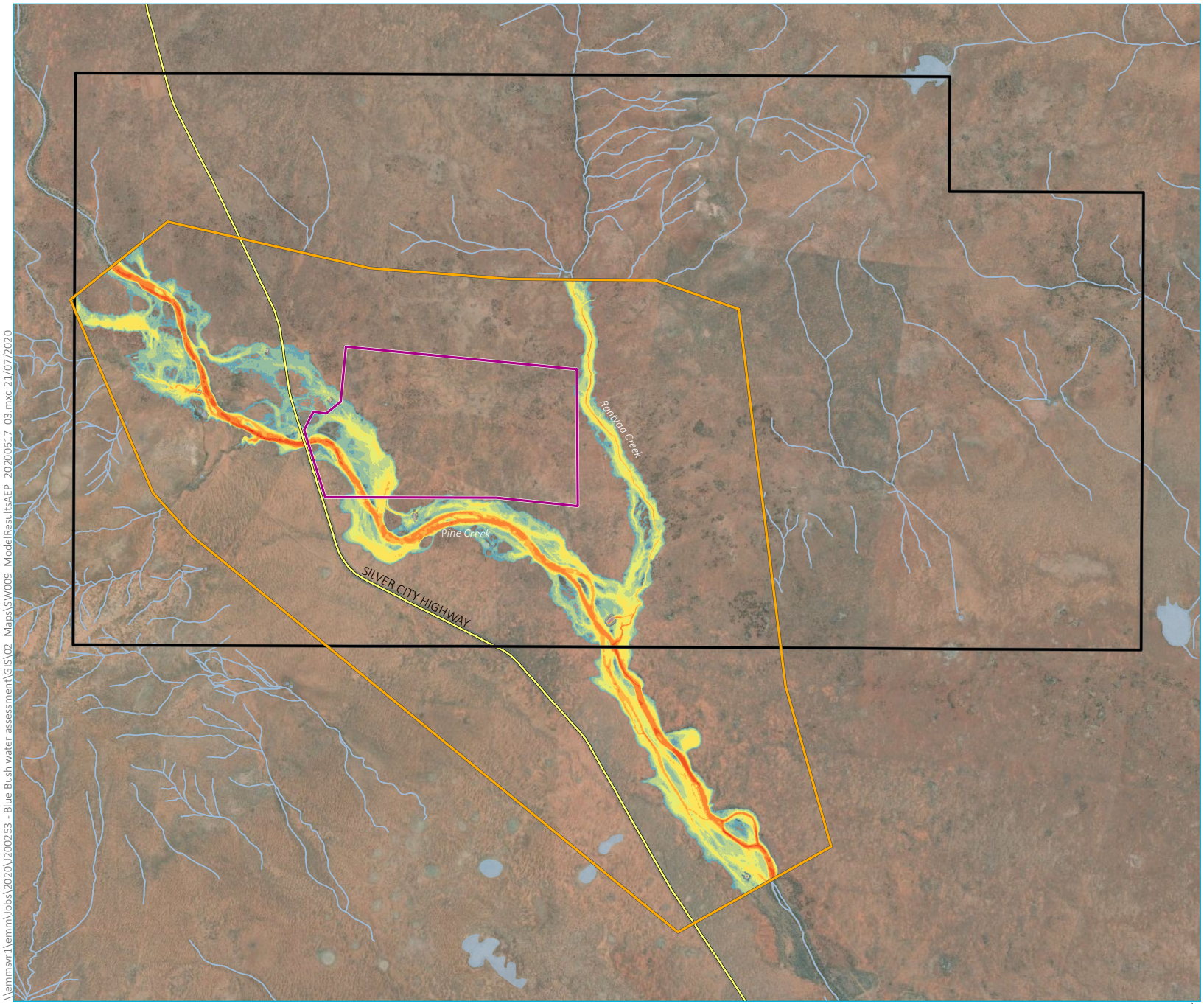

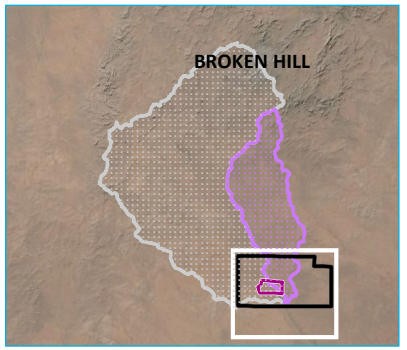

KEY

- EL 8188
- Development envelope
- Major road
- Watercourse/drainage line
- Waterbody

Major catchments (refer to inset)

- Pine Creek
- Rantyga Creek

TUFLOW model

- Model boundary

Inundation depth (m) - 1% AEP

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 3
- 3 - 4
- >4

Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

N

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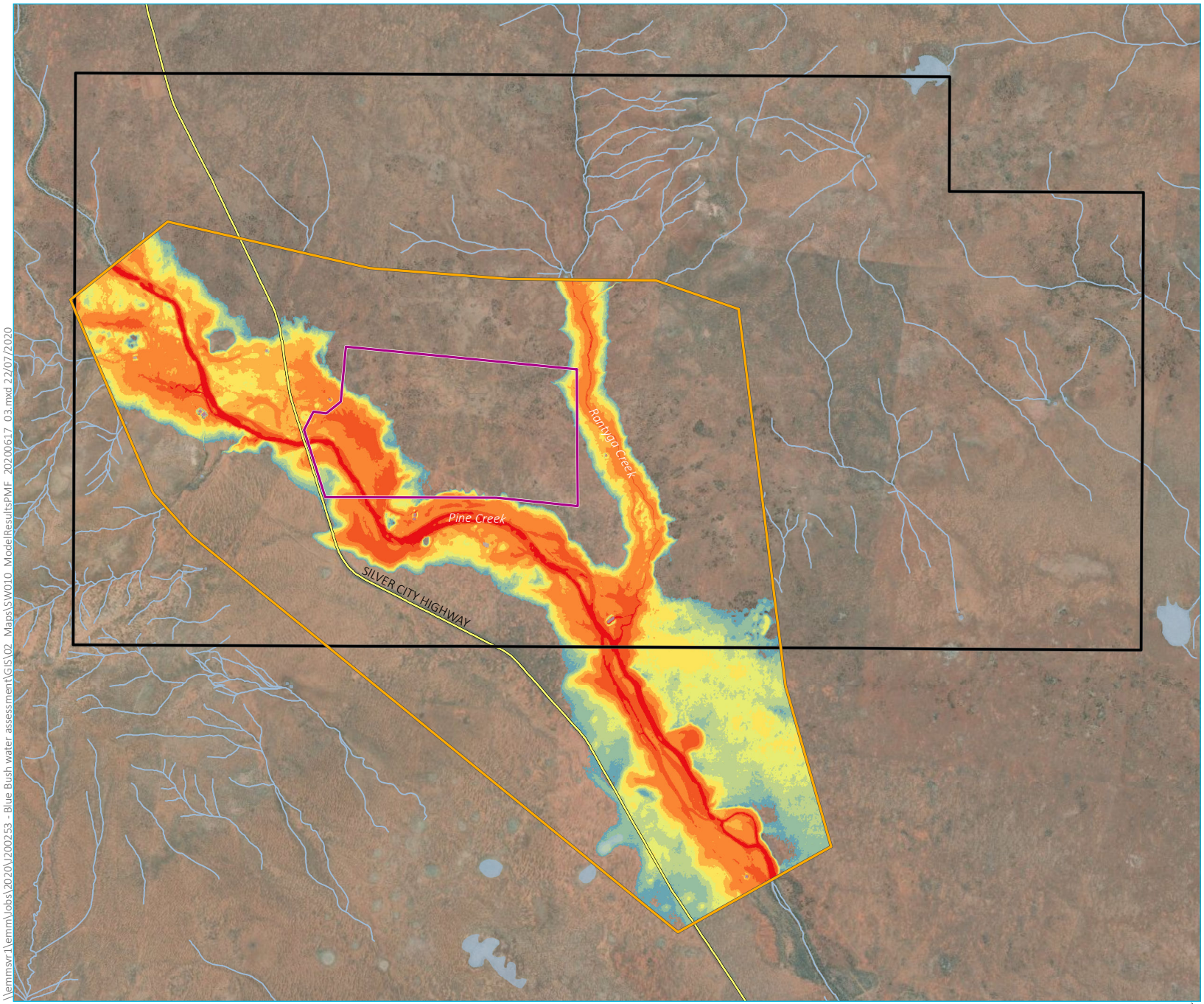
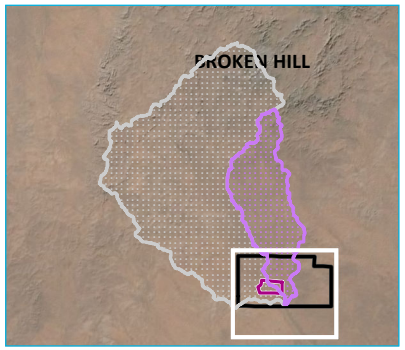
Indicative extent and depth of inundation – 1% AEP event

Tellus Holdings Limited – Blue Bush Facility
Preliminary surface water investigation
Figure 3.4

EMM
creating opportunities





KEY

- EL 8188
- Development envelope
- Major road
- Watercourse/drainage line
- Waterbody

Major catchments (refer to inset)

- Pine Creek
- Rantyga Creek

TUFLOW model

- Model boundary

Inundation depth (m) - PMF event

- 0 - 0.1
- 0.1 - 0.25
- 0.25 - 0.5
- 0.5 - 0.75
- 0.75 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 3
- 3 - 4
- >4

Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

N

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Indicative extent and depth of inundation – PMF event

Tellus Holdings Limited – Blue Bush Facility
Preliminary surface water investigation
Figure 3.5

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The following provides a brief summary of the key model results for each event:

- 5% AEP event:
  - Mainstream flooding in the vicinity of the development envelope is contained to the watercourses and immediate overbank areas.
  - Flow along Rantyga Creek does not encroach within the development envelope.
- 1% AEP event:
  - While the majority of the flow along Pine Creek and Rantyga Creek is conveyed within the in-bank section of the watercourses, more extensive out of banks flows are evident at this magnitude of flood event, particularly along Pine Creek.
  - The Silver City Highway is overtopped in several locations over a total length of about 1 km, extending north from Pine Creek. This is a result of flows breaking out of the creek upstream (west) of the highway. Downstream (east) of the highway overland flows continue through the south-western corner of the development envelope before re-joining the main arm of the creek near the Pine Point homestead.
  - Flow along Rantyga Creek remains relatively well confined to the creek, with the flood extent just reaching the eastern boundary of the development envelope.
- PMF event:
  - Extensive out of banks flows are evident at this magnitude of flood event for both Pine Creek and Rantyga Creek.
  - The Silver City Highway is overtopped over a total length of about 2 km, extending north from Pine Creek. This is a result of flows breaking out of the creek upstream (west) of the highway. Downstream (east) of the highway overland flows continue through the south-western corner of the development envelope before re-joining the main arm of the creek near the Pine Point homestead.
  - Along Pine Creek the PMF event engages a broad floodplain in the order of 1 to 2 km wide.
  - Flow along Rantyga Creek continues to follow the creek alignment with the flood extent now clearly encroaching on the development envelope.

3.6.2 Discussion of results

The following provides some additional interpretation and discussion of results:

- It is understood that the ongoing use of the Pine Point homestead during operation of the facility is under consideration. Based on the results presented herein, the homestead and surrounding area would be impacted by mainstream flooding along Pine Creek for a flood between 5% AEP and 1% AEP. The depth of flooding for the 1% AEP reaches at least 0.5 m in this area. The area would also be subject to local overland flows and runoff. This flood risk should be considered when weighing up potential operational usage.

- Mainstream flooding is likely to result in inundation times ranging from a few hours up to a day, and potentially longer. Whilst the critical duration was found to be 12 hours for events up to the 1% AEP event, a range of storm durations and associated rainfall depths can potentially result in a material flood response in Pine Creek and Rantyga Creek.

- Local flooding of higher ground away from these named watercourses is likely to be caused by more intense but shorter duration storms, with resulting flooding occurring more quickly and lasting for a shorter time, up to a few hours' duration.

3.7 Recommendations for further investigation

Based on the outcomes of the preliminary flood investigation it is recommended that further assessment of local flooding conditions is undertaken to support further design development and subsequent environmental assessment. This should include:

- Refinement of the hydrologic modelling to consider parameter selection and sensitivity, particularly rainfall losses once RFFE model estimates become available. In the absence of RFFE model results then consideration could be given to review of streamflow data from a remote gauging station with similar catchment and watercourse characteristics that could be used to refine and improve confidence in model parameter estimates.

- Incorporation of more accurate and contemporary LiDAR data, which is currently being acquired by Tellus, into the hydraulic model. Other hydraulic model refinements to be considered should include review of model grid sizing once new LiDAR data becomes available, consideration of the need for breaklines and other topographic modifiers, and incorporation of the existing Silver City Highway bridge into the model.

- Use of anecdotal historic flood data to enable testing of combined hydrologic/hydraulic model performance in reproducing observed flood behaviour for historic events.

- Consideration of local overland flow and associated flooding mechanisms that may affect parts of the development envelope and therefore require consideration as part of future design development and environmental assessment.

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Abbreviations

AEP	annual exceedance probability
AHD	Australian Height Datum
ARR2019	Australian Rainfall and Runoff, 2019 edition
ASC	Australian Soil Classification
BoM	Bureau of Meteorology
CDFM	cumulative deviation from the mean
DEM	digital elevation model
DPIE	NSW Department of Planning Industry and Environment
EIS	Environmental Impact Statement
EL	Exploration Licence
ESR	Environmental Scoping Report
LiDAR	light detection and ranging
PMF	probable maximum flood
PMP	probable maximum precipitation
PSWI	Preliminary Surface Water Investigation
RFFE	Regional Flood Frequency Estimation
RFO	NSW River Flow Objective
SEARs	Secretary's Environmental Assessment Requirements
SRTM	Shuttle Radar Topography Mission
SSD	State Significant Development
WQO	NSW Water Quality Objective
2D	two-dimensional

APPENDIX H: PRELIMINARY GROUNDWATER ASSESSMENT

Blue Bush Facility

Scoping Report - Hydrogeological investigation

Prepared for Tellus Holdings
July 2020

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Blue Bush Facility

Scoping Report - Hydrogeological investigation

Report Number

J200253 RP5

Client

Tellus Holdings

Date

23 July 2020

Version

v1 Final

Prepared by

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23 July 2020

Approved by

James Duggleby
Associate Director, Hydrogeologist
23 July 2020

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1 Introduction

1.1 Background

Tellus Holdings Limited (Tellus) is proposing to develop a near-surface arid geological repository for permanent isolation and long-term storage of hazardous chemical waste materials. To achieve this, overburden material including sands and kaolin clay will be excavated to create waste cells. The proposal and its supporting infrastructure are collectively known as the Blue Bush Facility (the Facility). The waste repository has capacity to receive up to 200,000 tonnes per annum of waste for up to 25 years.

The proposed Facility is located approximately 45 kilometres (km) south of Broken Hill in western NSW, within the Unincorporated Far West Region. The primary road access to the facility will be via the Silver City Highway. A preliminary development envelope for the facility has been prepared, and this is located entirely within Exploration Licence (EL) 8188.

Transport of product and supplies will most likely occur between a proposed third-party operated inter-modal transfer facility, located in Broken Hill, and the proposed project location via the Silver City Highway. Consideration of the inter-modal transfer facility does not form part of this current investigation.

The Facility has been recognised by the NSW Government as State Significant Development (SSD) under Part 4, Division 4.1 of the NSW *Environment Planning and Assessment Act 1979* (EPA Act 1979). Classification of SSD status is provided under Section 89C of the EPA Act 1979 and State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP). As such, the proposal will be assessed by the NSW Department of Planning Industry and Environment (DPIE) through an Environmental Impact Statement (EIS) and against the Secretary's Environmental Assessment Requirements (SEARs). SEARs will be issued following review of the Environmental Scoping Report (ESR) to which this report is appended. Once the ESR is submitted, Tellus expect to receive SEARs by October 2020.

1.2 Report purpose

This preliminary hydrogeological investigation report has been prepared to inform preparation of the ESR. It provides a broad characterisation of the existing environment, with a focus on groundwater. It also presents an overview of the current hydrogeological field investigation program (Section 2), an identification of potential groundwater dependent receptors (Section 3), a preliminary hydrogeological conceptual model (Section 4) and outlines how Tellus propose to address the *minimal impact considerations* defined in the *Aquifer Interference Policy 2012* (Section 5).

This report is intended to provide Tellus with an overview of potential hazards and risks to local and regional groundwaters to inform fatal flaw analysis and support early design development by Tellus for the proposal. It will also provide DPIE with a concise overview of the local and regional hydrogeological environment, based on current available data, suitable to inform the ESR and request site specific / tailored project SEARs. The information within this document will assist with ongoing consultation with the community, regulators and other stakeholders.

1.3 Environmental setting

1.3.1 Climate

The site is located in the arid zone of NSW, which is characterised by hot and persistently dry summers and cool winters. Average annual rainfall is low (200 – 250 millimetres (mm) per year), and potential evaporation rates are high (exceeding 2500 mm per year) leading to generally low surface water availability. The temperature range is

large with summer maximum temperatures routinely over 35°C and winter minimum temperatures typically reaching 5°C and lower, dropping below freezing on occasion.

Several long-term daily read weather stations operated by the Bureau of Meteorology (BoM) are available to inform understanding of key variables related to hydrology including temperature, rainfall and evaporation. The closest pluviographic station that measures continuous rainfall is located at Menindee Lakes, approximately 75 km to the east of the site.

Should the project proceed, Tellus will establish a local automated weather station to record and verify site specific climatic conditions. This data will be used to compare against regional data.

1.3.2 Topography and land use

The site topography falls generally to the south from a regional ridgeline, forming part of the southern Barrier Ranges, that runs generally north-east to south-west through the town of Broken Hill. The ridgeline sits at an elevation of about 320 metres relative to Australian Height Datum (m AHD), whilst the site is situated at about 150 m AHD.

The development envelope forms part of the Pine Point property, with the existing homestead located on the left (northern) overbank of Pine Creek just outside and to the south of the development envelope. The property was used for grazing through multiple generations dating back to the early 1900's. Grazing has ceased in recent years and whilst occupation of the homestead continues there is no current use of the land. Surrounding land use in the region is dominated by grazing and associated pastoral use.

Other existing infrastructure in the vicinity of the site is limited but includes the Silver City Highway immediately to the west.

1.3.3 Hydrology

The regional hydrologic setting for the site is within the Lower Darling River catchment of the Murray Darling Basin. The site and surrounding area form part of a smaller sub-catchment that drains to Pine Creek, which ultimately flows into Kudgee Lake approximately 40 km to the south. Kudgee Lake, with a catchment area of about 1,500 square kilometres (km^2), is understood to be a terminal waterbody with no surface connectivity to the Lower Darling River system. The site is located immediately upstream of the confluence of Pine Creek and Rantyga Creek, a tributary of Pine Creek. The respective catchment areas are about 910 km^2 for Pine Creek, and 250 km^2 for Rantyga Creek.

Pine Creek is a seventh-order watercourse[1] where it runs through and to the south of the development envelope. The creek flows generally from north to south and is highly variable in width at top of bank, up to about 150 m in width. The creek bed is sandy and sparsely vegetated.

Rantyga Creek is a fourth-order watercourse where it runs to the east of the development envelope. The creek forms one of the major tributaries of Pine Creek, flowing generally from north to south. Similar to Pine Creek, the bed of Rantyga Creek is sandy and sparsely vegetated.

The confluence of Pine Creek and Rantyga Creek is located immediately downstream (south) of the development envelope.

Several lower order unnamed watercourses are also mapped within the development envelope. Typically, these are mapped as first-order streams. However, higher order streams include a third-order unnamed tributary to Pine

[1] 'Stream order' is used to describe the hierarchy of streams from the top to the bottom of a catchment, determined using the Strahler system.

Creek which runs north-west to south-east through the development envelope, and a second-order unnamed tributary to Rantyga Creek, which runs west to east.

All watercourses in the region are ephemeral in nature with flows only occurring for a short time following rainfall events of sufficient total depth to generate surface runoff.

No known flooding investigations have been undertaken in the vicinity of the site.

Previous geomorphologic characterisation of Pine Creek and Rantyga Creek describes the watercourse reaches adjacent to the development envelope as laterally unconfined, with margin control provided by the floodplain. The creek channels here are continuous and typically with a sandy bed. Stream condition is rated as poor to moderate with low to moderate recovery potential and little to no instream refugia present.

There is no existing water quality or streamflow monitoring in either the Pine Creek or Rantyga Creek catchments. The closest known monitoring locations in current operation are situated on the main arm or anabranches of the Darling River.

In the context of the NSW Water Quality Objectives and River Flow Objectives, Pine Creek, Rantyga Creek and all their tributaries are located within the *Barwon-Darling and Far Western Catchment* and would be classified as *uncontrolled streams* as they are free of structures that would otherwise regulate flows (eg dams).

The site lies within the *Lower Murray – Darling Unregulated Water Source*, and surface water is managed through the *Water Sharing Plan for the Lower Murray-Darling Basin Unregulated and Alluvial Water Sources 2012*.

1.3.4 Geological setting

The site lies within the Murray Geological Basin (MGB). The MGB covers an area of approximately 23,000 km^2 and was deposited during the Cenozoic Period. The MGB is a sedimentary basin, comprising layers of consolidated and unconsolidated sand, gravel and clay sediments, described later in Section 1.3.5 as near-surface sediment deposits.

The MGB overlies a significant basement depression within the Kanmantoo Fold Belt. The Kanmantoo Fold Belt is Precambrian in origin and comprises a mix of metasedimentary and volcanic rocks, typically presenting as fractured gneiss ('Redan Gneiss') at the site. This unit hosts what is later described as a fractured rock groundwater system.

1.3.5 Hydrogeology

The local hydrogeological regime comprises:

- shallow, unconfined and temporary groundwater of limited extent associated with the near-surface sediment deposits; and
- regional fractured rock groundwater associated with the underlying basement geological units (gneiss).

i Near-surface sediment deposits

This unproven groundwater system comprises a mix of alluvium and colluvium, consisting of sand, silt, clay and gravel. This undifferentiated unit presents consistently across the project envelope as an unsaturated system.

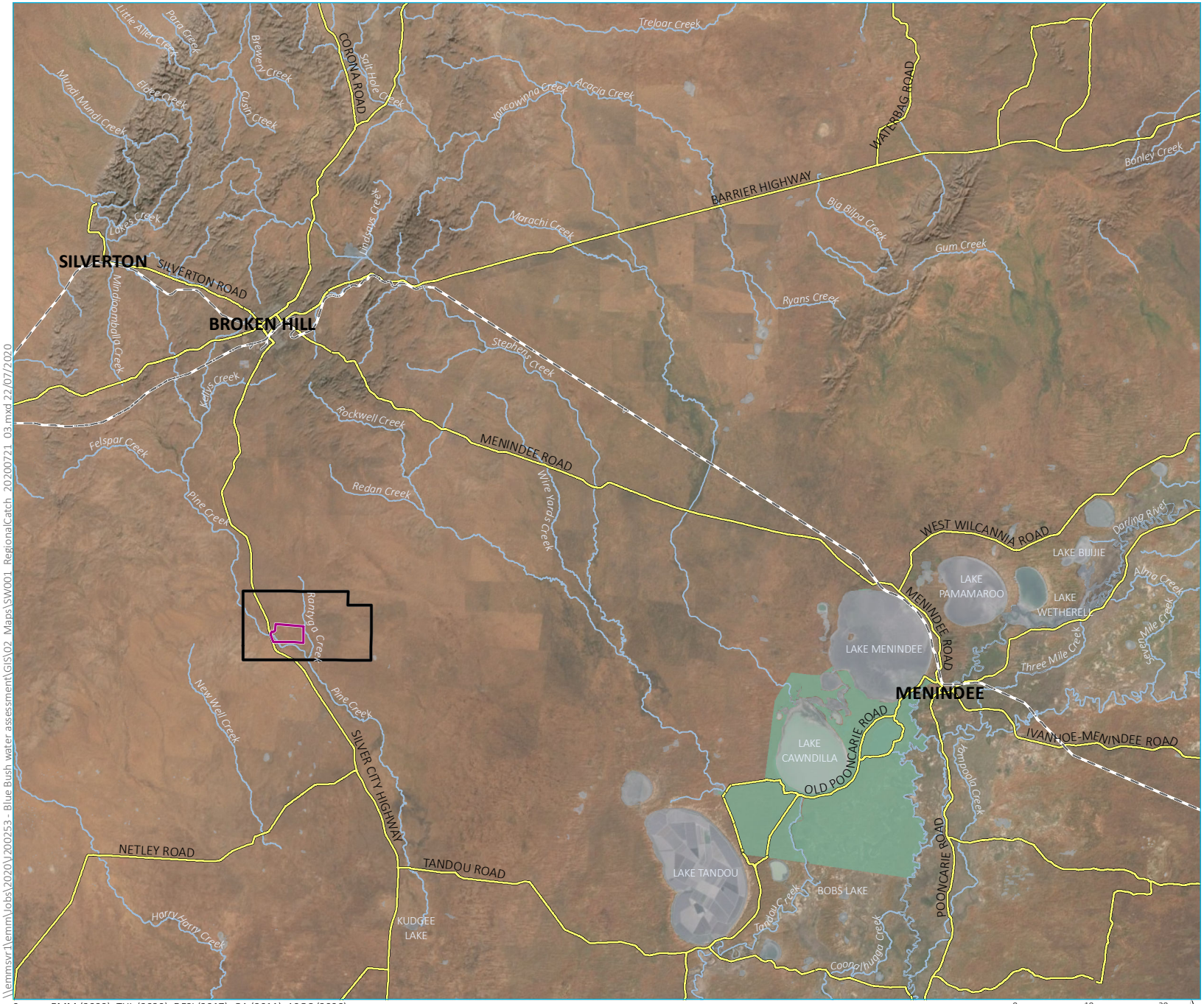
The shallower deposits, comprising sand and gravel support two major drainages; Pine Creek and Rantyga Creek, which flank the southern and eastern boundary of the site. It is assumed and supported through government mapping (BoM 2020) that these shallow systems are episodically recharged during flooding events, holding water in storage which is accessed by riparian vegetation opportunistically. Groundwater residence time within the alluvium is expected to be relatively short, with ongoing discharge to terrestrial riparian vegetation and high evaporative losses.

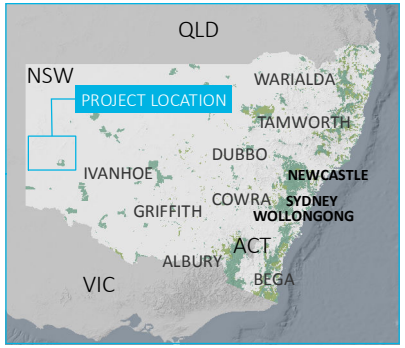
ii Fractured rock

The underlying fractured rock groundwater system, associated with the basement rocks, is the primary regional water bearing system in the area. The unit outcrops to the north of the project envelope, dipping north-south. The fractured rock groundwater system is assumed to receive the majority of its recharge through direct rainfall in areas where the unit outcrops or subcrops below shallow near-surface sediments. Recharge to this system is thought to be low due to the massive nature of the rock, low matrix permeability, and as indicated by the elevated salinity (~19,000 microsiemens per centimetre (µS/cm)) of the groundwater within system.

Groundwater flow follows topography and the structural dip of the unit, trending north-south. Groundwater is intercepted in the northern extent of the project envelope at monitoring bore TBBMW05A at approximately 52 meters Below Ground Level (mBGL) and intercepted further south at TBBMW01A at approximately 92 mBGL.

Neighbouring landholder bores (see Section 3) intercept this fractured rock groundwater at depth. The condition of neighbouring landholder bores and the purpose (use) of the supply is currently not understood, however given the known salinity of the groundwater within the system it is unlikely that nearby bores are used for potable or even stock supply.





KEY

- EL 8188
- Development envelope
- Rail line
- Major road
- Named watercourse
- Waterbody
- NPWS reserve
- State forest (refer to inset)

Site location

Source: EMM (2020); THL (2020); DFSI (2017); GA (2011); ASGC (2006)

0 10 20 km

GDA 1994 MGA Zone 54

N

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Figure 1.1

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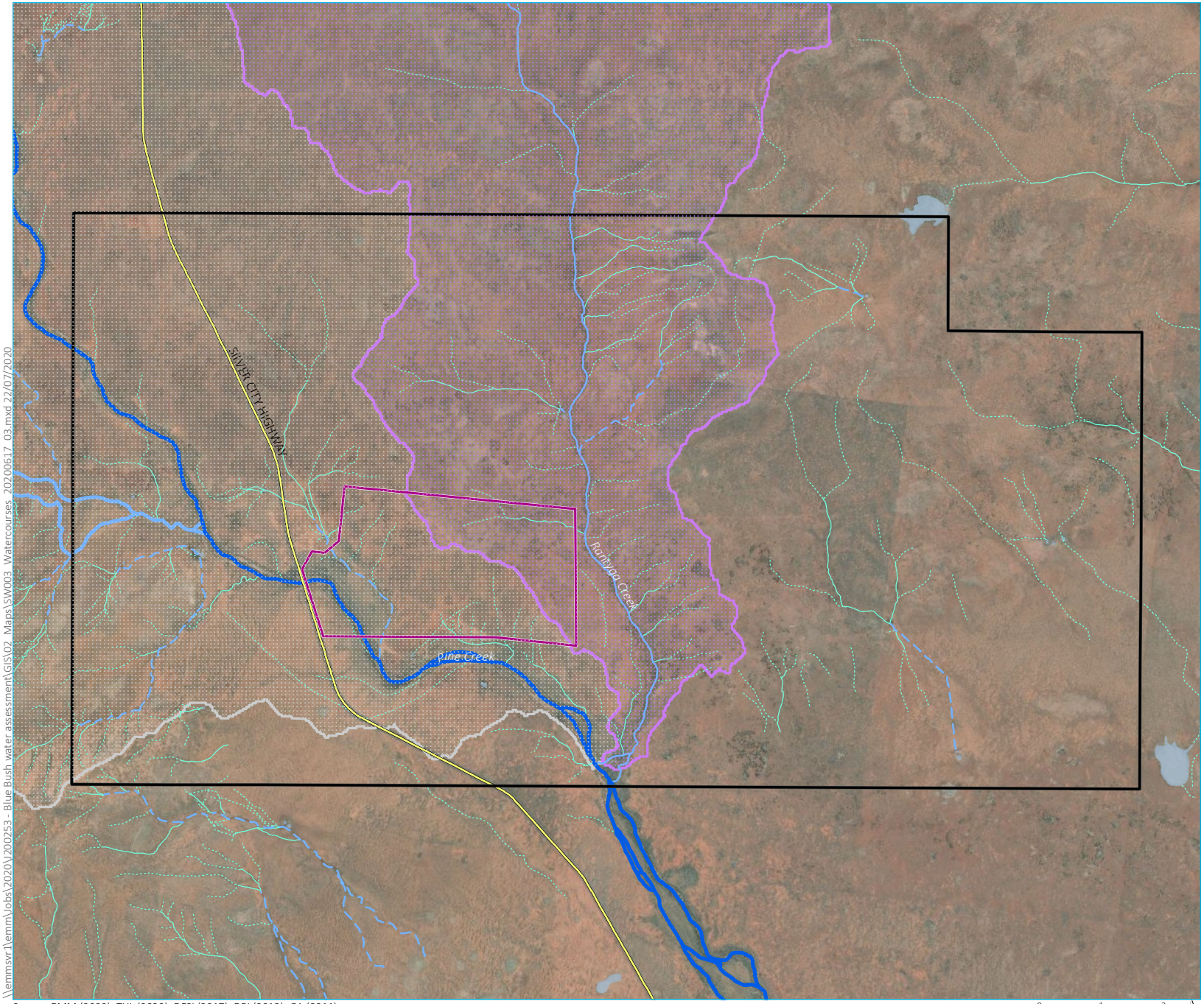

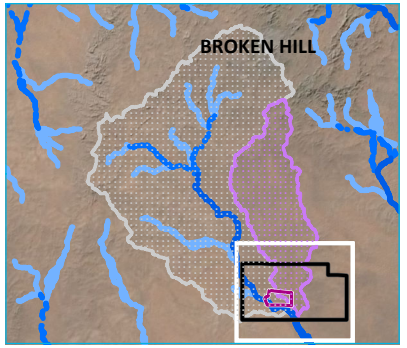

KEY

- EL 8188
- Development envelope
- Major road
- Waterbody

Strahler stream order

- 1st order
- 2nd order
- 3rd order
- 4th order
- 5th order
- 6th order
- 7th order

Major catchments

- Pine Creek
- Rantyga Creek

Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

N

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Surface water features

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Figure 1.2

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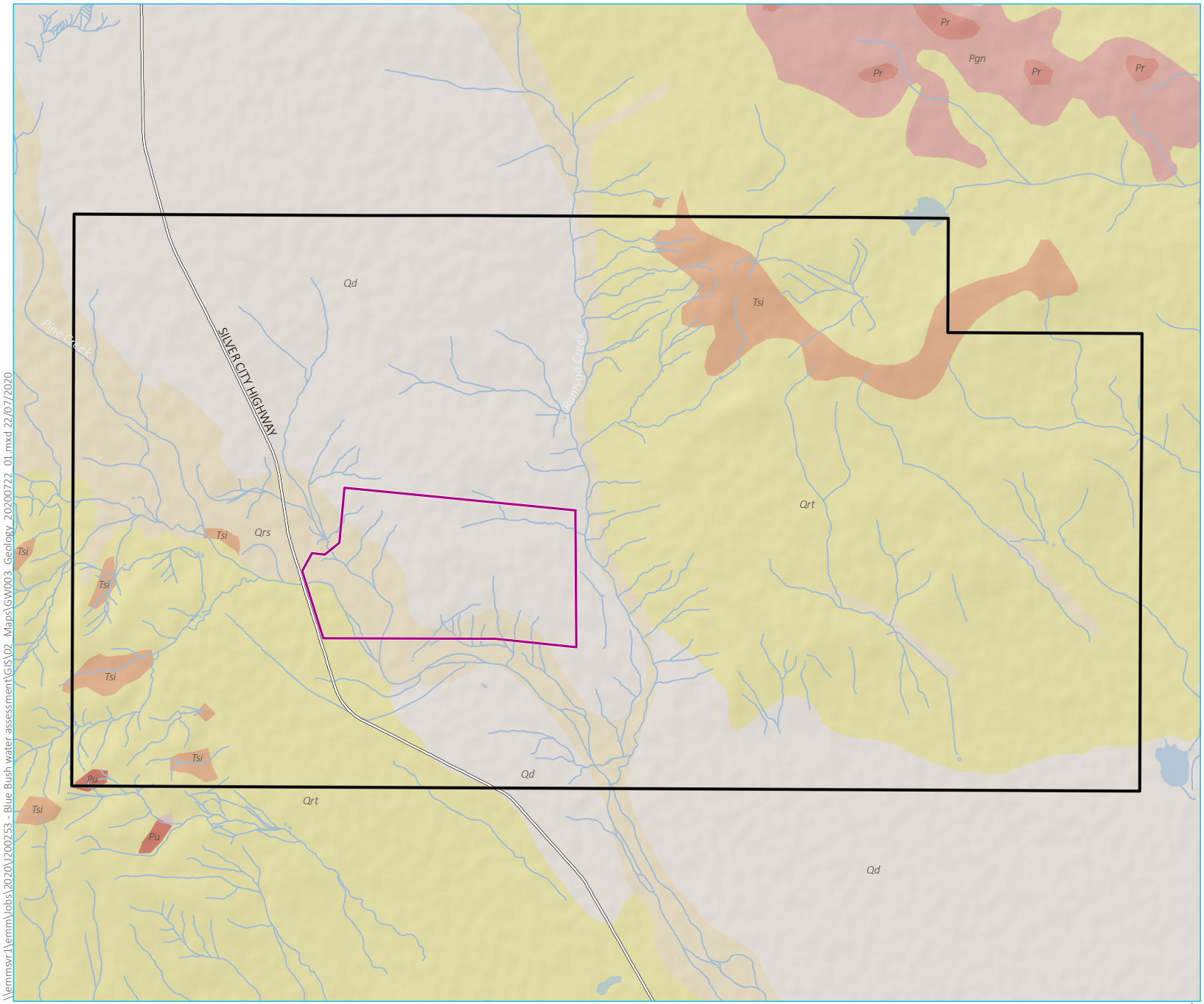

KEY

- Major road
- Watercourse/drainage line
- Waterbody
- EL 8188
- Development envelope

Geology (1:250,000)

Quaternary
- Qrs
- Qd
- Qrt

Tertiary
- Tsi

Proterozoic
- Pr
- Pa
- Pu
- Pgn

DRAFT

Source: EMM (2020); THL (2020); DFSI (2017); BoM (2017, 2020); DPI (2013); DRE (1969); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

N

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Geology

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Scoping report - hydrogeological investigation
Figure 1.3

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1.4 Regulatory context

1.4.1 Legislation

The *Water Act 1912* (Water Act) and the *Water Management Act 2000* (Water Management Act) are the two key pieces of legislation governing the management of water resources in NSW. The Water Act is progressively being repealed and replaced by the Water Management Act as water sharing plans (WSP) commence across NSW. However, the Water Act remains valid for certain aspects of groundwater legislation. As an example, each groundwater monitoring bore constructed, commenced or proposed as part of the current field program (see Section 2) is licensed under the Water Act.

1.4.2 Aquifer Interference Policy

The *NSW Aquifer Interference Policy* (AIP) defines the regimes for protecting and managing impacts of aquifer interfering activities on NSW's water resources (NoW 2012). The AIP requires consideration of the potential impacts of an aquifer interference activity with respect to the water table, water pressure and water quality. Proponents must estimate water 'take' (including incidental take) from each water source and connected water sources, where relevant. Water take estimates are to be assessed against *minimal impact considerations* for each water source.

The AIP requires the following information to assess aquifer interference:

- type and conditions of applicable WSP, or the management conditions under the Water Act if a WSP is absent;
- identification of potential groundwater receptors;
- baseline groundwater level and quality information, and aquifer hydraulic characteristics;
- conceptualisation of the hydrogeology; and
- predictions of water table/water pressure impacts and water take.

Baseline groundwater levels, water quality and aquifer characteristics obtained through hydraulic testing are collected from the various strata that are conceptualised to directly or indirectly interact with the proposed project. Tellus are currently establishing a baseline groundwater monitoring network to inform assessment against the AIP (see Section 2).

2 Groundwater field program

Tellus are currently installing a comprehensive groundwater monitoring network at the site. The monitoring network, once established, will form the basis for hydrogeological field testing, which will then inform the development of a robust conceptual model and ultimately, the EIS.

2.1 Groundwater monitoring network

EMM Consulting Pty Limited (EMM) have been engaged by Tellus to design and install a comprehensive groundwater monitoring network at the site. Drilling commenced in early July 2020 and once established, the groundwater monitoring network is designed to provide information on lateral and vertical groundwater flow (if present), investigate major geologies and hydrogeological environments, and monitor potentially groundwater dependent features.

The groundwater monitoring network will include both background (regional) groundwater monitoring locations and targeted monitoring bores at key locations likely to be impacted through construction and operation of the project.

The groundwater monitoring network will target all hydrogeological units in the project envelope to determine their depth and thickness, hydraulic behaviour and interaction between layers and any connected surface water bodies. The network captures data from the near-surface alluvial sediments associated with Pine Creek and an unnamed tributary to Rantyga Creek, as well as the deeper underlying fractured rock groundwater bearing unit. The network targets areas that host potentially sensitive features such as potential groundwater dependent ecosystems (GDEs) and areas of potential interaction between surface water and groundwater (see Section 3).

The network, as summarised in Table 2.1 and shown on Figure 2.2, includes 11 conventional groundwater monitoring bores at seven sites. Monitoring bores are installed to monitor groundwater level and water quality within a target aquifer formation.

Table 2.1 Groundwater monitoring network

Site ID	Plan ID	Easting	Northing	Surface elevation (mAHD)	Bore/Target depth (mBGL)	Target lithology	Completion status (as of 24 July 2020)	Licence number
1	TBBMW01A	547315	6421273	149	105.5	weathered basement	Complete	60BL216732
	TBBMW01B			149	42.3	kaolin/clay horizon		
2	TBBMW02A	545324	6421278	144	39.6	kaolin/clay horizon	Complete	60BL216732
	TBBMW02B			144	15	Pine Creek alluvium		
3	TBBMW03A	544821	6423347	161	92	weathered basement	Scheduled	60BL216732
	TBBMW03B			161	57	kaolin/clay horizon		
4	TBBMW04A	545352	6422466	157	53	kaolin/clay horizon	Scheduled	60BL216732
5	TBBMW05A	546872	6423100	150	64.7	weathered basement	Complete	60BL216732
	TBBMW05B			150	28	kaolin/clay horizon		
6	TBBMW06A	546620	6422418	154	51.5	kaolin/clay horizon	Complete	60BL216732
7	TBBMW07A	544800	6422700	157	53	kaolin/clay horizon	Scheduled	60BL216732

2.2 Drilling and bore construction

All monitoring bore will be drilled and constructed in accordance with the *Minimum Construction Requirements for Water Bores in Australia* (NUDLC 2020) and the conditions stipulated on the relevant monitoring bore licences issued by the NSW Natural Resources Access Regulator (NRAR).

The groundwater monitoring network has been designed, constructed and implemented by experienced hydrogeologists, in consultation with NRAR. The network includes open hole monitoring bores targeting multiple water bearing zones.

Groundwater monitoring bores were drilled using a combination of sonic and rotary percussion using compressed air to evacuate cuttings from the bore during drilling.

At some locations multiple monitoring bores are installed next to one another (a nested location) (see Figure 2.1). Each bore at a nested location is installed to a different depth, monitoring a different zone within the groundwater system (if present). Water level and water quality data are obtained from each of these conventional monitoring bores to provide information to determine the vertical hydraulic gradient and inferred vertical connectivity at that location.

The following information was collected during the installation of the network:

- identification of lithology changes by geological and geophysical appraisal (logging);
- identification of water bearing units by recording all water strikes (depth, yield and salinity);
- estimation of aquifer properties by hydraulic testing (rising/falling head tests); and
- determination of standing water levels and water quality through the installation of dataloggers and water quality monitoring.

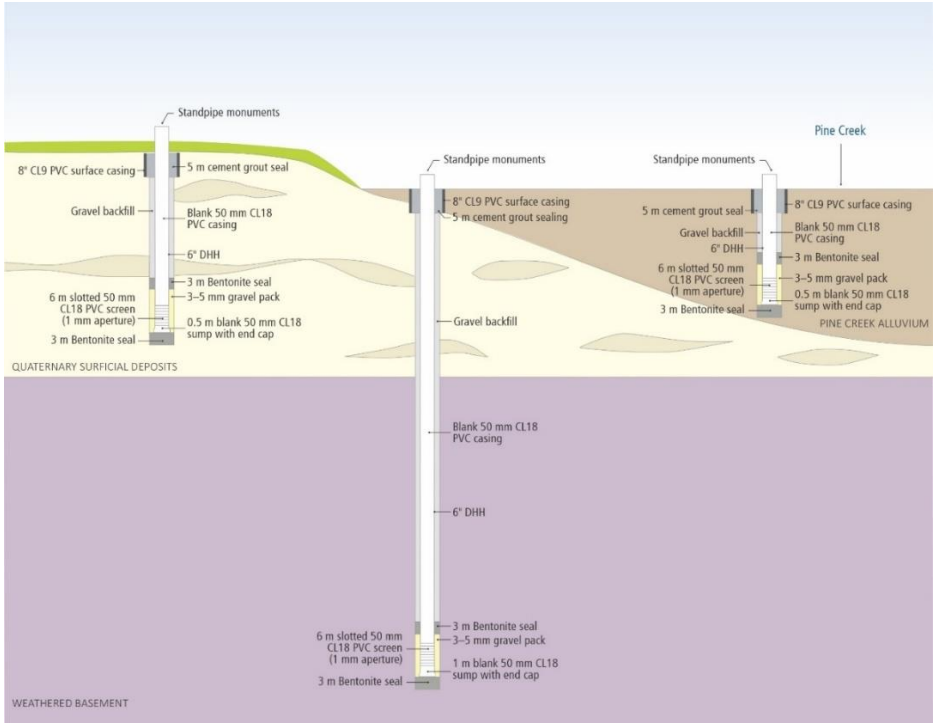
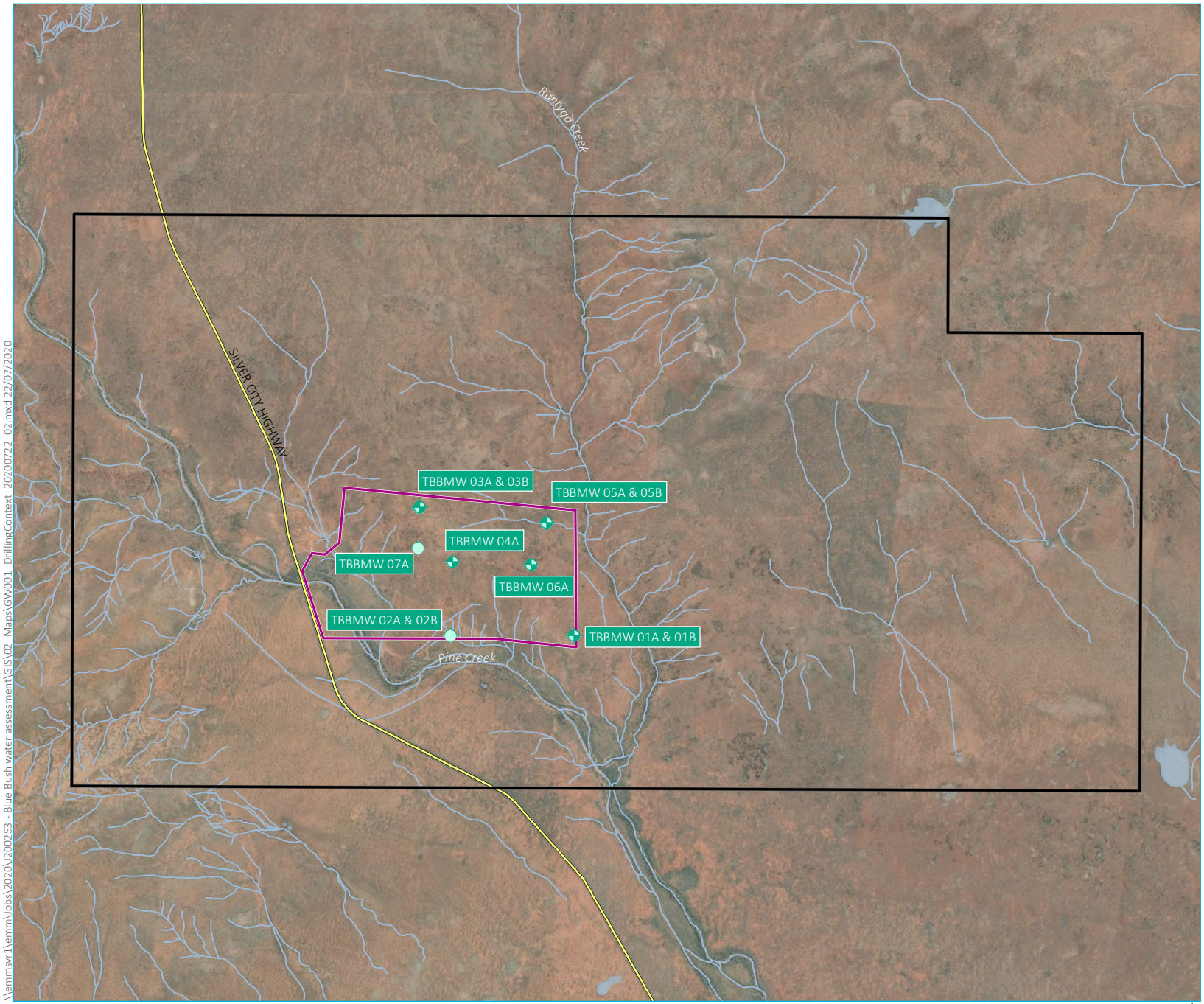
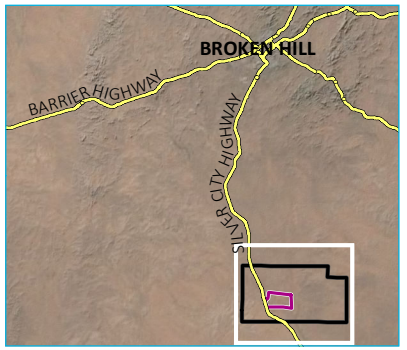


Figure 2.1 Nested groundwater monitoring installation (schematic cross-section)





KEY

- Monitoring bore
- Major road
- Watercourse/drainage line
- Waterbody
- EL 8188
- Development envelope

Source: EMM (2020); THL (2020); DFSI (2017); DPI (2013); GA (2011)

0 1 2 km

GDA 1994 MGA Zone 54

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Groundwater monitoring locations

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Figure 2.2

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2.3 Hydraulic testing

Hydraulic testing of the groundwater monitoring network provides information on the aquifer properties (hydraulic properties) of the target groundwater units.

Rising and falling head (slug) tests will be undertaken on all monitoring bores that intercept groundwater. Slug tests involve the instantaneous displacement of a known volume of water in the bore using a slug (typically a solid bailer). Changes in water level are recorded as the water level recovers following the displacement. Once analysed, the test results will provide an estimate of the bulk hydraulic properties of the geological formation in the immediate vicinity of the monitoring bore.

2.4 Groundwater monitoring program

Groundwater monitoring is an essential component in characterising the baseline (pre-mining), mining and post-mining hydrogeological environment of the project envelope. Baseline groundwater level and groundwater quality information collected from the various groundwater systems will be used to understand the groundwater flow paths, the connection or separation of groundwater bearing zones, groundwater-surface water connectivity, and the likely changes of these characteristics over the long term.

2.4.1 Groundwater levels

Groundwater levels across the site are monitored by automated pressure transducers (groundwater level dataloggers), programmed to record a groundwater level every six hours. Automated groundwater level measurements are calibrated to a manual 'dip' measurement periodically and typically monthly.

As detailed in Table 2.1, seven of the planned 11 groundwater monitoring bores have been installed at the site as of 24 July 2020. Only two bores (TBBMW01A and TBBMW05A), installed within the underlying fractured rock groundwater system, intercept groundwater. Preliminary groundwater level measurements indicate a steeply dipping north-south groundwater flow direction below the site, intercepted at 52 mBGL (TBBMW05A) in the north and 92 mBGL (TBBMW01A) in the south of the project envelope.

The initial hydrogeological conceptual model, presented below in Section 4, reflects our understanding of the site hydrogeology based on available information.

2.4.2 Groundwater quality

Groundwater quality samples from the 11 monitoring bores will be analysed for a comprehensive suite of analytes listed in Table 2.2.

Table 2.2 Groundwater quality sample suite

Analysis/classification	Parameter
In-field analysis	
Chemical properties	pH, dissolved oxygen (DO)
Physical properties	temperature, electrical conductivity (EC), total dissolved solids (TDS), Redox Potential (ORP), turbidity
Laboratory analysis	
Hydrocarbons	TPH/TRH, BTEXN

Table 2.2 Groundwater quality sample suite

Analysis/classification	Parameter
Dissolved metals	aluminium, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc
Major ions	alkalinity, bicarbonate, calcium, carbonate, chloride, hydroxide, magnesium, potassium, sodium, sulfate, fluoride
Nutrients	total nitrogen, total phosphorus, nitrite, nitrate, ammonia
Radionuclides	K-40, Ra-226, Ra-228, Pb-210, U-234, U-235, U-238, Th-232
PFAS	Short suite – 12 standard compound analytes

Initial groundwater quality results for bores completed and encountering groundwater by 20 July 2020 are included in Table 2.3.

Table 2.3 In-field groundwater quality analysis

Monitoring bore	Date sampled	Hydrogeological unit	pH	Electrical conductivity (µS/cm)	Total Dissolved Solids (mg/L)	Temperature (°C)	Redox Potential (mV)
TBBMW01A	14 July 2020	Fractured rock	8.26	19,827	13,923	20.9	65.1
TBBMW05A	18 July 2020	Fractured rock	8.16	19,963	13,383	23.7	68.7

3 Identification of groundwater receptors

3.1 Overview

The receptors of interest are existing groundwater users and ecosystems that are potentially dependent on groundwater. Surface water users and stream environments are identified and characterised in the *Blue Bush Facility: Preliminary surface water investigation* (EMM 2020a).

3.2 Private landholder bores

The NSW DPIE Water database has been searched to identify records of private landholder bores within a 25 km radius of the project envelope. Water entitlement data from the Water Access Licence Register has also been considered.

The search revealed 43 groundwater bores within the 25 km search radius. Bore details are summarised in Table 3.1.

Total bore depths ranged between 30 to 174 mBGL and standing water level ranged from 29 to 94 mBGL. Where data was available, groundwater salinity (measured as Total Dissolved Solids (TDS)) was in the range of 3,000 – 30,000 milligrams per litre (mg/L). Most bores are located to the south-east of the development envelope towards the Darling River. Measured yield from the established bores was generally low, typically <1 litres per second (L/s).

Table 3.1 NSW DPIE Water database search results

Bore ID	Groundwater works ID	Easting	Northing	Total depth (m)	SWL (m)	Salinity (mg/L)
1	GW005584	535407	6443320	145.4	81.7	-
2	GW006134	565323	6418722	92.3	74.7	-
3	GW006657	549048	6430947	89.9	-	-
4	GW006687	558363	6430990	155.4	-	-
5	GW007151	570051	6410961	62.3	53.9	-
6	GW008865	521892	6419957	79.9	74.7	-
7	GW009591	543967	6441747	110.6	-	-
8	GW009592	543853	6439561	29.6	-	-
9	GW009593	535450	6440487	51.8	-	-
10	GW009596	523384	6409576	102.1	-	-
11	GW009614	564597	6407487	59.4	59.4	-
12	GW009615	550276	6404366	88.1	-	-
13	GW009637	557218	6422774	111.3	50.3	-
14	GW010250	571464	6415047	73.2	-	-
15	GW010609	568601	6420394	105.2	70.1	-

Table 3.1 NSW DPIE Water database search results

Bore ID	Groundwater works ID	Easting	Northing	Total depth (m)	SWL (m)	Salinity (mg/L)
16	GW010767	550699	6400238	86.0	61.0	-
17	GW010842	565323	6418722	90.5	70.1	-
18	GW011165	563388	6410235	92.3	61.0	-
19	GW011432	559559	6407518	84.4	59.4	-
20	GW015448	539020	6402045	140.2	-	-
21	GW016654	560018	6401264	68.6	56.4	-
22	GW017685	544717	6445470	42.7	-	-
23	GW018417	566246	6431988	127.1	93.9	-
24	GW023594	550670	6399622	87.2	61.0	-
25	GW032550	569719	6427161	152.4	70.1	-
26	GW035719	550670	6399622	85.3	62.4	-
27	GW040143	549419	6410375	-	-	-
28	GW040147	566716	6423886	109.7	-	-
29	GW040160	550412	6400270	85.3	-	-
30	GW049019	554910	6402310	173.7	-	-
31	GW049020	549264	6400153	157.0	-	-
32	GW049021	543324	6401750	134.1	-	-
33	GW049022	534223	6403048	97.5	-	-
34	GW049024	543746	6396914	143.3	-	-
35	GW049026	542710	6398458	157.0	-	-
36	GW055747	563388	6410235	93.1	62.1	-
37	GW065147	541867	6396645	68.3	61.2	-
38	GW500073	571727	6418204	87.0	69.7	3,500
39	GW500299	556878	6408107	-	-	-
40	GW600184	564412	6437182	61.3	29.3	5,496
41	GW600185	558113	6435367	100.0	32.3	30,933
42	GW600414	561185	6424278	-	-	-
43	GW600417	556878	6408107	74.5	34.9	2,100

Notes: 1. SWL = Standing Water Level;
2. mg/L = milligrams per litre.

The site lies within two WSPs; the *Water Sharing Plan for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020* and the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011.* At the site, the porous rock unit overlays the fractured rock unit. Depending on the depth of the bore and the target unit, either of these WSPs may be applicable.

Local water entitlements draw water from the *Western Murray Porous Rock groundwater source* (NSW MDB Porous Rock WSP) and the *Kanmantoo Fold Belt groundwater source* (NSW MDB Fractured Rock WSP). The majority of water entitlements in these groundwater sources are aquifer access licences. The *Western Murray Porous Rock groundwater source* also has a significant allocation for salinity and water table management. In both groundwater sources, a portion of total available water is made available for local water utilities.

A breakdown of water entitlement by category for the two relevant groundwater sources is provided in Figure 3.1.

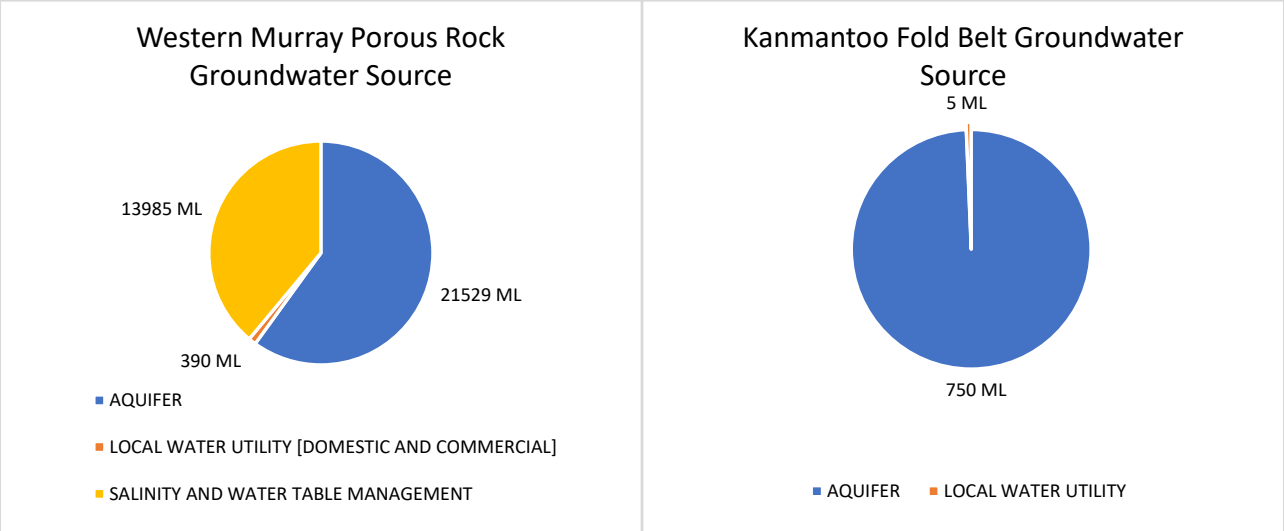


Figure 3.1 Water entitlements by groundwater source and licence category

3.3 Potential groundwater dependent ecosystems

A desktop assessment was undertaken to identify potential groundwater dependent ecosystems within the vicinity the project envelope and the surrounding area. The desktop assessment involved:

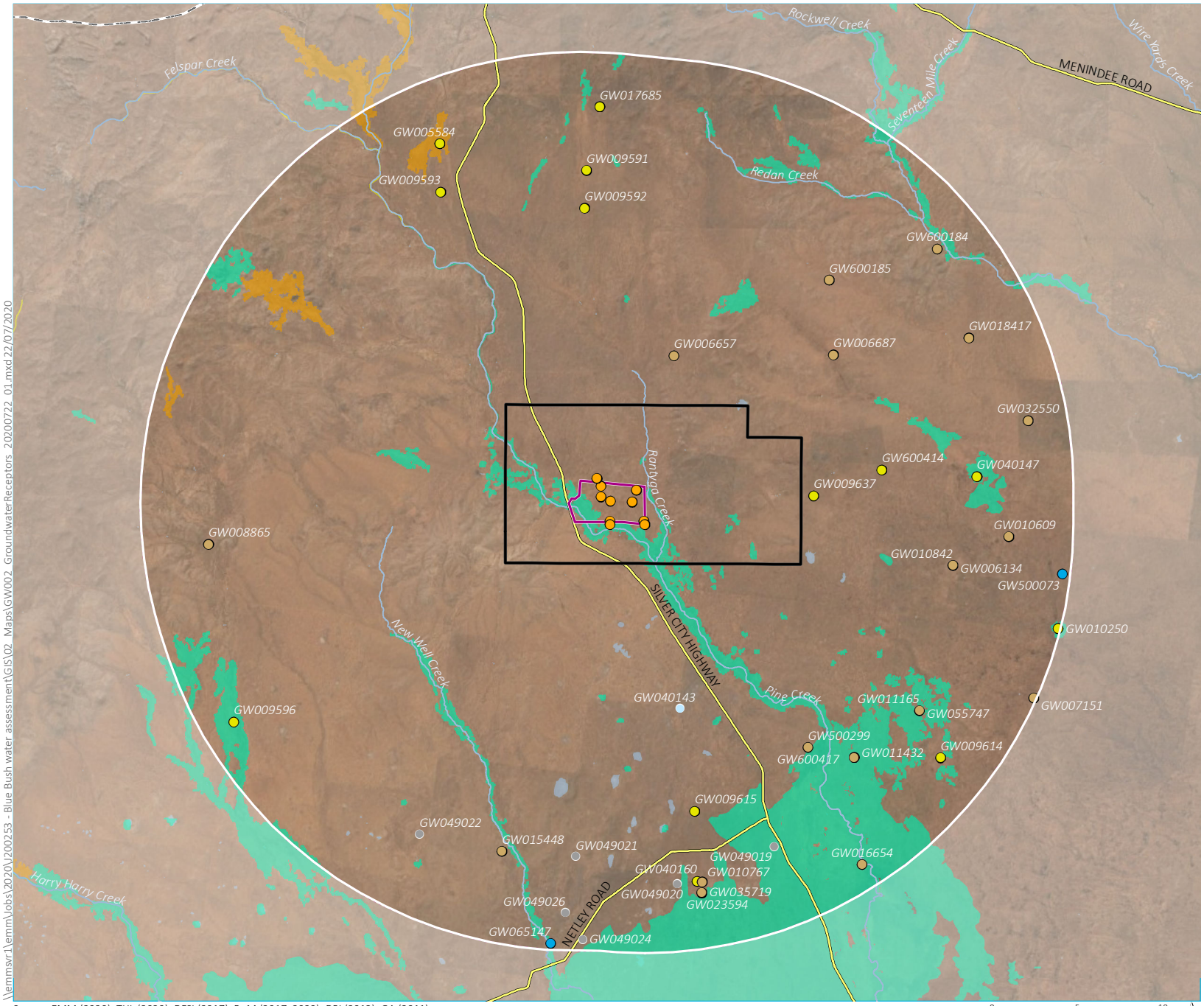
- review of the Groundwater Dependent Ecosystem (GDE) Atlas (Bureau of Meteorology (BoM) 2020);
- review of the *WSP for the NSW Murray Darling Basin Porous Rock Groundwater Sources 2020*;
- review of the *WSP for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011;*
- collation of depth to groundwater information from the NSW DPIE Water database; and
- review of aerial photographs, topographic and geological maps.

There are no 'high priority' groundwater dependent ecosystems listed in the WSP for the *NSW Murray Darling Basin Porous Rock Groundwater Sources* (2020) for the Western Murray Porous Rock groundwater source. There are also no 'high priority' groundwater dependent ecosystems listed in the WSP for the *NSW Murray Darling Basin Fractured Rock Groundwater Sources* (2020) for the Kanmantoo Fold Belt groundwater source.

A review of the Bureau of Meteorology (BoM) GDE Atlas (BoM 2020) identified Chenopod Shrublands, Samphire Shrublands and Forblands and Eucalypt Woodlands communities located within the vicinity of Pine Creek and adjacent floodplains, as well as along minor tributaries in the Pine Creek catchment. These features are noted in BoM (2020) as having a low potential for dependence on the surface expression of groundwater (see Figure 3.2).

Some Eucalypt Woolands along the Pine Creek floodplain downgradient of the development envelope and other low-lying areas are mapped as having high potential for dependence on subsurface groundwater. Ecosystem dependence associated with these plant community types are thought to have a facultative-opportunistic reliance on groundwater, accessing temporary groundwater within shallow alluvial sediments immediately following flooding events.

There are no mapped cave or aquifer ecosystems in the vicinity of the site.



KEY

- Rail line
- Major road
- Named watercourse
- Waterbody
- EL 8188
- Development envelope
- Development envelope 25 km buffer
- Proposed groundwater monitoring bore

National Groundwater Information System

- Stock and domestic
- Water supply
- Unknown
- Irrigation
- Other

Groundwater dependent ecosystems

- High potential for groundwater interaction
- Moderate potential for groundwater interaction
- Low potential for groundwater interaction

DRAFT

Source: EMM (2020); THL (2020); DFSI (2017); BoM (2017, 2020); DPI (2013); GA (2011)

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Groundwater receptors

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Figure 3.2

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4 Hydrogeological conceptual model

4.1 Overview

A hydrogeological conceptual model defines: the local hydrogeological domain and hydrostratigraphy including groundwater systems and confining layers, aquifer properties, groundwater flow paths, recharge and discharge mechanisms, water quality, and groundwater-surface water connectivity. Hydrogeological conceptual models are refined as new data is collected and interpreted.

The initial hydrogeological conceptual model for the site collates the findings from desktop studies and data collected to-date during the current groundwater field investigations.

4.2 Groundwater systems

As introduced in Section 1.3.5, there are two groundwater systems underlying the site. The near-surface alluvial sediments and the underlying fracture gneiss rock basement.

4.2.1 Near-surface sediment deposits

This unproven groundwater system comprises a mix of alluvium and colluvium, consisting of sand, silt, clay and gravel varies in thickness across the site and is typically more developed closer to Pine Creek and Rantyga Creek. This undifferentiated unit presents consistently across the project envelope as an unsaturated system. No groundwater was encountered in this unit during the current groundwater monitoring bore drilling campaign and it is assumed that it is only episodically recharged during flooding events, holding water in storage which is opportunistically accessed by riparian vegetation along the banks of Pine Creek and Rantyga Creek (both outside of the Development Envelope).

4.2.2 Fractured rock groundwater system

Preliminary groundwater level measurements indicate a steeply dipping north-south groundwater flow direction in the fractured rock groundwater below the site, consistent with the topography and structural dip of the unit. Groundwater was intercepted at 52 mBGL (TBBMW05A) in the north and 92 mBGL (TBBMW01A) in the south of the project envelope. Water quality within the fractured rock underlying the site is moderately saline (EC = ~20,000 µS/cm).

4.2.3 Groundwater use

Short-term or temporary groundwater is thought to occur following rainfall as shallow, discrete lenses across the riparian reaches of Pine Creek, as supported through GDE mapping (BoM 2020). The limited extent of the near-surface sediments system and high evaporation rates precludes the widespread use of this groundwater system as a sustainable groundwater supply. The near-surface sediments encountered as dry (unsaturated) during the drilling of the groundwater monitoring network.

The underling fractured rock groundwater system has a significant storage volume due to the overall thickness and extent of the unit, although productivity is limited by the low permeability of the rock matrix with groundwater occurrence and flow restricted to compact fractures within the rock. Groundwater within this geological unit is of limited use due to poor water quality and low yields available regionally.

4.3 Refinement of conceptual model

The conceptual model will continue to be refined. The conceptualisation will be enhanced with data and information collected through the continued installation of the monitoring network and the ongoing baseline monitoring program.

5 Aquifer Interference Policy (AIP) 2012

5.1 Overview

The NSW Office of Water (now DPIE Water) released the AIP in 2012 to address water licensing and guidance on how potential impacts of aquifer interference activities in NSW are to be assessed. The AIP defines the regime for considering impacts of aquifer interference activities on the water resources of NSW and outlines the policy and information requirements for the collation and preparation of an EIS.

5.2 Requirements of the AIP

The following section details how Tellus are currently and/or proposing to address the requirements of the AIP 2012 as part of their EIS (Table 5.1).

Table 5.1 How AIP requirements are addressed by Tellus

Requirement	How this has been addressed:
Type and conditions of applicable water sharing plans (*Water Management Act 2000*)	The project is within the *NSW Murray Darling Basin Porous Rock Groundwater Sources* (2020) and the *Kanmantoo Fold Belt Groundwater Source* of the *NSW Murray Darling Basin Fractured Rock Groundwater Sources* (2011). Aquifer access licence entitlement (under the Water Management Act) will be obtained if required. Licences have been applied for and granted under Part 5 of the Water Act for the drilling and installation of all groundwater monitoring bores.
Conditions under the *Water Act 1912*	Licences have been applied for and granted under Part 5 of the Water Act for the drilling and installation of all groundwater monitoring bores.
Identification of sensitive receptors	A desktop assessment was completed to identify ecosystems that potentially utilise groundwater in the project envelope and broader surrounding region. The assessment included reviewing the Groundwater Dependent Ecosystem Atlas (BoM 2020), the applicable Groundwater WSP, previous studies completed in the region, and groundwater monitoring data. A search has also been undertaken for private landholder bores within 25 km of the project envelope.
Baseline groundwater level information	Tellus are in the process of implementing a groundwater monitoring network, anticipating network commissioning in early August 2020.
Baseline groundwater quality information	Tellus are in the process of implementing a groundwater monitoring network, anticipating network commissioning in early August 2020. Groundwater quality will be assessed against the comprehensive analytical suite identified in Section 2.4.2.
Aquifer hydraulic characteristics	Rising and falling head hydraulic tests will be completed at all groundwater monitoring bores in August 2020. Hydraulic testing will provide site specific information on bulk aquifer hydraulic properties.
Conceptualisation of the hydrogeology	The conceptualisation of the groundwater system draws upon the significant volume of data collected and analysed for the site. The extensive regional groundwater monitoring program targets the different geology types, ie the near-surface sediments (quaternary alluvium/colluvium, tertiary sediments) and the underlying fractured rock basement to ensure a robust approach to the conceptualisation. Detailed rainfall assessment and runoff coefficient and infiltration analysis will allow site specific surface water and groundwater connectivity to be considered and assessed as part of the EIS process.

Table 5.1 How AIP requirements are addressed by Tellus

Requirement	How this has been addressed:
Sufficient licence entitlement can be obtained from each water source that water is taken from	The current hydrogeological investigation has determined that the project is highly unlikely to intercept groundwater and as such, Tellus will likely not require a licence entitlement for indirect take through Construction or Operation of the Project.

References

EMM Consulting, 2020, *Blue Bush Facility: Preliminary surface water investigation*, prepared for Tellus Holdings

National Uniform Drillers Licensing Committee (NUDLC) 2020. *Minimum Construction Requirements for Water Bores in Australia (4th Edition).*

NSW Department of Primary Industries Office of Water (NOW)

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Serov P, Kuginis L, Williams J.P., May 2012, *Risk assessment guidelines for groundwater dependent ecosystems, Volume 1 – The conceptual framework*, NSW Department of Primary Industries, Office of Water, Sydney.

APPENDIX I: COMMUNITY ENGAGEMENT STRATEGY

TELLUS

LONG-TERM SAFETY AND SUSTAINABILITY

BLUE BUSH PROJECT COMMUNITY ENGAGEMENT STRATEGY

Prepared for NSW Department of Planning, Industry and Environment

July 2020

TELLUS

Document control

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TELLUS

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Abbreviations

Blue Bush Project	Encompasses the proposed Blue Bush Facility and the proposed Blue Bush Inter-modal
DPIE	NSW Department of Planning, Industry and Environment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
Tellus	Tellus Holdings Ltd
tpa	tonnes per annum
SEARs	Secretary's Environmental Assessment Requirements
NSW	New South Wales

Glossary

Application	An application seeking development consent for a State Significant Development project under Part 4 of the EP&A Act.
Community	Anyone affected by or interested in the Blue Bush Project. Includes individuals, groups, businesses, industry, non-government organisations, and local, state and federal government.
Engagement	The activities by which the community has their say and potentially influence decisions.
Hazardous waste	Includes hazardous waste and special waste as defined per Clause 49, Division 1 of the *Protection of the Environment Operations Act 1997* (NSW) and only if it meets Tellus' strict Waste Acceptance Criteria (WAC).
Modification	Changing the terms of an approved State Significant Project, including revoking or varying a condition of approval or imposing additional conditions. A modification requires approval under the EP&A Act.
Scoping	The process of identifying the matters that require detailed assessment in an EIS and informing the setting of SEARs for State Significant Projects.
SEARS	The Planning Secretary's environmental assessment requirements for the preparation of an EIS for a State significant Project.
State Significant Development	Pursuant to Section 89C of the EP&A Act, projects are classified as State Significant Development (SSD) if they are declared to be as such by the State Environmental Planning Policy (State and Regional Development) 2011 (SRD SEPP).
Submission	A formal response from an individual or organisation, including a government agency, that is submitted to DPIE during the public exhibition of an EIS for a State Significant Project.

1 Introduction

1.1 Background

Tellus Holdings Ltd (Tellus) propose to construct and operate a near-surface geological waste repository and associated infrastructure, herein referred to as the 'Blue Bush Facility'. An off-site inter-modal transit station is also proposed to be developed and is herein referred to as the 'Blue Bush Inter-modal'. Collectively, the two proposed facilities are referred to as 'the project' or 'the Blue Bush Project'.

If approved, the Blue Bush Facility would be located approximately 45 kilometres south of Broken Hill and the Blue Bush Inter-modal would be located adjacent to the Adelaide-Sydney Railway Line and within an industrial precinct of Broken Hill in the far west of New South Wales (NSW) (refer to Figure 1-1).

1.1.1 BLUE BUSH FACILITY

Clay would be extracted from open-cut pits at the proposed Blue Bush Facility. The voids created from this extraction would then be used for the storage and/or permanent isolation of hazardous waste. The Blue Bush Facility would receive up to a maximum of 200,000 tonnes per annum (tpa) of waste for approximately 25 years.

The following infrastructure would be constructed at the proposed Blue Bush Facility:

- Waste infrastructure – excavated pits to be used as waste cells, stockpile areas for overburden and clay, container hardstand, waste inspection area and unloading areas and warehouses, waste laboratory, waste immobilisation equipment, kaolin and clay processing equipment, and a cell cover(s).
- Other ancillary infrastructure – including an administration building, workshop, laydown yard including repair and maintenance facilities, mobile equipment re-fuelling and washdown, site access and internal haul roads, site fencing and gatehouse, a water treatment system and tanks for raw and potable water, wastewater treatment system and effluent disposal equipment, diesel storage tanks (including piping reticulation and bowsers), hydrocarbon/renewable hybrid power generation system, permanent accommodation village, services and infrastructure (if required) and road upgrades at the intersection of the Silver City Highway and access road to the proposed Blue Bush Facility.
- Construction-related infrastructure – temporary construction accommodation village, services and infrastructure and gravel borrow pit(s).

1.1.2 BLUE BUSH INTER-MODAL

The proposed Blue Bush Inter-modal would be used for the temporary storage of hazardous waste materials prior to their onward transfer to the Blue Bush Facility. Infrastructure including a road and rail interchange area, a temporary open container storage area, and office and maintenance and storage sheds would be constructed to support operations at the Blue Bush Inter-modal.

1.1.3 APPROVAL PATHWAY

The Blue Bush Project is classified as State Significant Development and will require approval under Part 4, Division 4.7 of the *Environmental Planning and Assessment Act 1979* (NSW) (EP&A Act).

A Scoping Report has been prepared to enable the NSW Planning Secretary to set the Secretary's Environmental Assessment Requirements (SEARs) that would scope the content of an Environmental Impact Statement (EIS) required under the EP&A Act for the Blue Bush Project.

1.2 Purpose of community participation

The purpose of this Community Engagement Strategy is to ensure that the community has the opportunity to be involved in the planning, design and assessment of the Blue Bush Project. It has been prepared with reference to the following documents:

- Community Participation Plan (DPIE 2019a).
- Engagement in EIA. Guidance for State Significant Projects, June 2019' (DPIE 2019b).
- Stakeholder Engagement Management Plan (Tellus 2019).

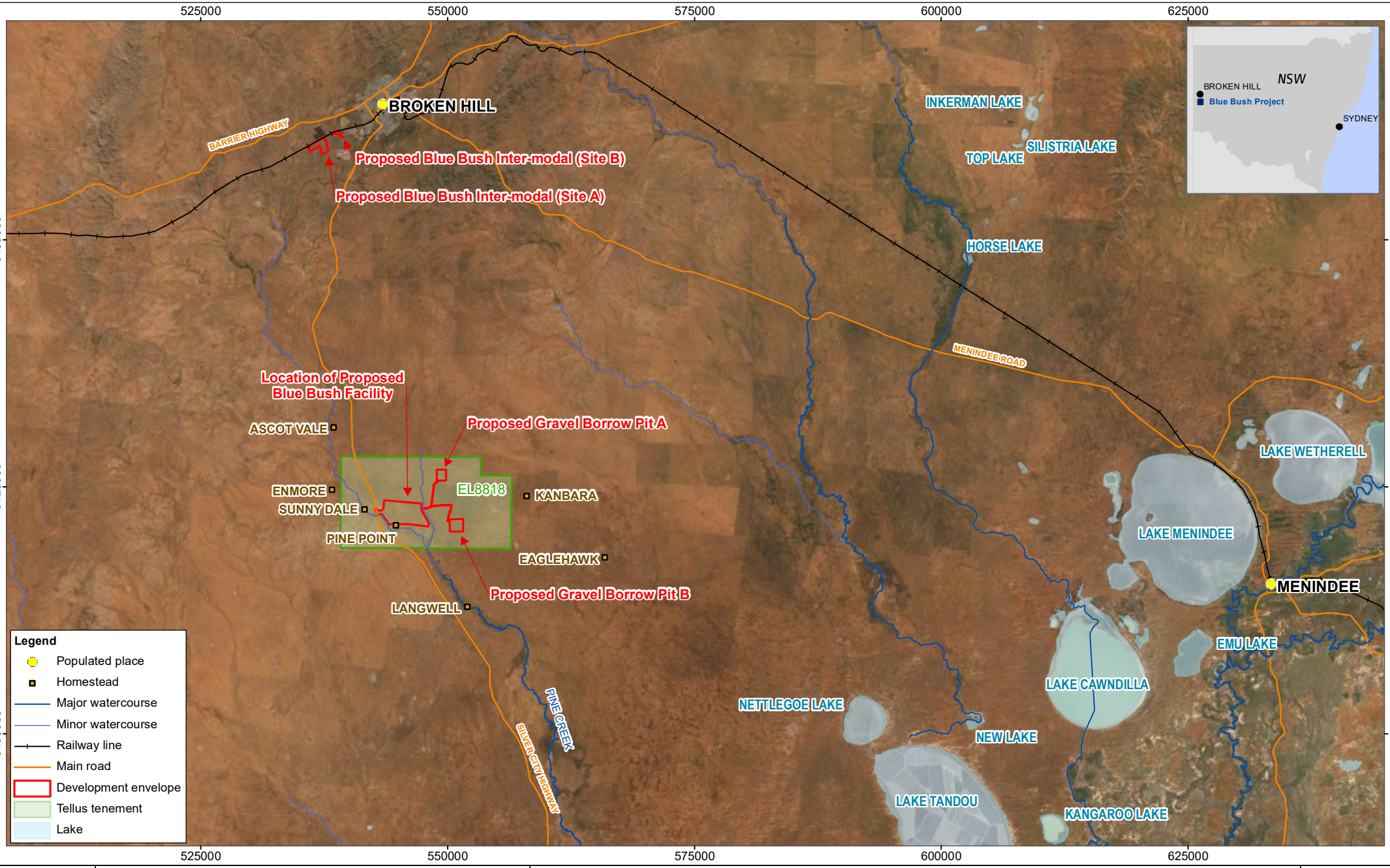
The Community Engagement Strategy will be revised upon receipt of the SEARs for the Blue Bush Project.

1.3 Structure of this document

The structure of the Community Engagement Strategy is presented in Table 1-1.

Table 1-1 Document structure

Chapter no.	Chapter title	Scope
1	Introduction	This chapter provides an overview of the project, details the objectives for community engagement, and states the purpose of the community engagement strategy for the Blue Bush Project.
2	Community participation objectives	This chapter outlines the objectives for community participation in the Blue Bush Project.
3	Identification of community stakeholders	This chapter details the methods that will be used to identify key community stakeholders and lists the community stakeholders that have already been identified as being affected by or having an interest in the Blue Bush Project.
4	How and when the community can participate	This chapter outlines the how and when the community can participate in the environmental impact assessment of the Blue Bush Project.
5	Collecting, collating and using community feedback	This chapter describes the ways in which information obtained from community engagement will be collated and used in the planning, design and environmental impact assessment of the Blue Bush Project.
6	References	This chapter lists the references used in this Community Engagement Strategy.



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Regional location

Figure

1-1

Version: 2

Tellus Holdings Ltd endeavours to ensure this map is free of errors but does not represent or warrant (either expressly or impliedly) that the map or its features are accurate or fit for a particular use.

2 The Community Engagement Strategy

2.1 Objectives of engagement

The purpose and objectives of community participation for the Blue Bush Project are outlined in Table 2-1. The objectives have been adopted from the 'Community Participation Plan' prepared by DPIE (2019a).

Table 2-1 Objectives of community participation

Objective	Action
Open and inclusive	➢ Keep the community informed. ➢ Promote participation. ➢ Seek community input and accurately capture community views. ➢ Build strong partnerships with the community. ➢ Incorporate culturally appropriate practices when engaging Aboriginal Torres Strait Islander and culturally and linguistically diverse communities. ➢ Conduct community participation initiatives in a safe environment.
Easy to access	➢ Outline in advance how and when the community can participate. ➢ Use best practice community participation techniques. ➢ Make relevant information available in plain English and translate information when engaging linguistically diverse communities or people living with disabilities. ➢ Incorporate visual representations to clearly illustrate possible impacts of the project. ➢ Ensure information is accessible for groups who find it difficult to participate in usual community participation activities. ➢ Stage events at convenient times and locations.
Relevant	➢ Establish what is up for discussion. ➢ Ensure as many community members as possible can participate. ➢ Recognise previous community input on the project and similar issues. ➢ Tailor activities to the: • Context, which could include location, type of application, stage of the assessment process, previous engagement undertaken. • Scale, nature and known impacts for the project. ➢ Adjust activities (if necessary) in response to community interest and participation preferences.
Timely	➢ Start community participation as early as possible and continue for an appropriate period. ➢ Provide regular project updates to the community. ➢ Ensure the community has reasonable time to provide input. ➢ Facilitate ongoing discourse with local community networks. ➢ Consider holidays and other community events when setting dates for engagement initiatives.
Meaningful	➢ Always explaining at the end of projects how community views were considered when reaching decisions. ➢ Be clear about what aspects of a plan, project or proposal the community can inform. ➢ Have planners and decision makers engage directly with the community. ➢ Ensure responses to community input are relevant and proportionate. ➢ Give genuine and proper consideration to community input. ➢ Keep accurate records of community input and participation activities.

Objective	Action
	➢ Regularly review the effectiveness of community participation initiatives. ➢ Integrate community input into the evaluation process. ➢ Comply with statutory obligations, protect privacy and respect confidentiality.

2.2 Types of engagement

Throughout the environmental impact assessment (EIA), a variety of methods will be implemented in order to disseminate project information and to seek feedback from both the communities in the vicinity of the Blue Bush Project and from other community stakeholders with an interest in the Blue Bush Project. These methods will include direct engagement (such as public drop-in sessions) and indirect engagement (including website links to fact sheets, project timelines, and key contacts).

The level, type and scale of engagement for the Blue Bush Project will increase following the receipt the Secretary's Environmental Assessment Requirements (SEARs). At that time, the following will be undertaken:

- Direct public engagement (via public drop-in sessions) over many months where important project information will be made publicly available. Public feedback will be sought through a public forum such as a questionnaire, project website, fact sheet, newsletter or where appropriate, social media.
- Targeted engagement where feedback is sought from key stakeholder groups to obtain their views on the project. Tellus will make the following information publicly available throughout the EIA:
    - A description of the project.
    - Plans, maps and photos of the site of the proposed Blue Bush Facility and Blue Bush Inter-modal.
    - Current phase in the assessment and indicative timing for the later phases.
    - information on engagement events and activities.
    - Contact details for the project team so that those who are potentially impacted or interested can ask questions about the project and provide feedback to the project team.
    - Updates as the planning and design of the project progresses.

2.3 Identification of community stakeholders

Key community stakeholders have been identified as those that may be interested in or who may be affected by the Blue Bush Project.

Key community stakeholders were identified (and will continue to be identified) via desktop screening whereby potential stakeholders and relevant information such as interests, involvement, interdependencies, influence, and potential impact on project success are gathered, documented and analysed. This desktop screening will follow the detailed methodology provided in Tellus' corporate Stakeholder Engagement Management Plan (Tellus 2019).

Key stakeholders identified are summarised in Table 3-1. Community stakeholders will continue to be identified during the preparation of the EIS.

Table 3-2 Key community stakeholders identified to-date

Community/stakeholder group	Identified community/stakeholder group
Residents and landowners (directly affected and those on or near transport routes to/from the site)	➢ Pine Point Station Homestead. ➢ Sunny Dale Homestead. ➢ Enmore Homestead. ➢ Ascot Vale Homestead. ➢ Kanbara Homestead.
Community and advocacy groups	➢ Broken Hill Historical Society. ➢ Broken Hill, Menindee Lakes WE WANT ACTION. ➢ Pastoralist Association. ➢ Broken Hill and Darling River Action Group. ➢ Broken Hill Landcare. ➢ Foundation Broken Hill. ➢ Barrier Industrial Council (trade unions association). ➢ The Broken Hill Environmental Lead Program (BHELP). ➢ NSW Farmer's Association. ➢ Broken Hillites who live away from home.
Aboriginal people/native title groups	➢ Broken Hill Local Aboriginal Land Council. ➢ Barkandji Native Title Group. ➢ Wilyakali Group.
Nearby local businesses	➢ Broken Hill Chamber of Commerce. ➢ Shops/Businesses surrounding the project site. ➢ Broken Hill Freight Centre. ➢ Broken Hill Community Recycling Centre.
Broken Hill City Council	➢ Darriea Turley – Mayor of Broken Hill City Council. ➢ Christine Adams – Deputy Mayor. ➢ Manager Planning, Development and Compliance. ➢ Marion Browne -Councillor. ➢ Jim Nolan - Councillor. ➢ Branko Licul – Councillor. ➢ Dave Gallagher – Councillor. ➢ Ron Page – Councillor. ➢ Bob Algate - Councillor. ➢ Tom Kennedy – Councillor. ➢ Maureen Clark – Councillor.
Regional committees connected to council	➢ West Regional Advisory Committee (liaises between community and the National Parks and Wildlife Service). ➢ Unincorporated Far West.
Elected members including local councillors, State and Commonwealth Members of Parliament	➢ Mr (Roy) Royal Francis Butler MP - Member for Barwon. ➢ Hon Mark Coulton MP - Federal Member for Parkes. ➢ Matt Kean – New South Wales Minister for Energy and Environment. ➢ Hon Keith Pitt MP – Minister for Resources, Water and Northern Australia. ➢ Ryan Park – NSW Shadow Health Minister.
Government departments, consent authorities, public authorities, utility companies, regulatory agencies	➢ NSW Department of Planning, Industry and Environment. ➢ NSW Department of Aboriginal Affairs. ➢ NSW Department of Crown Lands. ➢ NSW Environment Protection Authority. ➢ NSW Department of Primary Industries. ➢ NSW Department of Industry. ➢ NSW Department of Environment, Energy and Science. ➢ NSW Department of Roads and Maritime Services.

Community/stakeholder group	Identified community/stakeholder group
	➢ NSW Local Land Services (Western Region). ➢ NSW Mining. ➢ Nature Conservation Council of NSW. ➢ National Parks and Wildlife Service. ➢ Essential Energy (Broken Hill). ➢ Essential Water (Broken Hill). ➢ Water NSW. ➢ Department of Agriculture, Water and the Environment. ➢ Australian Rail Track Corporation. ➢ Australian Government Murray-Darling Basin Authority. ➢ Australian Conservation Foundation. ➢ TransGrid.
Media commentators	➢ ABC Broken Hill. ➢ Barrier Daily Truth, Broken Hill Newsroom. ➢ Pastoralist's Association. ➢ National Tribune Newspaper.
State Significant Projects and nearby infrastructure	➢ Broken Hill Solar Farm (next door to new site). ➢ Broken Hill MSP – Mineral Separation Plant – Tronox. ➢ Broken Hill North Project. ➢ Broken Hill Cobalt Project. ➢ Pacific National Freight Terminal.
Local educational institutions	➢ Broken Hill Public School. ➢ Robinson College. ➢ Broken Hill North Public School. ➢ Burke Ward Public School. ➢ Broken Hill High School.
Visitors to Broken Hill	➢ Broken Hill Visitor Information Centre. ➢ Recreational and commercial/ tourist groups.

3 Community engagement during our environmental impact assessment

3.1 How the community can participate in the environmental impact assessment of the Blue Bush Project

The ways in which the community can participate in the environmental impact assessment of the Blue Bush Project are listed in Table 4-1.

Table 4-1 How the community can participate in the environmental impact assessment process

Mechanism	Details
Keep up to date	Throughout the assessment process, the community will be updated on the progress of the environmental impact assessment via a project website, electronic notifications and written correspondence. The progress of the environmental impact assessment will also be tracked on the Major Projects website maintained by DPIE.
Attend events	During public exhibition periods within the assessment process, targeted engagement activities will be undertaken. These activities may include information sessions, community reference groups, workshops, site visits or individual meetings. Advance notice of these events will be given, and the events will be staged at convenient times and locations to ensure as many community members as possible can participate.
Provide in-formal feedback	The community can provide informal feedback through various channels, for example, by contacting the project team (contact details provided on project website), via written correspondence and verbal discussions or via public meetings and site visits.
Provide formal feedback	When the application is lodged, the application is exhibited and during this period, the community can make a written submission which outlines their views on the project. The written submissions will be forwarded to Tellus (by DPIE). Issues raised in submissions and Tellus' response will be considered when DPIE prepares the assessment report for the Blue Bush Project.

3.2 Engagement during preparation of the Scoping Report.

Early engagement has been undertaken during preparation of the Scoping Report to identify key issues for the Blue Bush Project. The purpose of this early engagement was to:

- Inform the community about the project.
- Establish working relationships and open lines of communication between the project team and the community.
- Give the community the opportunity to voice their concerns or share local knowledge.
- Enable the community's views to be considered early on in the planning, design and assessment process.
- Understand issues of importance and interest to the community.

The ways in which the community participation objectives have been implemented during scoping are presented in Table 4-2.

Table 4-2 Implementing community participation objectives during scoping

Objective	Implementation during scoping
Open and inclusive	➢ Provide information about the project and contact details for the project team. ➢ Identify those that are interested in or who are likely to be impacted by the project. ➢ Directly involve targeted community members via meetings, interviews, etc. ➢ Document approach to community engagement via the preparation of a Community Engagement Strategy (as part of Scoping Report). ➢ Notify the community when the Scoping Report is submitted to DPIE.
Easy to access	➢ Make publicly available (via project website) both the Scoping Report and the Community Engagement Strategy.
Relevant	➢ Discuss community engagement at Scoping Meeting with DPIE. ➢ Provide relevant information on the project to the community. ➢ Communicate known negotiable elements of the project that the community may be able to influence. ➢ Summarise community feedback and they ways the community's views have been considered in the Scoping Report.
Timely	➢ Engage early with the community to allow feedback on issues that will be considered in project planning and design. ➢ Be timely in providing information on the project so that the community has enough time to be informed.

3.3 Engagement during preparation of the EIS

Engagement will continue throughout the preparation of the EIS. The purpose of this engagement will be to:

- Keep the community informed.
- Consider community concerns when making project refinements and evaluating the merits of the project.
- Consider community concerns when assessing potential impacts of the project.

The ways in which the community participation objectives will be implemented during the preparation of the EIS are presented in Table 4-3.

Table 4-3 Implementing community participation objectives during preparation of the EIS

Objective	Implementation during preparation of the EIS
Open and inclusive	➢ Keep the community informed about the project (e.g. project website, newsletters, public meetings, digital and print media etc). ➢ Identify additional people interested in or potentially impacted by the project. ➢ Directly involve community as part of the assessment and facilitate engagement with any vulnerable groups (e.g. hold events in appropriate accessible locations, focus groups, surveys, interviews, meetings, etc). ➢ Prepare a suitable summary that assists the community to understand the project and its impacts and include in EIS.
Easy to access	➢ Prepare a suitable summary that assists the community to understand the project and its impacts and include in EIS. Make publicly available on project website.
Relevant	➢ Keep records of engagement including describing any activities, information provided, views on potential impacts and benefits, and how feedback was considered in EIS. ➢ Communicate any known negotiable elements of the project that may be influenced by submissions (e.g. via public meetings, project website, digital or print media, etc). ➢ Summarise the feedback from the community in the engagement chapter of the EIS. Explain how the community's views have been considered during the preparation of the EIS.
Timely	➢ Be timely in providing information on engagement opportunities throughout the preparation of the EIS (e.g. via project website, digital or print media, etc.). ➢ Provide regular project updates (e.g. via project website, digital or print media, etc.).

3.4 Engagement during exhibition of the EIS

Engagement will continue throughout the public exhibition of the EIS. The purpose of this engagement will be to:

- Explain the environmental impact assessment process to-date.
- Explain the findings of the environmental impact assessment.
- Help the community to make informed submissions.

The ways in which the community participation objectives will be implemented during the exhibition of the EIS are presented in Table 4-4.

Table 4-4 Implementing community participation objectives during exhibition of the EIS

Objective	Implementation during exhibition of the EIS
Open and inclusive	➢ Keep the community informed about the project (e.g. project website, newsletters, public meetings, digital or print media, etc). ➢ Encourage those who are interested in or potentially impacted by the project to make a submission to DPIE.
Easy to access	➢ Make EIS publicly available on project website.
Relevant	➢ Continue engagement activities during exhibition of the EIS. Explain findings of specialist studies included in EIS. Engage via public meetings, project website, digital and print media, etc. ➢ Keep records of engagement including describing any activities, information provided, views on potential impacts and benefits, and how feedback will be considered in Supplement Report.
Timely	➢ Be timely in providing information on engagement opportunities throughout the exhibition period of the EIS (e.g. via project website, digital or print media, etc.).

3.5 Engagement following exhibition of the EIS

Engagement may continue following public exhibition of the EIS. The purpose of this engagement may be to:

- Clarify issues of concern.
- Seek feedback of proposed refinements to the project.

The ways in which the community participation objectives will be implemented following the exhibition of the EIS are presented in Table 4-5.

Table 4-5 Implementing community participation objectives following exhibition of the EIS

Objective	Implementation following exhibition of the EIS
Open and inclusive	➢ Keep the community informed about the project (e.g. project website, newsletters, public meetings, digital and print media, etc). ➢ Provide a response to submissions in a Submissions Report, unless not required by DPIE.
Easy to access	➢ Make Submissions Report publicly available on project website.
Relevant	➢ Consider whether further engagement is needed to respond to the issues raised in submissions. ➢ Ensure proper consideration is given to the issues raised and responses to submissions are genuine. ➢ Summarise the feedback from the community in the engagement chapter of the Submissions Report. Explain how the community's views have been considered in the Submissions Report.
Timely	➢ Be timely in providing information on engagement opportunities following the exhibition period of the EIS (e.g. via project website, digital or print media, etc.). ➢ Provide regular updates on the project's status during the preparation of the Submissions Report (e.g. via project website, digital and print media).

3.6 Engagement during preparation of an Amendment Report or Modification Report

Engagement would be required if there is a need to prepare an Amendment Report or Modification Report. The purpose of this engagement would be to:

- Keep the community informed.
- Consider community concerns regarding the proposed amendment/modification to the project.
- Consider community concerns when assessing potential impacts of the amendment/modification.

The ways in which the community participation objectives would be implemented during the preparation of an Amendment Report/Modification Report are presented in Table 4-6.

Table 4-6 Implementing community participation objectives during preparation of Amendment Report or Modification Report

Objective	Implementation during preparation of Amendment Report or Modification Report
Open and inclusive	➢ Notify the community about the amendment or modification (e.g. via public meetings, project website, digital or print media, etc). ➢ Identify those with an interest in or likely to be impacted by the amendment or modification (e.g. via previous engagement records, project website, digital and print media, etc). ➢ Directly involve community as part of the assessment and facilitate engagement with any vulnerable groups (e.g. hold events in appropriate accessible locations, focus groups, surveys, interviews, meetings, etc). ➢ Prepare a suitable summary that assists the community to understand the amended or modified project and its impacts.
Easy to access	➢ Make Amendment Report or Modification Report publicly available on project website.
Relevant	➢ If changes are significant (major), undertake a similar level of engagement as for a new project (e.g. public meetings, surveys, project website, digital and print media, etc). ➢ Keep records of engagement including describing any activities, information provided, views on potential impacts and benefits, and how feedback was considered in Amendment Report or Modification Report. ➢ Communicate any known negotiable elements of the project that may be influenced by submissions (e.g. via public meetings, project website, digital and print media). ➢ Summarise the feedback from the community in the engagement chapter of the Amendment Report or Modification Report. Explain how the community's views have been considered in the Amendment Report or Modification Report.
Timely	➢ Determine the engagement requirements for modification applications with DPIE. ➢ Be timely in providing information on engagement opportunities throughout the preparation of the Amendment Report or Modification Report (e.g. via project website, digital or print media). ➢ Provide regular project updates (e.g. via project website, digital and print media).

4 Collecting, collating and using community feedback

Community feedback will be collected and collated via an online communications register (specifically, INX Inform). The communications register will allow the project team to record and classify all types of stakeholder engagement including emails, phone calls, meetings, etc. The feedback collected will be used in the planning, design and the environmental impact assessment of the Blue Bush Project.

Community feedback will be collated in the Scoping Report, EIS, Submissions Report and Amendment Report or Modification Report (if required).

5 References

NSW Department of Planning, Industry and Environment [DPIE], 2019a, 'Engagement in EIA. Guidance for State Significant Projects, June 2019'.

NSW Department of Planning, Industry and Environment [DPIE], 2019b, 'Community Participation Plan, November 2019'.

Tellus Holdings Ltd [Tellus], 2019, 'Stakeholder Engagement Management Plan, November 2019'.